



The University of Rome "Foro Italico"
The German Sport University, Cologne
The University of Southern Denmark, Odense
The Norwegian School of Sport Sciences, Oslo
The University of Vienna

European Master in Health and Physical Activity
(Laurea Magistrale Internazionale in Attività Fisica e Salute)
LM 67- I

“Worksite Physical Activity Interventions and their effect on employees’ sickness absence”

-A literature review

Herdís Eiríksdóttir

Candidate
(Herdís Eiríksdóttir)

Yngvar Ommundson

Supervisor
(Yngvar Ommundson)

Academic Year 2014-2016

Abstract

Objective: To investigate the effect of physical exercise interventions, done in the workplace, on sickness absence. The review was done with special interest in progress in the intervention effect and design the last 5 years.

Method: The literature was identified by search in three scientific databases, PubMed, Sport Discus and Web of Science. The search identified 660 studies that were screened and then excluded if: 1.They were not in English. 2. Full text was not available. 3. The intervention was not implemented at the workplace or in relation with the workplace. 4. Sickness absence was not reported. 5. The study was not experimental design. 6. Intervention did not comprise physical exercise or aim to increase physical exercise. In total 10 studies were included in the review.

Results: Two of the ten included studies showed significant decrease in sickness absence, revealing the effect of increased physical exercise on sickness absence. The positive effect in those two studies were shown with physical exercise during work hours and focused on high intensity exercise. In terms of intervention strategies, three studies targeted consultation and lifestyle coaching to increase physical activity and the other seven studies had active physical exercise intervention. The intervention design varied between studies both of intensity and type of exercise. All of the studies had the aim to decrease sickness absence.

Conclusion: Based on the results of this review, a fair conclusion seems that out of the amount of exercise interventions or interventions that promote physical activity to reduce sickness absence that has been conducted, only a small minority have shown evidence of effect. In this review studies comprising different kind of interventions were included in terms of intervention content, strategies as well as physical activity intensity.

Table of Contents

Table of Contents	4
1. Introduction	6
1.2 Background for research question	6
1.2 Health benefits of physical activity	7
1.2.1 Cardiovascular disease (CVDs)	8
1.2.2 Type 2 Diabetes (Diabetes Mellitus)	8
1.2.3 Obesity	8
1.2.4 Cancer	9
1.2.5 Osteoporosis	9
1.2.6 Depression and anxiety	9
1.3 Sickness absence and the workplace	9
1.4 Physical activity and the workplace	11
1.4.1 Work ability and relationship with sickness absence	12
1.5 Promotion of Physical Activity: Cost-effectiveness	13
1.6 Previous studies on the relationship between PA interventions in the workplace and sickness absence	14
1.7 Main aim of thesis	16
2. Method	17
2.1 Literature Review	17
2.2 Search strategy	17
2.3 Search Words	18
2.4 Screening for relevance	19
2.5 Inclusion- and exclusion criteria	19
2.6 Exclusion criteria	20
2.7 Experimental study design as inclusion criteria	22
3. Results	23
3.1 Included Studies	23
3.1.2. Nurminen et al. Finland, 2002	24
3.1.3. Proper et al. The Netherlands, 2004	24
3.1.4 Brox et al. Norway, 2005	25
3.1.5. Schwarz et al. Sweden, 2012	25
3.1.6 Reijonsaari et al. Finland, 2012	26

3.1.7 Strijk et al. The Netherlands, 2013	27
3.1.8 Christensen et al. Denmark, 2013	27
3.1.9 Viester et al. The Netherlands, 2014	28
3.1.10 Jakobsen et al. Denmark, 2015	29
3.2 Summarized results	29
4. Discussion	33
4.1 Strength and limitations: Risk of Bias	33
4.2 Sickness absence	34
4.3 Characteristics of the Studies	34
4.4 Evaluation of the method	36
4.4.1 The search	36
4.4.2 Reliability	37
4.4.3 Validity of this review in terms of trustworthiness of the results	37
5. Conclusion	39
6. Suggestion for further research	40
References	41

1. Introduction

1.2 Background for research question

Physical Activity has been proven to improve health and prevent a number of lifestyle diseases (Jonas & Phillips, 2009). The recommendation for Norwegian adults are to be physical active in moderate intensity for 150 minutes a week or 75 minutes of vigorous intensity.

These recommendations are the minimum amount of exercise to maintain good health according to the Norwegian rapport on public health (*Folkehelse rapporten 2014 : helsetilstanden i Norge*, 2014), and they are based on evidence that people who regularly exercise and have higher cardiorespiratory fitness have lower overall mortality rate and are less likely to develop a number of preventable diseases than inactive people (*Physical activity and health : a report of the Surgeon General*, 1996).

When the physical activity level in the Norwegian population is measured by self-reports, 30% of Norwegian adults actually meet the recommendation (*Folkehelse rapporten 2014: helsetilstanden i Norge*, 2014), whereas only 20% meets the recommendations when PA is measured objectively with ActiGraph GT1M activity monitor (Hansen, 2013).

There is not a high percentage of unemployment in Norway and people who are healthy and looking for a job are about five percent of the adult population (Statistics Norway, 2016). Interestingly, however, there is a high number of sickness absence in Norway as compared to other Nordic countries. In an international comparison of sickness absence tried to explain the high prevalence of sickness absence in Norway as compared to other countries (Berge, 2012). They did not succeed in finding one good explanation for this difference. In a systematic review examining whether interventions in the workplace would decrease the sickness absence

a found moderate evidence that workplace education and physical exercise did not reduce sickness absence.

It is interesting to investigate if there has been any progress in modifying physical exercise interventions for workplaces to reduce sickness absence in the last 5 years. With evidence of high sickness absence there is definitely a need for updated knowledge regarding effect of up to date interventions aimed to reduce the sickness absence in Norway. Hence, my purpose with this literature review is to examine the recent evidence with respect to the extent to which physical activity interventions may help reduce sickness absence. More specifically, I will have a look at what kind of intervention characteristics eventually may prove effective, in particular focusing on the design of recent interventions with respect to reported outcome in terms of decrease in sickness absence.

1.2 Health benefits of physical activity

Physical inactivity and sedentary behavior have become one of the main health risks in the world, and during working hours people are getting more and more sedentary (Thorp et al., 2012). Hence, initiating people to exercise in their spare time has become more important. Nevertheless, being sedentary is not the same as being physical inactive. The definition of sedentary behavior is

“Sedentary behavior refers to activities that do not increase the energy expenditure substantially above the resting level and includes activities such as sleeping, sitting, lying down, and watching television, and other forms of screen-based entertainment; or those activities that involve energy expenditure at the level of 1.0-1.5 metabolic equivalent units.”

(Karin I. Proper, Singh, van Mechelen, & Chinapaw, 2011).

The definition of physical inactivity encompass lack of physical activity or not being sufficiently active to meet with health recommendations of physical activity. Physical demanding jobs are not categorized as sedentary although the employees can be physical inactive. Sedentary behavior has been found to relate strongly with all-cause mortality and cardiovascular disease mortality. Significant positive relationship between sedentary behavior and type 2 diabetes with moderate evidence has been found (Proper et al., 2011). Physical activity has been proven to decrease the risk of diseases and dangerous health conditions. In the following, I will briefly explain the relationship between those diseases and lack of physical activity.

1.2.1 Cardiovascular disease (CVDs)

Cardiovascular disease comprise a group of disorders of the heart and blood vessels. These disorders have been the major cause of mortality in developing countries. Studies have shown that physical activity can decrease the risk of getting coronary heart disease (CHD), stroke and hypertension. Coronary heart disease includes heart attack (Hardman, Stensel, & Morris, 2003).

1.2.2 Type 2 Diabetes (Diabetes Mellitus)

This disease is caused by high blood glucose concentration, which over time will cause damage to blood vessels walls that leads to reduced life expectancy. There are many risk factors that increase the likelihood of getting Diabetes 2, and some of those risk factors are possible to prevent with physical activity, such as obesity and sedentary lifestyle (Hardman et al., 2003).

1.2.3 Obesity

Obesity is defined as too much fat and energy intake that exceeds energy expenditure so as to threatens ones health. Obesity, particular abdominal obesity, is a risk factor for many diseases and increases all-cause mortality by approximately 50%. The main risk factor for obesity is physical inactivity (Hardman et al., 2003).

1.2.4 Cancer

Cancer is not one disease but a group of diseases that lead to unregulated cell growth leading to invasion of surrounding tissues that then spreads to other parts of the body and often leads to death. Studies have now shown that increased levels of physical activity reduces the risk of getting several types of cancer, such as colon and breast cancer (Hardman et al., 2003).

1.2.5 Osteoporosis

Osteoporosis is a skeletal disorder that effects bone strength and increases the risk of bone fracture. This also effects the reaction time and increases numbers of falls. Bone mass increases during growth but reaches a peak point in the second decade of peoples life. Physical activity can both decrease the risk of developing osteoporosis and the risk of falls with improving balance and strength (Hardman et al., 2003).

1.2.6 Depression and anxiety

Mental illnesses are growing health problem in line with growing sedentary population. Studies have shown that physical activity is simple and effective therapy for depression and anxiety (Paluska & Schwenk, 2000). People who do not engage in physical activity are two times more likely to show symptoms of depression and anxiety (De Mello et al., 2013).

Knowing these risk factors for diseases the recommendation for physical activity have been made to decrease the amount of people affected by those diseases. The amount of exercise needed to maintain health benefits has been put together in physical activity recommendations and even to develop medical description to exercise (Marcus & Forsyth, 2009).

1.3 Sickness absence and the workplace

Sickness absence is not just an individual problem; it is a problem for companies and the health care system too. As such, interventions with an aim to reduce sickness absence should

prioritize to develop a better health and work environment. In Norway the main reasons for short time sickness absence are self-reported subjective health complaints given by the patients in consultations with their doctor. Most common health complaints are muscle pain, stomach pain, depression, anxiety, allergy reactions and getting feverish (Mikkelsen, 2002).

The high sickness absence in Norway can't be explained with differences in monitoring absence or the maximum length of sickness absence from work. There is a reason to believe that the Norwegian sick pay system is generous in comparison to other countries (Berge, 2012). In the international comparison of sickness absence from 2014 Berge states that their research shows the same results as earlier findings of this topic; women report higher sickness absence than men, and this difference is highest in young people 18-30 years old. Further, the sickness absence increases as people get older, permanent employees have higher sickness absence than temporary staff and smaller companies have smaller problem with sickness absence of the employees (Berge, 2012). When conducting an international comparison of sickness absence, the differences of the government's regulation of sick pay in each country should to be taken into account. The reason for this is that the amount of days one can be sick home from work without a certificate from a doctor can vary from country to country. Further, how and if the government pays for long-term sickness absence also differ. There is also a difference in if and for how many days' employees can be absent from work when their children or children they are responsible for are sick (Barmby, Ercolani, & Treble, 2002). Labor Force Survey (LFS) is used to compare the sickness absence between countries. The LFS analysis and the international comparison of sickness absence done in Norway 2014 show similar results. According to the LFS analysis those factors that can explain the differences between countries are the companies composition of employees gender, age and marital status, what kind of job people have, how many hours per day and permanent contract or temporary (Berge, 2012).

When investigating sickness absence two definitions hold promise; absenteeism and sickness presenteeism. The definition of sickness absence comprise an employee that is away from work because of sickness; his own or ones children. Sickness absence can effect workplaces in terms of productivity loss and thus have economic consequences (Marklund, Aronsson, Johansen, & Solheim, 2015). Presenteeism concerns a situation in which employees come to work but are not fulfilling their duties at work due to health problems. Research has shown a relationship between perceived work ability and presenteeism (Vanni, Virtanen, Luukkaala, & Nygard, 2012).

1.4 Physical activity and the workplace

Currently, during waking hours, adults spend about half of their life at work (Gilson, Burton, Uffelen, & Brown, 2011) and workplace sedentary behavior is increasing (Waters et al., 2016). Waters and co-workers conducted research on Chinese women working for 9.5(0.5) hours per day spend 76.9% of their working hours in sedentary activities. Interventions in the workplace may not only be able to decrease sedentary behaviors during workhours, but also in terms of transportation to and from work. It is not only the sedentary behavior during work-hours that workplace interventions can possibly target, but the transportation to and from work as well (Petrunoff, Wen, & Rissel, 2016). Indeed, intervention research has revealed that a travel plan aimed to increase active travel to work was modestly effective showing small but significant increase in active travel. By contrast, no increase in physical activity levels during work hours was observed (Petrunoff et al., 2016).

Taylor et al found no significant difference between interventions that targeted individual specific behavior change (CBT's) and those who did not (Taylor, Conner, & Lawton, 2012). In addition, they did not find studies that used more than one different to be more effective than

others. When designing interventions, aims should be clearly stated together with expectations for results. Moreover, as part of the intervention content, the duration (units of time), frequency (number of sessions) and intensity should be clearly stated for the participants. Definition of intensity is often described in metabolic equivalent task (MET) where one MET equals the energy expenditure during rest. Light physical activity (LPA) (walking slowly < 3,5km/h), moderate physical activity (MPA) (brisk walking or activities that requires 3-6 METS) and vigorous physical activity (VPA) (activities requiring > 6 METS) (Jeon, Lokken, Hu, & van Dam, 2007). Typically, for workplace interventions to be effective, they should aim to reduce health complaints, stress and increase good work environment. The goals should also be to increase individuals' personal fitness state. These interventions have to be partly individualized in situations which the exercise experience varies between employees (Mikkelsen, 2002). It could be kept in mind when designing an intervention to decrease the risk of developing diseases that the risk can be decreased with moderate intensity as well as high intensity. Studies have shown that 3 hours of brisk walking a week have the same protective effect as 1.5 hours a week of vigorous exercise. This study was done on women from 50-79 years old, those who reported either brisk walking or vigorous exercise were 30-40% more likely to develop cardiovascular disease. Another study showed that 2.5 hours (30 min 5 times a week) is associated with 30% reduction in cardiovascular incidents over a 3 year follow up (Bassuk & Manson, 2010).

1.4.1 Work ability and relationship with sickness absence

Lifestyle factors and work ability factors such as obesity, smoking, lack of job control, lung restriction and less-than-excellent work ability (measured by the work ability index) has been shown to be predictors for sick leave lasting 2-12 weeks and >12 weeks (Alavinia, van den Berg, van Duivenbooden, Elders, & Burdorf, 2009).

The Work Ability Index (WAI) is a self-report based questionnaire tool that can be used in occupational health programs with the aim to decrease the number of employees that quit working in early age (Tuomi, Huuhtanen, Nykyri, & Ilmarinen, 2001). The WAI comprises seven items that measure peoples' work ability. For each item there is a certain score, then all the 7 scores are put together in a final score from 7-49. Employees work ability can be poor (7-27 points), moderate (28-36 points), good (37-43 points) and excellent (44-49 points) (de Zwart, Frings-Dresen, & van Duivenbooden, 2002). This questionnaire has been tested for validation and no significant difference was found between test and re-test (de Zwart et al., 2002). Studies have shown that the WAI can be predictive for disability in employees that leads to work-related disability pension or long lasting sickness absence (Alavinia, Boer, Duivenbooden, Frings-Dresen, & Burdorf, 2009).

1.5 Promotion of Physical Activity: Cost-effectiveness

Physical inactivity has great cost effect on the society. More specifically, it has an impact on the health care system, lost productivity due to sickness absence, as well as lost productivity due to unfitness and social services due to individuals' loss of ability to perform daily activity at home. If a 30-year old inactive person would start exercising and reach the recommendations for physical activity, the expected gains in production would approximately be 65,000-79,000 DKK (Danish kroners) (Hagberg, 2007). Smoking, alcohol consumption, socioeconomic factors, BMI, increased blood pressure and cholesterol are then controlled for in the analysis. The annual cost per patient, in Sweden, that had diabetes 2 was 25,000 Swedish kroners. Health care costs of about 1 billion Swedish kroners are because of physical inactivity, according to the World Health Organization (WHO). The drugs that doctors need to describe to people to reduce the blood pressure, blood fat and blood sugar account 15% of Swedish drug cost (Hagberg, 2007).

1.6 Previous studies on the relationship between PA interventions in the workplace and sickness absence

In the Norwegian context Odeen et al. (2013) and co-workers conducted a systematic review of active workplace interventions. The aim of the review was to provide an overview of the effectiveness of workplace interventions targeting sickness absence. The inclusion criteria were studies on subjects over 18 years, interventions conducted in the workplace or at the initiative of the workplace, and the sickness absence had to be recorded. Further, to assess for biases, they only included studies designed as Randomized Controlled Trials (RCT's). Odeen and colleagues (Odeen et al., 2013) found moderate evidence that graded activity reduces sickness absence and moderate evidence that workplace exercise programs do not. Interventions in which the intervention group are given various types of physical activity programs, while the control group gets different or no treatment at all, has been proven to increase health but has not significantly decreased sickness absence.

In a qualitative study among seventy-nine Australian business owners and leaders in companies who are responsible for occupational health in their workplace well-being and health at the workplace were investigated. This study made use of discussion groups in which participants were asked to discuss the role of the workplace in improving employees' health and well-being. Interestingly when the participants in the discussion group were asked about their definition of a healthy worker, they described a cheerful, focused, calm and confident worker. They also mentioned that a healthy worker had high productivity, a healthy appearance, ability to maintain a work-life balance and were able to maintain a healthy diet and slept enough. When asked to describe an unhealthy worker, they described a person that was stressed, had

negative attitude, lack of self-respect and seemed unhappy. They also mentioned that an unhealthy worker had a lack of productivity, lack of fitness and vitality, and was not a good companion, and did make poor food choices and who was addictive to caffeine or cigarettes. Productivity was mentioned most often as an important factor in relation to having healthy workers. Having healthy workers who are not frequently absent from work was believed to have influence on financial impact. The next topic of the discussion group was about the role of the workplace in influencing employee's health and well-being. Many of the participants thought that safety at work were their responsibility but when it comes to individual's health and well-being outside of work, they were not responsible. This is interesting when leaders and owners of companies all want to have healthy workers, and think that would have positive financial effect on their business but that is not corporate responsibility (Pescud et al., 2015). The influence of research design on the effect on physical activity on sickness absence was investigated with respect to using a RCT versus a non-RCT (no control group) (Amlani & Munir, 2014). In this review the results from the RCT studies suggest that moderate physical activity does overall not decrease sickness absence. However, the RCT interventions with weekly resistance training or endurance training showed a positive effect, but the intervention was not precisely described, and the intensity not reported. Evidence from the non-RCT showed that overall increase in physical activity does decrease sickness absence, mostly moderate to vigorous intensity physical activity. The non-RCT mostly made use of self-reported physical activity at follow up (Amlani & Munir, 2014).

Marshall (2004) investigated the challenges and opportunities for promoting physical activity at the workplace. The studies that were included in the review were of different designs, RCT, quasi-experimental and cohort studies. In this review the authors noted that the programs that used annual health checks to identify employees' risk factors did not have high participation

rates, it varied from 28% to 80%. Individuals who were found at risk were referred to a doctor, or to make use of the onsite facility or a certain program that would have an educational purpose. Those strategies did not show any effect in terms of behavior change. Evidence shows that onsite fitness facilities and programs for health promotion are mostly attended by already healthy workers.

1.7 Main aim of thesis

The main aim of this thesis is to scope recent evidence about physical exercise intervention done in the workplace and their effect on sickness absence. Odeen et al. (2013) did his literature search for studies on this topic and compared the design and results of studies before and after 2011. It would seem particularly interesting to investigate if there has been any progress in modifying physical exercise interventions for workplaces to reduce sickness absence in the last 5 years. Moreover, given that previous studies have not revealed significant intervention effects, my focus was also to scope recent studies, particularly keeping an eye on the potential influence of intervention design and content on effects on sickness absence. Indeed, the evidence of high sickness absence in Norway gives reason for the need for updated knowledge regarding effect of up to date interventions aimed to reduce the sickness absence. Hence, my purpose with this literature review is to examine the recent evidence with respect to the extent to which physical activity interventions may help reduce sickness absence. More specifically, I will have look at what kind of intervention characteristics eventually may prove effective, in particular focusing on the design and content of recent interventions with respect to reported outcome in terms of decrease in sickness absence.

2. Method

2.1 Literature Review

In this thesis a systematic literature review is used to answer the research question if physical exercise interventions conducted in the workplace, or by the initiative of the employer, influence employees' sickness absence. Conducting systematic reviews has been considered valuable in order to sum up the current literature base, identify what we know about the topic, and what we need to know more about in further research. Hence, I scoped studies aiming to identify the current knowledge base and gaps in literature on the topic. Literature review as a method is described as a directed overview of the major studies and discussion about the main findings on this topic (Atkinson, 2012). The aim should not be to combine results for statistical analyses, rather to analyze studies with respect to theoretical base, quality of methodology, as well as trustworthiness in terms of findings and discussion of the results.

2.2 Search strategy

In this thesis three databases - Pubmed, SportDiscus and Web of Science were chosen as search engines to identify relevant empirical sources. These three databases contain a huge number of studies and are accessible from the library at Norwegian School of Sport Science. *Pubmed* is a free version of Medline database that includes about 20 million references from scientific journals. Mainly in English and includes articles from 1950 – 2016 (or newest available). Many institutions, including Norwegian School of Sport Sciences, have access to free full text through the library, which makes it easily accessible for students (Kilvik & Lamøy, 2005).

SportDiscus is a database that provides references from about 1500 scientific journals covering multiply topics within the domain of sports, physical exercise and physical activity. Focus

on sport medicine, physiotherapy, biomechanics and coaching physiology. SportDiscus has also conference reports, books, videos and more. The articles are in many languages and cover the year 1800- 2016 (or newest available) (Kilvik & Lamøy, 2005).

ISI Web of Science is a combination of three databases: Science Citation Index Expanded, Social Sciences Citation Index and Art & Humanities Citation Index. This covers references from about 8700 world leading scientific journals printed in English (Kilvik & Lamøy, 2005).

2.3 Search Words

After having decided on relevant databases, identifying key words to guide the searching process to identify the most relevant studies to include in the review is pertinent.

My final selection of key words reflect my research question: ***Does physical activity interventions, conducted in the workplace or in relation to the workplace, decrease employees' sickness absence?***

Hence, I made use of the following string of words when search in the literature: ***Physical activity, physical exercise, intervention, workplace, sickness absence.***

By only using the search words without combining them in an advanced search, I did not obtain relevant results. Consequently, with help of the book of search strategy (Kilvik & Lamøy, 2005) the words were combined in a subsequent search with the following combinations of the words:

1. **“Physical Activity” OR “Physical Exercise”;**
2. **Intervention/s AND Workplace**
3. **“Sickness Absence”.**

This search gave the following hits: Pubmed 231; SportDiscus 63; Web of Science: 366; in total 660 hits.

With search results of 660 articles, references were imported into EndNote, a reference program where the articles were screened for duplicates. Screening for duplicates resulted in 513 articles that were then screened for relevance. The search period was from January 2016- February 2016.

2.4 Screening for relevance

Before assessing inclusion- and exclusion criteria, the articles (N=513) were screened for relevance and availability in full text for the topic by reading the abstract. In a first round, sources were screened in order to decide whether the articles were about physical exercise, sickness absence and workplace. In most cases, this could be observed by inspecting the abstract. If not, the full article was read for deciding on relevance to the topic. This first screening resulted in excluding 440 articles and leaving 73 articles to be read in full text and further assessed in light of pre-determined inclusion- and exclusion criteria.

2.5 Inclusion- and exclusion criteria

Choosing criteria for what studies to include in this thesis, I read some systematic reviews on similar topics and tried to use those as guidelines for what to include and fill in gaps that I thought were needed. One systematic review was made in Norway 2013 (the literature search was done 2011) called *Systematic review of active workplace interventions to reduce sickness absence*. In this review, no positive effect of workplace interventions on sickness absence was observed. I wanted to investigate if there has been any progress in intervention design since this review was conducted, the last 5 years. Odeen et al (2013) excluded studies 1.that did not

define worksite, 2.had multiple articles from the same study 3.did not have active interventions, 4. had insufficient reporting of sickness leave data, 5.if they could not locate article, 6.had high overall risk of bias. My exclusion criteria were the following:

2.6 Exclusion criteria

Study in English

Studies written in any other language than English were excluded because of lack of time and knowledge to translate from other languages.

Full text available

Studies that did not provide full text on internet or by ordering from the library, were excluded. This was done so the time to assess all of included studies would not have effect on time to write this thesis.

Intervention done outside of the workplace

Studies with physical exercise intervention that were not done in the workplace or in relation with the workplace (for example at home) were excluded.

Sickness absence not recorded

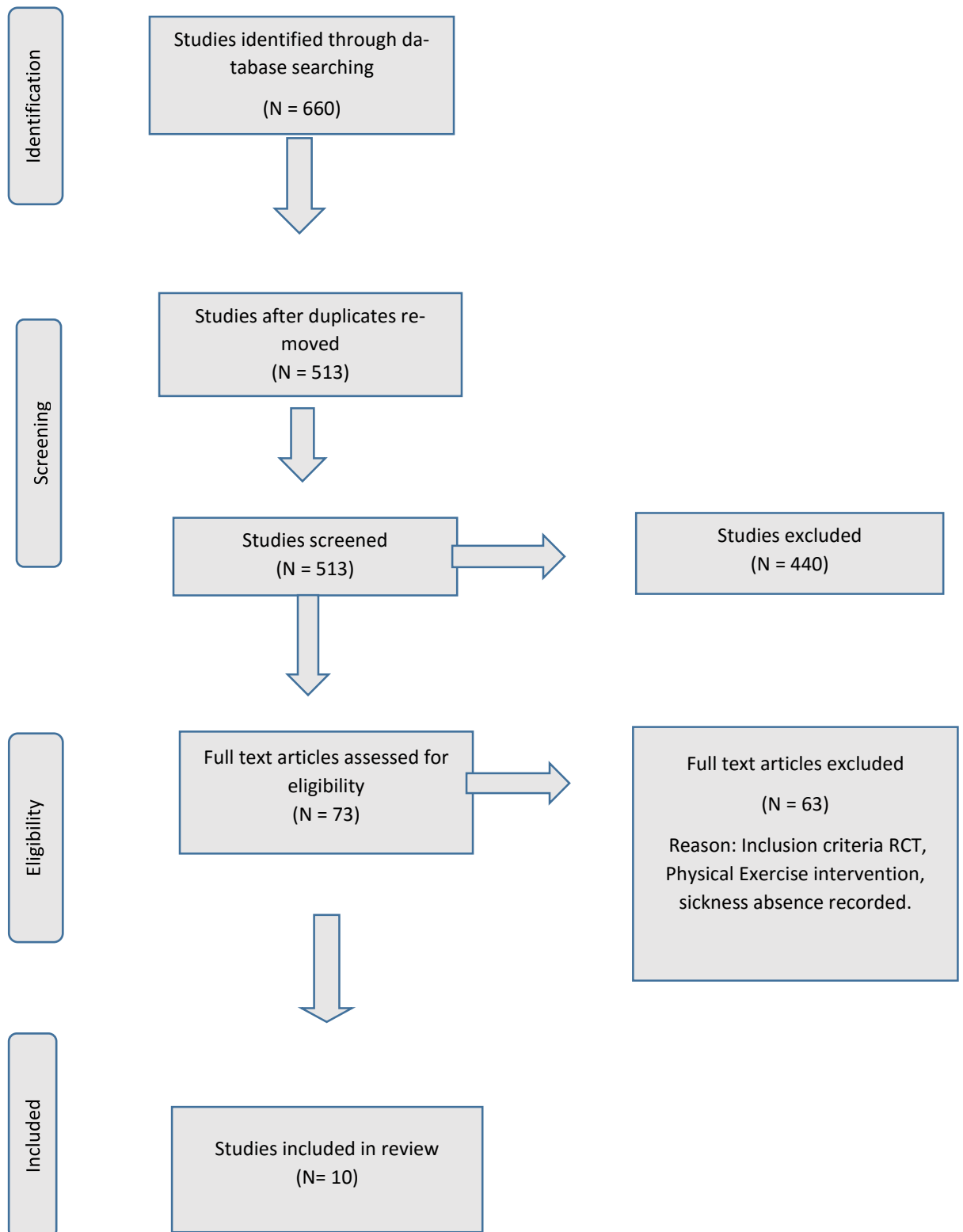
If sickness absence were not recorded or collected the studies were excluded. Sickness absence data were extracted from each study.

Experimental research design

Studies done with any other design than experimental design were excluded. In earlier systematic reviews on this topic it was noted that studies with good quality methods were asked for. Hence, experimental design studies are included.

Exercise Intervention

All studies with interventions that were not exercise interventions or interventions that promote physical exercise with interventions were excluded. This study searches for finding an effect of exercise interventions on sickness absence, so other intervention types were not relevant to this study.

Figure 1. Flow diagram of article selection.

2.7 Experimental study design as inclusion criteria

The experimental approach in sport and exercise research is ideal, this method is a quantitative and the purpose is to observe the effect of presumed causes and to make observations free from bias (Smith, 2010). When deciding on a topic for this thesis the effect of physical exercise came first to mind and this would ideally be investigated with a randomized controlled trial design. In light of the restricted time for conducting a thesis of 30 ECTS, naturally I would not be able to conduct a randomized control trial myself. Hence, I chose the design of literature review. Nevertheless, to keep up with the golden standard of RCT, I only included studies using the experimental design that is randomized control trial (RCT), cluster-randomized control trial to fulfil strict scientific criteria when performing my analysis. By including RCT's I can be confident that subjects are randomized into two groups (or more if there are more than one intervention) by chance. This will take account of biases, but there is still a possibility for a researcher bias if the researchers know in which group the subjects are. To avoid this the researchers should use blinding. The ideal method is double blinding when both researcher and subjects do not know in which group the participants belong in, intervention or control (Laake, Olsen, & Benestad, 2008). In this thesis, I did not exclude studies that did not meet with the criteria of double blinding. Indeed, it can be difficult to blind the groups in the workplace when they will see which group gets more treatment. By including RCT's only, one should be more confident that the differences in the outcome should be caused by the intervention rather than some external uncontrolled factors. Hence, generally using a RCT would indicate strong validity and overall study quality.

3. Results

In this chapter, the results for each included study in the review will be presented in a summarized format. The summary of each study focuses on study design, number of participants, intervention program including types of physical exercise, duration of program and method for reporting sick leave. In cases in which the summary does not include these aspects it will be noted together with the intervention effect on sick leave.

3.1 Included Studies

3.1.1 Eriksen et al, Norway 2002

In this intervention study conducted in the Postal Service in Norway 2002 the aim was to evaluate the effect of 12 weeks of physical exercise (PE), stress management training (SMT) and integrated health program (The IHP). The study comprised a randomized control trial in which participants (N=860) were randomized into these three intervention groups (PE, SMT and IHP) and one control group (N=344). The PE program was a Norwegian aerobic fitness program with an aim to improve physical capacity, muscle strength and flexibility. This program specifically aimed to use relaxations to reduce pain in neck, arm and shoulders. The exercise was at moderate intensity or 70-80% of maximal heart rate. The IHP program was specially made for this intervention with an interdisciplinary aim to increase knowledge about physical exercise, nutrition, coping with stress and general health. The IHP program comprised both a theoretical part about training as well as practical components comprising physical exercises relevant to the work situation. The SMT was designed with the aim to improve coping ability with a cognitive-behavioral approach. Lifestyle factors such as, eating habits, sleeping and physical fitness was modified for each individual. Topics were covered with lectures, group discussions and practical exercises with autogenic training, visualization and relaxation. Sick leave data was obtained with questionnaires, participants had to report their

sick leave the last 30 days, both how many times they had reported sick and for how long time. There was no significant difference between the groups on self-reported sick leave.

When only included those who attended more than 50% of the intervention activities, it did not show more positive effect on sick leave (Eriksen et al., 2002).

3.1.2. Nurminen et al. Finland, 2002

In this study the aim was to examine the effects of a worksite exercise program on women with physical demanding work. The study was designed as a RCT comprising an intervention and control group. To collect data questionnaires at 3, 8, 12 and 15 months were handed out to the participants. Participants were women (N=260) who had physically demanding laundry jobs. The Intervention where partly individualized with 30 minutes feedback from physiotherapist who gave each woman prescription of exercise and counseling. The intervention subjects also participated in worksite exercise 1 hour a week for 8 months. The exercise lessons where at moderate intensity aiming to increase muscle strength, cardiovascular exercise and stretching. Self-reported sick leave data for the last 12 months was provided by the companies' administration office. The intervention did not show a significant decrease in sick leave (Nurminen et al., 2002).

3.1.3. Proper et al. The Netherlands, 2004

Proper and colleagues examined the effect on a nine month long individualized worksite health promotion program on sick leave using a RCT design. Participants in this study were civil servants (N=299) who worked in three municipal services in Enschede, The Netherlands. The intervention group received individual consultation from physiotherapist aimed to increase physical activity and improve dietary habits. Each participants was offered in total

seven meetings with the physiotherapist, each lasting 20 minutes. Sick leave data were collected from the personnel office. Results revealed a decrease in sick leave in the intervention group, but the difference between intervention and control was not significant (K. I. Proper, van der Beek, Hildebrandt, Twisk, & van Mechelen, 2004).

3.1.4 Brox et al. Norway, 2005

This study RCT study comprising an intervention and control group was designed to investigate the effect of physical exercise at the workplace and comprised employees of a community based nursing home in Norway (N= 129). The intervention group were given the possibility to participate in a weekly group exercise session based on aerobic fitness model. Sessions were designed to increase cardiovascular fitness, muscle strength and flexibility. The intervention group was also offered information about physical exercise, nutrition and stress management. No physical exercise or information were offered to the control group, they were only told to continue with their regular activity. The sick leave data were collected from the community register, both from the year before and the year of the intervention. Whereas total sickness absence was collected, absence due to children's sickness or civic duties was not considered relevant and was excluded. No effect of the intervention was found between groups on sickness absence (Brox & Froystein, 2005).

3.1.5. Schwarz et al. Sweden, 2012

In this study the aim was to examine the effect of physical exercise during work hours and reduced work hours on direct costs associated with sickness absence. The method was quasi-experimental design and the intervention was conducted in six workplaces of Swedish public dental health care organization. The selection of workplaces was based on number of employees and workplaces with high and low number of short-term sick leave days recorded. The

workplaces were chosen in pairs that matched so each pair had approximately same number of employees and one with high sickness absence recorded and one with low. The employees (N=1311) of the workplaces were randomized to physical exercise group, reduced work hours group and control group. The physical exercise group was supposed to exercise at 55% to 89% of maximum heart rate or medium to high intensity on two different days of the week. Subjects could choose own exercise form, but had to report their activity to a coworker who was assigned to the task. Sick leave data was collected from company administrative records, for the year prior to the intervention and the year after. Sick leave was reported in days per year and for how long time it lasted. The number of sick leave days were reported to decrease significantly in all of the groups compared to the year before (Schwarz & Hasson, 2012).

3.1.6 Reijonsaari et al. Finland, 2012

The purpose of this study was to investigate the effectiveness of 12 months intervention with aim to increase employees' physical activity, work productivity and decrease sickness absence. Subjects (N=544) in this study were recruited from an insurance company in Helsinki and randomized in to two groups, intervention and control group. The intervention group received distance counseling about physical activity, their activity was monitored with accelerometers, they got help from an online service to set and reach their goals and track their activity. The control group only got results of a fitness test and information about PA in the beginning of the study. The counseling was provided by two exercise specialists. Sick leave data was obtained from employer payroll without any medical diagnoses. This intervention did not have effect on sickness absence of the employees given that no significant difference between groups could be observed (Reijonsaari et al., 2012).

3.1.7 Strijk et al. The Netherlands, 2013

The aim of this study was to investigate if worksite lifestyle intervention had effect on pro-long employees labor participation. In this study, employees older than 45 years and working in one of two hospitals in the Netherlands were invited to participate. Subjects who agreed to participate (N=730) were randomized into two groups of intervention and control. Both groups were provided with written information about healthy lifestyle. The intervention group participated in 6 months vitality exercise program who consisted of weekly yoga sessions, weekly aerobic workout sessions (65-90% of maximum heart rate) and meeting with a personal coach, they were in addition asked to do exercise of their own for 45 minutes a week at high intensity. These weekly exercise sessions aimed to increase muscle strength and physical fitness. In addition, the intervention group was offered free fruits at group sessions. The sick leave data was collected with a single item question from the Productivity and Disease (PRO-DISQ) questionnaire. This questionnaire asks the workers about how many times they have been home from work due to health related reasons/health problems during the last 3 months. The Sick leave data at 6- and 12 months follow up after intervention was recorded and revealed no significant difference between the groups (Strijk, Proper, van Mechelen, & van der Beek, 2013).

3.1.8 Christensen et al. Denmark, 2013

The aim of this study was to investigate if workplace interventions that are currently successful in improving health outcomes could also have positive effect on absenteeism and presenteeism. This study is a part of FINALE-health study that is a cluster-randomized single-blinded controlled trial and shows results of its secondary outcomes. A number of secondary outcomes are published in this study and for the current purpose, I summarize data about ef-

fect of the intervention on sickness absence. This was a 1 year workplace randomized controlled trial for (N=144) health care workers in Denmark. Randomization was done by an external research group, who had no information about the participants or the workplace. The intervention group got 1 hour of weekly exercise during work time. Those who were overweight and obese had a weight reduction aim for the first 3 months and those normal weight aimed to maintain their weight. During the first three months, these two groups received different intervention programs, focusing on diet, physical exercise and cognitive behavior training, respectively. The last 7 months both the overweight and normal weight got the same intervention content focused on diet, physical exercise and cognitive behavior training. Sick leave data were collected 12 months pre-intervention and 12 months post-intervention. Data was collected through the executive director at the workplace. This intervention was not found to be effective in terms of reducing sickness absence; no significant difference between the groups was observed (Christensen, Overgaard, Hansen, Sogaard, & Holtermann, 2013).

3.1.9 Viester et al. The Netherlands, 2014

The aim of this study was to investigate the effects of a health promotion program conducted in the workplace on multiple outcomes, including sickness absence. The subjects (N=314) in this study were blue collar workers of a construction company in The Netherlands. This study comprised a blinded RCT, in which subjects were randomized into 2 groups (intervention and control, respectively). The intervention was comprised of an individualized coaching based lifestyle change program, which lasted for 4 months, based on the subjects' weight status and how physical active they were. In this program the subjects got exercise instructions, both face-to-face and by telephone, and they were given a personal energy plan aimed to help the subjects record and plan their exercise. The control group were only contacted at baseline and follow up. Sickness data were collected from company records, 6 months, both before, during

and after the intervention. The between-group differences were not statistically significant on sickness absence in this study (Viester, Verhagen, Bongers, & van der Beek, 2015).

3.1.10 Jakobsen et al. Denmark, 2015

This study aimed to investigate the effect of the difference between work- and homebased exercise intervention and its effect on work related aspects, including sickness absence. The study comprised a cluster randomized controlled trial. Participants was female health care workers (N=200) from three different hospitals in Copenhagen. Subjects were randomized into two groups; one group was assigned home based exercise and the other group work based exercise for ten weeks. The work based exercise program consisted of exercises with high intensity 5 x10 min a week. Those who were assigned home based exercise got exercise equipment and posters with instructions about the exercise, also 5 x10 minutes a week. Outcome measures were work ability as indicated by scores on the Work Ability Index. Item 5 on this index concerned sickness absence for during the last year. Results for sickness absence was significantly better for participants taking part in the work based exercise program as compared to those in the home based exercise program (Jakobsen et al., 2015).

3.2 Summarized results

Included studies were all European, from Norway, Finland, The Netherlands, Sweden and Denmark. The sample sizes varies from 129-860 subjects. There was a great variation in the design and intensity of the interventions. To summarize the results of those ten included studies, only two of them ((Schwarz & Hasson, 2012) and (Jakobsen et al., 2015)) showed significant decrease in sickness absence, revealing the effect of an intervention targeting increased physical exercise on sickness absence. Three of these studies targeted consultation and lifestyle coaching to increase physical activity, and the other seven of the studies had active physical exercise intervention. All of the studies aimed to decrease sickness absence. The two studies that showed positive results, ((Schwarz & Hasson, 2012) and (Jakobsen et al., 2015))

both targeted moderate to high intensity exercise two or more days a week. They were both RCT's performed after 2011, and can be categorized as newer studies on this topic. As shown in table 1, those which included consultation and theoretical aspects or both distance counseling and at the workplace, did not show any significant effect on sickness absence.

TABLE 1. STUDY CHARACTERISTICS

Year	Country	Author	Study sample (N)	Intervention type	Reduced Sickness Absence
2002	Norway	Eriksen <i>et al.</i>	Norwegian Postal Service (860)	Physical Exercise and Integrated health program	No
2002	Finland	Nurminen, E <i>et al.</i>	Women with physical demanding work (260)	Worksite exercise	No
2004	The Netherlands	Proper <i>et al.</i>	Civil Servants of municipal services of Enschede (299)	Consultation aimed to promote Physical Activity	No
2005	Norway	Brox <i>et al.</i>	Employees in Nursing Home (129)	Aerobic Fitness	No
2012	Sweden	Schwarz <i>et al.</i>	Hospital workers (6 workplaces)	Physical exercise	Yes
2012	Finland	Reijonsaari <i>et al.</i>	Insurance company employees (544)	Distance Physical Activity counseling	No
2013	The Netherlands	Strijk <i>et al.</i>	Hospital workers (500)	PA and Yoga	No
2013	Denmark	Christensen <i>et al.</i>	Health care workers (144)	Physical exercise	No
2014	The Netherlands	Viester <i>et al.</i>	Construction workers (314)	Lifestyle coaching program to increase physical activity	No
2015	Denmark	Jakobsen <i>et al.</i>	Health care workers (200)	Workplace and Homebased Physical Activity	Yes

TABLE 2. STUDY CHARACTERISTICS

Year	Country	Author	Intervention Intensity	Male	Female
2002	Norway	Eriksen <i>et al.</i>	Moderate	N=401	N=658
2002	Finland	Nurminen, <i>et al.</i>	Moderate	N=0	N=260
2004	Netherlands	Proper <i>et al.</i>	Not Reported	Not Reported	Not Reported
2005	Norway	Brox <i>et al.</i>	Light	N=3	N=126
2012	Sweden	Schwarz <i>et al.</i>	Moderate to Vigorous	10%	90%
2012	Finland	Reijonsaari <i>et al.</i>	Not Reported	36%	64%
2013	Netherlands	Strijk <i>et al.</i>	Moderate to Vigorous	N=179	N=551
2013	Denmark	Christensen <i>et al.</i>	Not Reported	N=5	N=139
2014	Netherlands	Viestar <i>et al.</i>	Vigorous	Not Reported	Not Reported
2015	Denmark	Jakobsen <i>et al.</i>	Vigorous	N=0	N=200

4. Discussion

The main purpose of this study was to conduct a literature review to investigate if physical exercise interventions done in the workplace have an effect on reducing the sickness absence among employees. The literature was reviewed with a particular focus on including studies with a RCT design, and whether interventions conducted more recently might have found novel ways to make use of exercise focused intervention to reduce sickness absence, thus potentially increasing the possibility of effectiveness. The focus of the discussion will be to evaluate the strength and limitations of the thesis and discuss the evidence of intervention effectiveness so far based on the results observed in my included studies as well as results from those included in previous reviews. Methodological parts of the thesis will be critically discussed both in terms of reliability and validity. I will look at the results critically and the possible reasons for the results observed.

4.1 Strength and limitations: Risk of Bias

Included studies in this review were all based on an experimental design in which the effect of the intervention is tested by measuring the difference between treated and not treated groups from pre-intervention to post-intervention. By randomizing participants into groups, intervention and control, you are making sure that the groups do not have differences at baseline, so if a difference is found between intervention and control from pre- to post-test that should likely be attributed to the intervention program. Such a research design is considered a "golden standard", a high quality and most reliable design given that researchers are - by using randomization - are able to control for confounding factors (bias). Nevertheless, there is always a possibility, even for randomized trials to be undermined by flaws in design, analyses and reporting that could easily lead to underestimation or in some cases overestimation of the true

effect of the intervention (bias). It is usually impossible to know which biases have had an effect on the results of a trial (Higgins et al., 2011). In the current case, two studies of those included could be seen as deviating somewhat from the golden standard, and may thus have provided biased estimates.

4.2 Sickness absence

Table 1.2 shows that in all of the studies the majority of participants in the interventions are women. Studies have shown that women have higher sickness absence than men (Berge, 2012). That could be the reason for including mostly women in the studies, that there is more need to decrease the sickness absence among females. In Norway, whereas there are more women than men that meet the recommendations for physical activity (*Folkehelse rapporten 2014 : helsetilstanden i Norge*, 2014), the sickness absence is still higher among females. That raises the question if the sickness absence is really because of bad health.

This review did not add to former evidence about the effect of exercise on sickness absence. The interest of studying absenteeism is decreasing and more studies presently rather try to find ways to decrease presenteeism. There is evidence that focusing on both absenteeism and presenteeism at the same time may be beneficial in terms of intervention effects (Bierla, Huver, & Richard, 2013).

4.3 Characteristics of the Studies

In the international comparison of sickness absence made by Berge (2012) where he uses results from the Labor Force Survey included results from Norway, Denmark, Sweden, The Netherlands, Finland and Iceland. In this thesis, the included studies were from the same countries except Iceland, so using this to compare with my thesis seems fair. Further, the in-

cluded studies in this review were published from the year 2002 to 2015, two of the ten studies did show positive effect. Those two that showed positive effect were published in 2012 (Schwarz & Hasson, 2012) and 2015 (Jakobsen et al., 2015), so they are relatively new studies. What do they have in common? Jakobsen et al stated that there is need of high quality randomized controlled trials that investigate the effect of physical exercise on work ability and gives therefore a good reason for the study in 2015. He and his co-workers investigated if Work- or Home-based exercise interventions would show different effects on work ability, including sickness absence. Schwarz et al examined the effect of physical exercise during work hours on direct cost and indirect cost associated with sickness absence. In terms of design, sample and type of workplaces, these two studies were quite similar. They both recruited mostly women, Jakobsen et al included only females and Schwarz et al included dental health care workplaces that were 90% females. Both of these studies were looking at the effect of two different intervention types on sickness absence, where the worksite physical exercise group in both cases did have positive effect. The interventions did both focus on high intensity exercise and at least 2 days a week, although Schwarz et al did not assign an instructor to their intervention. Schwarz and colleagues designed the exercise interventions as self-reported by participants and exercise type were of own choice as long as they just met the intensity criteria. In sum, the two intervention studies generally did not differ in study characteristics or intervention type.

What can explain the positive effect of these studies?

It seems likely that the reason for the positive effect of the studies by (Schwarz & Hasson, 2012) and 2015 (Jakobsen et al., 2015), as opposed to non-significant findings in the previous ones, is a question of differences in methodology. The study by Jakobsen et al was conducted with a cluster randomized controlled trial, looking at the difference of two interventions, but without a control group. They observed that the sickness absence in the work-based exercise

group did decrease in comparison to the home-based exercise group. Would it decrease using this intervention type if comparing with a control group? This question remains unanswered. The study conducted by Schwarz et al was a part of a longitudinal intervention project with the aim to investigate health- and productivity effects of physical exercise and reduced work hours. This part of the study was conducted with a longitudinal quasi-experimental design in which participants were not randomized into interventions but three pairs of workplaces were randomly allocated to one of the interventions or control group. While the possible implications of this randomization procedure in terms of influence on results would seem difficult to ascertain, the bias in results cannot be ruled out.

Nevertheless, these two studies both set clear criteria for intervention design, where they describes precisely the intensity, duration and frequency of the exercise. Schwarz & Hasson's (2012) physical exercise intervention involved 2,5 hours of weekly working hours that were allocated to mandatory physical exercise of high intensity or up to 89% of maximum heart rate, on two different days a week. The work based exercise intervention in Jakobsen et al (2015) study were during work hours as well, five times ten minutes a week high intensity strength training. The high intensity was reported only in those two studies showing positive effect.

4.4 Evaluation of the method

4.4.1 The search

In this thesis, I did the search myself and the databases used for the search were chosen by me as well. The databases were chosen with time and access to published articles in mind. The library in The Norwegian School of Sport Science did recommend a number of databases, and I chose three to base my literature search on. The databases I chose were Pubmed, SportDiscuss and Web of Science; those are all reported as high quality databases and recommended for

sport science literature search. The fact that I did not search all possible databases because of lack of time could have an effect on the results and important information may not be included in cases when some databases are left out of the search (Laake et al., 2008).

4.4.2 Reliability

The concept of reliability when conducting literature review concerns how precise and accurate one has carried out the search and the screening of the literature. In this study the method was precisely described in the method chapter, thus transparent, and could be repeated by other researchers. This is important in literature reviews because the possibility of including or excluding studies (consciously or unconsciously) by personal preference cannot be ruled out. Thus, by describing exactly the process from search to screening of the literature, you make sure your study is reliable (Laake et al., 2008), it is important to have clear criteria of which studies were included or excluded after the search, and not to forget explain why those criteria were chosen. Indeed, the reason for including and excluding studies is clearly described in the method chapter.

4.4.3 Validity of this review in terms of trustworthiness of the results

The definition of validity concerns the degree you measure what you were supposed to measure, and if the literature review really, with help of the search strategy, really answers the research question. All of the included studies stem from highly regarded scientific journals and they were carried out using an experimental design with clear statement of study purpose. Interestingly, two of RCT studies that was included were shown to reduce sick leave significantly. Indeed, in earlier review studies the need for inclusion of RCT studies on this topic was stated. Irrespective of study results, it seems fair to conclude that the included studies, which all leant themselves to a RCT design, hold up in terms of internal validity. Indeed, as

already stated, less so for the two studies revealing positive findings. When it comes to external validity, it seems hard to generalize from review findings. The main reason for this is that most of the participants across the ten included studies were females. Hence, findings cannot be generalized to other study populations.

5. Conclusion

Based on the results of this review, it seems that only a small minority of the included RCT studies focusing on exercise interventions or interventions that promote physical activity to reduce sickness absence is effective. Moreover, aside of the indices comprised by the studies by Swartz et al (2012) and Jacobson et al (2015) there is little evidence that studies after 2011 have proved more effective than studies reported earlier in the literature. Further, the two studies revealing positive estimates in terms of reduced sick leave may have produced biased estimates. The studies reviewed comprise different kind of intervention strategies with respect to intervention content, methods as well as physical activity intensity (high, moderate and vigorous intensity). Further, the duration of the intervention period did also vary a lot among studies. There is little evidence that any particular aspect of intervention strategies and activities may have proved especially effective. Indeed, irrespective of a great variety in several aspects of intervention content between studies, a lack of effectiveness was generally revealed. While the results seem somewhat discouraging, it should be noted that the two studies conducted most recently were the ones that holds promise. This is of course a positive trend. Nevertheless, for research on physical activity interventions to reduce sickness absence to be moving forward, it seem pertinent to keep strict to the golden standard of RCT. Further, there seems to be a need for novelty and exploration in terms of intervention efforts. Such efforts would seem to imply testing out new strategies, activities and approaches that meet with the needs of the workers.

6. Suggestion for further research

In this review the intervention design varied in types of exercise and intensity that did not show to be effective. In the light of the results of this review there is need for novelty in research in which new approaches in terms of intervention efforts are explored in combination with a strong research design. Earlier studies have shown great variations in reasons for short-time sickness absence, both in terms of physical health problems and psychological conditions. Investigating the combined effect of both mental training programs and new approaches physical exercise training tailored to individual groups of workers on sickness absence might be one of several avenues for future research.

References

- Alavinia, S. M., Boer, d. A. G. E. M., Duivenbooden, v. J. C., Frings-Dresen, M. H. W., & Burdorf, A. (2009). Determinants of work ability and its predictive value for disability. *OCCUP MED-OXFORD*, 59(1), 32-37.
- Alavinia, S. M., van den Berg, T. I., van Duivenbooden, C., Elders, L. A., & Burdorf, A. (2009). Impact of work-related factors, lifestyle, and work ability on sickness absence among Dutch construction workers. *Scand J Work Environ Health*, 35(5), 325-333.
- Amlani, N., & Munir, F. (2014). Does Physical Activity Have an Impact on Sickness Absence? A Review. *Sports Medicine*, 44(7), 887-907.
- Atkinson, M. (2012). *Key concepts in sport and exercise research methods*. London: Sage.
- Barmby, T. A., Ercolani, M. G., & Treble, J. G. (2002). Sickness absence: An international comparison. *Economic Journal*, 112(480), F315-F331. doi:10.1111/1468-0297.00046
- Bassuk, S. S., & Manson, J. E. (2010). Physical activity and cardiovascular disease prevention in women: A review of the epidemiologic evidence. *Nutrition, Metabolism and Cardiovascular Diseases*, 20(6), 467-473. doi:<http://dx.doi.org/10.1016/j.nu-mecd.2009.12.015>
- Berge, C. (2012). Internasjonal sammenligning av sykefravær. *Økonomiske analyser*.
- Bierla, I., Huver, B., & Richard, S. (2013). New evidence on absenteeism and presenteeism. *The International Journal of Human Resource Management*, 24(7), 1536-1550. doi:10.1080/09585192.2012.722120
- Brox, J. I., & Froystein, O. (2005). Health-related quality of life and sickness absence in community nursing home employees: randomized controlled trial of physical exercise. *Occup Med (Lond)*, 55(7), 558-563. doi:10.1093/occmed/kqi153

- Christensen, J. R., Overgaard, K., Hansen, K., Sogaard, K., & Holtermann, A. (2013). Effects on presenteeism and absenteeism from a 1-year workplace randomized controlled trial among health care workers. *J Occup Environ Med*, 55(10), 1186-1190.
doi:10.1097/JOM.0b013e31829b2816
- de Zwart, B. C., Frings-Dresen, M. H., & van Duivenbooden, J. C. (2002). Test-retest reliability of the Work Ability Index questionnaire. *Occup Med (Lond)*, 52(4), 177-181.
- Eriksen, H. R., Ihlebaek, C., Mikkelsen, A., Gronningsaeter, H., Sandal, G. M., & Ursin, H. (2002). Improving subjective health at the worksite: a randomized controlled trial of stress management training, physical exercise and an integrated health programme. *Occup Med (Lond)*, 52(7), 383-391.
- Folkehelse rapporten 2014 : helsetilstanden i Norge.* (2014). Rapport (Nasjonalt folkehelseinstitutt : online), Vol. 2014:4.
- Gilson, N. D., Burton, N. W., Uffelen, J. G. Z. v., & Brown, W. J. (2011). Occupational sitting time: employees' perceptions of health risks and intervention strategies. *Health Promotion Journal of Australia*, 22(1), 38-43.
- Hagberg, L. (2007). *Cost-effectiveness of the promotion of physical activity in health care.* (no. 1085), Umeå university, Umeå.
- Hansen, B. H. (2013). *Physical activity in adults and older people : levels of objectively measured physical activity in a population-based sample of Norwegian adults and older people (20-85 years).* Norwegian School of Sport Sciences, Oslo.
- Hardman, A. E., Stensel, D. J., & Morris, J. N. (2003). *Physical activity and health : the evidence explained.* London: Routledge.
- Higgins, J. P., Altman, D. G., Gotzsche, P. C., Juni, P., Moher, D., Oxman, A. D., . . . Sterne, J. A. (2011). The Cochrane Collaboration's tool for assessing risk of bias in randomised trials. *Bmj*, 343, d5928. doi:10.1136/bmj.d5928

- Jakobsen, M. D., Sundstrup, E., Brandt, M., Jay, K., Aagaard, P., & Andersen, L. L. (2015). Physical exercise at the workplace reduces perceived physical exertion during healthcare work: cluster randomized controlled trial. *Scand J Public Health, 43*(7), 713-720. doi:10.1177/1403494815590936
- Jeon, C. Y., Lokken, R. P., Hu, F. B., & van Dam, R. M. (2007). Physical activity of moderate intensity and risk of type 2 diabetes: a systematic review. *Diabetes Care, 30*(3), 744-752. doi:10.2337/dc06-1842
- Kilvik, A., & Lamøy, L. I. (2005). *Litteratursøking i medisin og helsefag : en håndbok*. Trondheim: Tapir akademisk forl.
- Laake, P., Olsen, B. R., & Benestad, H. B. (2008). *Forskning i medisin og biofag* (2. utg. ed.). Oslo: Gyldendal akademisk.
- Marcus, B. H., & Forsyth, L. H. (2009). *Motivating people to be physically active* (2nd. ed. ed.). Champaign, Ill: Human Kinetics.
- Marklund, S., Aronsson, G., Johansen, V., & Solheim, L. J. (2015). Previous sickness presence among long-term sick-listed in Norway and Sweden: A retrospective study of prevalence and self-reported reasons. *International Journal of Social Welfare, 24*(4), 376-387. doi:10.1111/ijsw.12143
- Marshall, A. L. (2004). Challenges and opportunities for promoting physical activity in the workplace. *J Sci Med Sport, 7*(1 Suppl), 60-66.
- Mikkelsen, A. (2002). *Tiltak mot sykefravær*. Oslo: Cappelen akademisk forl.
- Nurminen, E., Malmivaara, A., Ilmarinen, J., Ylostalo, P., Mutanen, P., Ahonen, G., & Aro, T. (2002). Effectiveness of a worksite exercise program with respect to perceived work ability and sick leaves among women with physical work. *Scandinavian Journal of Work Environment & Health, 28*(2), 85-93.

- Odeen, M., Magnussen, L. H., Maeland, S., Larun, L., Eriksen, H. R., & Tveito, T. H. (2013). Systematic review of active workplace interventions to reduce sickness absence. *Occup Med (Lond)*, *63*(1), 7-16. doi:10.1093/occmed/kqs198
- Pescud, M., Teal, R., Shilton, T., Slevin, T., Ledger, M., Waterworth, P., & Rosenberg, M. (2015). Employers' views on the promotion of workplace health and wellbeing: a qualitative study. *BMC Public Health*, *15*. doi:10.1186/s12889-015-2029-2
- Petrunoff, N., Wen, L. M., & Rissel, C. (2016). Effects of a workplace travel plan intervention encouraging active travel to work: outcomes from a three-year time-series study. *Public Health*. doi:10.1016/j.puhe.2016.02.012
- Physical activity and health : a report of the Surgeon General*. (1996). McLean, Va: International Medical Publ.
- Proper, K. I., Singh, A. S., van Mechelen, W., & Chinapaw, M. J. M. (2011). Sedentary Behaviors and Health Outcomes Among Adults: A Systematic Review of Prospective Studies. *Am J Prev Med*, *40*(2), 174-182. doi:10.1016/j.amepre.2010.10.015
- Proper, K. I., van der Beek, A. J., Hildebrandt, V. H., Twisk, J. W., & van Mechelen, W. (2004). Worksite health promotion using individual counselling and the effectiveness on sick leave; results of a randomised controlled trial. *Occup Environ Med*, *61*(3), 275-279.
- Reijonsaari, K., Vehtari, A., Kahilakoski, O. P., van Mechelen, W., Aro, T., & Taimela, S. (2012). The effectiveness of physical activity monitoring and distance counseling in an occupational setting - results from a randomized controlled trial (CoAct). *BMC Public Health*, *12*, 344. doi:10.1186/1471-2458-12-344
- Schwarz, U. v. T., & Hasson, H. (2012). Effects of Worksite Health Interventions Involving Reduced Work Hours and Physical Exercise on Sickness Absence Costs. *Journal of Occupational and Environmental Medicine*, *54*(5), 538-544. doi:10.1097/JOM.0b013e31824e11cd

- Smith, M. F. (2010). *Research methods in sport*. Exeter: Learning Matters.
- Strijk, J. E., Proper, K. I., van Mechelen, W., & van der Beek, A. J. (2013). Effectiveness of a worksite lifestyle intervention on vitality, work engagement, productivity, and sick leave: results of a randomized controlled trial. *Scand J Work Environ Health*, *39*(1), 66-75. doi:10.5271/sjweh.3311
- Taylor, N., Conner, M., & Lawton, R. (2012). The impact of theory on the effectiveness of worksite physical activity interventions: a meta-analysis and meta-regression. *Health Psychology Review*, *6*(1), 33-73. doi:10.1080/17437199.2010.533441
- Thorp, A. A., Healy, G. N., Winkler, E., Clark, B. K., Gardiner, P. A., Owen, N., & Dunstan, D. W. (2012). Prolonged sedentary time and physical activity in workplace and non-work contexts: a cross-sectional study of office, customer service and call centre employees. *Int J Behav Nutr Phys Act*, *9*, 128. doi:10.1186/1479-5868-9-128
- Tuomi, K., Huuhtanen, P., Nykyri, E., & Ilmarinen, J. (2001). Promotion of work ability, the quality of work and retirement. *Occup Med (Lond)*, *51*(5), 318-324.
- Vanni, K., Virtanen, P., Luukkaala, T., & Nygard, C.-H. (2012). Relationship Between Perceived Work Ability and Productivity Loss. *International Journal of Occupational Safety and Ergonomics*, *18*(3), 299-309.
- Viestar, L., Verhagen, E. A. L. M., Bongers, P. M., & van der Beek, A. J. (2015). The effect of a health promotion intervention for construction workers on work-related outcomes: results from a randomized controlled trial. *Int Arch Occup Environ Health*, *88*(6), 789-798. doi:10.1007/s00420-014-1007-9
- Waters, C. N., Ling, E. P., Chu, A. H., Ng, S. H., Chia, A., Lim, Y. W., & Muller-Riemenschneider, F. (2016). Assessing and understanding sedentary behaviour in office-based working adults: a mixed-method approach. *BMC Public Health*, *16*(1), 360. doi:10.1186/s12889-016-3023-z

