NORWEGIAN SCHOOL OF SPORT SCIENCES

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The physical activity health paradox

Occupational and leisure-time physical activity and number of pain sites in construction and healthcare workers during a 2-year follow-up.

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Abstract

Title:

Occupational and leisure-time physical activity and number of pain sites in construction and healthcare workers during a 2-year follow-up.

Background:

Occupational physical activity (OPA) is often associated with higher prevalence of musculoskeletal pain, while leisure-time physical activity (LTPA) is associated with health benefits. The purpose of this study was to examine this physical activity health paradox by analysing the association between OPA and number of pain sites (NPS), the association between LTPA and NPS, and whether a possible association between OPA and NPS was moderated by LTPA.

Methods:

At baseline, 99 workers (construction n=45; healthcare n=54) wore Actiheart® 4 (Camntech, Cambridge, United Kingdom) monitors for 1-4 consecutive days, during work and leisure. As a measure for physical activity (PA) we calculated the average duration (hours) with work ≥33% of the heart rate reserve (HRR), and the average duration (hours) with leisure ≥40%HRR. At baseline and every 6 months for two years, participants reported on NPS (0-9). Confounder adjusted associations between HRR and NPS were examined using linear mixed models for the whole sample and stratified by sector.

Results:

OPA measured as time ≥33%HRR was not associated with NPS (β=0.025, 95% Cl -0.29 -0.34) in the whole sample, nor when stratifying by sector (construction: β=0.31 95% Cl -0.26-0.88; healthcare: -0.09 Cl -0.5-0.33). Although not statistically significant, increased LTPA time ≥40%HRR showed a decrease in NPS (β= -0.97 95% Cl -2.0-0.05); the negative association was stronger for healthcare (β=-1.83 95% Cl -

3.7-0.04) than construction workers (β=-0.74 95% Cl -2.0-0.55). LTPA ≥40%HRR did not modify the association between ≥33%HRR at work and NPS (β=-0.03 95%Cl -0.61-0.56).

Conclusions:

OPA measured with time ≥33%HRR was not associated with NPS in construction or healthcare workers. In contrast, our results suggest LTPA may be associated with fewer pain sites in healthcare workers. This study does not support the PA health paradox, nor recject it. Therefor there are still requested more research concerning the differential effects of OPA and LTPA on NPS.

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Abbreviations

PA	Physical activity
OPA	Occupational physical activity
HR	Heart rate
HRR	Heart rate reserve
HR_{max}	Heart rate maximum
HR_{min}	Heart rate minimum
VO_{2max}	Maximal oxygen uptake
MET	Metabolic equivalent
RPE	Ratings of perceived exertion
LTPA	Leisure-time physical activity
MSP	Musculoskeletal pain
NPS	Number of pain sites
DAGs	Directed acyclic graphs
ACSM	American College of Sport Medicine
IASP	International Association for the Study of Pain
STAMI	Statens Arbeidsmiljøinstitutt
WHO	Worlds Health Organization
NOA	Nasjonal statistikk om arbeidsmiljø og helse
BMI	Body Mass Index
WAI	Work Ability Index
QPS_{nordic}	General Questionnaire for Psychological and Social factors on Work

1. Introduction

PA is a widely used term and a high level of PA is often associated with health benefits (Warburton, Nicol & Bredin, 2006). Increasing the PA level among the population is an important strategy in preventing the growing trend of sedentary lifestyles (World Health Organization, 2010). PA is associated with reduced risk of early mortality, cardiovascular diseases, diabetes, some types of cancer and hypertension (American College of Sport Medicine, 2011; Warburton et al., 2006; Wennberg et al., 2016). PA is also used in treatment of many musculoskeletal conditions (ACSM, 2011; Grooten, 2016; Lofgren, Mannerkopi, Bergman & Knardahl, 2016). PA increases muscular- and cardiovascular fitness, which in turn can increase the individual's physical work capacity and musculoskeletal health (Henriksson & Sundberg, 2016). Global and national guidelines exist that recommend at least 150 minutes of moderate to vigorous PA during a week (Helsedirektoratet, 2014). Although research on associations between PA and health benefits often refer to leisure-time physical activity (LTPA) (ACSM, 2011), as of now, these global and national guidelines of PA apply to any PA done throughout the day. This suggests that health benefits can be attained when following the recommendations at work or during leisure. However, a high level of occupational physical activity (OPA) is known as a risk factor for reduced health status and musculoskeletal pain (MSP) (Hallmann, Birk Jørgensen & Holtermann, 2017; Heuch, Heuch, Hagen & Zwart, 2017; Haukka, Ojajarvi, Takala, Viikari-Juntura & Leino-Arjas, 2012; Solidaki et al., 2010 & Coggen et al., 2013). The contrasting effects of OPA and LTPA on health, has given rise to the term "physical activity health paradox" (Holtermann, Hansen, Burr, Søgaard & Sjøgaard, 2012).

Construction- and healthcare workers are sectors that are characterised by a high degree of PA in daily working tasks. Lifting, carrying heavy loads, static work, transferring patients and patient care are examples of activities that increases risk of MSP (Bruno, da Costa & Vieira, 2010). Several potential pathways may lead from high levels of PA to MSP. MSP includes a wide range of inflammatory and degenerative conditions as well as pain syndromes not attributable to specific pathology (Punnet & Wegman, 2004). Within pain research, studying multiple pain sites has shown to be of interest because pain at more than one body site is more severe compared with pain at one site; counting number of pain sites (NPS) is a predictor of disability (Natvig, Ihlebæk, Kamaleri & Bruusgaard, 2010).

The exposure to heavy physical work has been associated with multiple pain sites (Coggen et al., 2013) and construction- and healthcare workers performing heavy physical work in their daily tasks (Lunde et al., 2014). Heavy physical work is an imprecise definition but can be considered as work requiring moderate to high power, involving large parts of the body and increased use of energy expenditure (Bruno et al., 2010; Veiersted et al., 2017). Previous studies on the association between heavy physical work and NPS are based on self-reports of mechanical workloads (Coggen et al., 2013; Haukka et al., 2012; Solidaki et al., 2010). The limitations of self-reports are risk of subjective biases; therefore, measuring PA and mechanical exposures using objective measures are more accurate methods.

Studying and understanding the PA health paradox and the association between OPA and LTPA using objective measures is crucial for giving the working population optimal activity recommendations for better health. This knowledge could help to tailor interventions to prevent health problems and give more specified recommendations for workers performing physically demanding tasks. Hopefully, knowledge about PA in work and leisure-time can help prevent MSP which is beneficial for the working place as well as individual's quality of life. To my knowledge, this is the first study using objective measures from heart rate for evaluate associations of PA during work and leisure with number of pain sites.

1.1 Research question

For this thesis the research questions are as follows:

1. Is duration in moderate to high occupational physical activity among construction- and healthcare workers associated with the number of pain sites during a 2-year period?
2. Is duration in moderate to high leisure-time physical activity among construction- and healthcare workers associated with the number of pain sites during a 2-year period?

3. Does duration of moderate to vigorous leisure-time physical activity moderate the association between a high level of occupational physical activity and the number of pain sites?

The hypothesis for this study is that increased duration of heavy physical work is associated with increased NPS among construction- and healthcare workers. In contrast, duration of LTPA at moderate to vigorous intensity is associated with a lower NPS for this population. Additionally, the hypothesis is that LTPA will be more beneficial for the NSP among individuals with longer duration of heavy physical work than those with shorter duration of physical work.

2. Theory

2.1 Physical activity

Physical activity is a widely used term and it is defined as*; any bodily movement produced by skeletal muscles that requires energy expenditure* (Howley, 2001). This means that PA is performed in many domains, for instance as activities at home, active transportation, during work or as physical training/exercise. Occupational physical activity (OPA) is activity done in a working situation, usually within a time frame of an eight-hour working day (Howley, 2001). Leisure-time physical activity (LTPA) is activity performed during free time based on a person's needs or interests (Howley, 2001). LTPA can vary from planned exercise training to household and active transportation; thereby, the activities are of different duration and intensities. OPA is usually performed in regard to productivity, for instance, working fast can be cost beneficial for the worksite and increase productivity. LTPA is performed and determined by the individuals own direction and it may be performed aiming to enhance health (Søgaard & Sjøgaard, 2017). LTPA performed as exercise is characterized as structured, planned and repeated activity with the intention to improve, or maintain physical fitness (cardiorespiratory fitness, muscular strength and endurance, body composition, flexibility and balance) (ACSM, 2011; Howley, 2001). Adequate restitution time is also of importance to achieve physical fitness (Søgaard & Sjøgaard, 2017).

The dose of PA is determined by frequency, duration and intensity (Howley, 2001). Frequency is described as number of activity sessions during for instance a day or week, and duration as minutes or hours during a particular session. Intensity refers to the amount of effort used in a particular activity and can be expressed in different ways depending on whether it is performed during leisure time, work or performed as resistance training (Howley, 2001).

Within physical activity research, two common ways of measuring intensity levels are as absolute and relative values. Absolute are the actual rate of energy expenditure. Energy expenditure can be measured using the metabolic equivalent (MET) which is the rate of energy expended during an activity minus the rate of energy expenditure during rest (ACSM, 2011). Using this method, light, moderate and high intensity are categorized into <3METs, 3-6 METs and >6 METs.

Relative intensity is related to the individual's maximum capacity and, therefore, takes into account variation between individuals. When comparing intensity between individuals, this method is more precise, because it is related to a person's own fitness and abilities (Mattson et al., 2016). There are several possibilities of measuring relative intensity and in Table 1 different measures and categories of intensity are presented. Recommendations of PA often refer to intensity of activity with moderate to vigorous intensity being associated with health benefits (Helsedirektoratet, 2014). From Table 1 we can see that moderate intensity is defined as >40% of an individual's heart rate reserve (HRR), which is equivalent to >64% of the heart rate max (HR_{max}). The heart rate reserve is the difference between HR_{max} and HR_{min}. The percentage of the HRR (%HRR) is calculated by subtracting resting HR from physical activity HR, divided by the HRR, and multiplying by 100% (Howley, 2001). Often % HR_{max} is used for measuring intensity levels, but this method does not account for individual differences in resting heart rate. Percentage of heart rate reserve is an accurate estimation of intensity level especially when individual's minimum heart rate is high and/or maximum heart rate is low (Mattson, Jansson & Hagstromer, 2016). This is often seen in deconditioned- and older people and when studying participants in the general population there are expected to be differences in age and a wide range of physical condition. Therefore, %HRR is preferred over $\%HR_{max}$ and exercise intensity is less likely to be overestimated or underestimated. Subjectively reported PA intensity (Perceived Exertion Rating Scale in Table 1) is easy to use when heart rate monitors are unavailable or inappropriate to use. Although this is an easy method, subjective measurements of PA intensity may be inaccurate and a meta-analysis studying PA intensity from heart rates and Perceived Exertion (Borgs scale) has shown moderate correlation (0.62) between methods (Chen, Fan & Moe, 2002). This implies that subjective ratings are imprecise when determining PA intensity and using objective measures are more accurate.

Table 1. Classification of relative exercise intensities. Obtained from the American College of Sport Medicine (2011)

Intensity	% HRR/ %VO_2R	% HR_{max}	%VO_{2max}	Perceived Exertion (Rating on 6-20 RPE Scale)
Very light	<30	<57	<37	<Very light (RPE<9)
Light	30-39	57-63	37-45	Very light to fairly light (RPE 9-11)
Moderate	40-59	64-76	46-63	Fairly light to somewhat hard (RPE 12-13)
Vigorous	60-89	77-95	64-90	Somewhat hard to very hard (RPE 14-17)
Near-maximal to maximal	≥90	≥96	≥91	≥ Very hard (RPE ≥18)

Tabel are obtained from American College of Sport Science, (2011). HRR, heart rate reserve; VO_2R, oxygen uptake reserve; HR_{max}, maximal HR; VO_{2max}, maximal oxygen uptake; RPE, ratings of perceived exertion.

2.1.1 Physical activity guidelines

The Norwegian physical activity guidelines are in line with global health recommendations proposed by the World Health Organization (Helsedirektoratet, 2014; WHO, 2010). The recommendations are based on a “dose-response” relationship between PA and health benefits. The first recommendations for PA were published by American College of Sport Medicine (ACSM) in 1978 in order to promote physical capacity, since then ACSM has revised the recommendations four times (Jansson, Hagstromer & Anderssen, 2016). In 2014, the PA recommendations were changed from 30 minutes of daily moderate intensity aerobic PA (210 minutes per week), to at least 150 minutes of weekly moderate intensity aerobic PA. The current PA guidelines from the Norwegian health authorities is presented below and translated to English (Helsedirektoratet, 2014):

- To be in at least 150 minutes of moderate-intensity aerobic PA throughout the week or at least 75 minutes of vigorous-intensity aerobic PA throughout the week. A combination of moderate and vigorous activity is also recommended.
- Aerobic PA can be performed in bouts of at least 10 minutes.
- For additional health benefits, adults should increase their aerobic PA at moderate- intensity to 300 minutes per week, or their aerobic PA at vigorous-

intensity to 150 minutes per week. An equivalent combination of moderate and vigorous PA intensity is also recommended.

- Muscle-strengthening activities that involve major muscle groups should be done at least two days per week.
- To reduce sedentary time.

As of now, these recommendations apply to any PA done throughout the day. This suggests that health benefits can be attained when following these recommendations at work or during leisure.

2.1.2 Physical activity and health

PA is associated with health benefits and there is evidence that regular PA reduces the risk of premature death, cardiovascular diseases, diabetes, some types of cancer, hypertension, obesity and osteoporosis (Warburton et al., 2006; ACSM, 2011). PA and exercise also preserve bone mass and may prevent mild to moderate depression and anxiety (ACSM, 2011; Kronhed & Ribom, 2016). Research has shown a linear relationship between increased dose of PA and health status (Warburton et al., 2006; Anderssen & Strømme, 2001). Although there seem to be a dose-response relationship, the curve may differ depending on the health outcome and the relationship is not fully understood (Anderssen & Strømme, 2001). For instance, the dose-response of PA could differ depending on whether it is affecting osteoporosis, osteoarthritis, mental health conditions etc. Although PA and exercise are recommended as treatment for several musculoskeletal conditions, the dose-response relationship between PA and MSP is one association that is not fully understood .This is probably because there is a wide range of different musculoskeletal conditions (ACSM, 2011; Grooten, 2016; Lofgren, Mannerkopi, Bergman & Knardahl, 2016) PA and MSP will further be discussed in section 2.2.3.

2.1.3 The physical activity health paradox

The PA guidelines promote PA in all settings in order to enhance health and does not distinguish between work and leisure (WHO, 2010; Helsedirektoratet, 2014). Therefore, there is an assumption that OPA and LTPA provide similar health benefits. Researchers have questioned this assumption, because a high level of OPA is also associated with impaired health. The contrasting effects of OPA and LTPA on health has given rise to the term “physical activity health paradox” (Holtermann, et al., 2012). A high level of

OPA is associated with long-term sickness absence (Holtermann et al., 2012) and disability pension (Fimland, Vie, Holtermann, Krokstad & Nilsen, 2017), risk of cardiovascular disease (Hallmann et al.,2017; Harari, Green, Zelber-Sagi, 2015), and musculoskeletal pain or disorders (Heuch, et al., 2017; Haukka, et al., 2012; Solidaki et al., 2010; Coggen et al., 2013).

The reasons for differences in health outcome has been discussed both for cardiovascular health (Holtermann, Krause, van der Beek & Straker, 2018; Straker, Mathiassen & Holtermann, 2018) and musculoskeletal health (Søgaard &Sjøgaard, 2017) and when comparing OPA and LTPA, the PA pattern differs specially in duration and intensity. OPA may be too short or too long to improve or maintain muscular fitness, cardiovascular fitness and cardiovascular health status. A high level of OPA also increases the 24-hour blood pressure because tasks require heavy lifting, manual material handling and/or static work during many working hours, while LTPA only requires high blood pressure for short durations. Further, OPA has little recovery time and high OPA may increase inflammations levels which are associated to aetiology of atherosclerosis. (Holtermann et al., 2018; Straker et al., 2018). Additionally, concerning a high level of physical load, the capacity to resist high physical load of the muscular system may be exceeded (Søgaard &Sjøgaard, 2017). To a certain extent these mechanisms are hypotheses; therefore, there are still important questions that remain unanswered concerning reasons for the “physical activity health paradox”.

2.1.4 Occupational- and leisure-time physical activity among construction and healthcare workers

Occupational health sciences traditionally consider a high level of OPA as a risk factor for decreased health status and terms of power, frequency, intensity and duration have been used when studying PA and exposure in working situations (Veiersted et al., 2017). OPA includes exposures of mechanical strain during awkward postures, manual handling, repetitive movements and heavy physical work (Gram et al. 2016; Veiersted et al., 2017). The term heavy physical work is an imprecise definition, but can be described as OPA requiring moderate to high power, involving large parts of the body and increased use of energy expenditure (Bruno et al., 2010; Veiersted et al., 2017). Heavy physical work has been quantified as effort above an average of thirty-three percent of an individual’s heart rate reserve over an eight-hour working day (Veiersted et al., 2017; Rodgers & Kenworth, 1986). The International Labour Organization has used this boundary for maximum permissible intensity level as a step towards better occupational health (Bonjer, 1971). To give a picture of how many workers experience heavy physical work, statistics from Norway shows that 15% of the working population subjectively reported to perform work requiring faster breathing at least a quarter of a working day. There was a difference regarding gender: 18% of the men and 12% of the women reported that they exceed this boundary. A 6% higher proportion of employees worked above this limit for the youngest age group compared with other ages (NOA, 2018).

The daily work activities of construction workers include lifting/carrying of heavy loads and static work. In addition, they are exposed to vibration and extreme weather conditions (Boschman, van der Molen, Sluiter & Fries-Dresen, 2011). An article by Arias et al. (2015) studying objectively measured PA intensity, showed a high level of moderate to vigorous PA during work among construction workers with 73% of the participants meeting the global PA guidelines at work during a week. The PA with moderate to vigorous intensity was mainly done in short bouts and when using guidelines of 10 minutes bouts, 29% of the participants met the PA guidelines. Although they were exposed to strenuous mechanical workload that may impair their health (Gram et al., 2016), studies suggest that few construction workers exceed the boundary of 1/3 of individuals metabolic load during a working day (Gram et al., 2016; Lunde, Koch, Veiersted, Moen, Wærsted & Knardahl, 2016),

During leisure-time, construction workers may not exceed the PA guidelines (Arias et al., 2016) and a study including focus group data indicated that the construction workers "*felt they already get significant physical activity out of their job because they are "moving all the time and not sitting behind a desk*." (Caban-Martinez et al, 2014).

Healthcare workers also perform physically demanding tasks (Lunde et al., 2014), but these tasks often involve patient care with transferring- and repositioning patients as well as carrying and pushing objects and equipment (Chappel, Verswijveren, Aisbett, Considine & Ridgers, 2017). A systematic review by Chappal et al. (2017) on OPA among nurses, highlights that most working time is spent in light activity interceded with moderate intensity in direct patient care tasks, walking and standing. Nurses' OPA also exceed the PA recommendations of >150 minutes of moderate to vigorous PA during a week, but the review questions the reliability and validity of methods estimating PA level. The review included subjective and objective measures and objective tools varied with the use of accelerometer, heart rate measures, and direct observation. There are few studies estimating LTPA among healthcare workers, but one study using subjective measures of PA showed a high level of inactivity during leisure time (Rocha, Barbosa & Araujo, 2018). This study was among healthcare workers in Brazil, therefore, generalization to Norwegian healthcare workers has to be considered.

2.1.5 Measuring physical activity

Measuring PA using methods that are reliable, valid and are responsive to change are important for understanding the association between PA and health (Dowd et al., 2018). There are several methods being used within PA research. Feasibility, costs, study design, study objectives and characteristics of the target population need to be considered when selecting measurement methods (Dowd et al. 2018; Matthews, Hagstromer, Pober & Bowles, 2012; Butte, Ekelund & Westerterp, 2012). PA is a multidimensional behavior and methods being used are often categorized into subjective or objective measures. For measuring free-living PA, subjective measurements can be self-report (recall, questionnaire, logs) and objective measurements are motion sensors, heart rate monitoring, direct observation and double label water (Warren, Ekelund, Besson, Mezzani, Geladas & Vanhees, 2010).

Subjective measurement

The most used subjective measurements are questionnaires and it is often chosen because of low costs, convenience and because it is a simple method when studying many individuals (Helmerhorst, Brage, Warren, Besson & Ekelund, 2012). Questionnaires can also measure all the different dimensions of physical activity (intensity, frequency, duration) and type of activity within different domains. Although questionnaires are widely used, a systematic review from Helmerhorst et al. (2012) concludes that subjective measures have acceptable reliability and moderate validity at its best. Reasons for measurement bias can be social desirability, cognitive limitations and recall bias (Helmerhorst et al., 2012). Questionnaires also require the target population to understand terms and the language being used. There has also been an extensive use of questionnaires for measuring exposure and physical demands during work (Veiersted et al., 2017). Although this method is often convenient, a study by Koch et al. (2016) showed no correlation between physical exertion assessed by questionnaire and relative heart rate estimated with Actiheart monitoring (Actiheart, Camntech, Cambridge, United Kingdom). The authors further found that time spent in different activities assessed with a questionnaire and accelerometer (Actigraph GT3X+, Actigraph, Florida, U.S.A) showed low to moderate correlation (Koch et al., 2016). Therefore, objective measurements are a more precise method when studying biomechanical exposures during work, because they exclude subjective biases that may lead to misclassification. High physical demanding tasks during work increase the chance of overreporting the duration and underreporting other tasks that are less demanding (Barrero, Katz & Dennerlein, 2009).

Objective measurements

Today, objective measures of PA using wearable monitors have become a more common assessment when quantifying PA (Butte et al., 2012; Dowd et al. 2018). The methods are calibrated and validated against gold standard PA measures which are calorimetry or the double label water method (Butte et al., 2012). The gold standard methods are grounded in measures of energy expenditure, which can determine PA energy expenditure by subtracting resting metabolic rate (Warren et al., 2010).

Heart rate monitoring is one method used to measure free-living PA. There is a linear relationship between the increase in energy expenditure and heart rate during dynamic exercise involving large muscle groups (Warren et al, 2010). The use of heart rate monitoring (Actiheart) is valid in free-living conditions and during occupational and leisure time activities (Kristiansen, Korshøj, Skotte, Jespersen, Søgaard, Mortensen & Holtermann, 2011). A weakness of using heart rate monitors is when measuring low intensity PA. Heart rate is affected by stimuli other than PA, for example emotional states like stress increase heart rate (Butte et al., 2012). In addition, medication/drugs like β-blockers used for high blood pressure affect heart rate.

Accelerometery is another method to measure PA during free-living. The method is based on the principle that the movements of the body are in relation to muscular forces and thereby energy expenditure (Warren et al, 2010). This device registers the acceleration in the body in one, two or three planes by measuring amplitude and frequency of acceleration registered as counts (Warren et al., 2010). The raw data are collected in epochs, usually between 5-60 seconds and the counts can be plotted against energy expenditure. By using cut-off values, intensity levels (low, moderate and high) are determined (Dowd et al., 2018). Accelerometers are often used to measure habitual activities over several days and are especially suitable for activities such as walking and jogging (Dowd et al., 2018). National surveys in Norway measuring activity levels within the population use accelerometer worn on the hip (Hansen et al., 2015).

A weakness of accelerometers used on one place is the inability to distinguish between activity types (cycling, rowing etc) and static loads (lifting, carrying) (Butte, Ekelund & Westerterp, 2012). While the national surveys of PA mainly focus on intensity of PA in regard to the national PA guidelines, other methods for measuring activity types using triaxial accelerometers have been suggested (Skotte, Korshøj, Kristiansen, Hanisch & Holtermann, 2014). Using two Actigraph accelerometers (hip or back and thigh) a costum made software, Acti4, has shown high accuracy in detecting activity types (lying, sitting, standing, walking, running, walking stairs and cycling). Therefore, this setup has a potential to distinguish duration of different activity types and this is important to further understand the causality between OPA and exposure during work with MSP (Skotte et al., 2014).

2.2 Musculoskeletal pain

2.2.1 Musculoskeletal pain among the working population

MSP is a major public health problem concerning substantial costs and impact on individual's quality of life (Punnet & Wegman, 2004). Worldwide, musculoskeletal conditions are the second largest contributor to years lived with disability (WHO, 2018). In Europa, chronic MSP is the main cause of absence from work (Bevan et al., 2009) and in Norway, 27% of the working population reports having MSP with half of these individuals claiming MSP is totally or partially caused by work (STAMI, 2018). Sickness absence reported by doctors shows that 38% of lost days at work were due to musculoskeletal disorders in 2016, and musculoskeletal disorders were the reason for 29% of the individuals to receive disability pension (STAMI, 2018). The occurrence of MSP among the working population has been relatively stable the last fifteen years and most reported pain sites are back pain and pain in neck and shoulder region (STAMI, 2018).

Construction and healthcare are sectors in working life with a high level of sickness absence. Statistics from the Norwegian population shows that the healthcare sector had the highest sickness absence (7,7%) and the construction sector the fifth highest percentage (5,5%) in the fourth quarter of 2018. (NAV, 2018). MSP is frequently reported among construction- and healthcare sector and statistics from The Department of Occupational Health Surveillance in Norway (NOA, 2019) show that a total of 52% of healthcare workers in institutions reports back pain and neck/shoulder pain, while among construction workers 38% reports back pain and neck/shoulder pain (NOA, 2019). One work-related risk factor for MSP is performing physically demanding tasks. These tasks can include heavy physical work, excessive repetition, awkward postures, heavy lifting, pulling and pushing, increased speed and lack of restitution (Bruno et al., 2010; Punnet & Wegman, 2004). Employees working in construction and healthcare perform such tasks and, therefore, are at increased risk of developing MSP, which in turn can lead to sickness absence.

2.2.2 Musculoskeletal pain and number of pain sites

The International Association for the Study of Pain (IASP) defines pain as: *"An unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage."* (IASP, 2011). The human pain system is complex, and the experience of pain is influenced by both physiological and psychological responses to injury (Steeds, 2016).

Nociceptors are sensory neurons that respond to potential or actual damage of the tissue. They respond to high mechanical stimuli, high level of temperature deviation, damage of cells and inflammation (Brodal, 2005). Nociceptors are localized in tissue such as the skin, blood vessels in muscles, joints and organs. When nociceptors are activated, signals are sent through fast Aδ-fibres and slower C-fibres to the dorsal horn in the spinal cord. There are several synapses from the dorsal horn to higher centres in the brain and these afferent signals are recoded and further sent to numerous places in the brain (Brodal, 2005). Because of the plasticity of the nervous system, signals can be strengthened or inhibited which can result in increased or reduced pain experience. Pain is therefore an interplay between different signal systems, modulated by high centres in the brain that result in unique pain experiences (Steeds, 2016).

Pain is often categorized into acute or chronic pain. Acute pain is mostly related to specific tissue damage and the problem resolves as the tissue heals, while chronic pain can be defined as pain that persists for more than three months (Börjesson, Mannerkorpi, Knardahl, Karlsson & Mannheimer, 2009) Reasons for MSP include a wide range of inflammatory and degenerative conditions as well as pain syndromes not attributable to specific pathology (Punnet & Wegman, 2004). Typically, conditions with chronic pain are low back pain, neck pain, chronic widespread muscle pain (fibromyalgia) and osteoarthritis (McBeth & Jones, 2007; Fayaz, Croft, Langford, Donaldson & Jones, 2016). One discussed mechanism explaining chronic pain is central sensitization. If stimulation of nociceptors is prolonged or intense, structural changes in the nervous system and the brain can occur. This mechanism leads to exaggerated response to painful stimuli (hyperalgesia) and pain elicited by normally non-painful stimuli (allodynia). Because the nervous system is plastic, this exaggerated pain response is reversible and pain can diminish (Scholz, 2014). For chronic pain patients, psychological states such as pain catastrophizing, fear of pain and depression are also possible predictors of MSP and it is discussed whether these determinants can lead to the spreading of pain (Niederstrasser et al., 2014). Although the terms of acute and chronic pain already are widely used, a concept of multiple pain sites has been proposed within research. The importance of studying multiple pain sites is reasonable, because the consequences of having pain at more than one site seems to be more severe compared with one site. Having multiple pain sites are associated with the condition getting chronic (Croft et al., 2006), with reduced work ability (Pan, Byrne, Ramakrishnan, Ferreira, Dwyer & Jones 2018) and with reduction in overall health (Kamaleri, Natvig, Ihlebæk, Benth & Bruusgaard, 2008). For the working population, heavy physical work is associated with multiple pain sites (Haukka et al., 2012; Coggen et al., 2013). In addition, individual- and lifestyle factors, such as age, somaticizing tendency, obesity and low LTPA, have been associated with multiple pain sites (Pan et al., 2018; Coggen et al., 2013; Solidaki et al., 2010). Therefore, multiple pain sites can be the consequence of various factors, including work, leisure-time and individual factors. There is no consensus for a definition of multiple pain sites, but the term includes widespread pain and is not diagnose specific. This means that the experience of pain can be considered before it is a diagnose, making it a useful tool in prevention of more severe MSP.

2.2.3 Musculoskeletal pain and physical activity

There are several potential pathogenic pathways to MSP, with several theories trying to explain these pathways. Within occupational health sciences, such pathways include mechanical, static or repetitive pressure on tendons (Seitz et al., 2011), muscular fatigue (Armstrong et al., 1993; Kumar, 2001), prolonged muscle activation (Visser & van Dieen, 2006), and cumulative trauma disorder (Kumar, 2001). A general hypothesis based on these potential pathways posits that when intensity is too high and/or duration is too long of biomechanical exposures during work due to of physical strenuous tasks, MSP can occur because of tissue changes and damages. The model proposed by Armstrong et al. (1993) (Figure 1), illustrates the relationship between individual's capacity, dose, exposures during work and response. The original intention of making the model was to illustrate the multi-factorial nature of work-related neck and upper-limb musculoskeletal disorders. Exposure during work, according to the model, can be psychosocial factors as well as physical exposure directly related to working tasks that affect internal tissue loads and metabolic demands. The dose refers to factors that disturb the internal state and affect the tissue or psychological states such as anxiety about workloads or lack of support. The capacity refers to individual's ability (physiological or psychological) to resists destabilization due to various doses. Further, responses to doses can diminish (impaire) or increase (adapt) the capacity (Armstrong et al., 1993). For instance, if an individual performs heavy physical work that fatigues the muscles, without sufficient recovery time, MSP is more likely to occur. In contrast, the model proposes that right doses of exposure, can lead to adaption of the tissue and enhance the capacity and reduce risks of MSP (Armstrong et al., 1993).

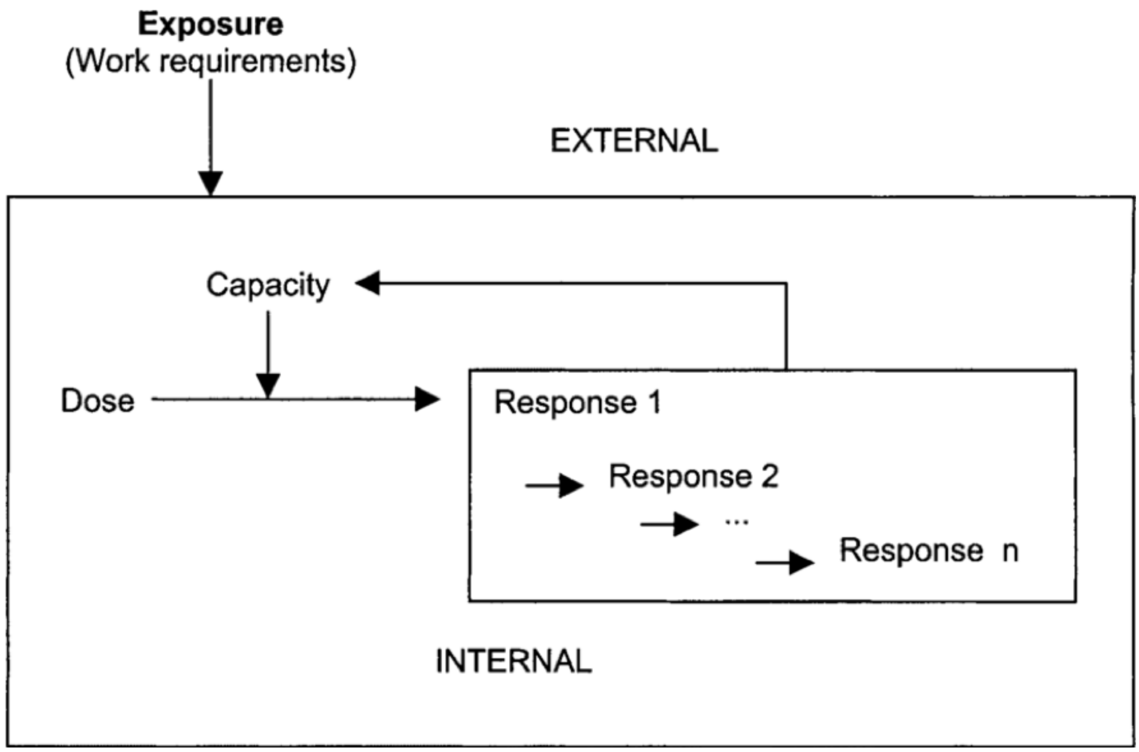

Figure 1. Dose-response model for work-related neck and upper limb MSP. Obtained from Armstrong et al. (1993).

The model can also be relevant when considering effects of PA and exercise. Within PA and exercise sciences, the term “overload” describes high doses of load, for instance aerobic or strength training, which results in training effects and progression of cardiovascular- and muscular fitness (Mattson et al., 2006). Additionally, within exercise science, training needs to be in balance, because high frequency, duration and intensity can lead to injuries when the body’s tissues are not able to adapt to the load (Karlsson & Andersen, 2016).

As previously described, some research has illustrated a linear relationship between increased dose of PA and health status (Warburton et al., 2006; Anderssen & Strømme, 2001). In contrast, a U-shape relationship between PA and low back pain has been proposed. A cross-sectional study among adults (>25 years) in the Netherlands, showed that both inactivity and extreme PA are associated with chronic low back pain (Heneweer, Vanhees & Picavet, 2009). If there is a U-shape relationship between PA and MSP, high OPA and LTPA levels can be a risk factor for MSP. For the perspective of musculoskeletal health, the relationship between OPA and LTPA is important to gain insight into reasonable PA levels for those with heavy physical work.

The multi-factorial focus in the model of Armstrong et al. (1993) points out that associations between work-related exposure and MSP are complex and involve physical, psychological and social determinants. The European Agency for Safety and Health at Work also inform that there are important psychosocial risk factors for work-related MSP; these are high job demands, low worker control and support, role conflicts, bullying, harassment and poorly handled changes at the workplace (EU-OSHA, 2017).

As previously described, PA can improve cardiovascular- and muscular fitness, which in turn can improve musculoskeletal health. In addition, PA and exercise have been studied as a mechanism to relieve pain. There is still a lot of uncertainty involved in how PA prevents pain and how exercise can reduce chronic pain; this research is still in its early phase (Law & Sluka, 2017). One hypothesis suggests that less pain occurs due to activation of the central opioid system, which can provide pain-relief in different parts of the pain system (Börjesson et al., 2009). There seems to be a dose-response relationship for the system that favors high intensity exercise (Law & Sluka, 2017). For instance, an experimental study on pain showed increased pain tolerance among healthy adults after exercise at an average of 63% of VO_{2max} compared with individuals having sedentary tasks before pain tolerance test (Gurevich, Kohn & Davis, 1994). In contrast, an experimental study examining exercise at 50% of VO_{2max} showed no effect on pain rating (Hoffmann et al., 2004). It is an important notice that these pain experiments were done in science laboratories and on healthy, pain-free subjects. Therefore, studies on patients with pain are still requested (Law & Sluka, 2017). Expectations of pain is another explanation of PA as pain inhibitor (Börjesson et al., 2009). For instance, LTPA is often associated with less pain, i.e. a positive expectation, while OPA is often explained as a risk, i.e. negative association. Therefore, psychological mechanisms could explain and reinforce the subjective experience of pain.

2.2.4 Measuring pain and number of pain sites

Pain is always a subjective experience; therefore, measurement of pain relies on self-reports. There are many measures available with the intention of quantifying qualities of pain like intensity, characteristics, affective response and coping (Litcher-Kelly, Martino, Broderick & Stone, 2007). For measuring clinical pain, the Visual Analog Scale (VAS) is frequently used to measure the intensity of current pain. The scale is a

10-centimeter line where the endpoints illustrating “no pain” and “worst imaginable pain”. Another method used for clinical pain assessment is Numeric Rating Scale (NRS) and the intensity of pain is reported with numbers 0 (no pain) -10 (worst imaginable pain) (Litcher-Kelly et al., 2007). These methods are widely used in clinical and experimental settings and are easy to use, but they do not consider duration- or past pain. Within occupational health sciences, “The Nordic Musculoskeletal Questionnaire” (NMQ) was developed for epidemiological studies (Crawford, 2007). This method evaluates intensity and duration of pain/complaints during the last four weeks for different body parts. A more detailed explanation of the questionnaire and how it is used in this thesis is presented in section 3.3.1. For measuring NPS, counting sites has been recommended as a method in research and in clinical practice, because NPS is an important predictor of identifying risk of disability (Natvig et al., 2010).

3. Methods

3.1 Study design

3.1.1 Larger cohort study

This thesis uses data from a longitudinal cohort study among employees working in construction and healthcare in the Oslo region, Norway (Lunde et al., 2014). Data was collected from 2014 to 2017 and consisted of baseline objective measurements of cardiorespiratory fitness, muscle strength, muscle activity, ground reaction force, body positions and physical activity during work and leisure. Questionnaires were answered at baseline and consequently every 6-month for a total of five times during a 2-year follow-up. In the questionnaires, participants were asked to report on the intensity of pain in several areas of the body, as well as on health, physical activity and exercise, sickness, disorders, work ability and psychosocial and organizational work factors. The participants were recruited from four construction companies (n=580 workers) and two local health care distributors (n=585). Informational meetings were held at the work sites where participants were informed about the purpose, format and methods of the study. Further recruitment is presented in the flow chart below (figure 1). At baseline, a total of 371 participants agreed to answer questionnaires, participate in a clinical examination, and participate with technical measures. Based on availability, age, occupational titles and work schedule, a sample of 138 participants (constructions workers: n=66; health care workers: n=72) wore technical equipment for 1-4 weekdays. Technical measurements included wearing force in-soles in the shoes and electromyography equipment for one working day, and accelerometers and heart rate monitoring for 3-4 weekdays.

3.1.2 This master thesis

This master thesis is based on data from the technical assessments of heart rate at baseline, supplemented with accelerometer data, and on the questionnaire data during the two-year follow-up. Longitudinal data of pain at all five time points and technical measures of heart rate were used for the main analyses. As a measure of physical activity, calculations of average duration (hours) with work ≥33% HRR and the average duration (hours) with leisure time ≥40% HRR were estimated. The outcome for this thesis is NPS. Covariates were individual data (gender, age, body mass index and smoking habits), psychosocial work-related factors, cardiorespiratory fitness, subjective rating of work ability, weekly working hours, manual or non-manual worker, general health and perceived exertion at work. The combination of heart rate (Actiheart) and accelerometer data (Actigraph) was used to describe baseline activity characteristics during work and leisure.

3.2 Study population

White- and blue-collar workers were invited to participate in the study. To get sufficient variation in work exposure, participants with different work tasks were selected for technical measurements. It was a natural collection of participants considering gender, leading to a higher proportion of men in the construction sector and a higher proportion of women in the health care sector.

The exclusion criteria of participants were inadequate skills in reading and writing Norwegian, an allergy for plaster/tape/bandages, and pregnancy. Included participants at baseline are presented in figure 2.

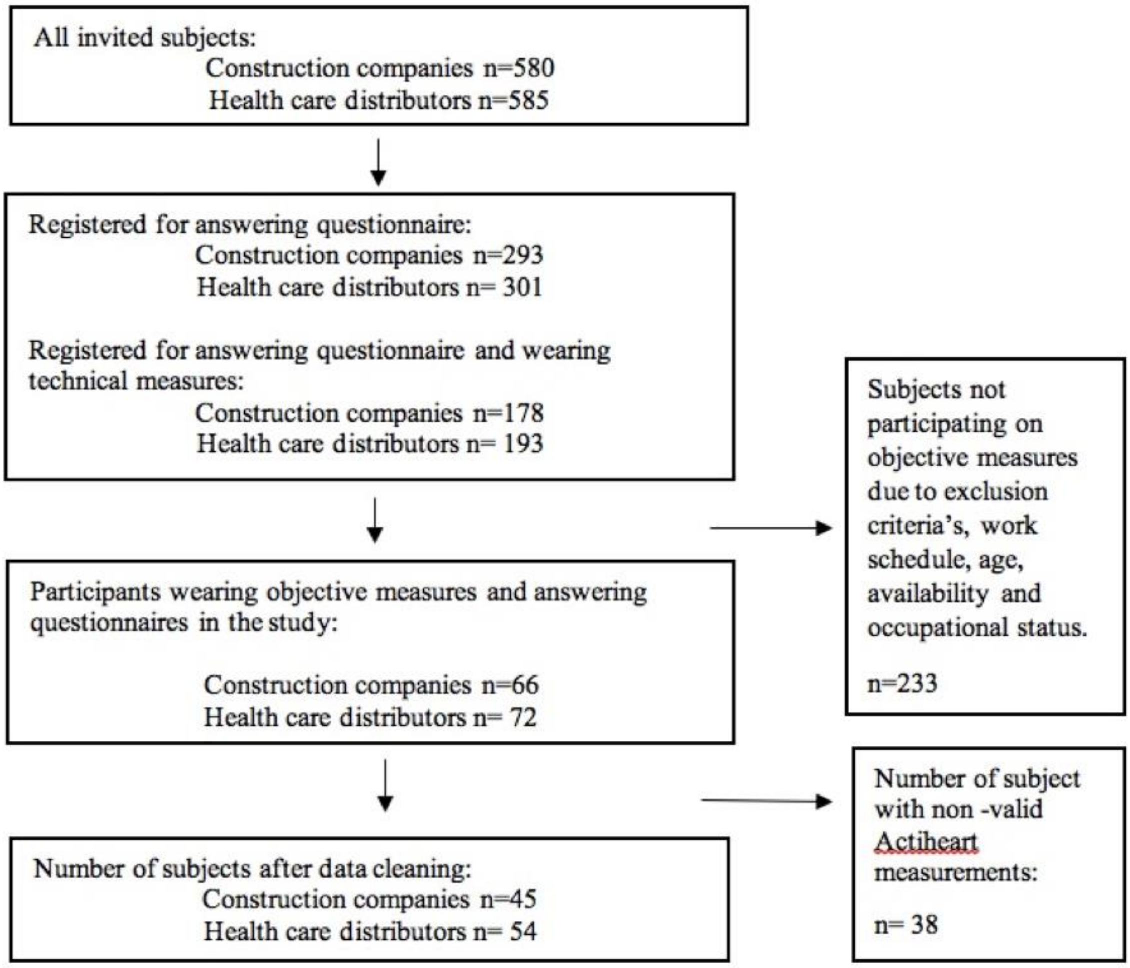

Figure 2. Flow chart

3.3 Measurements

3.3.1 Dependent variable, number of pain sites

At each time point during the study period, occurrence of pain during the last four weeks was assessed for nine sites of the body. A drawing from the "Nordic questionnaire on musculoskeletal symptoms" was shown to visualize locations of body regions (figure 2) (Kourinka et al., 1987). Pain in different sites was then rated on a four-point scale; "not troubled=0", "a little troubled=1", "somewhat trouble=2", and "intensively troubled=3" (Steingrímsdóttir, Vøllestad, Røe & Knardahl, 2004). The word "being troubled by" reflects discomfort of pain when using the Norwegian language (Vleeshouwers, Knardahl & Christensen, 2018; Christensen, Nielsen, Finne & Knardahl, 2018). For estimating number of pain sites, first each question was dichotomized into "no trouble" or "any trouble". Then a new continuous scale variable was constructed by counting the number of pain sites (0-9 sites). This was done for the individuals at each time the questionnaire was answered. The following pain sites were included neck, right shoulder, left shoulder, higher back, lower back, elbow/hands, hips, knees, and feet.

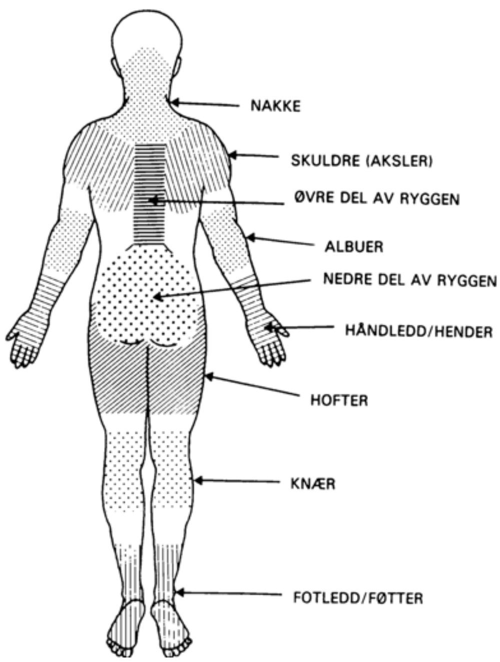

Figure 3. Visual presentation of different locations of body regions in Norwegian (Kourinka et al., 1987)

3.3.2 Independent variable, objective assessment of physical activity

In this thesis, physical activity during work and leisure was estimated as percentage of the heart rate reserve (%HRR). For capturing heart rate during work and leisure, the participants wore an Actiheart monitor (Camntech, Cambridge, United Kingdom) at the apex of the sternum and on the left intercostals at the level of the sixth and seventh costae (Brage et al., 2006). Prior to application, the skin was prepared by shaving- and cleaning it with ethanol spirits. The monitor has previously been validated for measuring occupational and leisure-time physical activity during a whole day (24 hours) among physically active workers (Korshøy et al., 2013). The Actiheart uses electrocardiography (ECG) and is a waterproof, lightweight and compact device with capacity of collecting data for 72 hours in total (Lunde et al., 2014). ECG signals were sampled with a frequency of 128Hz. The output from Actiheart was imported into a custom-made program, Acti4 (National Research Centre of the Working Environment; Copenhagen Denmark and Federal Institute of Occupational Safety and Health, Berlin, Germany). The Acti4 program has previously been used for detecting heart rate reserve during work (Gupta et al. 2014) and during work and leisure (Coenen et al., 2018).

Data processing in the Acti4 program

Participants wearing technical measurements kept diaries in which they filled in start and end times for work, leisure and sleep. They were also asked to stand in a reference position, i.e. in an upright standing position with arms down for approximately 10 seconds. This was done at the start and end of each measurement period and once a day after getting out of bed. This information made it possible distinguish between OPA and LTPA. Raw files from Actiheart were entered in the Acti4 program together with the start and end times registered in the diary and with data from the Actigraphs. Based on this information, a Windows Excel file (Setup File) containing the paths to the folders in which individual data from the raw files could be found and diary of times was created by the Acti4 program. To calculate %HRR, age and heart rate minimum were manually added in the Setup File. For this thesis, maximal heart rate (HR_{max}) was estimated by 208- (0,7*age) (Tanaka, Kevin, Monahan, Douglas & Seals, 2001) and minimum heart rate (HR_{min}) was defined as the minimum of a running average of ten beats during the waking periods of all assessment days. The percentage of HRR was calculated in the

Acti4 program using the following equation %HRR = $\frac{HR-HRmin}{HRmax-HRmin}$ (Karvonen & Vuorimaa, 1988).

The last data process in the Acti4 program was synchronizing the Actigraphs with each other, then synchronizing the Actiheart data with the Actigraph data and making a Batch analyses. The Batch analyses created a text file that contained the output of Acti4, i.e. %HRR, as well as duration and %HRR during the activity types. Activity types can be distinguished in Acti4 based on the accelerometer data from the tight and hip or back. The text file was imported in IBM SPSS. Figure 3 visually presents quality checks of activities and heart rate in the Acti4 program.

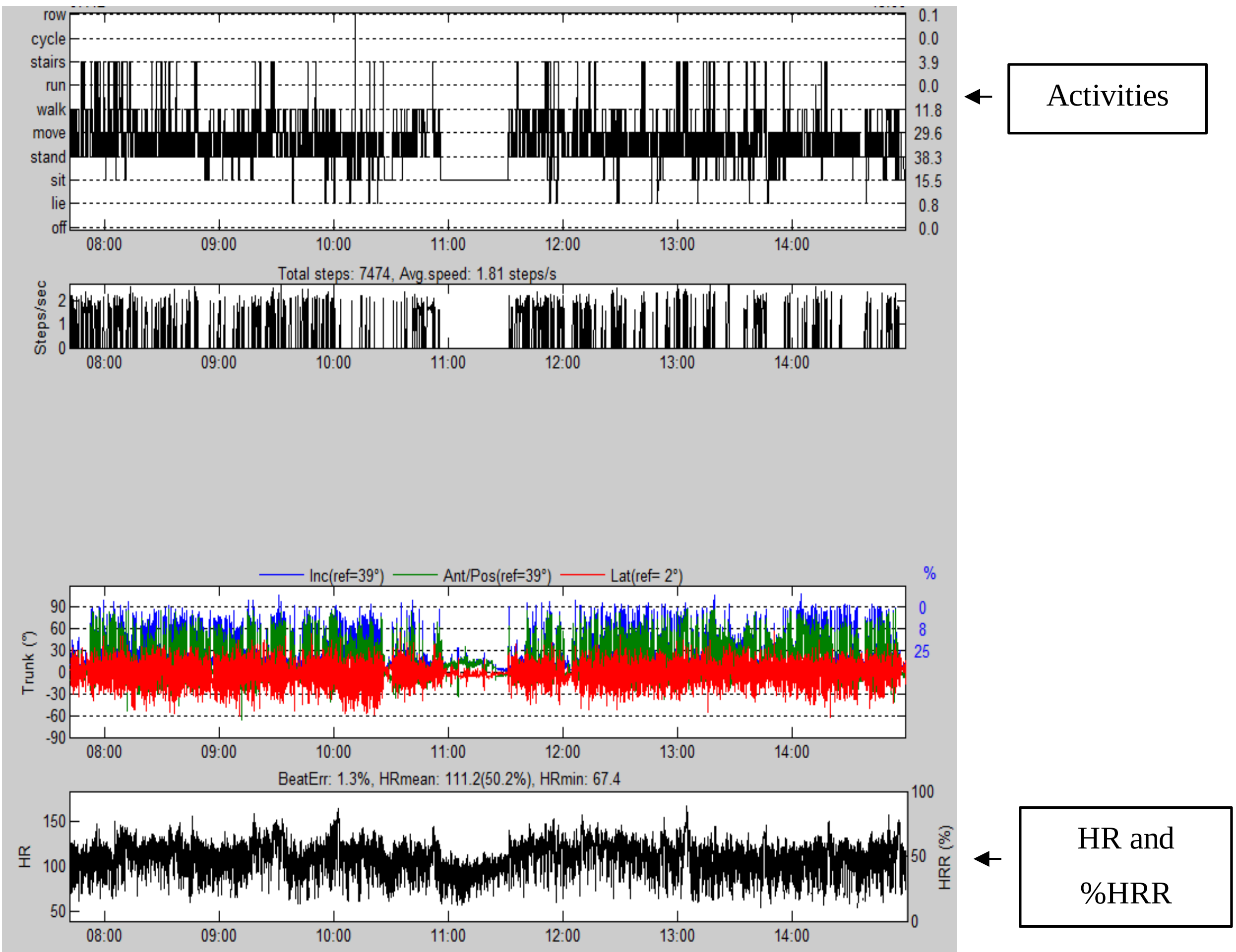

Figure 4. OPA measurement of one working day; male, bricklayer, 36 years.

Estimating valid working days

The Actiheart monitors were worn from one to four days. Some participants removed the monitors, and some fell off. If wearing the monitors on all days, a person from the study group removed the monitor. To give a representative picture of a full working day a cutoff was chosen of ≥ 4 hours per day. A thorough process choosing the cutoff point was done by checking diary and comparing Actiheart measures with activities from Actigraph. For instance, if data from Actiheart stopped in the middle of the last measurement day, this indicated the Actiheart was full and therefore measures from the last day did not represent the actual working day. The participants reported average working hours during a week with a mean level of 37 hours (construction = 38 hours and healthcare = 35 hours). This also represents average working hours for the general population within these working sectors in Norway with limits of working 40 hours or 37,5 hours during a week in general, while 36 hours limit for employees working shifts, including nights (Arbeidstilsynet, n.d.) By choosing these criteria for cutoff, the data includes participants working at least 20 h/week and this cut off has also been used in previously studies (Gupta et al., 2014). Data on %HRR was excluded if beat error exceeded 50% for a measurement period, defined as HR<35 or >230 bpm or >15% difference between two succeeding beats (Lunde et al., 2016). For this thesis, leisure-time was defined as time before and after work, but excluded sleep. Some participants had measures during weekends or had days without work during weekdays. Because of few registered days with leisure-time only, these days were not selected for further analysis. Therefore, this thesis only consider time spent in PA during work and leisure on working days.

Independent variable: time ≥33 % heart rate reserve during work

After the data cleaning process, the output from Acti4 estimated daily time (hours) spent in percentage of HRR (1-100%) for work and for leisure-time. A new continuous variable containing mean time (hours) spent ≥33% HRR during work was computed for each participant by averaging the time (hours) spent >33% HRR for all included days. Mean duration at or above 33% HRR during a working day of 8 hours is a threshold for OPA intensity defining heavy physical work in Norwegian literature (Veiersted et al., 2017 p.10; Rodgers & Kenworth, 1986).

Independent and moderator variable: time ≥40% heart rate reserve leisure-time

Mean moderate to vigorous leisure-time physical activity was computed as a continuous variable with time (hours) ≥40% HRR by averaging the time (hours) spent >40% HRR for all included days. For research question 2 that assessed the association between LTPA and NPS, moderate to vigorous LTPA was considered the independent variable. For research question 3, moderate to vigorous LTPA was considered a moderator in the association between OPA ≥33% HRR and NPS. Equation models for analyses are presented in section 3.5.

3.3.3 Covariates

Covariates presented in this thesis are from baseline assessment.

Background characteristics

Information about age, gender, smoking habits and body mass index (BMI) was collected from the questionnaires. Body Mass Index (BMI) was calculated using information on height and weight (kg/m^2). Smoking habits were asked for with the question: Do you smoke, or have you smoked in the past? Answers were categorized into “no, never”(0), “yes, but I have quit” (1), “yes, sometimes” (3) and “yes, every day” (4). This answer was dichotomized into “no” (0-1) and “yes”(2-3). General health was assessed using a single-item: “In general, would you say your health is:” with answers reaching from 1. Excellent to 5. Poor (Ware, 2000).

Cardiorespiratory fitness

At baseline, participants who were able, performed a submaximal test on an ergometer cycle (Ergometer 839 E, Varberg, Sweden) (Astrand, Rodahl, Dahl & Strømme, 2003). The maximal oxygen consumption (VO_{2max} in ml/min/kg) was estimated according to Åstrand nomogram (Astrand and Ryhming 1954), modified by age and gender (Astrand, 1960). #

Work-related information

Depending on working tasks, participants were categorized into manual or non-manual workers. For the construction sector, non-manual workers were manager, leaders, foremen and engineers, while in healthcare sector this represented leaders. Manual workers were carpenters, bricklayers, concrete workers and other workers with manual handling tasks. Manual workers within healthcare were nurse or nursing assistant, working at the kitchen staff, cleaner, social educators or employees with other healthcare tasks.

Weekly working hours were subjectively reported as a number of normal working hours during a week, including overtime.

Perceived exertion at work was assessed with the questions “how physically demanding is your work?” This was answered on a categorical scale from 0-10, from “not exhausting at all” to maximal exhausting (Noble, Borg, Jacobs, Ceci & Kaiser, 1983). Answers were then categorized into “not at all-light” (0-2), “moderate-somewhat heavy work” (2-7) and “heavy manual work” (8+). Perceived exertion at work and mean NPS in these categories are presented as descriptive statistics. The perceived exertion scale has been used in both exercise and occupational settings with heart rate increasing linearly to perceived exertion (Noble et al., 1983). In occupational settings the scale has showed to be a good indicator of high muscular loading (Jacobsen, Sundstrup, Persson, Andersen & Andersen, 2013).

Questions about psychosocial factors were obtained from the General Questionnaire for Psychological and Social Factors at work (QPS_{Nordic}). This questionnaire has been validated for psychosocial and organizational factors (Dallner et al., 2000). For this study, the subscales about Control Work Pacing and Social Climate were included as confounding factors. Control work pacing included four questions:1. “*Can you set your own work pace?”*, 2. “*Can you decide yourself when you are going to take a break?*”, 3. *“Can you decide the length of your break?”*, 4. “*Can you set your own working hour*?”. The answers were on a 5 point scale from 1 = Very seldom or never 2= quit seldom, 3= sometimes, 4=often, 5= very often or always. Social climate included three questions about if the experience of the work unit is 1. *“Encouraging and supportive”*, 2. *“Distrustful and suspicious”*, 3. *“Relaxed and comfortable”*. The 5 point scale was 1=Very little or not at all, 2. Rather little, 3. Somewhat, 4. Rather much, 5. Very much. Questions about social climate were reversed before aggregating the values.

Work ability was assessed using a single-item question from the Work Ability Index (WAI) questionnaire. The question was: “current work ability compared with the life-time best", and the participants scored from 0-10; 0, represented completely unable to work and 10 work ability at its best. The WAI-questionnaire has been used in occupational health services as well as occupational health sciences and the single-item question from the WAI-questionnaire has shown to be a good indicator for assessing work ability (Ahlstrom, Grimby-Ekman, Hagberg & Dellve, 2010).

Description of activities

Data from accelerometers, Actigraph GT3X+ (Actigraph, Florida, U.S.A) were used for descriptive information about physical activity and as quality checks when data processing raw Actiheart files. Actigraph is a small and waterproof and has the capacity of capturing data at 30 Hz for 10 days continuously. The participants wore eight Actigraps that were attached to the body by double-sided tape, fixomull (BSN Medical, Hamburg, Germany) and covered with transparent film (Tegaderm, 3 M, Minnesota, U.S.A. For this study, the thigh and hip or trunk accelerometer had to be worn for capturing activity types and to differentiate between sitting and lying. Accelerometer data was processed with the Acti4 program. The Acti4 program has been shown to reliably detect activity types: lying, sitting, standing, moving, walking, running, rowing, stairs and cycling (Stemland et al., 2015). Average time (hours) and percentage of HRR during activities in work and leisure were estimated using the Acti4 program and are presented as descriptive statistics.

3.4 Statistics

Statistical analyses were done in IBM SPSS Statistics version 25 (IBM Corporation, New York, USA) with linear mixed models as method for analyses. In longitudinal studies that contain repeated measures at the same unit and often have missing values, linear mixed model is a preferable method. The p-value was set to 0.05 and 95% confidence interval are presented. The assumption for normally distributed residuals was checked with Q-Q plots. A best-fit model for the use of a random intercept and random slope was determined by the -2log likelihood test. In this thesis the random intercept was used in all three analyses. All statistical analyses were done for the total sample and stratified by working sector.

3.4.1 Directed acyclic graph (DAGs)

For this thesis confounding factors were visually represented by making Directed acyclic graphs (DAGs) (Figure 5). After making DAGs, one-by-one the possible confounding factors were added to the model on the association between duration >33% HRR and NSP. When adding the potential confounder changed the association between >33%HRR and NPS by ≥10%, the variable was considered a confounder.

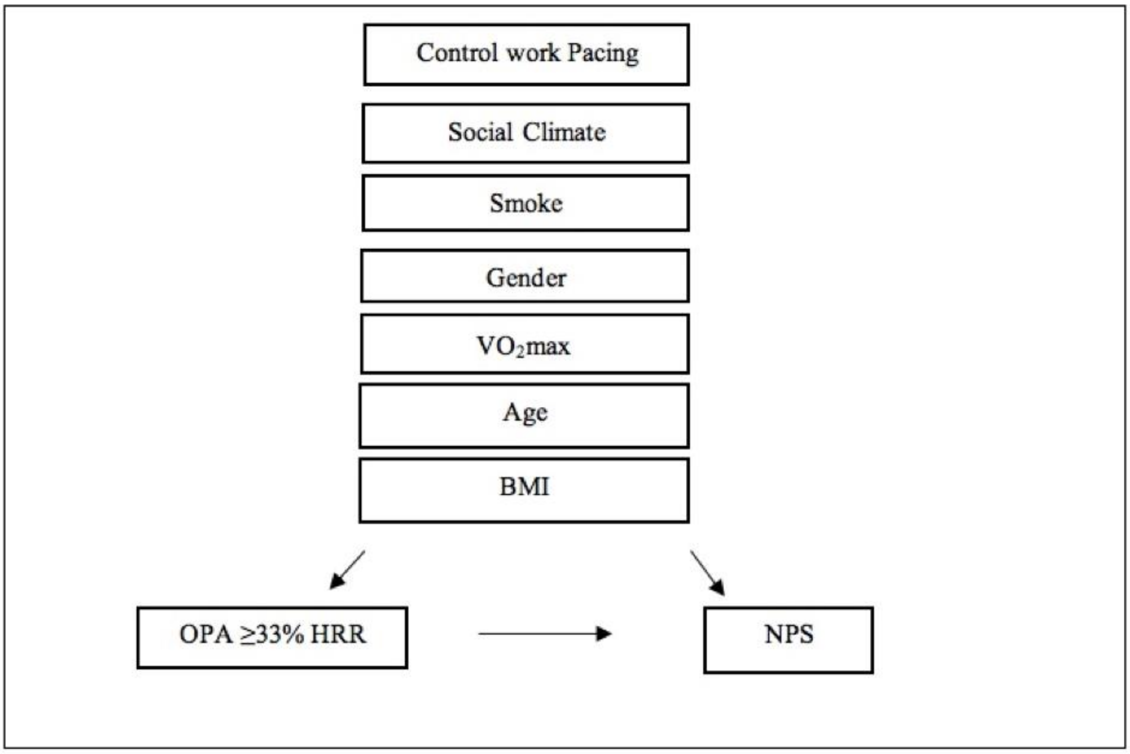

Figure 5. DAGs presented for research question 1.

3.4.2 Statistical analyses

The dependent variable of this study was NPS and the independent variable was duration (hours) ≥33% HRR during work for research question one and three, and duration (hours) ≥40% HRR during leisure for research question 2. Confounding factors were added in the equation and a simplified version of the equations used in the linear mixed model analyses are presented in figure 5. NPS is analyzed as a main effect variable during the two-year follow up. An article by Steingrímsdóttir et al. (2004) studying variation in pain reports with participants answering questions about pain monthly in a period of 32-34 months, shows high intra-individual variability. Therefore, more than two samples are suggested for producing data that is representative for the individuals. Descriptive statistics are presented as number (n), percentage (%), mean with standard deviation and minimum and maximum values.

Research question 1:

$$NPS = \beta + \beta_1 \geq 33\%HRR_{work} + \beta_2 Time + \mu_p + \varepsilon_{p,t}$$

Adjusted for confounding factors:

$$NPS = \beta + \beta_1 \geq 33\%HRR_{work} + \beta_2 Time + \beta_3 Age + \beta_4 Sex + \beta_5 VO_{2max} + \beta_6 Smoke + \beta_7 BMI + \beta_8 SocialClimate + \beta_9 WorkPacing + \mu_p + \varepsilon_{p,t}$$

Research question 2:

$$NPS = \beta + \beta_1 40\%HRR_{Leisure\text{-}time} + \beta_2 Time + \mu_p + \varepsilon_{p,t}$$

Adjusted for confounding factors:

$$NPS = \beta + \beta_1 40\%HRR_{Leisure\text{-}time} + \beta_2 Time + \beta_3 Age + \beta_4 Sex + \beta_5 VO_{2max} + \beta_6 Smoke + \beta_7 BMI + \beta_8 SocialClimate + \beta_9 WorkPacing + \mu_p + \varepsilon_{p,t}$$

Research question 3:

Interaction variable and adjusted for confounding factors:

$$NPS = \beta + \beta_1 \geq 33\%HRR_{work} + \beta_2 40\%HRR_{Leisure\text{-}time}\ \beta_3 Time + \beta_4 Age + \beta_5 Sex + \beta_6 VO_{2max} + \beta_7 Smoke + \beta_8 BMI + \beta_9 SocialClimate + \beta_{10} WorkPacing + \beta_{11} \geq 33\%HRR_{work} * \beta_2 40\%HRR_{Leisure\text{-}time}\ \mu_p + \varepsilon_{p,t}$$

Figure 6. Equation models for the linear mixed model analyses. μ_p is a random intercept for person and $\varepsilon_{p,t}$ is the residual term.

3.5 Ethical aspects

This cohort study about" Musculoskeletal health and work ability in physically demanding occupations – a field study on construction and healthcare workers" was approved by the Regional Committee for Medical and Health Research Ethics in Norway (2014/138/REK south-east D). The study was done in line with the "The Helsinki declaration" which are ethical principles for medical research involving humans (World Medical Association, 2013). The principles include voluntary participation, informed consent, confidentiality of personal information and careful evaluation of risks and burdens on the participants (World Medical Association, 2013). Ethical aspects are important for protecting individuals and the welfare of the participants should always be priority. In this study, the workers participated on informational meetings before the study started. If interested, they signed a written consent with information about purpose, measurement procedure and physical examination. The participants were also informed about the possibility to withdraw from the study at any time without stating a reason.

The participants wore technical equipment for several days. This can be considered as a burden for the individuals, but the measurements had little health risks. In case of allergic reactions from technical equipment, the participants were encouraged to remove the equipment right away. The participants were adults and were not considered as a vulnerable group.

Personal information from this study is safely stored and de-identified at The National Institute of Occupational Health.

4. Results

4.1 Baseline characteristics of participants

The study sample consisted of 99 participants (45 from construction, 54 from healthcare). Baseline characteristics of the participants is presented in Table 1. Mean age was 42 years; healthcare workers had a higher mean age (44 years) compared with construction workers (40 years). Fifty-seven percent of the total sample were males, but when stratified by sector all participants were males in the construction sector and for healthcare workers seventy-eight percent were female. Both sectors had manual and non-manual workers (84% manual workers) and non-manual workers. Body mass index (kg/m^2) were equally distributed with a total mean level of 25.4 which represent a mean level just above the threshold representing the category of overweight defined by the World Health Organization (Angelantionio et al., 2016). The maximal oxygen consumption (VO_2 max) showed a higher mean value for construction workers (38.3 ml/min/kg) compared to healthcare workers (32.2 ml/min/kg). Workers who subjectively reported to have heavy manual work reported more NPS (construction NPS= 4.3 and healthcare NPS = 6.4) compared to those who reported to have moderate to somewhat heavy work (construction NPS= 3.1 and healthcare NPS = 3.0) or not at all to light work (construction NPS= 1.5 and healthcare NPS = 3.2).

Table 1. Baseline characteristics of participants in the study, stratified by working sector

	Total (n=99)			Construction (n=45)			Healthcare (n=54)		
	n	mean (SD)	min-max	n (%)	mean (SD)	min-max	n (%)	mean (SD)	min-max
Age (years)	99	42.2 (11.8)	19-64		39.6 (13.5)	19-63		44.4 (9.7)	20-64
Gender									
Female	42			0 (0)			42 (78)		
Male	57			45(100)			12 (22)		
Manual worker	84			34 (76)			50 (93)		
Non-manual worker	15			11 (24)			4 (7)		
Smoke									
yes	27			15 (33)			12 (22)		
no	72			30 (66)			42 (79)		
Body mass index (kg/m^2)	97	25.4 (3.6)	16.53-37.9	45	25.6 (3.5)	18.6-31,9	52	25.2 (3.8)	16.5-37.9
VO_{2max} (ml/min/kg)	92	34.9 (9.9)	15.8-79.10	41	38.3 (10.3)	21.7-79.1	51	32.2 (8.7)	15.8-67.3
Social climate (1-5)[a]	90	3.9 (0.7)	1.3-5	43	3.9 (0.8)	1.7-5.0	47	4.0 (0.7)	2.3-5.0
Work pacing (1-5)[b]	97	2.8 (0.8)	1-4.8	44	3.0 (0.8)	1.5-4.8	53	2.7 (0.7)	1-4.25
General health[c]	99	2,5 (1,0)	1-5	45	2,5 (0.9)	1-4	54	2.5 (1.0)	1-5
Weekly working hours	99	36.5 (5.0)	10-55	45	37.7 (4.7)	10-50	54	35.5 (4.5)	22-55
Work ability [d]	97	8.9 (1.3)	3-10	45	8.4 (1.5)	3-10	52	9 (1.1)	7-10
NPS and subjective reported physical demands at work									
Not at all-light	28	2.6 (2.2)		10	1.5 (1.8)		18	3.2 (2.3)	
Moderate-somewhat heavy work	46	3.0 (1.9)		23	3.1 (2.1)		23	3.0 (1.7)	
Heavy manual work	22	5.3 (2.8)		11	4.3 (3.0)		11	6.4 (2.2)	

[a] QPS_{Nordic}: 1. 1 =Very little or not at all, 2= Rather little, 3= Somewhat, 4 =Rather much, 5 =Very much.
[b]$QPS_{Nordic.}$: 1= never or seldom, 2= quit seldom, 3= sometimes, 4=often, 5= vary often or always.
[c]General health: 1=excellent, 2= very good , 3=good ,4= pretty bad, 5=poor [d] Work ability: 1=unable, 10=best

Figure 6 illustrates time (hours) and percentage HRR in activities during work and leisure. Construction workers had more time in activity on their feet during work (stand, move, and walk) and higher %HRR during these activities than healthcare workers. Within each sector, average time in activities differentiate depending on profession. As an example, average time standing at work was 3.1 hours for bricklayers and 0.6 hours for engineers.

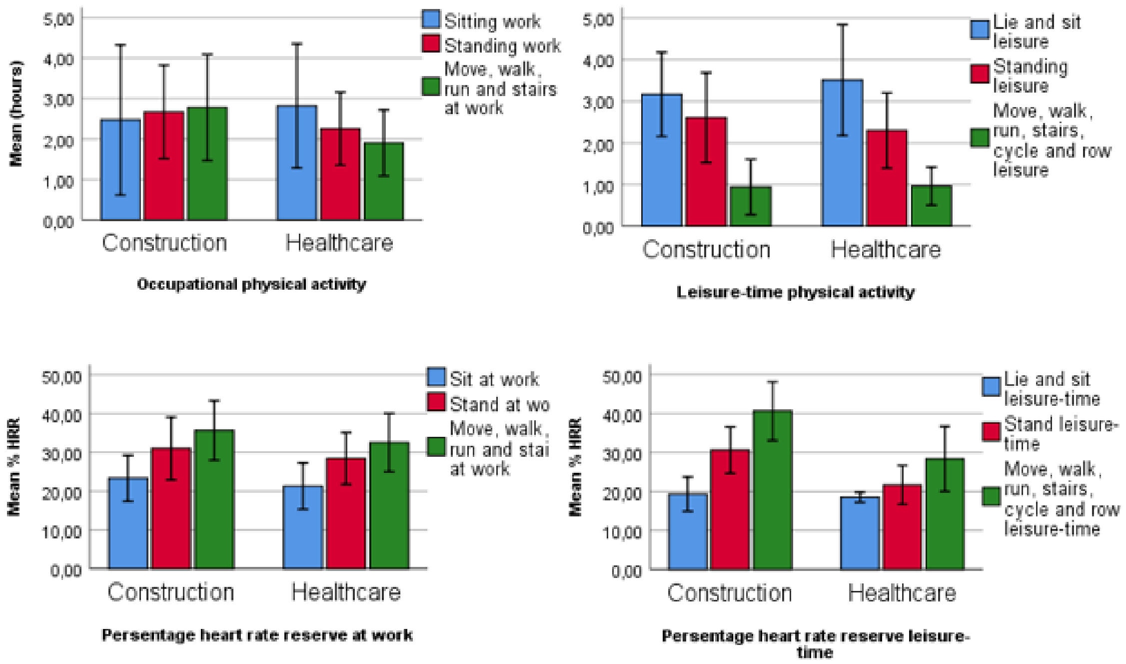

Figure 7. Average duration (hours) and %HRR in activities during work and leisure-time.

The average duration (hours) with OPA ≥33% HRR during a working day was longer for construction workers (2.8 hours) than healthcare workers (1.6 hours) and participants from constructions sector had a higher range in time ≥33% HRR (construction SD =2.0; healthcare SD =1.4). The average duration (hours) with LTPA ≥40%HRR was 0.5 hours with small variations stratified by sector (construction = 0.5 hours; healthcare = 0.4 hours). LTPA had a high range both for construction (min=0.15h to max = 2.9h) and healthcare worker (min=0h to max = 1.36h) showing individual differences.

Table 2. Physical activity ≥33% HRR (hours) during work and ≥40%HRR leisure

	Total sample (n=99)			Construction (n=45)			Healthcare (n=54)		
	n	mean (SD)	min-max	n	mean (SD)	min-max	n	mean (SD)	min-max
OPA ≥33%HRR (hours)	99	2.1 (1.8)	0.1-9.5	45	2.8 (2.0)	0.15-9.5	54	1.6 (1.4)	0.09-4.9
LTPA ≥40 %HRR (hours)	93	0.5 (0.5)	0-2.85	43	0.5 (0.6)	0-2.9	50	0.4 (0.3)	0-1.36

During the two-year follow-up the response rate of the NPS questionnaire decreased from 97% to 53%. For construction workers, the response rate decreased to 59%, while response rate for healthcare workers was 50% at last time point. The mean level of NPS had small variations during follow-up (figure 7). Construction workers reported NPS of 3 at baseline and 3.1 after 24 months. In contrast, healthcare workers reported 3.7 NPS at baseline and 3.0 NPS at the last time point.

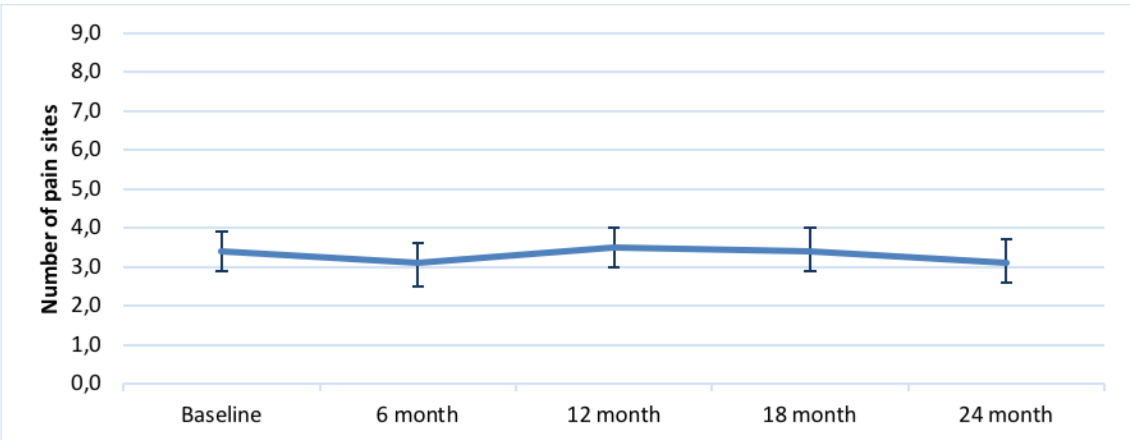

Figure 8. Number of pain sites reported for all participants at baseline and after 6,12,18 and 24 months presented with 95 %CI. Missing values are included and estimated using linear mixed model.

4.2 Association between NPS and OPA ≥33%HRR

Main analyses are presented in Table 5. The adjusted model for OPA measured as time ≥33%HRR was not associated with NPS (β=0.025, 95% Cl -0.29 -0.34) in the whole sample, nor when stratifying by sector (construction: β=0.31 95% Cl -0.26-0.88; healthcare: -0.086 Cl -0.5-0.33). Confounders in the adjusted model were smoke, control work pacing, age, sex, social climate, BMI and VO_2max.

4.3 Associations between NPS and LTPA ≥40 %HRR

Increased LTPA time ≥40%HRR showed a decrease in NPS in the unadjusted model 2 (β= -1.04 95% Cl -2,02-0,06), but when adjusting for confounders the result was not statistically significant (β= -0.97 95% Cl -2.0-0.05). Stratified by sector the negative association was stronger for healthcare (β=-1.83 95% Cl -3.7-0.04) than construction workers (β=-0.74 95% Cl -2.0-0.55).

4.4 Moderating effect of LTPA on the association between NPS and OPA ≥33 %HRR

Model 3 showed no modifying effect of LTPA ≥40% HRR on the association between NPS and OPA ≥33%* LTPA time ≥40%HRR in the whole sample (β=-0,03 95% Cl -0,61-0,56), nor when stratifying by sector (construction: β=-0.14 95% Cl -0.98-0.62; healthcare: 0.03 95%CI -1.29-1.35).

*Tabell 3. Linear mixed model showing associations between NPS and time of OPA ≥ 33% HRR, NPS and LTPA ≥40% HRR and analyses of interaction variable (time OPA ≥33% HRR*time LTPA ≥40% HRR*

	Total (n=99)			Construction (n=45)			Healthcare (n=54)		
	Coef.	95% CI	p.	Coef.	95% CI	p.	Coef.	95% CI	p.
Model 1[a]									
Unadjusted: OPA≥33% HRR (hours)	-0.01	-0.26-0.24	0.946	-0.04	-0.38 -0,31	0.839	0.14	-0.23-0.56	0.502
Time	-0.04	-0.14-0,06	0.41	0.01	-0.11-0.14	0.856	-0.09	-0.24-0.05	0.191
Adjusted: OPA ≥33% HRR (hours)	0.025	-0.29-0.34	0.876	0.31	-0.26-0.88	0.286	-0.09	-0.5-0.33	0.684
Time	-0.01	-0.11-0.09	0.795	-0.02	-0.17-0.12	0.755	-0.03	-0.15-0.10	0.680
Model 2[a]									
Unadjusted: LTPA ≥40% HRR (hours)	**-1.04**	**-2.02-0.06**	**0.038**	-0.74	-1.9-0.5	0.223	-1.54	-3.4-0.3	0.105
Time	-0.04	-0.14-0.06	0.394	0.03	-0.10-0.16	0.669	-0.13	-0.13-0.06	0.063
Adjusted: LTPA ≥40% HRR (hours)	-0.97	-2.0-0.05	0.063	-0.74	-2.0-0.55	0.259	**-1.83**	**-3.7-0.04**	**0.054**
Time	-0.03	-0.13-0.08	0.626	0.02	-0.13-0.17	0.807	-0.07	-0.19-0.04	0.190
Model 3[a]									
OPA ≥33% HRR (hours)	0.10	-0.35-0.55	0.675	0.35	-0.38-1.08	0.349	-0.04	-0.76-0.69	0.922
Time	-0.04	-0.14-0.06	0.450	0.01	-0.13-0.15	0.872	-0.10	-0.21-0.00	0.058
Adjusted model with interaction of LTPA ≥40% HRR	-0.03	-0.61-0.56	0.931	-0.14	-0.98-0.62	0.714	0.03	-1.29-1.35	0.963

[a]All results contain variable Time as exposure. Adjusted models is analyzed with the confounders: smoke, control work pacing, age, sex, social climate, BMI and VO_2max.

5. Discussion

5.1 *Main results*

This study aimed to determine whether OPA and LTPA was associated with the number of pain sites during a 2-year period among construction and healthcare workers. The study further aimed to determine whether LTPA moderated the association between OPA and NPS. OPA measured as duration (hours) ≥33%HRR was not associated with NPS in the whole sample, nor when stratifying by sector. Increased LTPA duration (hours) ≥40%HRR had a tendency to be associated with a decreased NPS although this association was not statistically significant; the negative association was stronger for healthcare than construction workers. There was no moderating effect of LTPA ≥40%HRR on the association between ≥33%HRR at work and NPS.

5.2 *Methods: strengths and weaknesses*

Study design and sample

This thesis was based on a cohort study. Cohort studies are well suited to study potential cause-effect associations when the exposure precedes the effect. However, in this thesis the variables are used as main effect variables and, therefore, conclusions about associations can be determined and not the causal effects from exposure on outcome. When analyzing associations, it is not possible to determine the direction of the association and it may be bidirectional. For instance, concerning research question 2, there is a tendency of a negative association between high LTPA and decreased NPS among healthcare workers (p.0.054). Since the association may be bidirectional, we cannot determine if high LTPA led to decreased NPS, or if fewer NPS lead to an increased LTPA. This is a weakness for cross-sectional studies in general and has been discussed in a cross-sectional study of PA and multiple pain sites (Pan et al., 2018).

PA (%HRR) was measured at baseline. Using linear mixed models, physical activity level was considered the same at every time point. This is a limitation of the study, because PA patterns may have changed during the two-year follow-up, and thereby the baseline measures were not necessary representative during follow-up. For healthcare workers we may assume that working tasks are relatively similar throughout time; however, within the construction sector, working tasks may differ depending on the ongoing project. Additionally, levels of OPA may influence levels of LTPA; studies have shown that manual workers have lower levels of LTPA than more sedentary workers (Lunde et al., 2016; Fransson et al., 2012). Therefore, we may question whether the technical measures at one time point represent habits of PA during work and leisure also during the two-years after baseline.

There were a total of 99 participants (construction n=45; healthcare n=54) included in this study. Compared with other studies analyzing PA and NPS (Haukka et al., 2012, Solidaki et al., 2010; Neupane et al., 2012; Kamaleri et al., 2008; Coggen et al., 2013) this study has few participants. This may reduce the statistical power and limit the probability to do further sub group analyses. In contrast, this thesis is the only study associating PA with NPS using objective measurements of PA during work and leisure-time. Although few participants may be a limitation and conclusions have to be considered with caution, the quality of the study is high because of repeated measurements of NPS and objective measures of PA.

To give a representative selection of participants in construction- and healthcare, the study sample consisted of different professional titles with both manual and non-manual workers. When having a representative selection, the results are generalizable to the given population and this strengthens the study. However, there are important questions regarding the sample which may influence the representativeness. The study sample was recruited at informational meetings and volunteers participated. This could have given a selection bias due to highly motivated and healthy individuals volunteering. Individuals on sick leave may have been excluded if they were not able participate in informational meetings. From figure 7, the average NPS were stable and even had a small decrease during the two-year follow-up. This may be a result of missing values from individuals with more NPS maybe because of the inability to work. Therefore, this study may have missed those with present health issues. This is mirrored in high work ability (mean of 8.9 on a scale of 1-10) and general health (mean of 2.5, i.e. good to very good) reported by the employees in our sample.

Another aspect that may have influenced the choice to participate are the physical tests. Potentially, employees with a high level of physical fitness were interested in their scores and those with low fitness refused because they were afraid to receive negative feedback. However, we do not believe that such a possible selection mechanism played a role on our study. From the descriptive statistics, the VO_{2max} was comparable with the general population (Edwardsen et al., 2013). VO_{2max} was estimated to be 38.3 (SD 10.3) for construction workers and 32.2 (SD 8.7) for healthcare workers in this study, while mean estimations for general population in the ages 40-49 has shown to be 33.0 (SD 6.3) for women and 42.7 (SD 9.3) for men (Edwardsen et al., 2013).

Participants were also excluded if they were not able to understand Norwegian; therefore, minorities were excluded. How many were excluded is not clear, but from all employed immigrants, 10% work in the construction- and 19% in the healthcare sector (STAMI, 2018), showing that there could have been a selection bias.

Measurements

A major strength of this study is the use of objective measures of PA. This study focused on the intensity of PA; therefore, HR measures were considered more appropriate than accelerometer measures. A working day among construction and healthcare workers involves static work and carrying loads. Objective measures from accelerometers that provided duration in various activities (e.g. duration sitting, standing, walking) were therefore considered to not fully capture the actual exposure from work and HR measurement was chosen as variable of exposure.

The %HRR values used in this thesis were based on estimations of HR_{max} by using the equation 208 – 0,7*age (Tanaka et al., 2001). Using estimated HR_{max} may lead to misclassification of intensity, because variability is large at individual level (Edwardsen et al., 2013). HR_{max} may also be influenced in addition to age, by gender and physical fitness (Roy & Mccrory, 2015). A consequence of using the estimate of HR_{max} in this study, is that the %HRR may have been overestimated or underestimated; therefore, the actually cardiovascular workload may be imprecise. Had we wished to use measured HR_{max}, i.e. a measurement that requires a maximal load test and may be experienced as unpleasant, this could have resulted in fewer participants due to the high demands of such a test. A strength of the study regarding the estimation of %HRR was the use of individuals' HR_{min} that was the minimum of a running average of ten beats during the waking periods of all assessment days. The use of measured HR_{min} gives a more precise estimation of %HRR because an important factor influencing HR_{min} is physical fitness.

Participants wore the Actiheart measures for maximally four days but the wear-time varied. Ninety-nine participants wore the Actiheart for one day, 84 participants wore it for two days and 49 wore it for three days. Few measurement days may have influenced the representativeness of normal workload/exposure. The participants may have had different working tasks on different days during the week; therefore, exposure may have been underestimated or overestimated compared with other working days.

A strength of the study was that NPS was reported five times during the two-year follow-up, which contributed towards more reliable pain estimates. Due to large intra-individual variability of complaints, more than two measurements in the same individual is more representative of average pain compared to a single measurement (Steingrímsdóttir et al., 2004).

Statistics

In this study with repeated measurements and some missing values, linear mixed models were used. This model corrects for the fact that the repeated measures are dependent on each other and the model handles missing values well. Confounding factors were chosen based on previous studies that showed associations with the dependent and independent variables. The same confounding factors were used for OPA and LTPA (research question 1 and 2). This is a limitation of the study because a more correct method would have been to analyze confounding factors of LTPA independently. Yet, we expected the confounding factors also to be relevant for the association between LTPA and NPS. This study may have residual confounding, i.e. confounding due to factors that are not registered. For this study, such factors may be education level and psychological factors. Education level has been associated with both PA level and health problems (Shaw & Spokane, 2008) and psychological factors like somaticizing tendencies have been associated with OPA and NPS (Solidaki et al., 2010). These are factors that may have influenced the association between independent and dependent variables in this study.

Statistically significant level in this thesis were set to p-value <0.05. This is a boundary often used in epidemiological studies (Laake, Olsen & Benestad, 2015). When results are not statistically significant, there is a risk of making type 2 error; conclusions of no associations when there actually is an association (Laake et al., 2015). This is especially current when study sample is small, and variation is high. In this study, the p-value was 0.054 for the association between LTPA and NPS among healthcare workers. Using the statistically significant level of <0.05, the risk of making type 2 error is present if stating there is no association between LTPA and NPS. Therefore, this study may have failed to find an association that was actually there.

5.3 Results and interpretation of the results

High occupational physical activity and number of pain sites

In this study, measuring OPA as ≥33% HRR, there was no association with NPS in the whole sample nor stratified by sector. These results are in contrast to former studies on the association between high OPA and NPS that have found physically stressing occupational activities (Coggen et al., 2013), perceived physical workload (Haukka et al., 2012) and physical demands at work (Solidaki et al., 2010) to be associated with increased NPS. There are several possible explanations for the contrasting results and one such explanation is the use of different assessment methods (Bruno et al., 2010). The main difference between our study and former studies is the measurement of PA. Other studies have used questionnaires as assessment methods on physical workloads. Therefore, these studies have to consider subjective biases as high physical demanding tasks during work, increase the chance of overreporting the duration and underreport other tasks that are less demanding (Barrero et al., 2009). In our results, a higher level of NPS was also reported among those who subjectively reported higher levels of physical demands at work. From table 2, NPS among those who reported "heavy manual work" were higher than those reporting "moderate to somewhat heavy work" and "not at all-light" work. Since we did not find a similar association when using objective measurements, this supports previous research that subjectively reported physical workloads are biased. The chance of misclassification of exposure is limited in our study with objectively assessed PA and it provides novel findings on the effects of biomechanical workloads. Our results indicate that there may not be an association between biomechanical workloads from increased heart rate loads and NPS.

In our study, the intention was to measure "heavy physical work" from OPA by determining intensity and duration of OPA (≥33% HRR). As this term is identified by moderate to high power, using large parts of the body and increased use of energy expenditure, HR monitoring was considered to be appropriate as these type of PA increases HR. As this study estimates duration and intensity of OPA, a limitation of the study is that strenuous mechanical workloads are not considered in terms of power and frequency that may be important determinants for NPS. Construction- and healthcare workers perform activities such as lifting, carrying, static work, transferring, pushing objects and equipment. Although these activities are physically demanding, they may not increase HR considerably due to short bouts of activity and short bouts of PA are pronounced during OPA (Hallmann, Mathiassen, Gupta, Korshøj & Holtemann, 2015). Therefore, OPA and NPS may still be associated with each other, had we considered power and frequency of OPA.

In addition, the %HRR in both sectors did not exceed the boundary of 33%HRR in long duration and most working tasks were performed below the threshold (figure 6). As most participants worked ≥33%HRR for short durations, it is more difficult to determine if there is an association between high OPA and NPS. During data collection, researchers noticed that foreign workers did the heavier manual work. Many foreigners were excluded, an association between OPA and NPS may have been present if more workers doing heavier physical work were included.

Leisure-time physical activity and number of pain sites

Many studies show an association between LTPA and lower levels of MSP in the general population (Landmark, Romundstad, Borchevink, Kaasa & Dale, 2013; Kamaleri et al., 2008; Pan et al., 2018; Retzlaff et al., 2007)) and for manual workers specifically (Haukka et al., 2012; Ratzlaff, Gillies & Koehoorn, 2007; Hallmann, Jørgensen & Holtermann, 2017). The results from our study partly support this association among healthcare workers, showing that a higher level of LTPA on working days might be beneficial for NPS. Similar results were not present for construction workers. The reason for the different outcome may be due to outliers in LTPA. As visually presented in the appendix (a), in the construction sector, there are individuals with long duration of LTPA (an average of 1.5-2.9h of daily LTPA) who report several NPS. These findings are similar to another study concluding that construction workers engage in moderate to vigorous LTPA despite MSP (Caban-Martinez et al., 2014).

Our results on the association between LTPA and NPS among healthcare workers may be bidirectional because of cross-sectional analyses. As visually presented in the appendix (a), among those healthcare workers with high levels of NPS (≥7 NPS), LTPA levels are on average lower than for those with <7 NPS. Therefore, we cannot conclude whether increased LTPA may decrease NPS or whether those with increased LTPA were more active because they had less pain.

An important notice is that this study did not evaluate LTPA on non-working days. One study found differences in PA patterns between working days and days off: LTPA was increased on full days without work compared to working days (Thorp et al., 2012). The PA guidelines are recommendations with activities summed up for a whole week. Therefore, PA during a whole week would ideally be measured when considering LTPA throughout the whole week, but this thesis can only evaluated associates between LTPA and NPS on working days. As visually presented in the appendix, most workers did not spend much time ≥40% HRR during leisure. As construction- and healthcare mainly perform manual work, it is reasonable to assume that LTPA is lower on working days because of exhaustion, but may be higher on days without work. Therefore, LTPA during a whole week would ideally be assessed when LTPA levels are studied. Had we included non-working days in the study, we may have found clearer associations between LTPA and NSP.

Interaction effect of high occupational- and leisure-time physical activity

In our study, the PA health paradox was not supported as OPA were not associated with NPS, but LTPA had a tendency to do so among healthcare workers. The interaction effects of high OPA and high LTPA was therefore further analyzed. The study by Fimland et al. (2017) showed higher overall disability pension due to musculoskeletal disorders among individuals with high OPA and low LTPA, compared with low OPA and high LTPA (Fimland et al., 2017). Possible mechanisms could be that LTPA performed in moderate to vigorous intensity could enhance cardiovascular- and muscular fitness, which in turn decrease relative load during work. Therefore, LTPA would be especially important for individuals having high OPA. The possible positive effect from LTPA among construction- and healthcare workers with high OPA, was not supported in our study. Therefore, in this study we have no evidence stating that those performing increased level of heavy physical work, will have greater benefit of performing moderate to high LTPA on working days, nor stating that the U-shape relationship of high OPA and LTPA, together increase risk of NPS because of high cumulative physical exposure.

5.4 Implications

The physical activity health paradox highlights the importance of studying PA in work and leisure on health outcomes. Our results suggest that high OPA as assessed in this study (total duration ≥33%HRR) does not increase NPS for construction and healthcare workers. LTPA had a tendency to be beneficial for NPS among healthcare workers. If being in LTPA can reduce NPS, interventions aiming to increase the physical activity level in leisure-time among this population could be an important strategy for coping with MSP. In addition, LTPA is often performed to enhance other health outcomes than MSP, and therefore practitioners should continue promoting PA as a strategy for better health.

5.5 Conclusions

In this study, there was no associations between duration in high OPA measured as ≥33%HRR and NPS in construction and healthcare workers. The association between LTPA during working days and NPS differed for the two sectors; there was a tendency for a positive association between LTPA and NPS for healthcare workers only. A possible positive effect from LTPA among construction- and healthcare workers with high OPA was not supported in this study. The results suggest that increasing LTPA among healthcare workers can be a strategy to decreases NPS. This study does not support the PA health paradox, nor reject it. Therefor there are still requested more research concerning the differential effects of OPA and LTPA on MSP.

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Appendix

a. <u>Visual presentation of independent variables and NPS, stratified by sector with fit line. Assessment are from baseline:</u>

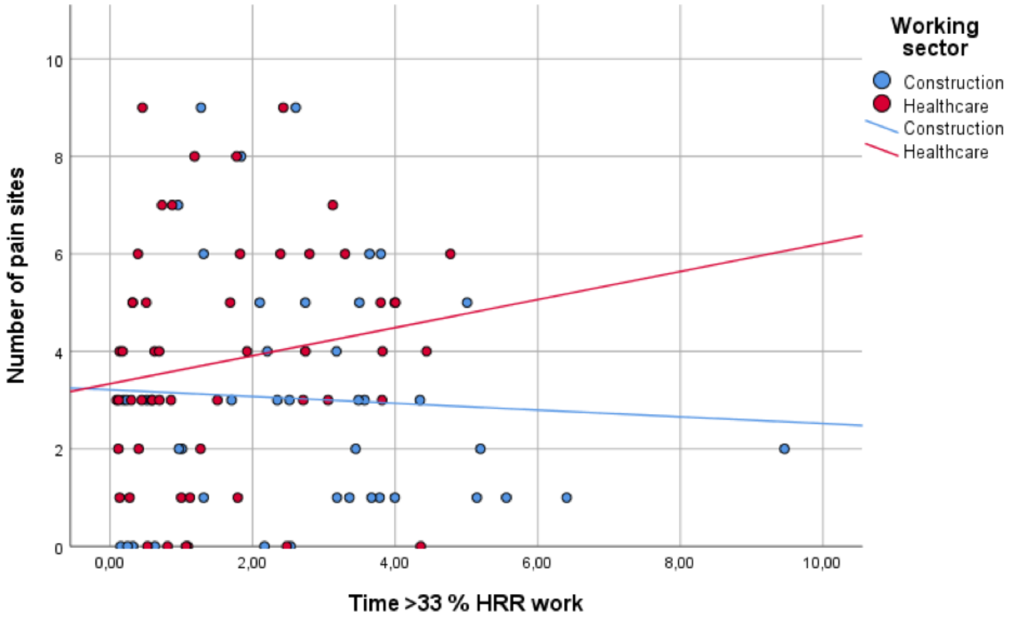


Figure: Visual presentation of NPS and OPA (duration ≥33% HRR), stratified by working sector.

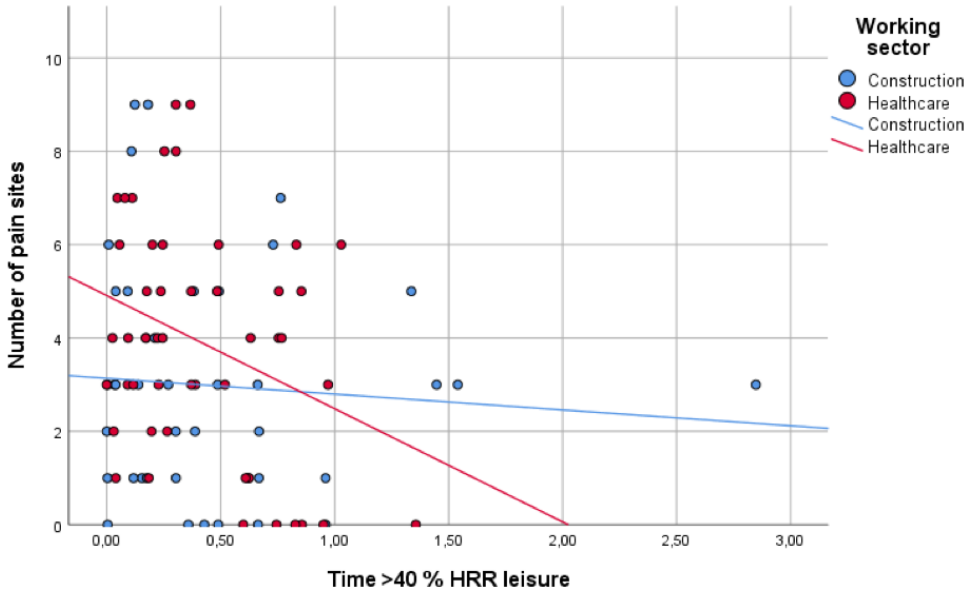


Figure: Visual presentation of NPS and LTPA (duration ≥40% HRR), stratified by working sector.

b. <u>Consent form:</u>

Statens arbeidsmiljøinstitutt

Forespørsel om deltakelse i forskningsprosjektet

"Tungt arbeid og helse"

Bakgrunn og hensikt

Statens arbeidsmiljøinstitutt (STAMI) gjennomfører for øyeblikket et forskningsprosjekt i 2013-2016 som særlig skal ta for seg fysiske forhold ved tungt arbeid. Prosjektet er finansiert av Norges forskningsråd (NFR). Vi vil undersøke arbeidstakere i bygg/anlegg og helsesektor og inviterer derfor deg til å delta på prosjektet. Målet er å avdekke ikke bare risikofaktorer, men også faktorer som kan virke forebyggende i forhold til arbeidsevne, muskel- og skjelettplager, helse generelt og sykefravær.

Hva innebærer studien?

Prosjektet består av en spørreskjemadel og en del med tekniske målinger, og man kan velge om man kun ønsker å delta i spørreskjemadelen eller både ved spørreskjema og de tekniske målinger. Det første spørreskjema tar ca 30 minutter å fylle ut og vil gjentas ca. hvert halvår ved fire anledninger og sendes per post til hjemmeadressen. De utsendte spørreskjemaer vil være noe mindre en det første. For en undergruppe vil det gjøres grundige målinger under arbeid og i fritid. For denne gruppe vil det gjøres styrke- og kondisjonstester og tekniske målinger av arbeidsbelastninger. I tillegg vil vi gjøre en enkel registrering av aktivitet utenfor arbeid. En klinisk undersøkelse av lege vil også inngå. Vi ønsker også å innhente data om sykefravær og uførepensjon fra NAV.

Mulige fordeler og ulemper for deg

Undersøkelsen som helhet vil gi informasjon om forhold på og utenfor arbeidet som er av betydning for din og andres helse fremover. De tekniske målinger vil gi informasjon om din fysiske kapasitet og aktivitet på og utenfor ditt arbeid. Ubehag ved de tekniske målinger kan komme i form av kløe eller lignende som følger av elektroder/teknisk utstyr/plaster festet på kroppen. Utstyret som skal bæres ved de tekniske målinger utenfor arbeidsplassen vil bli meget diskret og skal ikke være til hinder for normal livsførsel.

Hva skjer med informasjonen om deg?

Informasjonen som registreres om deg skal kun brukes slik som beskrevet i hensikten med studien. Alle opplysningene vil bli behandlet konfidensielt av forskerne i studien, noe som betyr at ingen andre (heller ikke din arbeidsplass) får innsyn i opplysningene du har gitt. På første spørreskjema vil vi be om navn, fødselsnummer og adresse. Videre i prosjektet vil en kode på spørreskjemaene knytte deg til dine opplysninger gjennom en

navneliste. Det er kun autorisert personell knyttet til prosjektet som har adgang til navnelisten og som kan finne tilbake til deg.
Hver deltaker får informasjon om hvordan tester har vært og resultatet av de tekniske målinger. Hvis du sier ja til å delta i studien, har Du rett til å få innsyn i hvilke opplysninger som er registrert om deg og få korrigert eventuelle feil i disse opplysningene. Dersom du trekker deg fra studien, kan du kreve å få slettet innsamlede opplysninger, med mindre opplysningene allerede er inngått i analyser eller brukt i vitenskapelige publikasjoner.
Data anonymiseres (navnelisten slettes) 6 år etter prosjektslutt. Det vil ikke være mulig å identifisere deg i resultatene av studien når disse publiseres.

Frivillig deltakelse

Det er frivillig å delta i studien. Du kan når som helst og uten å oppgi noen grunn trekke ditt samtykke til å delta i studien. Dersom du ønsker å delta, krysser du av aktuelle bokser og undertegner samtykkeerklæringen på neste side. Dersom du senere ønsker å trekke deg eller har spørsmål til studien, kan du kontakte Bo Veiersted (Prosjektleder):

Tlf.: 23195300(75), e-post: bo.veiersted@stami.no **(Denne første side kan beholdes)**

Statens arbeidsmiljøinstitutt

Samtykke til deltakelse i studien ”Tungt arbeid og helse”

(NFR-prosjekt 215328: Virkninger av fysisk tungt arbeid med spesiell fokus på arbeidsevne)

Denne side (samtykkeerklæringen) skal sendes inn sammen med spørreskjema.

Undertegnede har fått informasjon om studien og gir hermed:

❑samtykke til å delta i spørreskjemadelen
❑samtykke til å bli kontaktet om tekniske målinger ❑samtykke til at informasjon innhentes fra NAV registre

Dato:

Navn med blokkbokstaver: --

Signatur: --

c. <u>Baseline questionnaire for construction workers:</u>

Slik fyller du ut skjemaet

- Kryss av innenfor ruten: ☒
- Krysser du feil sted, retter du ved å fylle boksen slik: ■
- Skriv tydelige tall og bokstaver (blokkbokstaver). Kun ett tegn i hver rute.
- Bruk svart eller blå penn. Ikke bruk blyant eller tusj.

GENERELLE SPØRSMÅL

1. **Dagens dato:** □□ □□ □□□□ (Dag, Måned, År) **Klokkeslett:** :

2. **Navn**

3. **Adresse**

Postnr

Sted

E-post

Mobil

Er mobilen en smarttelefon? ❑Ja ❑Nei

4. **Hva er din fødselsdato?** □□ □□ □□□□ (Dag, Måned, År) - Personnummer

5. **Kjønn** ❑Mann ❑Kvinne

6. **Hva er ditt skonummer (europeisk standard - eksempelvis: 44)?**
Dette er til informasjon for eventuelle tekniske målinger

7. Hva er din offisielle yrkestittel?

Kryss av for den tittelen som passer best. Dersom du ikke finner din tittel, skriv under "annet".

Anleggsleder/Prosjektleder	❑	Kran- og heisfører	❑
Anleggsmaskin- industrimekaniker	❑	Kuldemontør mv.	❑
Anleggsmaskinfører	❑	Maler, byggtapetserer	❑
Betongarbeider/Forskalingssnekker	❑	Maskinfører	❑
Elektriker	❑	Murer	❑
Feier, fasaderenholder mv	❑	Overflatebehandler, lakkerer	❑
Formann/Driftsleder	❑	Rørlegger, VVS-montør	❑
Gips-sparklingsarbeider	❑	Skytebas, sprengningsarbeider	❑
Glassarbeider	❑	Sveiser	❑
Gulv- og flislegger	❑	Taktekkere	❑
Hjelpearbeider i anlegg	❑	Truckfører	❑
Hjelpearbeider i bygg	❑	Tømrer, snekker	❑
Isolatør mv.	❑		

For forskerne

Annet:

8. Hvem er din nåværende arbeidsgiver?

9. Er ditt ansettelsesforhold hos denne arbeidsgiveren:

❑ fast

❑ midlertidig

❑ vikar/ekstrahjelp

❑ annet

10. Marker det som best beskriver din arbeidstidsordning (svar ja eller nei på alle).

Fast arbeidstid på dagtid	❑ Ja	❑ Nei
Fleksibel arbeidstid (fleksitid)	❑ Ja	❑ Nei
Fast kveld	❑ Ja	❑ Nei
Fast natt	❑ Ja	❑ Nei
Skift/turnus	❑ Ja	❑ Nei

11. Hva er din normale arbeidstid (inkludert overtid) i denne stillingen per uke? ,
Timer

12. Jobber du normalt på akkord?

❑ Ja, 100%

❑ Ja, delvis

❑ Nei

13. Hvilke dager i løpet av uken jobber du vanligvis?

Kryss av for alle de dagene du vanligvis jobber.

Mandag	❑
Tirsdag	❑
Onsdag	❑
Torsdag	❑
Fredag	❑
Lørdag	❑
Søndag	❑

14. Hvor lenge har du arbeidet hos din nåværende arbeidsgiver? (Rund av til nærmeste år, hvis mindre enn ett år, skriv 1)

År

15. Hva er din totale ansettelsestid i dette yrket, uavhengig av bedrift?

År

16. a) Er du ansatt hos annen arbeidsgiver <u>i tilegg</u>? ❑ JA ❑NEI

Hvis du ikke er ansatt hos annen arbeidsgiver, hopp til spørsmål 20.

b) Hos hvilken arbeidsgiver er dette?

17. Hva er din yrkestittel for denne andre stillingen?

For forskerne

18. Hvor lang tid bruker du i gjennomsnitt på denne andre stillingen per uke? , Timer

19. Opplever du denne andre stillingen som fysisk tung? ❑ JA ❑NEI

20. Dersom du har hatt andre yrker i din yrkeskarriere enn nevnt over, vennligst nevn de siste (maks 3) du hadde før din nåværende.

1.

2.

3.

ARBEIDSOPPGAVER

Under ønsker vi å se på ulike arbeidsoppgaver i jobben din. Vi spør her om tidsbruk på arbeidsoppgaver der du ofte opplever/gjennomfører hendelsene beskrevet. For deg som har en hverdag som varier mye, forsøk å gi en gjennomsnittlig vurdering.

21. a) Er du i ditt daglige arbeid utsatt for vibrasjoner som får hele kroppen til å riste, f.eks fra traktor, truck eller annen arbeidsmaskin? ❑ JA ❑NEI

b) Hvis ja, kan du anslå hvor stor del av arbeidsdagen?

❑ Nesten hele tiden

❑ Ca ¾ av tiden

❑ Ca halvparten av tiden

❑ Ca ¼ av tiden

❑ Svært liten del av tiden

22. a) Er du i ditt daglige arbeid utsatt for vibrasjoner fra maskiner eller verktøy som du holder med hendene? ❑ JA ❑NEI

b) Hvis ja, kan du anslå hvor stor del av arbeidsdagen?

❑ Nesten hele tiden

❑ Ca ¾ av tiden

❑ Ca halvparten av tiden

❑ Ca ¼ av tiden

❑ Svært liten del av tiden

23. a) Arbeider du slik at du tar i så hardt at du puster raskere? ❑ JA ❑NEI

b) Hvis ja, kan du anslå hvor stor del av arbeidsdagen?

❑ Nesten hele tiden

❑ Ca ¾ av tiden

❑ Ca halvparten av tiden

❑ Ca ¼ av tiden

❑ Svært liten del av tiden

24. a) Må du sitte på huk eller stå på knærne når du arbeider? ❑ JA ❑NEI

b) Hvis ja, kan du anslå hvor stor del av arbeidsdagen?

❑ Nesten hele tiden

❑ Ca ¾ av tiden

❑ Ca halvparten av tiden

❑ Ca ¼ av tiden

❑ Svært liten del av tiden

25. a) Må du løfte i ubekvemme stillinger? ❑ JA ❑NEI

b) Hvis ja, kan du anslå hvor stor del av arbeidsdagen?

❑ Nesten hele tiden

❑ Ca ¾ av tiden

❑ Ca halvparten av tiden

❑ Ca ¼ av tiden

❑ Svært liten del av tiden

26. a) Arbeider du stående? ❑ JA ❑NEI

b) Hvis ja, kan du anslå hvor stor del av arbeidsdagen?

❑ Nesten hele tiden

❑ Ca ¾ av tiden

❑ Ca halvparten av tiden

❑ Ca ¼ av tiden

❑ Svært liten del av tiden

c) Hvor lenge arbeider du sittende en vanlig arbeidsdag?

❑ Nesten hele tiden

❑ Ca ¾ av tiden

❑ Ca halvparten av tiden

❑ Ca ¼ av tiden

❑ Svært liten del av tiden

❑ Aldri

27. a) Arbeider du med hendene løftet i høyde med skuldrene eller høyere? ❑ JA ❑NEI

b) Hvis ja, kan du anslå hvor stor del av arbeidsdagen du gjør dette?

❑ Nesten hele tiden

❑ Ca ¾ av tiden

❑ Ca halvparten av tiden

❑ Ca ¼ av tiden

❑ Svært liten del av tiden

28. a) Arbeider du i fremoverbøyde stillinger uten å støtte deg med hendene eller armene?

❑ JA❑NEI

b) Hvis ja, kan du anslå hvor stor del av tiden du gjør dette?

❑ Nesten hele tiden

❑ Ca ¾ av tiden

❑ Ca halvparten av tiden

❑ Ca ¼ av tiden

❑ Svært liten del av tiden

29. a) Hvis ja på spørsmål 28a, arbeider du i slike stillinger med ryggen kraftig vridd?

❑ JA ❑NEI

b) Hvis ja på 29a, når du arbeider slik må du da løfte noe som veier mer enn 10kg?

❑ JA ❑NEI

30. a) Arbeider du med hodet bøyd fremover? ❑ JA ❑NEI

b) Hvis ja, kan du anslå hvor stor del av arbeidsdagen du gjør dette?

❑ Nesten hele tiden

❑ Ca ¾ av tiden

❑ Ca halvparten av tiden

❑ Ca ¼ av tiden

❑ Svært liten del av tiden

31. a) Arbeider du med gjentatte og ensidige hånd- eller armbevegelser? ❑ JA ❑NEI

b) Hvis ja, kan du anslå hvor stor del av arbeidsdagen du gjør dette?

❑ Nesten hele tiden

❑ Ca ¾ av tiden

❑ Ca halvparten av tiden

❑ Ca ¼ av tiden

❑ Svært liten del av tiden

32. Må du daglig løfte noe som veier mer enn 20kg, og i tilfellet hvor mange ganger per dag?

❑ Ja, minst 20 ganger hver dag

❑ Ja, 5-19 ganger

❑ Ja, 1-4 ganger

❑ Nei

33. Innebærer dine arbeidsoppgaver at du utsettes for plutselige uventede store belastninger?

❑ Sjelden eller aldri

❑ Noe

❑ Ofte

34. Hvor fysisk tung opplever du vanligvis din arbeidssituasjon? *Sett ett kryss!*

Ikke i det hele tatt	0❑
Meget, meget lett	0,5❑
Meget lett	1❑
Lett	2❑
Moderat	3❑
Ganske tung	4❑
Tung	5❑
………..	6❑
Meget tung	7❑
……...	8❑
………..	9❑
Meget, meget tung (nesten maksimalt)	10❑
	>10❑

PSYKOSOSIALE FAKTORER

Under kommer en rekke påstander om jobben din. Vennligst kryss av for det som stemmer best for deg. Sett ett kryss per linje!

	Meget sjelden eller aldri	Nokså sjelden	Av og til	Nokså ofte	Meget ofte eller alltid
35. Er arbeidsbelastningen din ujevn slik at arbeidet hoper seg opp?	❑	❑	❑	❑	❑
36. Må du arbeide overtid?	❑	❑	❑	❑	❑
37. Er det nødvendig å arbeide i et høyt tempo?	❑	❑	❑	❑	❑
38. Har du for mye å gjøre?	❑	❑	❑	❑	❑
39. Er arbeidsoppgavene dine for vanskelige for deg?	❑	❑	❑	❑	❑
40. Utfører du arbeidsoppgaver som du trenger mer opplæring for å gjøre?	❑	❑	❑	❑	❑
41. Er dine spesialkunnskaper og ferdigheter nyttige i arbeidet ditt?	❑	❑	❑	❑	❑
42. Er arbeidet ditt utfordrende på en positiv måte?	❑	❑	❑	❑	❑
43. Ser du på arbeidet ditt som meningsfylt?	❑	❑	❑	❑	❑
44. Krever jobben din at du lærer deg nye kunnskaper og ferdigheter?	❑	❑	❑	❑	❑
45. Er det fastsatt klare mål for jobben din?	❑	❑	❑	❑	❑
46. Vet du hva som er ansvarsområde ditt?	❑	❑	❑	❑	❑
47. Vet du nøyaktig hva som forventes av deg i jobben?	❑	❑	❑	❑	❑
48. Må du gjøre ting som du mener burde vært gjort annerledes?	❑	❑	❑	❑	❑
49. Får du oppgaver uten tilstrekkelige hjelpemidler og ressurser til å fullføre dem?	❑	❑	❑	❑	❑
50. Mottar du motstridende forespørsler fra to eller flere personer?	❑	❑	❑	❑	❑

	Meget sjelden eller aldri	Nokså sjelden	Av og til	Nokså ofte	Meget ofte eller alltid
51. Hvis det finnes flere forskjellige måter å utføre arbeidet ditt på, kan du selv velge hvilken framgangsmåte du skal bruke?	❑	❑	❑	❑	❑
52. Kan du påvirke mengden arbeid som blir tildelt deg?	❑	❑	❑	❑	❑
53. Kan du selv bestemme arbeidstempoet ditt?	❑	❑	❑	❑	❑
54. Kan du selv bestemme når du skal ta pauser?	❑	❑	❑	❑	❑
55. Kan du selv bestemme lengden på pausene dine?	❑	❑	❑	❑	❑
56. Kan du selv bestemme arbeidstiden din (fleksitid)?	❑	❑	❑	❑	❑
57. Kan du påvirke avgjørelser om hvilke personer som du skal samarbeide med?	❑	❑	❑	❑	❑
58. Kan du selv bestemme når du skal ha kontakt med kunder?	❑	❑	❑	❑	❑
59. Kan du påvirke beslutninger som er viktige for arbeidet ditt?	❑	❑	❑	❑	❑
60. Om du trenger det, kan du få støtte og hjelp i arbeidet ditt fra dine arbeidskolleger?	❑	❑	❑	❑	❑
61. Om du trenger det, kan du få støtte og hjelp i arbeidet ditt fra din nærmeste leder?	❑	❑	❑	❑	❑
62. Om du trenger det, er dine arbeidskolleger villige til å lytte til deg når du har problemer i arbeidet?	❑	❑	❑	❑	❑
63. Om du trenger det, er din nærmeste leder villig til å lytte til deg når du har problemer i arbeidet?	❑	❑	❑	❑	❑
64. Blir dine arbeidsresultater verdsatt av din nærmeste leder?	❑	❑	❑	❑	❑

	Meget sjelden eller aldri	Nokså sjelden	Av og til	Nokså ofte	Meget ofte eller alltid
65. Oppmuntrer din leder deg til å delta i viktige avgjørelser?	❑	❑	❑	❑	❑
66. Oppmuntrer din nærmeste leder deg til å si fra når du har en annen mening?	❑	❑	❑	❑	❑
67. Hjelper din leder deg med å utvikle dine ferdigheter?	❑	❑	❑	❑	❑
68. Fordeler din nærmeste leder arbeidsoppgaver rettferdig og upartisk?	❑	❑	❑	❑	❑
69. Behandler din nærmeste leder de ansatte rettferdig og upartisk?	❑	❑	❑	❑	❑
70. Er forholdet mellom deg og din nærmeste leder en kilde til stress for deg?	❑	❑	❑	❑	❑
	Svært lite eller ikke i det hele tatt	Nokså lite	Noe	Nokså meget	Svært meget
Hvordan er klimaet i din arbeidsenhet (kolleger og nærmeste overordnede)?					
71. Oppmuntrende og støttende	❑	❑	❑	❑	❑
72. Mistroisk og mistenksomt	❑	❑	❑	❑	❑
73. Avslappet og behagelig	❑	❑	❑	❑	❑
74. Har du lagt merke til om eldre og yngre arbeidstakere blir behandlet ulikt på arbeidsstedet ditt?	❑	❑	❑	❑	❑
	Meget sjelden eller aldri	Nokså sjelden	Av og til	Nokså ofte	Meget ofte eller alltid
75. Får du belønning for velgjort arbeid i din bedrift/virksomhet?(*penger,oppmuntring)*	❑	❑	❑	❑	❑
76. Blir de ansatte tatt godt vare på ved din bedrift/virksomhet?	❑	❑	❑	❑	❑
77. Hvor meget er ledelsen i din bedrift/virksomhet opptatt av de ansattes helse og velvære?	❑	❑	❑	❑	❑

FYSISK AKTIVITET OG MOSJON

På spørsmålene om fysisk aktivitet og mosjon under er vi interessert i aktivitet som skjer utenfor arbeidstid.

78. a) Hvordan har din fysiske aktivitet i fritiden vært det siste året? *Tenk deg et ukentlig gjennomsnitt for året. Arbeidsvei regnes som fritid.*

	Timer per uke i gjennomsnitt			
	Ingen	Under 1	1-2	3 eller mer
Lett aktivitet (*ikke svett/andpusten)*	❑	❑	❑	❑
Hard fysisk aktivitet (*svett/andpusten)*	❑	❑	❑	❑

b) Angi bevegelse og kroppslig anstrengelse i din fritid. Hvis aktiviteten varierer meget f.eks mellom sommer og vinter, så ta et gjennomsnitt. Spørsmålet gjelder bare det siste året. *Sett ett kryss i den ruta som passer best!*

Leser, ser på fjernsyn eller annen stillesittende beskjeftigelse?	❑
Spaserer, sykler eller beveger deg på annen måte minst 4 timer i uka? (*Her skal du regne med gange eller sykling til arbeidsstedet, søndagsturer m.m)*	❑
Driver mosjonsidrett, tyngre hagearbeid e.l?	❑
Trener hardt eller driver konkurranseidrett regelmessig og flere ganger i uka.	❑

79. Dersom du de siste 12 månedene har drevet regelmessig med aktiviteter som gjør at du blir andpusten og/eller svett, nevn den/de viktigste aktiviteten(e).

Eksempler på slike aktiviteter er sykling, ballsport, ishockey, ridning, turn, kampsport, friidrett, svømming, skiaktiviteter, dans, aerobic, jogging og styrketrening.

1.

2.

3.

80. a)Hvor ofte gjør du øvelser eller trener for å forebygge eller behandle plager i rygg, nakke, skuldre, armer eller bein?

❑ Aldri

❑ 1 – 4 ganger i måneden

❑ 1 – 2 ganger i uken

❑ 2- 4 ganger i uken

❑ > 4 ganger i uken

b) Gjør du disse øvelsene eller denne treningen med tanke på å mestre din jobb?

❑ JA ❑NEI ❑Gjør ikke øvelser

81. Hvor ofte gjør du øvelser eller trener for å forebygge eller behandle <u>annen sykdom</u> enn plager i rygg, nakke, skuldre, armer eller bein?

❑ Aldri

❑ 1 – 4 ganger i måneden

❑ 1 – 2 ganger i uken

❑ 2- 4 ganger i uken

❑ > 4 ganger i uken

b) Gjør du disse øvelsene eller denne treningen med tanke på å mestre din jobb?

❑ JA ❑NEI ❑Gjør ikke øvelser

HELSE, SYKDOM OG PLAGER

82. Hvordan er helsen din nå?

❑ Utmerket

❑ Meget god

❑ God

❑ Nokså god

❑ Dårlig

83. De neste spørsmålene handler om aktiviteter som du kanskje utfører i løpet av en vanlig dag. Er din helse slik at den begrenser deg i utførelsen av disse aktivitetene nå?

Sett kun ett kryss per linje!

	Ja, begrenser meg mye	Ja, begrenser meg litt	Nei, begrenser meg ikke i det hele tatt
Moderate aktiviteter som å flytte et bord, støvsuge, gå en tur eller drive hagearbeid	❑	❑	❑
Gå opp trappen flere etasjer	❑	❑	❑

84. I løpet av de fire siste ukene, har du hatt noen av de følgende problemer i ditt arbeid eller i andre av din daglige gjøremål på grunn av din fysiske helse? *Sett ett kryss på hver linje.*

Du har utrettet mindre enn du ønsket ❑ JA ❑NEI
Du har vært hindret i å utføre visse typer arbeid eller gjøremål ❑ JA ❑NEI

85. I løpet av de fire siste ukene, har du hatt noen av de følgende problemer i ditt arbeid eller i andre av din daglige gjøremål på grunn av følelsesmessige problemer (som f.eks. å være deprimert eller engstelig)? *Sett ett kryss på hver linje.*

Du har utrettet mindre enn du ønsket ❑ JA ❑NEI
Du har utført arbeidet eller andre gjøremål mindre grundig enn vanlig ❑ JA ❑NEI

86. I løpet av de siste 4 ukene, hvor mye har smerter påvirket ditt vanlige arbeid (gjelder både utenfor hjemmet og husarbeid)?

❑ Ikke i det hele tatt
❑ Litt
❑ En del
❑ Mye
❑ Svært mye

87. De neste spørsmålene handler om hvordan du har følt deg og hvordan du har hatt det de siste 4 ukene. For hvert spørsmål, vennligst velg det svaralternativet som best beskriver hvordan du har hatt det. Hvor ofte i løpet av de siste 4 ukene har du:

Sett ett kryss på hver linje.

	Hele tiden	Nesten hele tiden	Mye av tiden	En del av tiden	Litt av tiden	Ikke i det hele tatt
Følt deg rolig og harmonisk?	❑	❑	❑	❑	❑	❑
Hatt mye overskudd?	❑	❑	❑	❑	❑	❑
Følt deg nedfor og trist?	❑	❑	❑	❑	❑	❑

88. I løpet av de siste 4 ukene, hvor mye av tiden har din fysiske helse eller følelsesmessige problemer påvirket din sosiale omgang (som det å besøke venner, slektninger osv.)?

❑ Hele tiden
❑ Nesten hele tiden
❑ En del av tiden
❑ Litt av tiden
❑ Ikke i det hele tatt

89. a) Har du de siste 12 måneder hatt alvorlig skade? ❑ JA ❑NEI

b) Hvis du svarte ja, hva slags alvorlig skade var dette?

Skriv hva slags skade dette var (maksimalt de tre mest alvorlige skader)

1.

2.

3.

90. a) Har du fått diagnostisert en kronisk sykdom hos lege? ❑ JA ❑NEI

b) Hvis ja, hvilke(n) diagnose(r) har du? *Nevn de (maks to) eller den som påvirker din hverdag mest*

1.

2.

91. a) Bruker du daglig medisiner? ❑ JA ❑NEI

b) Hvis ja, nevn hvilke sykdommer tar du medisinen for (maks 3):

1.

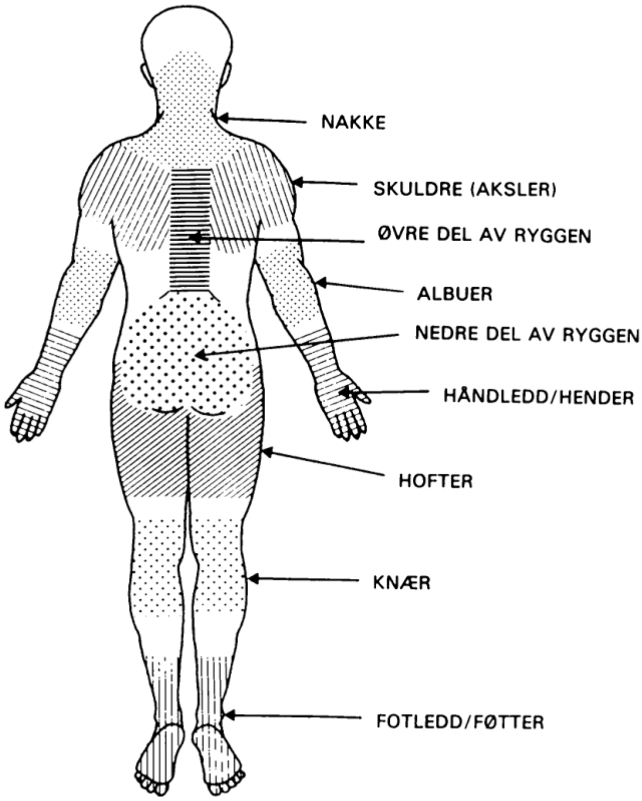
2.

3.

92. Har du brukt smertestillende (eks. paracet) eller betennelsesdempende (eks Ibux, Voltaren) den siste uken?
❑ JA ❑NEI

93. Har du noen form for allergi mot plaster/teip/bandasje eller lignende? ❑ JA ❑NEI
Dette er til informasjon for eventuelle tekniske målinger

På neste side følger spørsmål om plager og symptomer. Kryss av for symptomer og plager du har hatt i løpet av de SISTE 4 UKER. Sett ett kryss under PLAGENS INTENSITET og i tillegg ett kryss under VARIGHET TILSAMMEN for hvert spørsmål der du opplever plager. Figuren under viser til ulike kroppsdeler og kan brukes som hjelpemiddel når du krysser av under spørsmålspunkt 94. Du trenger <u>ikke</u> å krysse av på figuren.



Inndeling av kroppsdeler

94. Symptomer og plager siste 4 uker:

	Plagenes intensitet				Varighet til sammen			
	Ikke plaget	litt plaget	en del plaget	alvorlig plaget	1-5 dager	6-10 dager	11-14 dager	15-28 dager
a) Smerter i nakke	❑	❑	❑	❑	❑	❑	❑	❑
b) Smerter i høyre skulder	❑	❑	❑	❑	❑	❑	❑	❑
c) Smerter i venstre skulder	❑	❑	❑	❑	❑	❑	❑	❑
d) Smerter i øvre del av ryggen	❑	❑	❑	❑	❑	❑	❑	❑
e) Smerter i nedre del av ryggen	❑	❑	❑	❑	❑	❑	❑	❑
f) Smerter i albue, håndledd eller hender	❑	❑	❑	❑	❑	❑	❑	❑
g) Smerter i hofter	❑	❑	❑	❑	❑	❑	❑	❑
h) Smerter i knær	❑	❑	❑	❑	❑	❑	❑	❑
i) Smerter i fotledd/ankler eller føtter	❑	❑	❑	❑	❑	❑	❑	❑
j) Hodepine/migrene	❑	❑	❑	❑	❑	❑	❑	❑
k) Angst	❑	❑	❑	❑	❑	❑	❑	❑
l) Nedtrykthet/depresjon	❑	❑	❑	❑	❑	❑	❑	❑
m) Følelse av tretthet/matthet utover det vanlige	❑	❑	❑	❑	❑	❑	❑	❑

95. Røyker du, eller har du røykt?

❑ Nei, aldri
❑ Ja, men jeg har sluttet
❑ Ja, av og til
❑ Ja, hver dag

96. I tabellen under er det 6 spørsmål knyttet til søvn og tretthet. Vær vennlig å kryss av for det alternativet (antall dager per uke) som passer best for deg. 0 er ingen dager i løpet av en uke, 7 er alle dager i løpet av en uke.

	Antall dager per uke							
	0	1	2	3	4	5	6	7
a) I løpet av den siste måneden, hvor mange ganger per uke har du brukt mer enn 30 minutter for å sovne inn etter at lysene ble slukket?	❑	❑	❑	❑	❑	❑	❑	❑
b) I løpet av den siste måneden, hvor mange dager per uke har du vært våken mer enn 30 minutter innimellom søvnen?	❑	❑	❑	❑	❑	❑	❑	❑
c) I løpet av den siste måneden, hvor mange dager per uke har du våknet mer enn 30 minutter tidligere enn du har ønsket uten å få sove igjen?	❑	❑	❑	❑	❑	❑	❑	❑
d) I løpet av den siste måneden, hvor mange dager per uke har du følt deg for lite uthvilt etter å ha sovet?	❑	❑	❑	❑	❑	❑	❑	❑
e) I løpet av den siste måneden, hvor mange dager per uke har du vært så søvnig/trett at det har gått utover skole/jobb eller privatlivet?	❑	❑	❑	❑	❑	❑	❑	❑
f) I løpet av den siste måneden, hvor mange dager per uke har du vært misfornøyd med søvnen din?	❑	❑	❑	❑	❑	❑	❑	❑

Spørsmålene under gjelder anspenthet i musklene

Har du for vane å:

97. Heve skuldrene? ❑Aldri ❑ I blant ❑ Ofte
98. Spenne nakken? ❑Aldri ❑ I blant ❑ Ofte
99. Holde arbeidsredskap unødig hardt? ❑Aldri ❑ I blant ❑ Ofte
100. Spenne magemusklene? ❑Aldri ❑ I blant ❑ Ofte

ARBEIDSEVNE

101. Vi går ut ifra at din arbeidsevne på sitt beste verdsettes med 10 poeng. Hvor mange poeng vil du gi din nåværende arbeidsevne? (0 betyr at du ikke er i stand til å jobbe i øyeblikket, 10 betyr arbeidsevne tilsvarende ditt beste nivå)

Helt uten evne til å arbeide — *Arbeidsevne på ditt beste*

0	1	2	3	4	5	6	7	8	9	10
❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑

102. Egen oppfatning av hvordan helsen tillater meg å arbeide om to år. Sett ut ifra din helse, tror du at du vil være i stand til å utføre ditt nåværende arbeid om to år?

❑ Neppe
❑ Usikker på det
❑ Ganske sikker

Takk for din deltakelse!