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Promoting workplace stair climbing: Sometimes, not interfering is the best.

Masterstudium i idrettsvitenskap

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Table of Contents

Preface ....

1.0 Introduction 1

2.0 Theory 3

- 2.1 Physical activity and health benefits 3
- 2.2 Workplace physical activity 4
- 2.3 Benefits from stair climbing 5
- 2.4 Nudging 6
- 2.5 Point-of-choice prompts 9
- 2.6 Stair-riser banners and positive feedback 10
- 2.7 Office buildings or public places? 12
- 2.8 The effect of building design 12

3.0 Method 14

- 3.1 Design 14
- 3.2 Monitoring tools 15
- 3.3 Interventions 19
- 3.4 Ethical considerations 22
- 3.5 Statistical analyses 22

4.0 Evaluating the method 24

Literature 26

Figures and tables overview 33

Attachments 34

Preface

The process of planning, performing, and writing about this project has been very memorable. I owe big thanks to my supervisors, Ane Kristiansen Solbraa and Amund Riiser, for steering me in this direction, and for helping me navigate along the way. Bachelor students Ragnhild Eriksrud and Julie Flokenes Berland also contributed and their efforts are greatly appreciated.

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This thesis is submitted in two parts. Part 1 is an extended theory and methods-section. It is meant to supplement the following article. Part 2 is the journal article, which is written under author instructions from the American Journal of Health Promotion.

Lastly, I want to thank my fellow classmates, who have made this whole process very much enjoyable.

Andreas Åvitsland

Sogndal, April 2016

1.0 Introduction

A report by the Norwegian Directorate of Health states that only 32.0 % of Norwegian adults fulfill the recommended weekly 150 minutes of moderate physical activity (Hansen et al., 2015). This is considered the minimum amount to help prevent non-communicable diseases (WHO, 2015a). Inactivity causes 6.0 – 10.0 % of non-communicable diseases like coronary heart disease, type 2 diabetes, breast- and colon cancer, and is also responsible for 9.0 % of worldwide premature mortality (Lee et al., 2012). Older men, who fulfill the physical activity recommendations, may live ten to thirteen years longer than their inactive equals, as well as ageing with less chance of developing cognitive- and functional impairments, and depressions (Almeida et al., 2014).

Overweight and obesity is also a consequence of inactivity (Arsenault et al., 2009). In 2005, the worldwide adult overweight and obesity prevalence was estimated to be 23.2 % and 9.8 %, respectively (Kelly, Yang, Chen, Reynolds, & He, 2008). In 2014, the prevalence had risen to 39.0 % overweight and 13.0 % obese in adults aged eighteen years and older (WHO, 2015b), which translates to 1.9 billion and 600 million people, respectively.

From an economic perspective, USA spent 78.5 billion dollars on obesity related expenses in 2003, approximately 10.0 % of the healthcare budget (Barkin, Heerman, Warren, & Rennhoff, 2010). Obesity accounts for 0.7 – 2.8 % of global healthcare expenditures (Withrow & Alter, 2011), while physical inactivity accounts for 1.5 – 3.0 % of healthcare expenditures in developed countries (Oldridge, 2008).

Sitting more than four hours a day has been found to increase risk of all-cause mortality during a period of 2.8 years (van der Ploeg, Chey, Korda, Banks, & Bauman, 2012). At the same time, people in sedentary jobs may sit as much as twelve hours during the course of a normal workday (McCrady & Levine, 2009). Most adults spend half of their waking hours at work (Dishman, Oldenburg, O'Neal, & Shephard, 1998), while at the same time, American adults report that one of the main reasons for their inactivity is lack of time (Brownson, Baker, Housemann, Brennan, & Bacak, 2001). This makes the workplace a potential arena where a major impact could be made on physical activity levels. Stair climbing burns more calories than jogging at 9 km/h (Jette, Sidney, & Blümchen, 1990; The & Aziz, 2002), and facilitating inreased stair use in the workplace is a feasible way of increasing the daily physical activity levels. In the future prevention of non-communicable diseases, and the increased health costs that follow, more facilitation for physical activity is needed.

The aim of the present study is therefore to examine methods of encouraging physical activity at the workplace. In order to increase the population's physical activity levels, more knowledge is needed on how we can achieve this. The research question is as follows:

How can stair-leading footprints and stair-riser banners providing positive feedback affect stair climbing in a four-story office building?

2.0 Theory

2.1 Physical activity and health benefits

Physical activity is defined as "Any bodily movement produced by skeletal muscles that results in energy expenditure." (Caspersen, Powell, & Christenson, 1985, p. 126). The World Health Organization recommends 150 minutes of moderate to vigorous physical activity (MVPA) every week, because of the consequential health benefits (WHO, 2015a). The origin of these recommendations is a report from the Centers for Disease Control and Prevention (CDC) and the American College of Sports Medicine (ACSM), which concludes that adults should spend a minimum of 30 minutes in moderate activity most days of the week, in order to obtain the known health benefits that comes with physical activity (Pate et al., 1995). The CDC later specified that "most days of the week" meant five days of the week (U.S. Department of Health and Human Services, 2008), making it easier to assess how many met the requirements. In order to categorize physical activity intensity levels, metabolic equivalents are often used: "One metabolic equivalent (MET) is defined as the amount of oxygen consumed while sitting at rest and is equal to 3.5 ml O_2 per kg body weight x min" (Jette, Sidney & Blümchen, 1990, p. 555). By using METs, the metabolic rate and energy cost of activities are quantified. By definition, any activity exceeding one MET is physical activity (Caspersen, Powell, & Christenson, 1985). Pate et al. (1995) classified physical activity in three categories, based on intensity: light physical activity (<3.0 METs), moderate physical activity (3.0 – 6.0 METs) and vigorous physical activity (>6.0 METs). To put these numbers in perspective, jogging at 9 km/h is activity at 7 METs, raking in the garden is activity at 3.5 METs and competitive badminton is activity at 6-7 METs (Jette et al., 1990). Engaging in 150 minutes of moderate physical activity during a week provides an energy expenditure somewhere between 500 and 1000 METs, which helps achieve several health benefits, and is why these are the recommendations (Tucker, Welk, & Beyler, 2011). There are many examples of how an active lifestyle is beneficial, in terms of disease prevention and treatment. Some of these are described below.

High levels of physical activity have been associated with a 50 % incidence reduction in colon cancer (Colditz, Cannuscio, & Frazier, 1997). Patients who also exercise after cancer treatment have lower BMI and improved quality of life (Fong & Hui, 2012). Physical activity can also be an important factor in the prevention of cardiovascular disease (Hamer, Ingle, Carroll, & Stamatakis, 2012). When comparing physical activity and drug interventions, Naci & Ioannidis (2013) found that their benefits are often similar in the secondary prevention of coronary heart disease, primary prevention of diabetes, stroke rehabilitation and heart failure treatment. Diabetes incidence is inversely associated with leisure time physical activity (Helmrich, Ragland, Leung, & Paffenbarger, 1991) and when treating patients diagnosed with diabetes, physical activity is associated with reduced weight and blood pressure, and improved quality of life (Plotnikoff, Costigan, Karunamuni, & Lubans, 2013). The following paragraph emphasizes health benefits obtained specifically from vigorous physical activity, as defined by the MET equation.

High levels of vigorous physical activity have been associated with lower risk of hypertension and depressive symptoms in middle-aged women, compared with those exercising at moderate intensity (Pavey, Peeters, Bauman, & Brown, 2013). A longitudinal comparison between light, moderate and vigorous intensity in youth, found significantly more favorable results in the vigorous activity group (Carson et al., 2013). Results showed higher peak VO_2, lower BMI, waist circumference and systolic blood pressure. A study examining the physical activity prevention against premature cardiovascular death, found that seven minutes of daily vigorous physical activity reduces coronary heart disease incidence by almost two thirds (Yu, Yarnell, Sweetnam, & Murray, 2003). Stair climbing equals somewhere between 8.6 METs (Bassett et al., 1997) and 9.6 METs (Teh & Aziz, 2002) and can therefore be considered a vigorous activity. Thus, seven minutes of daily stair climbing should provide the same health benefits.

2.2 Workplace physical activity

Physical activity interventions at the workplace have yet to prove their effectiveness on weight outcomes (Verweij, Coffeng, van Mechelen, & Proper, 2011) and physical fitness (Dishman, Oldenburg, O'Neal, & Shephard, 1998). According to a meta-analysis by Conn, Hafdahl, Cooper, Brown, & Lusk (2009), some workplace interventions can improve physical activity levels, but evidence is inconsistent. Proper et al. (2003) however, found strong evidence of workplace intervention impact on physical activity levels and musculoskeletal disorders. They also found inconclusive or limited evidence regarding effects on cardiorespiratory fitness, muscle flexibility, muscle strength, body weight, general health and fatigue. In regards of financial returns from workplace physical activity interventions, one meta-analysis concluded that non-randomized studies showed reduced absenteeism and/or medical costs. At the same time, interventions in randomized controlled studies remained ineffective (Van Dongen et al., 2011). Another meta-analysis by Marshall (2004), found that interventions promoting a more active lifestyle could have, at least, a short-term effect on behavior change. Promotions could encourage stair use, walking to a colleague instead of sending e-mails and active transportation to, and from work. A factor that has been associated with employees' physical activity is the perception of organizational support for their health, and how coworkers' physical activity levels are perceived (Lemon et al., 2009). Thus, when the organization is outspoken and expresses care for their employees' health, physical activity levels are likely to rise.

In Norway, the employer is obligated to "assess measures to promote physical activity among the employees" (Arbeidsmiljøloven, 2005, § 3-4). As stair climbing can be described as a vigorous activity, employers could fulfill their obligation by facilitating stair use. Stairs are always available and their use requires no extra equipment, perhaps making it the most cost-effective form of physical activity available in the workplace.

2.3 Benefits from stair climbing

There exist a few studies that have been conducted in order to assess what impact stair climbing may have on health benefits. In the study by Boreham et al. (2005), sedentary but otherwise healthy women climbed stairs five days a week. Stair climbs increased from one each day to five each day, and every climb required approximately two minutes. The intervention group experienced a 17.1 % increase in peak VO_2 and a 7.7 % reduction in low-density lipoprotein cholesterol. The researchers concluded that short bouts of stair climbing every day, is a way of reducing cardiovascular risk factors in sedentary women.

In another study, Andersen et al. (2013) randomly assigned 160 office workers into an intervention- and a control group, before a ten-week intervention. The intervention group received weekly e-mails encouraging ten minutes of stair use every day, while the control group received weekly e-mails encouraging the recipients to carry on with their usual physical activity habits. Adherence was high in the intervention group, as 82.7 % of participants did at least three sessions of the encouraged stair walks per week. There were significant improvements in aerobic fitness, while blood pressure decreased.

To increase stair use among employees, an intervention was carried out in a university hospital (Meyer et al., 2010). In 77 selected participants, the median number of stair climbs and –descents was 4.5 each day, at baseline. After twelve weeks, the median was 20.6 stair climbs and –descents each day. This increase provided improvements in employees' fitness, body composition, blood pressure and lipid profiles.

Another benefit from using the stairs is that it can be time saving. One study concluded that employees at a six-story hospital could save fifteen minutes each workday by taking the stairs instead of the elevator (Shah, Byrne, Wilson, & Wilson, 2011). These results are supported by Westmeier-Shuh, Parr, Dewitt, & Woeber (2007), who concluded that ascending/decending one floor using elevator is twice as time-consuming as taking the stairs.

There is little doubt that stair climbing provides substantial health benefits. The following chapter describes how it may be possible to affect people's choice between stairs and elevators or escalators.

2.4 Nudging

To nudge is to affect the context in which we make choices. This is neatly called "choice architecture" (Thaler & Sunstein, 2009). In the book "Nudge", Thaler & Sunstein (2009) introduces the term "libertarian paternalism" (p. 5). In this context, "libertarian" means that people should be able to practice free will, and make their own choices. Paternalism, on the other hand, is the concept of creating choice architecture that influences people to make wise choices, to help them live longer and healthier. Libertarian paternalism and nudging can compare to strict paternalism and regulation. Where nudging does not affect a person's free will, regulation will elicit a certain behavior by prohibition or imposition. Nudging has been embraced by the British government, who in 2010 under Prime Minister David Cameron created the Behavioural Insights Team (BIT, 2015). One of their objectives is "enabling people to make 'better choices for themselves'". In other words, nudging.

2.4.1 A mode of governance

Mols, Haslam, Jetten, & Steffens (2015) argues that nudging is the fifth mode of governance. The previous four are hierarchy, markets, networks and, recently added, persuasion (Bell, Hindmoor, & Mols, 2010). Social marketing is an example of persuasion, which most western citizens are familiar with (Kotler & Zaltman, 1971). In relevance to physical activity, the Norwegian Directorate of Health (NDH) is trying to increase Norwegians' activity levels to the recommended 30 minutes a day, by using social marketing (Helsedirektoratet, 2014). Social marketing campaigns are often expensive: In 2013, the NDH released a campaign against excessive drinking, costing thirteen million kr (Kampanje.com, 2013). Social marketing can also be quite ineffective, and when based on fear it shows weak effects (Witte

& Allen, 2000). It may also backfire, as Cialdini (2003) points out, when a campaign depicts unwanted behavior as something everyone is doing. It is exemplified by an actual anti-littering campaign where a Native American boy is paddling down a litter-filled river. This could lead some to interpret that littering is the norm. Another challenge in social marketing is reactance (Brehm, 1966), a process that happens when the identity of a group is threatened by a marketing campaign and the reaction is defiant behavior.

Nudging, on the other hand, can be cheap, as there are few or no materials used and no expensive TV-commercials. It has proven successful in different settings, as when rearranging cafeteria foods to affect healthier eating (Paul et al., 2011), or when etching a fly inside urinals to prevent spillage (Pritchard, 2013). It is also known that when providing default options to choice sets, very few deviate from the default. This has been shown in the efforts to make more people organ donors (Johnson & Goldstein, 2003). If the default choice is not to donate organs, very few actively choose to do so. However, when the default is to be an organ donor, very few choose not to be one. The same effect has been shown when providing default menus in the efforts to promote more sustainable food choices (Campbell-Arvai, Arvai, & Kalof, 2014). Given nudging's efficacy and low cost, it is understandable that it may take over for, or assist social marketing in influencing behavior change.

2.4.2 A debate on nudging

After Thaler & Sunstein (2009) published their book Nudge, a philosophical and political debate has surfaced and some claim nudging and evidence of its effectiveness is not all positive. Thaler & Sunstein (2009) define nudging as "any aspect of the choice architecture that alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives" (p. 6). According to Hausman & Welch (2010), this definition is too broad. As Thaler & Sunstein use the phrasing "any aspect…", Hausman & Welch (2010) claim that too many measures, both overt and covert, would constitute as nudges. They present the following definition:

Nudges are ways of influencing choice without limiting the choice set or making alternatives appreciably costly in terms of time, trouble, social sanctions, and so forth. They are called for because of flaws in individual decision-making, and they work by making use of those flaws. (p. 126)

It is clear that this definition is somewhat negative towards the concept of nudging, as they claim nudges are only used to exploit the flaws in human decision-making. The main difference between the two definitions is that according to the latter, only covert measures can constitute as nudges. A covert nudge is exemplified in the studies by Paul et al. (2011) and by Johnson & Goldstein (2003), mentioned in the previous chapter. A covert nudge can be viewed as a way of tricking the individual to make an unconscious choice. Hausman & Welch (2010) call it "shaping" choices, and regard it close to manipulation. Goodwin (2012) goes so far as to ask if it might be a form of coercion, although he later in the same article states that there can be no force used in nudging. From an ethical viewpoint, this form of nudging may seem problematic, as people retain their illusion of free will, whilst they may choose differently than they would have without the nudge. Nudging's legitimacy, transparency and accountability as a governance intervention has been the subject of critique, however, in the words of Kosters & Van der Heijden (2015): "we have not traced any works that actually evaluated these criteria of real-world nudges" (p. 287).

As with social marketing, negative reactions can come from nudging. According to Mols et al. (2015), the unwillingness to change behavior occurs when subjects become aware that they are being nudged. Results from default choice nudging are not all positive either, and a study by Bronchetti, Dee, Huffman, & Magenheim (2013) found no effect from this type of intervention, in which a small part of tax returns, by default, was directed to specific savings bonds. Most people actively opted out and chose to receive the full amount. It seems that the efficacy is contingent on how aware individuals are in the choice context, and if their plans prior to the choice differ from the goal of the nudge. The main reason for opting out of the default choice in this study was plans to spend the refunded money.

2.4.3 Active and passive nudging

In an editorial article, Kremers, Eves, & Andersen (2012) argues that the concept of nudging can be divided into two categories: passive- and active nudging. Passive nudging is as defined by Hausman & Welch (2010) and agreed upon by Mols et al. (2015), namely covert nudging which utilizes human fallacies in decision-making. The study by Bassett et al. (2008) is an example of active nudging: They monitored the average calorie purchase from customers at selected fast food chains. When Subway posted signs containing calorie information by the register, it affected their customers to buy less calories than customers in chains without these signs. The nudge is now overt, but still it affects the choice context. There is no hidden agenda behind an active nudge, nor any attempt to manipulate.

Active nudges are also called prompts (Kremers et al., 2012). A prompt can be understood as a “reminder” (Oxford Dictionaries, 2015) and as such, it works best when individuals actually have a plan to change their behavior. For instance, people who have a personal goal to become more physically active are likely to be influenced by a prompt placed at the point of choice between stairs and elevator, advising them to take the stairs. If they do not have any previous intentions of behavior change, it is unlikely that they will be influenced (Lewis & Eves, 2012).

2.5 Point-of-choice prompts

In the scientific efforts to “remind” people that they should take the stairs and not the elevator, point-of-choice prompts are often used (Cohen, 2013; Eves, Webb, Griffin, & Chambers, 2012; Eves, Webb, & Mutrie, 2006; Lewis & Eves, 2012). This is often a sign placed near the elevator, or at the point of choice between stairs and elevators, or escalators. The sign can contain a simple encouragement: “Please use the stairs” or a more health related statement: “It is healthy to climb stairs” (Aksay, 2014). One study combined the point-of-choice health statement: “Regular stair climbing helps to prevent weight gain” with a reward poster at the top of the stairs saying: “Well done stair climbers! You have just burnt a 16th of the calories needed to avoid weight gain” (Lewis & Eves, 2012). When only one sign was present, the intervention was ineffective, but both signs visible gave a significant increase in stair ascent. They managed to increase stair climbing only in obese individuals by the assumption that their goal is to lose weight, as per the previous paragraph with regards to remind individuals of their planned behavior change. Calorific and health related messages seem to be more effective than simple commanding messages. Eves, Webb, Griffin, & Chambers (2012) displayed the following message on a workplace point-of-choice poster: “Stair climbing always burn calories. One flight uses about 2.8 calories, but 10 flights a day would use 28 calories. Over a year that adds up to 10 000+ calories; that’s more than four days worth of food” (p. 3). The same poster was also placed halfway up each stair flight. In another workplace, this intervention was combined with messages in the stairwell. In addition to the point-of-choice posters, they put six different messages on the wall beside the stair risers between each floor. “Regular stair climbing helps you control your weight” and “stair climbing…” followed by either “always burns calories”, “burns more calories per minute than jogging”, “is free exercise” or “provides daily exercise”. Posters only provided a 7.2 %

increase, while posters and stairwell messages provided 12.3 % increase.

Information about social norms is also known to elicit behavior change (Kallgren, Reno, & Cialdini, 2000). One study examined the difference between point-of-choice signs displaying either an exercise encouragement or a normative message saying most people use the stairs (Burger & Shelton, 2011). There was no difference in stair use from baseline at the exercise encouragement site, however; at the normative message site, elevator use dropped 46.0 %. Research has also been conducted to specifically target non-English speaking people. This study by Masters & Eves (2006) took place in Hong Kong and examined the effect of point-of-choice prompts on outside stair use. Although the baseline rates of stair climbing was only 0.4 %, no effect came of the intervention.

Previous studies measuring the effect of point-of-choice prompts on stair use, applied a video camera (Eves et al., 2006), observations (Aksay, 2014; Boutelle et al., 2001; Coleman & Gonzalez, 2001; Eves et al., 2009; Kerr, Eves, & Carroll, 2001) or objective frequency counters (Cohen, 2013; Engbers, van Poppel, & van Mechelen, 2007; Eves et al., 2012; Kerr et al., 2004) as monitoring tools. Most stair climbing interventions are performed within ten weeks (Aksay, 2014; Eves et al., 2012; Russel & Hutchinson, 2000; Ryan, Lyon, Webb, Eves, & Ryan, 2011; Swenson & Siegel, 2013; Titze, Martin, Seiler, & Marti, 2001). A two-week baseline monitoring is most common, followed by three to eight weeks of intervention exposure. The author of the present study has not found any published studies on this subject with longer intervention periods than 3.5 years (Kerr et al., 2004). In the other end of the scale is the study by Russel & Hutchinson (2000) with only one week of intervention exposure. It is fair to note that this study was conducted in an airport. An airport is heavy with pedestrian traffic, but it is often long between visits for each individual. Thus, it is likely that a longer intervention would have produced the same results as a short one.

There are other ways of affecting behavior to increase stair use, and as presented in the next chapter, they may prove equally effective as point-of-choice prompts.

2.6 Stair-riser banners and positive feedback

According to a study by Kerr, Eves, & Carroll (2001), stair-riser banners can be twice as effective as point-of-choice posters. In this study, the researchers carried out two weeks of baseline measuring, two weeks with point-of-choice posters and two weeks with stair-riser banners. The last two weeks of stair-riser banners showed a significantly higher effect, although this could be attributed the long-term effect of the two interventions combined.

Olander, Eves, & Puig-Ribera (2008) on the other hand, found no effect of a stair-riser banner intervention in a train station. It was argued that during dense pedestrian traffic, stair-riser banners are more difficult to see than posters. Webb & Eves (2007) were able to find a 161.0 % increase in stair climbing using stair-riser banners. The interesting part from this study was the additional increase at the generalization site: an adjacent staircase 25 meters from the intervention staircase. This suggests that the effect from stair use interventions can extend to other staircases where no intervention is present.

Another way of influencing behavior change is positive feedback. According to Thaler & Sunstein (2009) this is also a form of nudging, although Hausman & Welch (2010) would disagree, as it is not a covert influence, and it is not necessarily presented in a choice context but rather after a choice has been made. Whether or not it can be called a nudge, it has proven successful in behavior change: In the efforts to reduce electricity use, an experiment was conducted from the basis of social norm theory (Schultz, Nolan, Cialdini, Goldstein, & Griskevicius, 2007). Households with above or below average electricity use received a message communicating how much they used and how it compared with people from the same area. What followed was that the below average households increased their use, while the above average households decreased their use. This is called the boomerang effect (Prince, Reid, Carey, & Neighbors, 2014). In addition to the informational messages, some households received hand drawn smiley faces. Happy smileys for the below average and sad faces for the above average households. The boomerang effect decreased and the desire to establish low electricity use as the acceptable norm was successful. Positive feedback can have a major impact on reinforcing behavior, and a meta-analysis examining the effect of external rewards on internal motivation found that these types of rewards might have a negative influence, whereas positive feedback enhances motivation (Deci, Koestner, & Ryan, 1999). When people volunteer to do a task, those who are given rewards underperform, compared to those who do the task unrewarded (Gneezy & Rustichini, 2000). The decrement of motivation after receiving rewards is called the overjustification effect (Greene, Sternberg, & Lepper, 1976). It happens when a person engages in an activity, receives a reward and thus interprets participation in the activity as justified by the reward. The initial interest in the activity is undermined and the activity is no longer viewed as an end in itself. Though this is a well-known psychological phenomenon, at least one study has shown an increase in stair use from providing monetary rewards (Schumacher et al., 2013). This intervention took place in an office, an intervention site that has proven difficult to influence.

2.7 Office buildings or public places?

Interventions conducted in shopping centers (Aksay, 2014), train/tram stations (Eves, Olander, Nicoll, Puig-Ribera, & Griffin, 2009; Lewis & Eves, 2012), airports (Russel & Hutchinson, 2000) and similar public places have significantly increased stair use (Eves et al., 2006). According to Eves & Webb (2006), all published studies seeking to increase stair use relative to escalators have proven successful. Workplace interventions, however, have not shown the same efficacy. Coleman & Gonzalez (2001) tested individual- and family directed intervention posters in several intervention sites. They found a decrease in stair use for men in a library and in an office building. Marshall, Bauman, Patch, Wilson, & Chen (2002) investigated the effect of point-of-choice signs and footprints leading towards the stairs in an Australian hospital. Although there was a short-term increase, results from follow-up showed a decrease in stair use, relative to baseline. The use of art (Boutelle, Jeffery, Murray, Kathryn, & Schmitz, 2001), and music (Boutelle et al., 2001; Kerr, Yore, Ham, & Dietz, 2004) in the stairs seems to have small positive effects on stair use in office buildings. However, these studies did not separate ascent from descent, making impact on health benefits and stair behavior impossible to predict, given the fact that stair climbing produces three times the energy expenditure as stair descent (Teh & Aziz, 2002).

One reason for the discrepancy in intervention effects between public locations and workplaces could be the already frequent stair use at workplaces, relative to stair use in other public locations (Eves & Webb, 2006). In office buildings, the choice is most often between stairs and elevator, which provides an average baseline stair use of 20.9 %. In other public buildings where the choice is between stairs and escalator, the average baseline stair use is often lower than 10.0 % (Eves & Webb, 2006).

2.8 The effect of building design

In terms of building design, one study has examined how environmental features may affect stair use in ten academic buildings (Nicoll, 2007). The variable thought to be most associated with stair use was the width of the stairs. Other variables such as appeal was not considered to have an influence. The argument was that wide stairs could accommodate larger groups of people, which are quite common in academic buildings.

In a qualitative study, McGann, Creagh, Tye, Jancey, & Blackford (2014) reported that many people prefer to take the stairs, but are often deterred from it. Stairwells are sometimes hidden behind heavy steel doors, which make the automated elevator doors tempting. In addition, the study suggested that women who wear high heels less often take the stairs down, because they might stumble and fall.

Zacharias & Ling (2015) asked if stair use increases or decreases, when putting stairs and escalator next to each other, thus provoking a choice. Their results suggest that distance between stairs and escalators account for most of the variance in stair use. By increasing distance between stairs and escalator 100.0 %, stair climbing was likely to have a 95.0 % increase.

The aforementioned design related factors that influence stair use have been corroborated by Ruff et al. (2013) who examined stair use in fourteen New York office buildings. Naturally lit stairwells and stairwell visibility was emphasized as the most important factors. Another point that was made is that stair climbing is inversely connected with number of floors: The more floors need to be climbed, the likelihood of stair use decreases. Kerr, Eves, & Carroll (2001) reported that people in the workplace are willing to climb the stairs an average of 3.5 floors.

3.0 Method

3.1 Design

The present study has a quasi-experimental design, which means non-randomized control- and intervention groups (Harris et al., 2006). Two office buildings were used, and which building would receive the intervention was decided by coin toss. Employees in both buildings do mostly sedentary, computer-based work.

Population

The office buildings are located in a small town in western Norway, with a total population <2500 (Thorsnæs & Askheim, 2014). The intervention building is occupied by the local social services. The control building is occupied by the County Governor's office. There were no inclusion- or exclusion criteria, as anyone who passed the monitoring tools within the buildings were accounted for. Human resource management estimated that approximately 170 people worked in the control building, while 140 people worked in the intervention building.

Building design

Both buildings have four floors with offices and conference rooms. Distance from main entrance to the stairs in the control building is approximately fourteen meters. Distance to the elevator is closer to thirteen meters. In this building, elevator and stairs are separated by a wide hallway, as seen in Figure 1 below, which is taken at the entrance.

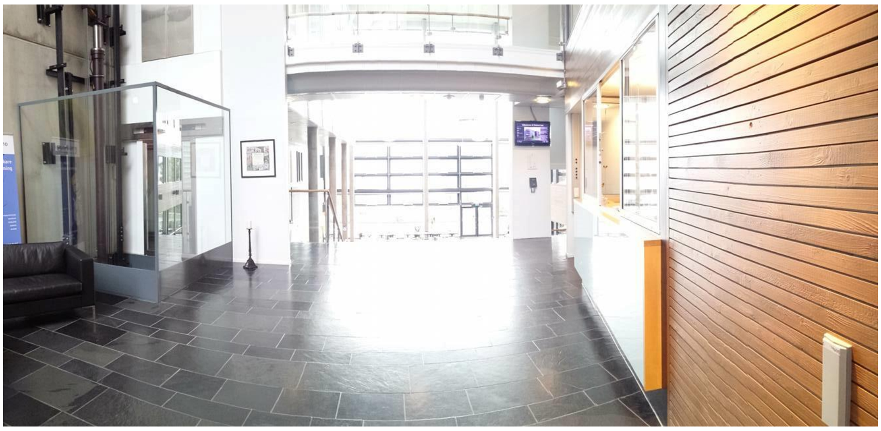

Figure 1: Point-of-choice between elevator on the left and stairs on the right, as seen from main entrance in control building. Stairs remain out of sight, just around the corner.

In the intervention building, distance from main entrance to the stairs is four meters. Directly beside the stairs is the elevator, six meters from the main entrance. Both buildings have other staircases as well, but these are placed in another area, farther from the elevator. The picture in Figure 2, below, is taken from the entrance of the intervention building.

Figure 2: Point-of-choice between elevator and stairs, as seen from main entrance in intervention building

3.2 Monitoring tools

Immotion (Sensor Development International, Dalen, Netherlands) infrared people counters were applied to monitor stair- and elevator use. The counters monitor passing frequency and are bi-directional. This means that the counters distinguish ascent and descent between floors. The counters record time of day as well as dates, making it possible to see if stair climbing differed throughout the workday, weekdays or between months. Data used in this study represents both day and night, thus all counts from start to finish have been used in the dataset. Data extraction was done on almost every Friday between 14.00 and 15.00, and the counters were reset after each extraction. Concerning which day data should be extracted, a few exceptions were made due to personal reasons. Extraction would then be set to the following week. These were only anomalies from the routine procedure and have no impact on the results.

Installing counters

Figure 3: Receiver at intervention stairs, close-up.

Four Immotion people counters were used in the present study. They are small, black boxes, as seen in Figure 3, above. The transmitter (PTx20-1) and the receiver (PRx20U2) each require two AA-batteries. According to the manufacturer, the counters can last up to four years without changing batteries. The receivers could all be connected to a computer for digital identification and thus named based on the positions they would have. Physical tags were also placed on the counters, displaying the names of their positions. The tags would say “building name” and either “stair” or “elevator”. The transmitters were also marked with “Property of HiSF” (Norwegian abbreviation of Sogn og Fjordane University College) as well as the researcher’s name and telephone number, in case of any questions.

Mounting counters

Figure 4: The process of attaching double adhesive tape and Velcro strips to the back of the receivers and transmitters.

The counters were mounted on the wall by the use of double adhesive tape and adhesive Velcro strips. Double adhesive Supertape (Stokvis Tapes, Høvik, Norway) was placed on the back cover of the counters. It was also placed directly on the wall. In one of the buildings, the wall was rough, non-smooth concrete. This was compensated for by taping Construction grade duct tape (Stokvis Tapes, Høvik, Norway) to the wall, making the surface smoother and more susceptible for attaching the counter. Hook & Loop (Gripband AB, Gusum, Sweden) Velcro strips were cut to fit the back cover of the counters. The adhesive side of the Velcro strips were attached to the double adhesive tape on the wall and on the back of the counters. Figure 4, above, depicts the process of attaching the double adhesive tape and Velcro strips.

Distance between the floor/step and the bottom of each counter-pair, measured 125 cm. The only exception being the receiver at the control site stairs, which was measured to be 124 cm above the step. This did not change the fact that it received the transmitter's infrared beam, as the LED-lamp in front flashed a continuous green light. Distance between receiver and transmitter, however, varied. This is shown in Table 1, below.

Table 1: Distance between transmitter and receiver in each mounting site.

Placement	Distance
Control site stairs	138 cm
Control site elevator	116 cm
Intervention site stairs	152 cm
Intervention site elevator	95 cm

According to the counters' instruction manual, transmitter and receiver can be mounted ten meters apart, and still function. However, the closer they are placed, the more accurate they are. It is then likely to assume the intervention site elevator counters to be the most accurate. The pictures below depict all four mounting sites.

Figure 5: Intervention site stairs

Figure 6: Intervention site elevator

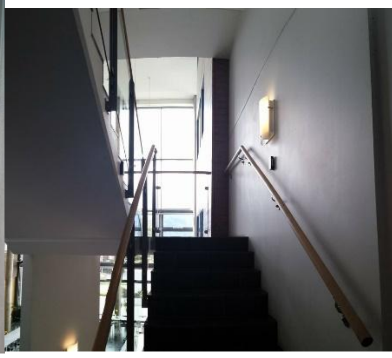

Figure 7: Control site stairs

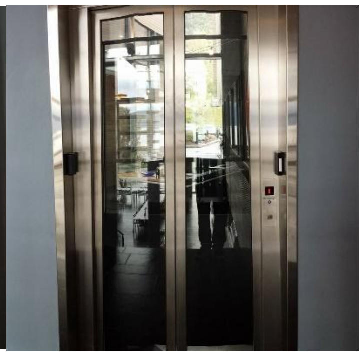

Figure 8: Control site elevator

In the morning of day six after mounting, the transmitter at the intervention building stairs had fallen down. The duct tape was removed from the wall and the transmitter was attached directly on the rough concrete with Powerbond (Tesa, Hamburg, Germany), another double adhesive tape. The fall resulted in a full day without counting. To compensate, counts for the four other weekdays were averaged and the resulting number was plotted in the no-count day. No further problems occurred with the counters.

Testing reliability

Counters were tested for reliability in their setup placement by passing 50 times in both directions. Two researchers observed the passings, and inter-observer reliability was 100 %. During testing at the intervention stairs, four employees at the site also descended the stairs. They have also been taken into account. After each test, the counters were reset. Results are presented in Table 2, below.

Table 2: Reliability testing of each counter-pair in their respective mounting sites.

	Witnessed passings up/in	Registered counts up/in	Witnessed passings down/ out	Registered counts down/ out	Percentage accuracy combined in/out
Control stairs	50	50	50	51	99.0 %
Control elevator	50	50	50	49	99.0 %
Intervention stairs	50	47	54	58	93.3 %
Intervention elevator	50	48	50	50	98.0 %

As Table 2 shows, the intervention stairs counters had the highest margin of error. The miscounts do not seem to be caused by a systematical error, but only random missed- or extra counts. Overall, the counters are 93.3 – 99.0 % accurate.

3.3 Interventions

Footprints

The first intervention was introduced Friday at 14.00, after two weeks of baseline monitoring. Only four footprints were placed on the floor, because of a large doormat inside the entrance. Additional footprints were placed on the first three steps as well, as shown in Figure 9, below. The footprints were provided by the Norwegian Directorate of Health and the Non-communicable disease alliance.

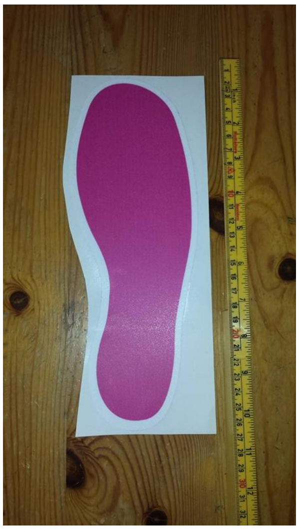

Figure 9:
Intervention setup as seen from entrance

Figure 10:
Footprint in perspective

The footprints were 27 cm long, as can be viewed in Figure 10, with a pink center and white color around the edges. Because of the doormat inside the entrance, the first footprint was placed 180 cm from the entrance door, with the following steps approximately 66 cm apart, from heel to heel. According to Wise & Hongu (2009), an average male step, measured from heel to heel is approximately 76.2 cm. The corresponding female step measures 67.1 cm. It was planned to average these numbers and place the footprints accordingly to get the most natural step length, however; because of the doormat, the floor would only fit three visible footprints, using these measurements. The step length was thus shortened in order to fit four footprints.

Stair-riser banners

The stair-riser banners were designed in cooperation with the Norwegian Directorate of Health, who also manufactured the product. The banners were introduced Friday, after five weeks of footprint exposure. The stair-riser banners were placed at the top riser of each stair flight. As the intervention building has four floors, three banners were used. The banners measured 13 cm height x 110 cm width. The text said (translated from Norwegian), “Thanks for taking the stairs. Have a nice day”. The text corresponded with the local dialect, because it was hypothesized that this would be more relatable for the employees. On both sides of the text were androgynous smiley faces, to amplify the positive feedback from the text. Photos from this intervention are shown below, in Figure 11 and Figure 12.

Figure 11: Second intervention setup, as seen from stairwell between third and fourth floor.

Figure 12: Second intervention up close

Intervention schedule

Table 3, below, depicts the experiment in its entirety. Two weeks of baseline monitoring were carried out. The first intervention was introduced and counts were monitored the following five weeks. The second intervention was then introduced and counts were monitored another four weeks. Total time of intervention was nine weeks, after which, all intervention materials were removed and follow-up counts were recorded for three weeks. The project as a whole lasted fourteen weeks.

Table 3: Intervention schedule, and actions taken at intervention- and control site.

Sites/week	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Intervention building	Baseline monitoring		1. intervention + frequency monitoring					1. + 2. Intervention + frequency monitoring				Removal of interventions Follow-up monitoring			Project termination
Control building	Baseline monitoring		Frequency monitoring					Frequency monitoring				Frequency monitoring			Project termination

Post-intervention questionnaire

The week after follow-up monitoring was terminated, a web-based questionnaire (QuestBack, New York, USA) was sent out to all employees in both buildings. The respondents were questioned about their stair habits and if the project had affected them in any way. They were also asked how many floors they are willing to climb by stairs. The complete questionnaire in Norwegian can be found as an attachment to this thesis.

3.4 Ethical considerations

Questions of anonymity are important in this context. No health variables were collected from participants, so it is impossible to distinguish any single person from the results, as the numbers include both employees and occasional visitors. These visitors only add to the results. The corporation names remain undisclosed, but the location of the buildings can be found in the literature section. Human resource managers at both workplaces gave permission to carry out the experiment.

It was hypothesized that the experiment could be met with some unwillingness among the participants. This could be caused by an excessive focus on health, weight and lifestyle, often communicated through media. It is quite possible that the footprints and stair-riser banners elicit different reactions from different people. Some might react positively to a reminder leading them to the stairs, while others might be offended by the notion that someone is advising them to choose a certain way.

Some people may feel left out, or stigmatized by the intervention. Paraplegic, who are forced to take the elevator may react negatively to influences regarding how unhealthy it is to take the elevator. They may also react negatively towards people who continue to use the elevator, knowing they should not.

3.5 Statistical analyses

Extracted data was immediately uploaded to a computer and viewed using Easy Reports through Sensor Server (Sensor Development International, Dalen, Netherlands), the provided software from the counters' manufacturer. Data was plotted into Excel (Microsoft, Redmond, Washington, USA) to obtain oversight and ways to organize. IBM SPSS Statistics 23 (IBM, Armonk, New York, USA) was used to analyze the data. Chi square tests were used to compare baseline data with each of the following periods. The main outcome variable was the frequency in people choosing stair climbing or elevator ascent. The same testing was done to compare stair- and elevator descent, as well as the difference between stair climbing and - descent.

4.0 Evaluating the method

Design

The reason for the quasi-experimental design was convenience. There was simply not enough time, resources or equipment to conduct a randomized controlled trial within the boundaries of a master thesis. The optimal design would be to select several office buildings and randomize which building gets an intervention or not, as done by Graham, Linde, Cousins & Jeffery (2013). This would have increased participants greatly and reduced chances of coincidental effects. In a randomized controlled study, one seemingly coherent population is divided in two, to make sure there are no systematical differences between the groups (Thomas, 2011). By using two similar buildings where similar work tasks are performed, as in the present study, the objective is to come as close to a randomized controlled study as possible.

Building design and population

Building similarities apply to a variety of factors like number of floors, distance between elevator and stairs, visibility of stairs and perhaps other variables not considered. It is also important that the employees have somewhat similar work tasks. One reason behind the need for similarity is to keep possible confounding variables constant. A confounding variable is a variable not accounted for, which can affect the results, thus provide the wrong basis for a conclusion (Thomas, 2011).

When the buildings are in the same local community, it may reduce potential biases due to differences in population. On the other hand, it is possible that employees at the different sites know each other, leading people from intervention- and control sites to communicate and create possible contamination effects at the control site. Differences between intervention site- and control site stairs are obvious, but there is one important factor where the sites are similar: Stairs and elevator are almost equally distanced from the main entrance in both buildings, which lessens the chance of a systematical difference.

Monitoring tool

Counters were applied because observation can be extremely time consuming. In addition, if a researcher were to sit and pay attention to the stair use in either of the two buildings, it would seem quite conspicuous and possibly affect the results. At least with the counters, there is a possibility that the employees forget about their presence. Limitations with objective counters are the missed variables, such as gender, carrying bags and if passing individuals are alone, or part of a group. If two or more people are walking side by side in the stairs, the counters will only register one passing. Another limitation is not because of the counters, but because of their visibility. The optimal solution would be if they could somehow remain hidden. Instead, they were placed quite visibly in the staircases and elevator entrances. This makes the participants aware that they are being monitored, and may influence one way or another. As Table 2 (page 19) shows, the counters are not 100 % accurate, which can be viewed as a limitation. Nevertheless, there seem to be no systematical differences between the counters, and miscounts can happen at random.

The bi-directional feature of the counters is very important. If it were not possible to tell ascent from descent in the data, it could be that the counts only represented descents. Although any stair use is better than no stair use, stair descent is nowhere near as interesting as ascent because of the aforementioned health benefits of ascent.

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Figures and tables overview

Figure 1 – Control building entrance……………………..14

Figure 2 – Intervention building entrance………………...15

Figure 3 – People counter…………………………..….16

Figure 4 – Attaching equipment………………………....17

Figure 5 & 6 – Intervention mounting sites……………....18

Figure 7 & 8 – Control mounting sites…………………...18

Figure 9 – Intervention footprints…………………….…..20

Figure 10 – Footprints length……………………………..20

Figure 11 – Stair-riser banner…………………………......21

Figure 12 – Stair-riser banner up close…………………....21

Table 1 – Transmitter and receiver distance…………..….18

Table 2 – Counter reliability……………………………....19

Table 3 – Intervention schedule…………………………...21

Attachments

Attachments can be found in the three subsequent pages, in the order described below:

1. Questions from the questionnaire, as posed to intervention- and control participants, respectively.
2. Confirmation e-mail from my contact person in the control building.
3. Confirmation e-mail from my contact person in the intervention building.

Spørreskjema for intervensjonsdeltakere

1. Hva er hovedgrunnen til at du vanligvis tar/ikke tar trappen på arbeidsplassen?
2. La du merke til tellerne som har vært montert i trappeoppgangen og i heisinngangen i høst?
3. Nevn en måte tellerne påvirket deg, eller nevn hvorfor du ikke ble påvirket.
4. La du merke til fotavtrykkene og trappetrinnsplakatene?
5. Nevn en måte disse påvirket deg, eller nevn hvorfor du ikke ble påvirket.
6. Har din trappebruk utenfor arbeidsplassen
    a. Økt?
    b. Minsket?
    c. Forblitt den samme?
    d. Vet ikke
7. Hvor mange etasjer er du villig til å bestige med trapp, før du heller velger heis?

Spørreskjema for kontrolldeltakere

1. Hva er hovedgrunnen til at du vanligvis tar/ikke tar trappen på arbeidsplassen?
2. La du merke til tellerne som har vært montert i trappeoppgangen og i heisinngangen i høst?
3. Nevn en måte tellerne påvirket deg, eller nevn hvorfor du ikke ble påvirket.
4. Hvor mange etasjer er du villig til å bestige med trapp, før du heller velger heis?

Masterprosjekt

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Felde, Jorunn <fmsfjfe@fylkesmannen.no> 1. september 2015 kl. 08.04 Til: Andreas Åvitsland <aavits1@gmail.com>

Hei,

Beklagar, eg forstod ikkje at vi måtte svare formelt på e-posten.

Ja, vi er med på prosjektet ditt.

Eg sjekkar at alt er i orden med målarane med jamne mellomrom, du får melding dersom det er noko som ikkje er i orden.

Jorunn

Med venleg helsing

Jorunn Felde

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Hei Anders

Dette kan vi sikkert vere med på.

Ta kontakt med meg i august; er tilbake frå ferie 10. aug.

Med helsing Frode Henden Presseansvarleg

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Promoting workplace stair climbing: Sometimes, not interfering is the best

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Abstract

Purpose. *Stair climbing is a vigorous activity and can lead to several health benefits. Studies seeking to increase stair climbing in various public locations have shown positive effects, while results from similar studies conducted in the workplace are inconclusive. This study examined stair climbing in the workplace, and monitored effects from a single- and a combined intervention. Intervention was inspired by nudging, the libertarian method of influencing behavior.*

Design. *Quasi-experimental design.*

Settings. *Two office buildings, located in western Norway.*

Subjects. *Stair- and elevator users, to- and from the ground floor.*

Intervention. *Stair leading footprints alone, and combined with stair-riser banners containing a positive feedback message.*

Measures. *Stair- and elevator traffic was measured by infrared people counters. Web-based questionnaires were distributed after follow-up period.*

Analysis. *Chi square tests to determine differences between baseline and the subsequent periods.*

Results. *Intervention site stair climbing at baseline (79.0 %) was significantly reduced with footprints (-5.1 %, p<0.001), footprints and stair-riser banners (-5.7 %, p<0.001) and in follow-up (-4.0 %, p=0.019).*

Conclusion. *Both intervention periods resulted in significant decreases in stair climbing, which was still the case after the follow-up period. These tactics in influencing stair climbing may be ineffective, or cause a negative reaction, when applied in a workplace with an existing high amount of stair climbing.*

PURPOSE

Physical inactivity is one of the major risk factors associated with non-communicable diseases (NCDs)[1]. The recommended 150 minutes per week of moderate to vigorous physical activity[2] is only fulfilled by 32.0 % of Norwegian adults[3] while inconclusive evidence suggests the equivalent portion in the USA to be somewhere between 8.2 %[4] and 57.0 %[5]. Physical activity is associated with reduced risk of cardiovascular disease[6], type 2 diabetes[7], colon cancer[8] and obesity[9]. The global prevalence of obesity is estimated to be 600 million people[10] which accounts for 0.7 – 2.8 % of healthcare expenditures[11]. Obesity is also associated with increased medical expenses and work-related absenteeism[12]. When North-American adults mention "lack of time" as a main reason for inactivity[13] while spending half their waking hours at work[14], the workplace should be considered an attractive arena for increasing physical activity levels. People in sedentary jobs are seated as much as twelve hours throughout a normal workday, which is more than on a leisure day[15]. It has also been shown that people in sedentary jobs have a higher risk of developing obesity than people in standing jobs[16]. Stair climbing expends between 8.6 METs[17] and 9.6 METs [18], and can therefore be categorized as a vigorous activity. Seven daily minutes of vigorous physical activity has been associated with a 62.0 % decrease in coronary death[6], thus seven daily minutes of stair climbing should provide the same benefit. Stair climbing has been associated with higher peak VO_2[19], lower blood pressure[20], improved fitness[21], and is also time-saving, compared to elevator[22, 23].

Several studies aiming to increase physical activity levels in the workplace have been published, and though significant effects have been reported, evidence is inconclusive[24]. Among these studies are interventions specifically aimed at increasing workplace stair use. Some have been ineffective[25-28], while others have been successful[29-31]. Similar interventions have also been carried out in public locations, such as shopping centers[32], train/tram stations[33], airports[34] and universities[35], and according to Eves & Webb[36], these types of interventions in public settings are often more successful than those in the workplace. The typical intervention tactic is to place a sign at the point of choice between stairs and elevator, displaying a message or image. Russel, Ryan & Dzewaltowski[37] used a deterrent message, which gave a small, but significant increase in stair climbing. Eckhardt, Kerr & Taylor[38] compared general health related messages to specific health related messages and found specific messaging to be significantly more effective. Webb & Eves[39] placed specific health- and calorie related messages on stair risers and were able to increase stair climbing significantly. Placing messages on the stair risers instead of point-of-choice posters, was first demonstrated by Kerr, Eves & Carrol[40], who concluded that this new message format was superior to posters. Other tested interventions are music and art[31, 41] and reward based programs[42], all of which seem to increase stair use to some degree.

In the efforts to change general behavior, positive feedback has been effective[43] and is known to have a more positive influence on motivation, as compared with external rewards[44]. This approach has also been used by Lewis & Eves[45] in a study aimed to increase stair use. Footprints leading towards the stairs have only been tested once before[28]. This, for some reason, yielded negative results and is in need of re-testing. All the aforementioned influences can be called nudges, as defined by Thaler & Sunstein[46], and their objective is to influence decision making, while people retain their opportunity to choose freely.

Successful ways of influencing employees to choose stairs over elevator means a major potential increase in physical activity levels. A natural consequence would be a decrease in NCD incidence in a cost-effective, available and timesaving way. Based on the mixed findings in this research field, the primary aim of the present study is to evaluate the effectiveness of stair-leading footprints in a solo intervention, and in combination with stair-riser banners providing positive feedback, to increase stair climbing in an office workplace setting. The secondary aim is to collect opinions of the intervention and of stair use in general.

METHODS

Design

The present study used a quasi-experimental time-series design. Stair and elevator use were monitored in two office buildings, located in a small town in western Norway. Monitoring took place from early September to mid-December, simultaneously in both buildings. Which building would receive the intervention and which would function as a control, was decided by coin toss. Both buildings had four floors. In the intervention building, stair and elevator proximity to the main entrance, measured four and six meters, respectively. The equivalent distances in the control building were fourteen and thirteen meters. In the intervention building, stairs and elevator were located next to each other, while in the control building; stairs and elevator were ten meters apart, separated by a wide foyer. Two weeks of baseline monitoring preceded a five-week intervention period. A second intervention was introduced and the combined interventions were displayed during four weeks, after which, follow-up monitoring lasted three weeks. After the fourteen-week monitoring period, a web-based questionnaire was distributed via e-mail to all employees in both buildings.

Sample

The intervention building accommodated the regional social services and contained approximately 140 employees. The control building accommodated the County Governor and contained approximately 170 employees. There were no inclusion- or exclusion criteria, as all registered counts from the monitoring period were included in the results. Human resource management in both buildings confirmed that although mostly employees frequented the stairs and elevators, they would receive occasional visitors. Both sites combined, 45 231 stair/elevator choices were counted. This includes 6601 baseline counts, 15 751 counts in the first intervention period, 12 996 in the second, and 9883 counts in the follow-up period.

Measures

Infrared bi-directional people counters (Immotion, Sensor Development International, Dalen, Netherlands) were placed in the ground floor stair flight and elevator entrance of both buildings, 125 cm ± 1 cm from the floor, as recommended by the counters' instructions. Because of structural differences in stairwells and elevators, the distances between receiver and transmitter at each site varied with 152 cm at the farthest, to 95 cm at the shortest. The outcome variables are ascent from-, and descent to the ground floor, by either stairs or elevator. The counters monitored at all time, providing counts also outside normal work hours, throughout the fourteen weeks. After the follow-up period, a web-based questionnaire (Questback, New York, USA) was distributed to all employees via e-mail. This consisted of both open-ended and closed questions. The respondents were questioned about their stair habits and if the project had affected them in any way. They were also asked how many floors they would climb by stairs, before choosing elevator.

Intervention

The first intervention consisted of pink footprints with white edges, leading from inside the main entrance to the closest stairs (Figure 1). Because of a large doormat inside, only four footprints were placed on the floor. Length of the footprints measured 27 cm, and distance between the heels of each footprint was 66 cm. Additional three footprints were placed on the three lowest stair steps. The second intervention consisted of stair-riser banners containing a positive feedback message, placed at every top stair riser before reaching the next floor (Figure 2). The banners displayed a light blue background, smiley faces on each side and the text (translated from Norwegian), “Thanks for taking the stairs. Have a nice day”. The text corresponded with the local dialect. All intervention materials were removed before follow-up monitoring. The project was performed within the guidelines of the Helsinki declaration.

Analysis

Before monitoring commenced, the counters were tested for reliability. The tests were performed by the means of a trial person passing all counters fifty times in both directions, in their place of set up. The resulting accuracy was between 93.3 % and 99.0 %. Analyses of the results were performed in IBM SPSS Statistics 23 (IBM, Armonk, New York, USA), where chi square tests were used to examine the difference in stair climbing and elevator ascent, by comparing baseline counts with counts from each of the following periods. Data are reported as complete counts from each period. The same testing procedure was used for examining the difference between stair climbing and stair descent, except the results were reported as complete counts from the entire project duration. Level of significance was set to $p<0.05$.

Questions 1, 3 and 5 in the questionnaire were open ended, but the answers we received led us to analyze them into related option categories. These were based on the wording and themes of the answers, and were formed after all answers were collected.

RESULTS

Effects of intervention

Throughout the fourteen weeks, 17 400 counts of stair and elevator use were registered in the intervention building while in the control building, 27 831 counts were registered. The complete results in stair use can be viewed in Table 1. Stair climbing at the intervention site decreased from 79.0 % at baseline to 73.9 % ($p<0.001$) in the first intervention period, 73.3 % ($p<0.001$) in the combined intervention period, and 75.0 % ($p=0.019$) in the follow-up period. The p-values represent decrease relative to baseline. The week-by-week progression in stair climbing at both sites is displayed in Figure 3. Overall stair climbing in the intervention building averaged 15.0 % lower ($p<0.001$) than stair descent, while there was no difference in the control building ($p=0.653$). In the control building, there was a significant decrease of 1.5 % ($p=0.027$) and 2.0 % ($p=0.002$) in stair climbing and –descent, respectively, during the combined intervention period. There was no significant change during the remaining periods.

Questionnaire

Response rates from intervention- and control building were 27.9 % (n=39) and 45.9 % (n=78), respectively. The qualitative answers from questions 1, 3 and 5 were coded for themes, while the rest of the answers were quantifiable. When asked about their main reason for choosing stairs, the most frequent answers in both workplaces were exercise related. When intervention participants were asked about the counters, one person "wanted to take the elevator in spite", while another said the project "felt like surveillance". A few respondents were irritated by the stair-riser banners and when asked about the intervention, one respondent "did not like nagging" while another called the banners "provoking". One respondent said "the banners gave base for some workplace discussion", in which some thought they were a good idea and others felt that they were intrusive. Two respondents wondered “who out there is thanking me” and called it “disturbing” to be thanked by someone unknown for taking the stairs. Others were more positive, and 10.3 % (n=4) of participants mentioned that the interventions were “fun” or “funny”. One person answered that the intervention made it a more “positive experience to walk the stairs” and another person thought the greetings on the stair-riser banners were “a nice way to start the day”. Within intervention participants, 89.5 % (n=34) would climb four floors or more, before choosing the elevator, while in the control building, 97.4 % (n=57) would do the same. Only 5.1 % (n=2) of intervention participants claimed to have increased their stair use outside the workplace. Complete results from the questionnaire are presented in Table 2.

DISCUSSION

The present study has demonstrated a negative effect in stair climbing from stair-leading footprints alone and in combination with stair-riser banners displaying positive feedback. The effect was still present three weeks after the removal of all intervention materials. The results are comparable with the findings of Coleman & Gonzalez[27], who reported negative effects with male participants in both a library and an office setting. They suggested the reason to be a ceiling effect, in which case the baseline values would be too high for any increase to occur. However, baseline stair climbing in their office building was 49.2 % lower than in the present study’s intervention building, but a ceiling effect in the present study is somewhat unlikely, since stair descent averaged 15.0 % higher than stair climbing throughout the monitoring period. In addition, average stair climbing in the control building was 19.0 % higher than in the intervention building and this site displayed no difference between stair climbing and – descent. Baseline stair climbing was unusually high at both sites and only Burger & Shelton[47] have published a study with comparable values, in which they reported 84.9 % as their highest. In any case, the potential for increased stair climbing in the present intervention setting was not fulfilled with the current methods.

In a similar study by Eves, Webb, Griffin & Chambers[30], more positive effects came from dual interventions in a workplace. Their results showed significantly higher increase with two simultaneous interventions, rather than one alone. The two interventions were placed at the point of choice and inside the stairwell, similar to the intervention placements in the present study. However, while they used verbal informational posters, the present interventions are non-verbal encouragements and non-informational positive reinforcements. It seems information is superior to the present intervention approach, as informational posters have been effective in the workplace on multiple other occasions[29, 48].

The footprints were selected as intervention because they are used as an effect to promote physical activity by various health organizations in Norway. However, to our knowledge, the only published study that has tested footprints as an intervention in the past also found negative effects[28], despite baseline stair use being lower than 16.0 %. This strengthens the results of the present study and it seems the Norwegian health organizations should consider discontinuing their use of footprints.

To our knowledge, stair-riser banners with a positive feedback message have not been tested in the past. The present results suggest that how a message is presented may be less important than the message itself. Kerr, Eves & Carrol[40] judged stair-riser banners to be superior to point-of-choice posters to increase stair use, but though they have proven effective a number of other times[33, 39], they may also be ineffective[49]. Nevertheless, the presented messages in past studies have almost always been calorie- or health related. The present stair-riser banners involved positive feedback, inspired by Schultz, Nolan, Cialdini, Goldstein, & Griskevicius[43] who were able to decrease participants' use of electricity with smiley faces.

Though it has been established that positive feedback may enhance motivation[44], the opposite happened in the present study. The reason for this difference may be that in the present intervention, the message was the same for everyone who went up the stairs. In the former experiment, participants were given personal information of their electricity use compared with their neighbors, and a smiley face if their electricity use was below average. Perhaps personalized social comparisons would have increased stair use in the present study, but that would have involved some form of self-reporting or personalized counting system, in which the participants register each time they climb a flight of stairs, and receive some form of feedback at the end of the week. In any case, further testing of the stair-riser banners in sites with lower baseline stair use would be of interest, before dismissing them completely as an intervention.

Throughout the fourteen weeks of monitoring, stair climbing at the control site averaged 19.0 % higher than at the intervention site. When comparing the design of the two buildings, the results are similar with previous research. Stairs and elevator are farther apart in the control building than in the intervention building, which can increase stair use[50]. The stairs in the control building were located openly in a large entrance foyer, leaving it exposed to natural lighting, which may also increase stair use[51]. In comparison, the intervention stairwell was without windows. Finding two identical buildings is difficult, even in a large city and especially in a small town, but the present buildings shared an important feature of containing another set of stairs. This means some stair use might be missing from the data, but although it would be interesting to know the exact amount of stair use, monitoring was limited to the setting where the stairs, elevator and intervention were in close proximity. The reason is that the present study was designed to monitor possible behavior change in the context of choice between stairs and elevator. Taking the other set of stairs is also a choice, but that choice is made without being subjected to the present intervention.

The present study is the first of its kind to be performed in Norway. The high portion of stair users suggests that inhabitants of this town are generally more physically active than average. This notion corresponds with previous research that found the people of the present county to be more active than the country average[52]. People of the municipality is also the second highest educated in Norway[53], and it is well known that higher education is associated with physical activity levels above average[54].

For some reason, the control building displayed a significant decrease in both stair climbing and -descent, during the combined intervention period. However, if the Bonferroni adjustment for multiple tests[55] is applied, the new level of significance is <0.017. This makes the stair climbing decrease at the control building non-significant. The stair descent decrease remains significant, although we suspect this to be a coincidence. Interestingly, with the Bonferroni adjustment, the intervention building's decrease in stair climbing during follow-up becomes non-significant, further strengthening the negative impact of the interventions.

Questionnaire

When the result, after nine weeks of intervention, is a decrease in stair climbing, questions concerning the methods are appropriate, which is why the questionnaire was distributed. Answers from the questionnaire suggest that the decrease in stair climbing can be attributed to a few respondents who were irritated that someone would come to their workplace and try to influence their behavior. The stair-riser banner text was written in local dialect because it was hypothesized that this would be more relatable for the employees. This was obviously ineffective, although it is possible that results had been even worse if the text was in common written Norwegian (bokmål). In a similar previous study, the researchers carried out pre-testing of messages and distributed questionnaires after monitoring had ended[30]. Their results suggested that for people to be motivated for increased stair climbing, the message needs to be believable. In the present study, the footprints are nothing but a non-verbal encouragement, while the stair-riser banners are positive reinforcements from an unknown source. Perhaps this caused the stair-riser banners to be interpreted as insincere, and the negative questionnaire answers reflect the notion that it may not seem believable that someone “out there” is thanking people for taking the stairs.

When merging related themes, 48.8 % (n=19) answered they were influenced in a positive way and one respondent wanted the intervention materials back, because the place became a “little empty when they were taken away”. These people were likely regular stair users anyway, therefore not affected by the intervention. In a similar study, questionnaires were distributed after a point-of-choice intervention. They reported from two respective intervention buildings, in which 62.0 % and 47.0 % felt negatively towards the intervention message[26]. In the present study, only 7.7 % (n=3) reported negative reactions towards the intervention. Nevertheless, there was a decrease in stair climbing, which may have a connection with these negative reactions.

The questionnaire answers suggest that the participants in this study were quite conscious about the fact that they use stairs for exercise reasons. This is yet another supporting argument that the present population is more physically active than average, as well as being conscious about this behavior. AlKandari, Mohammad, AlHashem & Talahoun[56] has shown that an 80 kg individual can expend approximately 700 kcal by one hour of stair climbing. It is unlikely that employees in a four-floor building can accumulate an hour of stair climbing throughout a workday, unless they have some sort of work breaks, in which they climb stairs for the purpose of exercise. However, if an employee uses the stairs to the office, meetings, lunch breaks, and when communicating with colleagues instead of sending e-mails, two minutes of accumulated daily stair climbing should be a fair assessment. This would mean 23.3 kcal expended every workday, from stair climbing, adding up to 5359 kcal yearly, when calculating with an 80 kg individual and 230 workdays. In the present results, stair climbing decreased by an average of 54 counts per week during the second intervention period. If all these counts represent 80 kg individuals who use ten seconds to climb each floor, the total amount of weekly decreased calorie expenditure is between 104.9 kcal and 419.4 kcal, depending on the number of floors climbed. This is a small decrease when the counts represent 54 individuals, but, however unlikely, if the counts represent a single individual who climbs 54 floors less than usual per week, the yearly decrease in calorie expenditure would be 4825.4 kcal. Although this is a substantial decrease, it is highly unlikely that one person alone was responsible for the overall decrease in stair climbing. However significant the decrease was, it was minor, thus the negative effects of the present intervention should not be exaggerated.

Another finding that makes this population out of the ordinary is how many flights of stairs they are willing to climb. If the option "more than 8" from the present questionnaire is calculated as nine, employees from both sites combined, are willing to climb an average of six floors, before choosing the elevator. On the other hand, in the present municipality, or county for that matter, buildings higher than four floors are not quite common. Anyone could say they would climb eight flights of stairs, but we do not know if this would be the case, were they given the opportunity. More studies are needed to establish if this is a tendency in the whole country, or if it only exists in the present municipality. Previous research has shown that people are on average willing to climb less than four floors[26].

When looking at previous studies, there is a tendency suggesting specific informative messaging[29, 33, 35] to be more effective than non-verbal interventions[28] or general messages[26, 38, 47]. Results from the present study is evidence against non-informative influences as a valid intervention tactic to increase stair climbing in a workplace. It seems that when people are presented specific information regarding the health- or exercise benefits of stair climbing, behavior change occurs more extensively than with general messaging. It is possible that when given the opportunity to make an informed choice, people can perceive their free will, while agreeing that behavior change might be a good idea, based on the provided information. Messages that can be interpreted as commanding[26, 28, 38] seem to be ignored to the extent that they become ineffective. The footprints can be interpreted as a commanding message as they "tell" respondents in a non-verbal way to "follow in my steps". According to Mols, Haslam, Jetten & Steffens[57], people who are aware they are being "nudged" are reluctant to change their behavior. In the present study, the nudge is overt, thus employees were aware of their position as "nudgees" from the beginning. With that being said, just because informative messages often result in significant change, the changes are, in reality, small. Researchers often accentuate the relative change, which can appear quite large, however; absolute increases are mostly found within a 2.0 % - 10.0 % range[32, 37, 39-41, 47, 58].

Limitations

A limiting factor is the unusual high percentage of stair users. This makes any increase difficult, and it is possible that effects would be different in a site with lower stair use. When a quasi-experimental design is used, the representativeness of the results are weakened, compared to results from a randomized controlled study. In further research on this topic, several buildings should be used and randomized, in order to diversify the results and investigate different work environments. The workplace can be a somewhat closed environment, where people act and behave in ways not representative for other workplaces in other geographical locations. Previous research has also taken other variables into account, such as gender, age and weight. This was prevented by the current monitoring tools, making it impossible to adjust for these variables or to do sub-group analyses. The intervention building's low response rate to the questionnaire is another weakness, prompting assumptions of representativeness to be treated with caution. The questionnaire still provides important knowledge of how the intervention was received. Some answers suggest that the counters had been intrusive to the extent that people would take the elevator in spite, making it clear that some other form of hidden monitoring is preferred. The counters' instructions clearly states that monitoring is more accurate when the receiver and transmitter are in close proximity. However, the widest and narrowest set up place differ by 57 cm.

Conclusion

Both intervention periods resulted in significant decreases in stair climbing, a decrease that was not present during follow-up, when applying the Bonferroni adjustment. The results suggest that non-verbal and non-informative tactics in influencing stair climbing, may be ineffective, or cause a negative reaction, when applied in a workplace with an existing high amount of stair climbing. Answers from the questionnaire suggest that the decrease is due to irritation among some employees, who did not like to be subjected to influence. In this case, the influence was telling people to do something they were already doing, which seems to have been interpreted as nagging, and resulted in spiteful behavior.

SO WHAT? Implications for Health Promotion Practitioners and Researchers

What is already known on this topic?

Interventions aimed at increasing stair climbing in various public places are often successful, while the results of similar interventions in the workplace tend to be more inconclusive. Successful interventions are often based upon believable health related information, placed at the point of choice between stairs and elevator.

What does this article add?

Workplaces displaying high amounts of stair use should, perhaps not be interfered with. Non-verbal, non-informational or non-personalized encouragements do not work with the majority, and may create discontent within a small minority.

What are the implications for health promotion practice or research?

Health promoters attempting to increase physical activity through stair use, should refrain from using non-informational, commanding interventions. Informational posters are preferred as interventions, until further research unveils more effective methods. The setting subject to influence should also have a low baseline level of stair climbing.

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Figure 1: The first intervention, as seen from the main entrance.

Figure 2: The second intervention, as seen from mid-stairwell, leading to the fourth floor.

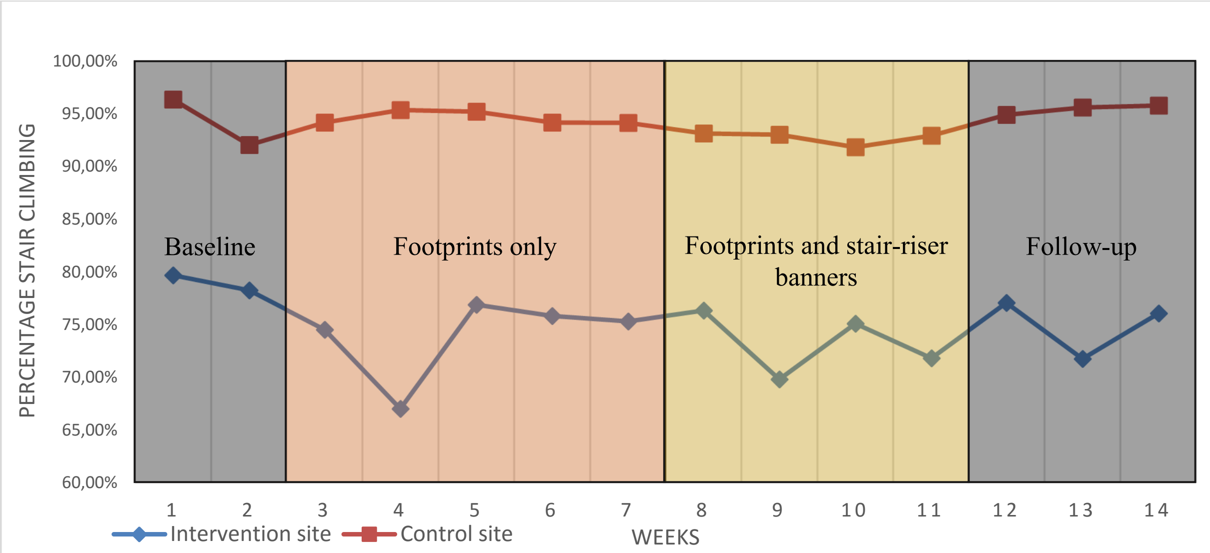

Figure 3: Stair climbing development in intervention site and control site.

Table 1: Stair use at both sites throughout fourteen weeks

	Intervention building		Control building	
	Stair climbing	**Stair descent**	**Stair climbing**	**Stair descent**
Baseline (2 weeks)	79.0 % (n=940)	91.3 % (n=1105)	94.2 % (n=1920)	94.9 % (n=2052)
Footprints only (5 weeks)	73.9 % (n=2353)†	89.0 % (n=2761)†	94.6 % (n=4394)	94.9 % (n=4566)
Footprints and SRBs* (4 weeks)	73.3 % (n=1825)†	90.2 % (n=2194)	92.7 % (n=3617)†	92.9 % (n=3873)†
Follow-up (3weeks)	75.0 % (n=1421)†	90.8 % (n=1713)	95.4 % (n=2813)	94.9 % (n=3001)

* SRBs = Stair-riser banners. † Significant decrease from baseline ($p<0.028$)

Table 2
Complete questionnaire and results.

Questions		Options/categorical themes	Intervention % (n)	Control % (n)
1.	What is the main reason why you use/do not use the stairs at the workplace?	Mentions exercise related reasons	45 % (18)	50 % (44)
		Mentions health related reasons	12.5 % (5)	6.8 % (6)
		Mentions efficiency related reasons	7.5 % (3)	15.9 % (14)
		Mentions habit related reasons	25 % (10)	20.5 % (18)
		Other reasons	2.5 % (1)	2.3 % (2)
		No stairs: bad knees, don't want to be out of breath	7.5 % (3)	0 % (0)
		Maybe elevator: because carrying heavy objects	0 % (0)	4.5 % (4)
2.	Did you notice the counters in the stairwell and the elevator entrance?	Yes	79.5 % (31)	35.5 % (27)
		No	20.5 % (8)	64.5 % (49)
3.	Mention a way the counters influenced you, or why they did not influence you.	Always take the stairs anyway	51.4 % (19)	7.2 % (5)
		Increased awareness of stair use	5.4 % (2)	1.4 % (1)
		Not influenced, no mention if stair user	8.1 % (3)	31.9 % (22)
		Did not notice the counters	13.5 % (5)	58 % (40)
		Always use elevator anyway	2.7 % (1)	1.4 % (1)
		Was reminded of stair use	8.1 % (3)	0 % (0)
		Negative reaction, spiteful, annoyed, sceptical	10.8 % (4)	0 % (0)
4.	Did you notice the footprints and the stair riser banners?	Both	76.9 % (30)	
		Only footprints	17.9 % (7)	
		Only stair riser banners	2.6 % (1)	
		No	2.6 % (1)	
5.	Mention a way the footprints and/or the stair riser banners influenced you, or mention why they did not influence you.	Always take the stairs anyway	28.2 % (11)	
		Was influenced to take stairs/felt pulled towards stairs	5.1 % (2)	
		Increased awareness of stair use	2.6 % (1)	
		Made stair walking a positive experience	20.5 % (8)	
		People felt "led" to the stairs by the footprints	10.3 % (4)	
		Thought they were fun/funny	10.3 % (4)	
		Created a basis for discussion in the workplace	7.7 % (3)	
		Not influenced, no mention if stair user	7.7 % (3)	
		Negative reaction, spiteful, annoyed, dislike	7.7 % (3)	
6.	Has your stair use outside the workplace…	Increased	5.1 % (2)	
		Decreased	0 % (0)	
		Remained the same	87.2 % (34)	
		Do not know	7.7 % (3)	
7.	How many floors are you willing to climb by stairs before choosing the elevator?	1	2.6 % (1)	0 % (0)
		2	0 % (0)	1.3 % (1)
		3	7.9 % (3)	1.3 % (1)
		4	10.5 % (4)	23.4 % (18)
		5	26.3 % (10)	23.4 % (18)
		6	13.2 % (5)	19.5 % (15)
		7	7.9 % (3)	3.9 % (3)
		8	5.3 % (2)	7.8 % (6)
		More than 8	26.3 % (10)	19.5 % (15)