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Exploring the Musculoskeletal Risk Exposure Associated with Laundry Service at Pohjolan Tekstiilipalvelu Oy

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Abstract

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Title of the Publication: Exploring the musculoskeletal risk exposure associated with laundry service at Pohjolan Tekstiilipalvelu oy

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The purpose of this research was to create an exercise poster and an information package according to the most common musculoskeletal disorders (MSDs) among laundry employees who work at Pohjolan Tekstiilipalvelu company. Moreover, explore the correlation between some risk factors (age, sex and work duration) with MSDs. The aim of research was to promote employees' musculoskeletal health by preventing/reducing MSDs. The original aim for commission party was to develop occupational safety and healthy work environment and having the better workforce in the future.

In the theoretical part of this research, the prevalence and risk factors of work-related musculoskeletal disorders (WMSDs) were explored and understanding of expenditure of WMSDs on business, society and nation level. These led to the importance of reducing and preventing of MSDs at work placement and have safer and healthier work environment. As a result, the solutions of how to prevent/reduce WMSDs with a focus on the physical activity, specific resistance exercise, and personal experience of the authors were compiled to create the poster and the information package.

The subjects that took part in a survey were a total 26 laundry employees 16 women and 10 men. They answered questionnaires; CMDQ and demographic. CMDQ questionnaire used to assess musculoskeletal symptoms in order to explore what is the most common MSDs among laundry employees and demographic questionnaire used to collect personal information to explore the relation between some factors (age, sex, work duration) with MSDs. The method used to draw the result was quantitative research and Pearson, Spearman and relative contingency coefficient used as statistical formulas to interpret the result.

The results indicated that the highest prevalence MSDs among laundry employees were knees and wrists 15% on the right side followed by left wrists and knees 12%, 8% respectively. Results from Pearson correlation showed no correlation on any MSDs and age/work duration except for the feet. Women had higher correlation than men. There was no generalization in this research due to small sample size, higher number of women than men and constant changes in workforce. In conclusion the exercise poster and the information package were created to help employees having better work environment in Laundry company besides better quality of life.

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1 Introduction

The most common work-related health problem which affects the employees through their work is work-related musculoskeletal disorders (WMSDs) (European Agency for Safety and Health at Work, 2019. Repetitive tasks and manual handling loads are recognized as the priority risk factors (European Agency for Safety and Health at Work, 2000), but also some individual factors like age, sex, country of birth, level of education influence on the developing of musculoskeletal disorders (MSDs). 60% of EU employees pointed about MSDs as their most health problem (European Agency for Safety and Health at Work[1], 2019, p 168). WMSDs besides the effect on employees, it makes high expenses for business, society and nation (European Agency for Safety and Health at Work, 2019). This information shows prevention of WMSDs is necessary and relevant and in this thesis showed different risk factors lead to MSDs and the solutions to prevent/reduce them.

The idea of this thesis came during one of the authors used to work in a laundry company and herself faced the symptoms of MSDs and it made wondered whether other laundry employees had faced the same issue. The purpose of this research was to identify the most MSDs associated with laundry employees who work at Pohjolan Tekstiilipalvelu company and find the correlation between some risk factors (age, sex and work duration) with MSDs. Eventually, after collecting data, an exercise poster and an information package would be provided which promote employees' musculoskeletal health. Poster provides some exercises according to the most common MSDS that can be done on break times or at homes to release the tension in their muscles because of long working hours. Besides that, an information package, which includes advice regarding the optimal type and dose for resistance exercises, are made accessible for the laundry company.

The commissioning party is a laundry company called "Pohjolan Tekstiilipalvelu oy", It is based in Kajaani, Finland. The aim of this research for commission party was by preventing/reducing the MSDs among employees, company can develop occupational safety and healthy work environment and employees feel good about their work environment. Consequently, by having better workforce and productive employees makes a good business sense.

Pohjolan Tekstiilipalvelu company is the biggest laundry company in Kajaani area which besides offering laundry service to hotels, hospital and restaurants, it rents out materials like garment, towels, carpet to customers. This company includes 27 number of employees and three managers who work beside employees when the work volume is high. There are two working shifts; in the morning and evening and most of the employees works fulltime. Morning shift usually starts at 7 a.m. and finishes at 3 p.m., evening shift starts at 11 a.m. until 7 p.m. It should be mentioned that different parts of laundry have different starting and finishing time, but most of the employees work 8 hours as a full-time job. This laundry company includes: Mankeli and Mankelin vastaanottaja, Lajittelija, Viikkaaja, Hotellipakkaaja, Apupakkaaja, Takkien laittaja, Froteentekijä, Huoltomies. Performing laundry tasks vary in different part of laundry service and expectation of the same task could vary in other laundry companies because of having different type of machines and facilities. Therefore, the musculoskeletal disorder for one task should not be generalized to other form of laundry tasks, but in this company, there is a job rotation which most employees after one or two weeks working in one specific part rotate and work in different part. The table 1 below shows the different sections in the laundry company and the job description of each section:

Job title	**Description of Job**
Mankeli	Hanging on wet materials on the machines to be ironed and folded
Mankelin vastaanottaja	Receiving materials from Mankeli, sorting out and putting in their own places
Lajittelija	Separating dirty materials and putting on the baskets for washing
Viikkaaja	Folding and sorting out different material
Hotellipakkaaja	Packing different materials for hotels
Apupakkaaja	Helping main Pakkaaja by packing small materials for customers
Takkien laittaja	Hanging up the wet clothes and trousers on coat hangers for drying
Froteentekijä	Putting washed towels in machines to be ironed and folded
Huoltomies	Repairing and fixing machines

Table 1. Different tasks in Laundry Company

2 Musculoskeletal disorders

World health organization WHO (2013) defines musculoskeletal disorder as follows; “Work-related musculoskeletal disorders refers to health problems of the locomotor apparatus, i, e. of muscles, tendons, the skeleton, cartilage, ligaments and nerves” (World Health Organization, 2013). Musculoskeletal disorders are one of the most prevalent medical issues in current society affecting people from various paid and unpaid occupation (Habib & Rahman, 2015). It has been reported that over million Finnish are suffering from chronic musculoskeletal disorders which more than a quarter complaint about backache and one third about having muscular pain. Back injuries and work-related upper limb disorder known as “repetitive strain injuries” and are main MSDs (European Agency for Safety and Health at Work, 2010).

Approximately every fifth doctor’s appointment is due to these problems which one third of diagnosed MSDs considered work-related (Kuopio, 2014; European Agency for Safety and Health at Work, 2010). According to WHO musculoskeletal disorders become work-related when they are aggregated by work or the circumstance of its performance (World Health Organization 2013). In Europe MSDs related to work are the most health problem, affecting millions of employees (Berberoğlu & Tokuç, 2013).

There is growing evidence that psychosocial risk factors can lead to MSDs especially when it is combined with physical work like having low job satisfaction or high demanding physical job with low autonomy (European Agency for Safety and Health at Work, n.d), in addition, research suggests that mental stress can create muscle tension as similar as physical load at work as well as leisure time (Lindofors, Von Thiele & Lundberg 2006; Andersen, Haahr, & Frost, 2007). In this view, there is multifactorial risk factors lead to MSDs, but the only way to reduce/prevent is to understand the mechanism and the causes of these problems, then eliminate those at workplace.

Working in laundry service is a form of manual work, that require substantial physical labour and the employees in laundry service can face the musculoskeletal disorders, because of awkward postures and repetitive motions they adopt. Doing laundry is also a part of household chore, Apostoli considered the physical demands in housework is from light to moderate loads that could contribute to the worsening of musculoskeletal disorders. (Apostoli et al., 2012 cited in Hong Rui

et al., 2016.) Low back pain was rated as one of the highest reported MSD symptoms in house-workers (Habib & Rahman, 2015; Samaei et al., 2017). A research in Singapore showed women are exposed to medium musculoskeletal risk exposure when perform laundry-drying due to constraint workspace and upper body like neck, wrist, thumb and trunk suffers the most stress (Hong Rui et al., 2016). This claim reinforces by statistic gained from Singapore hospital, in an outpatient occupational therapy hand clinic that up to 20.1% of the total upper limb musculoskeletal cases referred to the Occupational Therapy (OT) Department are housekeepers (Yang, Cheung, 2016 cited in Hong Rui et al., 2016).

2.1 Work-related musculoskeletal disorders

Musculoskeletal disorders are one of the reasons most Finnish get sick leaves, especially in aging individual and beside of discomfort, pain and other problems can cause remarkable amount of disability (Kuopio, 2014). MSDs require 38% more sick leave days than the average injury/illness to recover. (ErgoPlus, n.d[1]; European agency for safety and health at work, 2019.) It is considered as one of the three largest causes of work absence (Bernaards et al., 2011). In Europe, more 600 million working days are lost each year due to work-related ill health (Paoli, 1999). Although musculoskeletal disorders might not make a valid reason for sick leave, it can decrease individual's functional capacity, workability and well-being (Finnish Institution of Occupational Health, 2013) which will affect individual's quality of life. Musculoskeletal disorders reasons arise from work are due to physical labour work, handling heavy loads, inadequate recovery, high physical labour, static or awkward working posture for a long time and repetitive movements (Kuopio, 2014; Kauppinen et al., 2013; Kärkkäinen et al, 2013), a task is considered as a high repetition which repeated more than 4 times each minutes (Hong Rui et al., 2016). Other factors lead to an increase in MSDs are Individual risks include age, sex, smoking, obesity, insomnia, physical inactivity, physical capacity and genetic (Kuopio, 2014), and psychosocial factors include high workload and demands, inadequate feedback, poor co-operation (Finnish Institution of Occupational Health, 2013).

The work environment and human body are a complex set of systems (ErgoPlus, May 15) and musculoskeletal disorders occur at the intersection of these systems when the workload is higher than the musculoskeletal' system to bear the pressure. Workload can be combination of physical

and psychological demands, equipment and layout in workplace. Body deals with amount of forces coming from outside to maintain or move body. Force which comes from work or individual's free time activities have different effect on individual musculoskeletal system (World Health Organization 2013). Force by inducing high stress on the muscles for maintaining postures while doing physical work can cause MSDs and changes in individual's health. Furthermore, produced high intensity torsion force and forcing by itself inside the body cause overstress for tissues.

Musculoskeletal disorders can be reduced and prevented by providing tasks or work that require less muscle work, less repetitive movements, re-organizing the work environment, make use of ergonomically adjustable equipment, rearrange the layout of equipment and materials, and making sure that individuals have adequate breaks throughout the working hours (Arakoski, Alaranta, Pohjolainen, Salminen & Viikari-Juntura, 2009).

Muscles can contract either static or dynamic. In dynamic contraction, muscles lengthen, shorten and during relaxation bloods bring oxygen and nutrition for muscles. In static contraction muscles contract for longer period and the consequence of this is changing in tissue metabolism and the fatigue is a product which accumulate in muscles. Vessels due to constant contraction restricts the blood flow from and to contracted muscles and cannot bring oxygen and nutrition for them. Therefore, static muscle work should be avoided and reduced as much as possible (World Health Organization 2013).

Static working posture can cause imbalance. Long-time static posture is accompanied by long lasting muscular activity which may cause overload for muscular structures (World Health Organization 2013). Muscles have no time to relax and place muscular fatigued at a greater risk for muscular injuries even at low force level (Salavati et al., 2017; Lomond et al., 2011 cited Hong Rui et al., 2016). This can be harmful even though there is no clear sign of tissue damage, but function of muscles may be impaired and hurt (World Health Organization, 2013).

Therefore, static muscle work should be avoided and reduced as much as possible. Muscles that are fatigued from static muscle activity are best recovered by light dynamic movements, frequent stretching which improves blood circulation in tensed muscles. Moreover, exercises throughout the working time reduce discomfort, formation of trigger point, maintain range of motion and help employees to identify tightness in their body. Therefore, it is important that employees have

adequate breaks throughout the working day (Aulanko, Huovinen, Kiikka & Lehtinen, 2010 cited Kuopio, 2014; Valachi, & valachi, 2003).

Posture of the employees can have a great risk for musculoskeletal disorders (Hong Rui et al., 2016). A few studies showed the association between low back pain and time spent on sustained posture. Forward bended and rotated back posture as well as long period of working arms lifted can also cause neck and shoulder problems (Kauppinen et al., 2013). Muscles of trunk are important in maintaining healthy postures and can reduce risk from poor postures during working hours. Good body control and awareness of own body is essential for maintaining healthy postures (Fogelholm et al., 2007). Frequent postural changes help muscles of trunk with stabilizing function to get revile from fatigue and tissue strains due to constant static posture (Kelvin, Raymond, & Simon, 2009).

According to the study, employees in standing position complained more of consistent MSDs than employees in sitting position in all body region except upper back. Employees in siting position reported more intensity pain on their upper body, whereas, employees with standing position had higher pain in their lower body especially in the leg region (Abdul Aziza et al., 2015), and significantly women more than men had pain in their both side and lower legs pain strongly associated with women age 50 or older (Messing et al., 2008). Therefore, employees in standing position are more at risk of MSDs (Abdul Aziza et al., 2015; Messing, Tissot, & Stock, 2008) since prolonged standing causes physiological and biomechanical effects on body (Tissot et al., 2005). Constrained standing position and not have possibility to sit increases pain in lower body compared with standing with freedom to sit. As a result, change the position at work and freedom to sit can prevent lower body pain (Messing et al., 2008).

Duration that the individual is exposed to musculoskeletal disorder or injury is an important factor in development of problems. Duration is determined by number of repetitions e.g. per day as well as by the total exposure time for instance hours per day or days per month. Short-term exposure to loading may cause acute health problems and if the duration of work loading goes toward long-term loading may cause chronic health problems (World Health Organization, 2013).

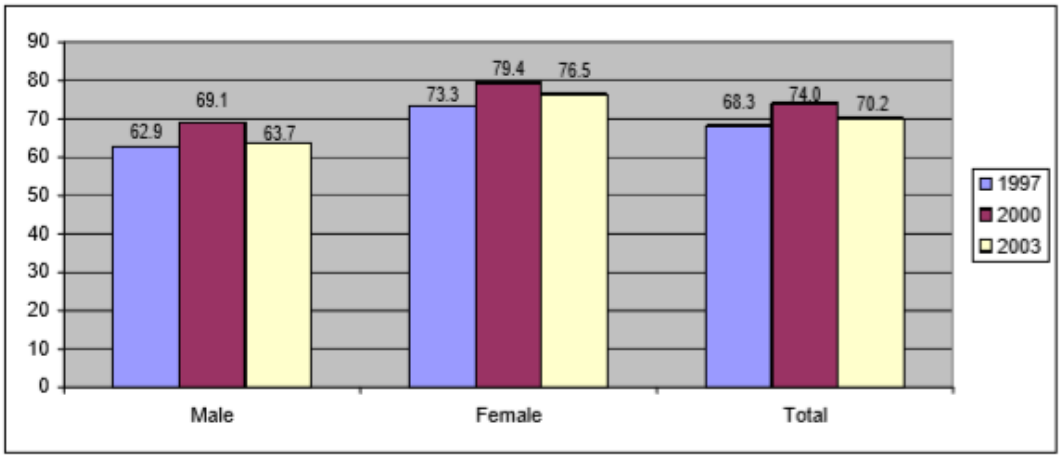
2.2 Risk factors

There are several individual risk factors that increase the likelihood of getting musculoskeletal disorders such as age, sex, experience, marital status, education and health habit. Below are few that we hypothesize to be most related to the thesis participants.

2.2.1 Sex

There is a growing realization that work-related health problems of women employees need special attention for several reasons. About one woman out of 300 is suffering from some work-related disorder. The physiological, psychological and health care needs of women are proportionately greater, as they have more responsibilities like: Bulk of house work (Srivastava and Bihari, 2000 cited Bilgham and Werner, 1973), care of young, aged and sick; responsibilities of home and the work, different body size or mass or endocrine function (Srivastava & Bihari, 2000; Punnett & Bergqvist, 1997). At work women are particularly at risk because most designed tools, workstation and personal protective equipment are not gender specific and fit the average men from an ergonomic angle (Srivastava and Bihari, 2000).

Many studies have reported gender differences in prevalence of musculoskeletal symptoms (Linton et al., 1998; Dahlberg et al., 2004; Wærsted et al., 2010; Picavet, Van Gils, & Schouten, 2000; Andersen et al, 2010). Some studies showed that women have significantly higher incidences of upper extremity musculoskeletal disorders than men even after controlling age and work factors (Treaster & Burr, 2011; Dahlberg et al., 2004). In addition, European Survey on Working Condition (ESWC) 2005, revealed Finish women have higher shares of work-related MSDS than men. Figure 1 below shows prevalence of musculoskeletal symptoms by sex and year (in %), 1997, 2000, 2003 (European Agency for Safety and Health at Work, 2010). Some studies showed that although women are expected to be more vulnerable of work-related risk factors, in many cases men are more vulnerable (Hoofman et al., 2009; Messing, Stock, & Tissot, 2009). In this thesis, it is explored which sex have more prevalence of MSDs.



Source: Work and health survey.
Note: Persons under 25 or over 64 years of age were not sampled.

Figure 1. Prevalence of musculoskeletal symptoms by sex and year in Finland (%), 1997, 2000, 2003. (Retrieved from European Agency for Safety and Health at Work, 2010)

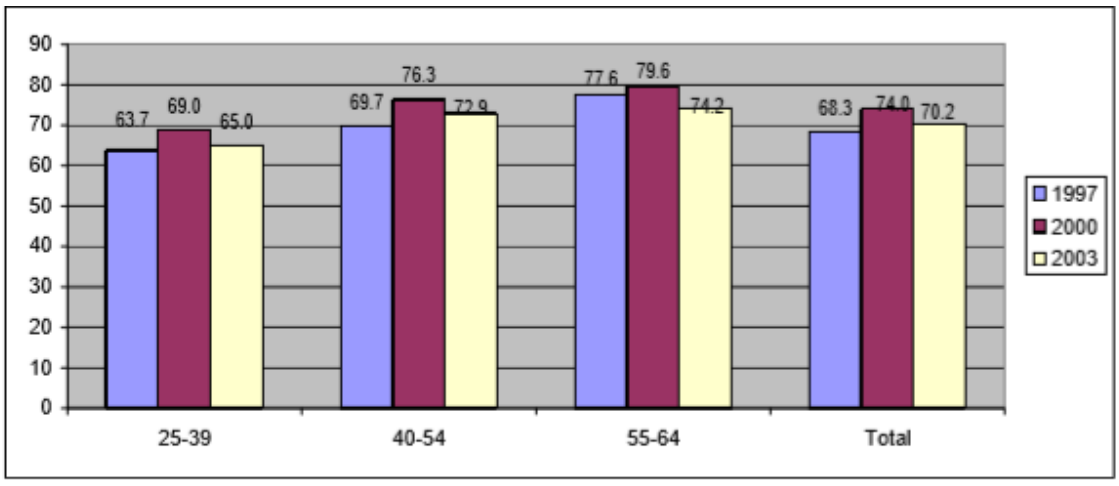
2.2.2 Age and work duration

Subjects with higher experience and age are exposed higher levels of MSD (Shankar et al., 2017; Picavet & Hazes, 2003). In a study found employees aged less than 30 years have lesser risk of MSD (Thangaraj et al., 2019), this reveals the fact that musculoskeletal disorders develop gradually through prolonged exposure (Teklehaymanot et al., 2018) and employees who were working for more than 10 years have greater risk of MSD (Thangaraj et al., 2019, cited Bandyopadhyay et al., 2012). A conducted research showed that employees with service of 11-15 years were above 5 times more likely to develop back disorder than those who have shorter work experience. This shows that working for long years increase work-related back musculoskeletal disorders due to cumulative exposure (Teklehaymanot et al., 2018).

National report in Finland reported MSDs increased with age among workers and the highest prevalence was between the age 40-54. Figure 2 below shows prevalence of musculoskeletal symptoms by age and year (in %), 1997, 2000, 2003 (European Agency for Safety and Health at Work, n,d). In Europe, older employees report more MSDs rather young employees (European agency for safety and health at work, 2000) because they have spent more time working in risky situation and jobs are generally designed for young and healthy male (Paoli, 1999).

However, it is incorrect to consider MSDs are only for older employees. European Risk Observatory demonstrated that although young employees have less average risk of MSDs than older employees, they are at risk of developing MSDs. This can be explained that MSDs need cumulative exposure and more time to develop and not always be recognized due to short-term contract (European Agency for Safety and Health at Work, 2007).

It showed in national level that workers with recognized diseases are mostly young employees under 25 years old that reported significant share of MSDs (European Agency for Safety and Health at Work, 2010). In Spain, young instead of old showed to be the most affected group (European Agency for Safety and Health at Work, 2010). It is argued that young employees are unfit for the job, they have lack of experience, awareness of health and safety issues, physical and psychological are immature, they are employed in a sectors where physical work is frequent, employers fail to provide appropriate training and safeguards (European Agency for Safety and Health at Work, 2007). It would be explored in this thesis whether young or older employees have more MSDs symptoms.



Source: Work and health survey.
Note: Persons under 25 or over 64 years of age were not sampled.

Figure 2. Prevalence of musculoskeletal symptoms by age and year in Finland (%), 1997, 2000, and 2003. (Retrieved from European Agency for Safety and Health at Work, 2010).

2.3 Prevent/reduce musculoskeletal disorders

Three factors to determine physical loading are amount, duration and repetition. Work can be organized in relation to these three factors to minimize health risk. Musculoskeletal systems and work relations are multi-dimensional for reasons being that loading is necessary for human body to maintain health, but this loading should be optimal otherwise loading is considered detrimental. Optimal loading for individual is loading that enhances individuals' health. Optimal loading weight at work depends on Individuals' load bearing capacity, body structure, size, sex and age (Martimo, Antti-Poika & Uitti, 2010).

Musculoskeletal disorders can be prevented or reduced by minimizing all the possible risks factors cause health hazard at work, organizing early medical treatment for possible problems, improving individuals' overall health through physical activity, making adjustable and adaptions work environment for individuals' suffering from musculoskeletal disorders and by affecting individual attitudes toward work and promoting the individual to take responsibility in the process (Martimo, Antti-Poika & Uitti, 2010).

Examples of possible ways to reduce and prevent musculoskeletal disorders at work are for instance to make changes in layout, worktops and their directions, to change the target the individual works with. Minimizing health hazard by removing uncomfortable equipment in order to provide ergonomic material and equipment that are designed the best possible way to maintain joints in neutral position and minimize compressive forces and reduce repetitions. All musculoskeletal disorders can be affected by reducing repetitive and monotonous movements (Martimo, Antti-Poika & Uitti, 2010).

Not all MSDs require medical treatment, when MSDs identified early enough most discomfort and fatigue can alleviate. One non-medical treatment is doing physical activity and lack of physical activity causes major health related risks (Muhammad, 2016; Bernaards et al., 2005). Based on the study, optimal regular physical activity can have positive impact on body (Shakerian et al., 2016), decreases sick leave, improving the work ability (Ilmarinen & Rantanen, 1999 cited Blangsted et al., 2008; Pohjonen & Ranta, 2001), reduce risk factor in MSDs (Proper et al., 2003) and it may help to maintain current functional capacity. Physical activity can be done in workplace which

can be effective as tertiary prevention and therapeutic relief of MSDs symptoms at last in the short term (Lowe & Dick, 2015). In order to achieve the benefits of physical activity, the loads and exercise intensity level on the body systems should be more than they are used to. The physical activity should be in a progressive manner because body systems will adapt itself to the level of exercise in time (Taimela et al., 2002).

Exercises for musculoskeletal health are specific and carefully targeted; the benefit of exercise is only seen in the muscles that are involved in training, but what type of training is most effective. In systematic review studies showed strong evidence for prevention of upper extremity musculoskeletal disorders (UEMSD) through resistance exercise trainings, whereas stretching training programs, movement awareness exercises, general physical exercises had a moderate evidence for a positive effect on preventing UEMSD. It is recommended implementing workplace-resistance training exercise programs help to manage and prevent MSDs symptoms and disorders (Van Eerd et al., 2016; Lowe & Dick, 2015; Munoz-Poblete et al., 2019; Andersen et al, 2008; Blangsted et al., 2008;). Muscle strengthening exercises should be carried out minimum three times a week and training has to be progressive. Coordination and motor control are also important factors in musculoskeletal systems health. In the neck and shoulder girdle it is important to exercise neck and shoulder girdle muscles together with motor control and coordination exercises. To maintain back health, it is important to exercise muscles which have stabilizing function in abdomen, back and pelvic girdle (Taimela et al., 2002).

3 The importance of physical activity

Physical inactivity is a fourth risk factor for all global mortality which is considered as a serious public health challenge. Estimated the reduction in the prevalence of physical inactivity in Europe save the costing around €16 billion, whereas estimated physical inactivity cost €80 billion (6.2%) across Europe, which contains €70 billion indirect costs and €9 billion direct cost (An ISCA/Cebr report, 2015).

Physical activity has economic benefits on the health care expenses, employees' productivity, healthier social and physical environments**,** and physical inactivity affects the economics of individuals, businesses and nations in total. In Canada and USA physical inactivity costs 6% and 8.7% (Carlson et al., 2015) respectively of total health care expenditures. In the USA workplace-physical activity, reduce the health care costs by (20%-50%), short-term sick leave by (6%-32%) and increase productivity by (2%-52%) (Health and Development Through Physical Activity and Sport, 2003).

In a study conducted by Jacobson and Aldana (2001), a significant relationship was found between exercise frequency and illness related absenteeism (Jacobson & Aldana, 2001). Furthermore, in other studies showed, men and women who had vigorous active reduced the risk of sick absence compered to men and women who had moderate intensity exercise (Lahti et al., 2010; Bernaards et al., 2005). It is suggested vigorous physical activity might contribute to better work ability and reduce sickness absence (Lahti et al., 2010), whereas, moderate physical activity was unrelated to sick leave (Lahti et al., 2010, Proper et al., 2006) and light aerobic exercise, muscle strengthen and stretching had no positive effect on sick leave (Brox & Froystein, 2005).

3.1 Resistance exercise

Muscle weakness is one of the risk factors for MSDs, in this case, exercises that promote muscle strength is effective. Resistance exercise can reduce pain and disability (Bischoff & Roos, 2003) and there might be chance of reducing the development of the MSDs (Slemenda et al., 1998). To optimize the efficacy of resistance exercise, the program variables (frequency, intensity, volume, and rest interval) should be individual (American College of Sports Medicine position stand, 2009).

Many different resistance exercise equipment can be used to improve muscle strength, including free weight, resistance bands, machines with stacked weights, pneumatic resistance and body weight (American College of Sports Medicine position stand, 2009).

The optimal characteristics of resistance exercises program include eccentric, concentric, isometric contraction. It is recommended exercises program target major muscle groups (shoulders, back, hips, chest, legs, trunk, and arms) before small muscle groups (quadriceps, hamstrings, biceps, calf muscles, abdominal), multiple-joint exercises before single-joint exercises and higher intensity before lower intensity exercises (American College of Sports Medicine position stand, 2009). To prevent muscular imbalance agonist and antagonist muscles should train (quadriceps and hamstrings). When training all major muscle groups in a workout, rotate upper body and lower body exercises or opposing (agonist-antagonist relationship) exercise (Kraemer & Ratamess, 2004). Exercises should be performed in a right technique and form, moving through the full range of motion of the joint, and using proper breathing techniques (American College of Sports Medicine position stand, 2009).

Selecting an appropriate load may be is the most important variable in resistance exercise. Load is defined as the amount of resistance or amount of weight lifted in one exercise (Baechile & Earle, 2008). 1RM (Repetition Maximum) load is the highest resistance which can be moved just once. The amount of resistance is moved depends on program variables like frequency, volume, repetitions, rest and training goal. It displayed loads of approximately 45-50% of 1 RM increased the dynamic muscular strength in untrained individuals (Kreamer & Ratamess, 2004; American College of Sports Medicine position stand, 2009) and for beginners are recommended to train with the moderate loading 60-70% of 1 RM (American College of Sports Medicine position stand, 2009; Ratamess et al., 2012). This moderate load help beginners to learn proper forms and techniques. In some studies, used the intensity of 30% 1RM to investigate the effect of resistance exercise on MSDs symptoms (Sjögren et al., 2005; Sjögren et al., 2006) and in other study used the intensity of 70-85% 1RM (Rodrigues et al., 2014; Zebis et al., 2011; Andersen et al., 2008). In this thesis, no specific amount of loading is determined to train resistance exercises. What should be considered is that using variety loads has the most advantage to maximizing muscular strength compare to performing all exercises with the same load, especially if long-term training is the goal (Fleck, 1999 cited in American College of Sports Medicine position stand, 2009).

Because the aim of this thesis is to provide resistance exercises for overall muscular strength associated health benefits (not hypertrophy), training per muscle with the volume (total number of sets and repetitions) of 4 set with 8-12 repetitions (American College of Sports Medicine position stand, 2009) is appropriate for untrained and recreationally trained individual (Peterson, Rhea, & Alvar, 2005). Changes in load for improvement is needed because physiological adaption occurs to a specific resistance (Kraemer & Ratamess, 2004). Once individual could easily perform exercise 12 repetitions, the load should be increased (Ashbya et al., 2015).

For gaining muscles function and size training two or three times per week is optimal (Peterson et al., 2005; Rhea et al., 2003). In each training session the whole body can be trained or by using split body routine, some selected group muscles are trained in one session and rest of them the next session (Carol Ewing et al., 2011). The rest period between session has to be sufficient. 48-72 hours rest between training sessions is needed to recuperate and promote cellular adaptions that associated gains in strength (Bickel et al, 2005).

4 Aim/purpose

One of the authors used to work in laundry company and faced the MSDs, this physical health problem caused to ask from other employees whether they had countered any physical health problem during working in laundry service. Some employees answered they had, and some used to have at the beginning of their work, but after a while the symptoms of MSDs had gone. Therefore, the purpose of this research was to identify the most MSDs associated with laundry employees who work at Pohjolan Tekstiilipalvelu company and find the correlation between some risk factors (age, sex and work duration) with MSDs. Another purpose was after collecting the data, create an exercise poster and an information package which promote employees' musculoskeletal health. Poster provides some exercises according to the most common MSDS that can be done on break times or at homes to release the tension in their muscles because of long working hours. Besides that, an information package, which includes advice regarding the optimal type and dose for resistance exercises, are made accessible for the laundry company.

The aim was to make employees and commission party aware of the existing WMSDs and try to prevent in an early stage or at least reduce the symptoms of them. Because this trend helps employees to have better quality of life and improve their lives by enjoy working in laundry service. The aim of this research for commission party was by preventing/reducing the MSDs among employees, company develop occupational safety and healthy work environment. Consequently, by having better workforce and productive employees makes a good business sense. In conclusion, by providing answers and products to the commission party help to develop its healthy work environment and safe work and employees feel good about their work environment.

4.1 Research questions/hypothesizes

In this part, authors covered the research questions/hypothesizes that were trying to uncover through this research. The research questions/hypothesizes of this thesis were the following:

1. What are the most common MSDS among laundry employees in laundry service company? It assumed the most main MSDs among laundry employees would be knees due to

long hour standing in constant posture and fingers due to grasping, pulling and holding laundry material.

2. Find the relation between some risk factors (sex, age and work duration) with MSDs:

2.1. It assumed that the number of women employees faced MSDs are more than men employees in laundry service.

2.2. It assumed that older employees have more MSDs than the younger employees.

2.3. It assumed the employees with more work duration have higher MSDs than the ones who have less work duration.

3. What exercises are appropriate to be considered for the poster and information package in order to help reduce/prevent MSDs.

4.2 Research limitation

There was a major change in the workforce of the commissioning party. The employer decided to fire a few of the employees and later hired new ones. Therefore, a few of employees were new and worked only for a few months. The MSDs from the participants would be drastically reduce due to lack of time exposure to working environment. Their previous work could also influence their MSDs. In this case, in the demographic questionnaire there was a question about their previous work to know if the cause of their MSDs come from their previous work.

The other problem in this research was that some employees were not able to speak English language in this case, authors had to provide questionnaire in Finnish is not their first language. The manager of the company did not have employees' contact information, we were therefore required to hand out questionnaire to them manually. The limitation in this study was that MSDs were assessed by self-reported data and not measured objectively by using standard scale or technique to measure pain and weakness. If either men or women had under or over reported, the results could have been biased, because men and women interpret differently in symptom description (Ekman et al., 2005).

There are other factors that may be affecting the participants answer on the questionnaire. Factors such as culture, work problems or other personal problems that may hinder them from answering honestly. Lack of incentives to answer could be the reason many participants chose not to answer the questionnaire or not answering honestly. These factors are not taken into consideration for this thesis, it could be used for future research.

5 Thesis process

This part explains about the thesis process which divided to two parts; research process and product development process.

5.1 Reaerch process

Facing the MSDs affects employees' work ability, performance, the quality of life and it also leads to the situation which employees no longer enjoy working and quit the job (Lahti et al., 2010). The process had started in December 2018 when one of the authors had a conversation with managers of laundry service about exploring whether employees had suffered MSDs during working hours. This idea came to authors' mind, because one of the authors worked in laundry company and faced MSDs symptoms after a few months of working and this leaded to ask a few of other employees whether they had countered the same physical health problem

After agreement between the authors and managers, the idea of the topic grew slowly, and authors started to compiled materials and literature in January 2019. It was tried to choose relatively new materials, between 2010-2018, but because of limited studies had been done about laundry employees, there were no new articles or research about it. Material from the internet has been searched mainly through Pubmed, Google Scholar, Theseus and Sportdiscus services including other reliable websites found from Google. In addition, we were using book that we found in Kamk library website and ordered from Oulu University of applied science.

5.1.1 Focus group

The group for whom we aimed to offer the participation for this thesis were employees in Pohjolan tekstiilipalvelu company. The reason was that this company was the biggest laundry company in Kajaani and one of the authors worked there and had access to the managers and em-

ployees easier. Employees were from different nationalities and both men and women in different age worked in this company. In this study pregnant women, or those diagnosed with any form of MSDs, and currently seeking medical treatment were removed to prevent affect the result.

29 employees; 19 women and 10 men participated in this research and questionnaires were distributed to get the results of MSDs faced by the employees in the company. The first questionnaire was demographic questionnaire which contained the personal information of employees (appendix 1&3) and provided by authors. The second questionnaire was and Cornell Musculoskeletal dis-comfort Questionnaire (CMDQ) which is a standardized questionnaire for collecting data about MSDs (appendix 2&4) and concentrates on symptoms employees encountered in their career (Kuorinka et all, 1987). CMDQ has used a lot in different researches about MSDs and the reliability has been approved.

All employees' data compiled and made a statistical calculation on the correlation between age, sex and work duration with MSDs. Pearson correlation used to calculate the correlation between it and found if there is any linear correlation. However, when the results did not show any correlation, the scatterplot graph did, we used both Pearson and Spearman to measure the correlation. Reason for using this formula was because it was the best formula to find the strength of correlation between the MSDs and work condition. Many researches use this formula to calculate correlation between data.

5.2 Product development process

According to World Health Organization and World Economic Forum workplace is an appropriate environment to implement health promotion program to reduce some risk factors on employees (WHO/WEF, 2008). After all the necessary information had been compiled the products were created. Two products were obtained from this thesis; poster and information package. The form of the poster and information package were chosen because employees would not look for advice on how to prevent/reduce the MSDs in research and scientific report and It is preferred to use easily accessible information which is understandable. The aim of the authors to provide poster was poster can be mounted, framed or stuck on to any surfaces and employees by looking at the picture of exercises remind them to care about their physical health before the serious damage

occurs in their bodies. In the poster mainly focused on visual aspect of exercise with short instruction due to eyes are the most important organs of sense and 90% of data information sent to brain is by means of eyes. Furthermore, Human brain process the images much faster than text (Eisenberg, 2014).

Evidence showed that employees due to lack of opportunity for exercise in the workplace through lack of time at work and/or access to exercise equipment may not do exercise (Lowe & Dick, 2015). In this case, it tried to choose some exercises which required minimal equipment and can be performed in the break times at workplace or either at home. This poster contains picturesque exercises with basic information regarding the most common MSDs which helps the employees relieve muscles tension and fatigued caused by monotonous movements and static working posture during the day. Furthermore, it helps to relieve MSDs symptoms and prevent new employees from getting them. The sources used to create the poster was mainly from the results of this thesis research with additional information from scientific literature beside authors' experience.

As it is known for everyone physical activity is beneficial for health status of employees and reduce MSDs, absenteeism, sick leaves, health costs and increase productivity (WHO/WEF, 2008), but what type of physical activity would be appropriate to prevent/reduce MSDs was a main question to create poster and information package. Authors decided to choose some resistance exercises for laundry employees since some studies showed resistance exercises were more effective than aerobic and stretching exercises (Ylinen et al., 2005, Van Eerd et al., 2016; Lowe & Dick, 2015). Moreover, specific resistance training was more effective in preventing the development of UEMSD symptoms among asymptotic (Blangsted et al., 2008;). In this case, the resistance exercise programs with enough intensity and frequency with respect to laundry employees' occupational load was planned to gain beneficial effects on prevent/reduce MSDs.

5.3 Guidance for creating poster

Poster can be used for different purposes; seminars, conferences and advertisements (guidance for creating academic poster, n.d). The purpose of this research to produce an exercise poster was using the poster as a tool to raise the awareness of employees about existing WMSDs in

laundry company. To create an effective poster there are number of subjects should be considered.

A) What is the purpose of creating poster?

The purpose of the poster is usually to draw the focus group attention and make them interested to look at or read the poster(guidance for creating academic poster, n.d) .In this research the purpose of creating the exercise poster was to provide some specific resistance exercises according to most common MSDs among laundry employees.

B) Who is the audience?

It should be considered who is the audience; students, researchers or public and it should be thought how much audience have knowledge about the topic of the poster. Because before thinking about what information should be mentioned in the poster, it is necessary to know whether audience understand some of our terminology and expressions (guidance for creating academic poster, n.d). In this research the audience were ordinary people who worked in laundry company. Hence, tried to use information in a context of poster which is simple to understand.

C) What content need to be included?

Everything which included in the poster should be relevant to the topic and should not try to cover entire research. Focus should be on the information which have the most relevant for the focus group. It is recommended to insert the references, sources or web links if the audience need for further information ((Stuckey & Hoyer, n.d). In this research poster references mentioned at the bottom left of its which if laundry employees wish to know more about the exercise' instructions can refer to the links. The content of the poster was focused specifically on knee and hand resistance exercises.

D) How the poster should be organized?

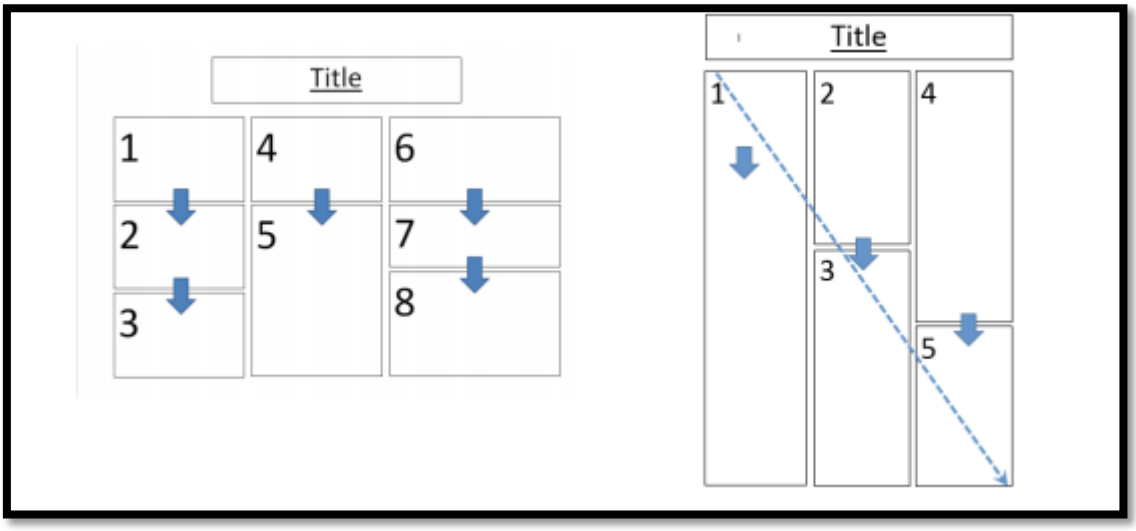
It should be considered how much text needed to explain about the theoretical background, research questions and result and what visual aesthetic used in the poster (guidance for creating academic poster, n.d). This poster which was the exercise poster, the image of each exercise was shown on the poster with the short instruction under each image. Because this poster is not an academic posture and focus group is laundry employees, it was avoided to explain in an academic way.

5.3.1 Poster design

The size of the poster and the visibility of content in the poster is important, all elements in the poster should be visible from at least 1.5 meter, if the elements would not be clear from 3-meter the audience most likely not approach it (guidance for creating academic poster, n.d). The size of the poster is usually A0, A1, A2, which for this research A2 was chosen. Poster should be well-designed, and the layout should be attractive and easy to follow, in addition, with clear headings and subheadings. In this research the heading of the poster “Knee strengthen exercise” and “Hand exercise” wrote with a big font size and tried to insert four relevant exercises on the right side of the poster and four others on the left side to make the poster appealing to audience. Moreover, the KAMK e-poster template were decided to choose for posters to show the provided information is based on the valid research.

5.3.2 Reading order

The first 3 seconds of looking at the poster reader decides to stay or leaves it. The poster is acceptable which has proper sequence of information and provides distinct reading order (guidance for creating academic poster, n.d). As it showed below (pic. 1) the most common way people read the poster is from top to bottom and left to write. This is the method was implemented in the exercise poster.



Pic. 1. Reading order in poster (retrieved from guidance for creating academic poster, n.d).

5.3.3 Balance

The good poster should have balance between the text and images in a way that both elements are arranged well across the poster. Balance can also mean that ensure the poster is not messy and by placing images throughout the poster break the text into chunks which makes easier for audience to read and follow (Stuckey & Hoyer, n.d). 40% of poster should be blank, strategically use this space draw attention to the most important messages and allow audience to pause and understand better (Making a better research poster, 2016).

5.4 Information package

An information package can be a simple collection of documents or formal handbook which used as a useful tool to provide key information for target group Depending on the nature of topic/work, it might be chosen to provide basic information package or comprehensive set of documents (how to make an information package, 2017). The information package which we create is very basic and informative, clearly illustrated start/finish position of exercise. Some instructions which are for poster applied for the information package, too, like considering the target

group, the purpose of research, what information should be included in it. It contains assortment of resistance exercises for common MSDs like neck, shoulder, back and knees. Resistance exercises is the one way to improve musculoskeletal health condition. The amount of the exercises was limited in a way that it covered all the body parts, but still the number was enough to produce a respectable result in given time. Like the poster, the sources are mainly from scientific literature and authors' experiences.

In summary, therefore, the products were created based on specific resistance exercises regarding the minimal needed equipment for poster exercise and more detailed, explanation and advice on exercises in the information package. Unlike the poster that cater for two most common MSDs, the information package is for all the most common MSDs.

5.5 Language of products

When producing the poster and the information package for public, the language plays essential part to understand the concept. The language should be an informal, simple and understandable. Shorter sentences are preferred over long ones in poster and shorter paragraph for the information package. The reason is that by reducing the amount of information keep the readers motivated to follow the instructions. Moreover, author should use the term of 'you' in order to connect with readers (Theard, 2019). It is recommended to avoid use of jargons or extraordinary words (Theard, 2019) which is used in a particular profession or by a particular group of people, which are difficult for others to understand (longman dictionary, 2019). Before publishing the poster and the information package editing should be done and attention should be toward limiting the unnecessary information and words and keep it as short as possible with the only necessary amount of information. Furthermore, grammar and spelling should be checked and if there is any cohesive between sentences (Theard, 2019). One solution is that to read the text loud because it is easier to find that whether there is rhythm and make sense (liz, 2019 cited in Theard, 2019).

6 Reliability and ethics

Reliability explains a tool measurement is reliable when the test repeats and gets the same or similar result over and over (Kasanen, 2019). If anyone using the tool measurement in a research study should undertake their own test-retest reliability (Hedge, n.d). One of the used questionnaires in this thesis was Cornell Musculoskeletal Discomfort Questionnaire (CMSDQ). CMSDQ can have different responses due to the nature discomfort musculoskeletal occurs over longer test-retest intervals (Hedge, n.d), but CMSDQ has highly used in MSDs researches and the reliability was proven by variety of researchers. The reliability of thesis was Improved by planning enough time to collect information and materials before the products would be created. The method, data analysis was an appropriate method to find reliable way of how to reduce/prevent MSDs in laundry service.

Work environment in laundry service was international, thus, English version of questionnaires was distributed among foreigner employees and the author translated questionnaires to Finnish also to make more understandable and clearer for Finnish employees. The correctively of language was checked by native Finish people. Hence, it can be claimed that the translation of questionnaire has not decrease the reliability of the thesis.

The products were reliable because they were based on theory and results which was gathered for thesis, moreover, reliability improved by using various sources. The instruction of each exercise in information package were clearly separated for each common MSDs and only information which was valid published on it. The validity of the products was improved by giving enough time for the creation of them.

Validity explains whether the tool measurement is appropriate for addressing the aim (Kasanen, 2019). If the tool is invalid, then the result would be meaningless. CMSDQ has high validity and it is derived from previous similar researches. The validity of the thesis was improved by collecting theoretical foundation information from different materials related to topic. Materials, articles and reports seem valid because the publishers of articles and peer reviewed articles have an obligation to publish reliable information.

The demographic questionnaire developed by author. The reason was to know about employees' age, sex and work duration to calculate the relationship between risk factors and MSDs. Other questions in the demographic questionnaire was in order to control the other variables (height, weight, any injuries) and if the employees would not fit to our sample test would be dropped out.

The ethical of the thesis was taken into consideration. The participants were asked to be honest in their answers for the questionnaires. The participants' information in the questionnaire were kept in confidential, including from the commissioning party. Participants confidentiality were protected by not giving out their names. Only information that was provided results to this thesis were in the questionnaire, the employer or third party did not know the participants of each questionnaire thus protecting their confidentiality.

Written informed consent was collected from each participant before starting the research. The participation was completely voluntarily, and we provided information package and a poster that are scientifically proving to be effective to reduce/prevent musculoskeletal disorders based on previous research with multiple sources for it. This ensured the reliability of the thesis.

The commissioning party which is "Pohjolan Tekstiilipalvelu Oy" provided the participants for this research. The research was done solely on their participants and the result was given to them for their future use. They will use it for their employees to prevent/reduce MSD arising from working in their company. This will improve their workforce and the general wellbeing of employees.

7 Research method and analyzes

The method used in this research are quantitative research process. Quantitative research interprets results through data (University of Southern California, 2019). This thesis is divided into two main parts, the first part being the population research and the second being the product development. Quantitative research is used in the first part of this thesis of describing the population through a sample data. The data are obtained by questionnaire given and interpreted using statistical formula to describe the population, the product is created based on the results from the data.

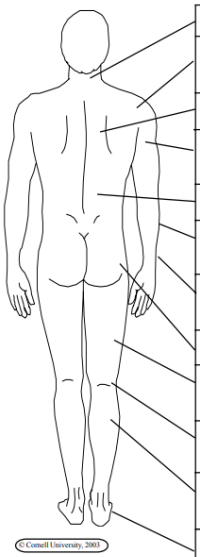
Reasons for using quantitative research is because a description is needed on the population regarding the scale of severity of MSD, target groups that are more likely to get MSD and joints that are most affected. An explanation of reason for the MSD is not the focus point in this thesis. However, future qualitative research can be conducted based on the results of this descriptive research thesis. The product of this thesis is based on the description of data and not on reasons of how and why the MSD are affecting and being affected by the population.

Quantitative research requires an amount of sample data to interpret its data, the bigger the data sample the better (University of Southern California, 2019). Questionnaire is given to every employee of Pohjolan Tekstiilipalvelu company which is the biggest laundry company in Kajaani. Due to its size and nature of the company, it is the best company to obtain a large sample size for this thesis research. With a large sample size, the data of this quantitative research would be very close to the population data (University of Southern California, 2019).

A major symptom in musculoskeletal disorders is pain. Symptoms data can be obtained easily through questionnaire. Self-administered questionnaire is chosen for data collection to explore the incidence and prevalence of musculoskeletal disorders. There was a total of 29 participants in this study. However, 3 of the subjects were excluded during the study due to incomplete and unclear data. Therefore, the results of 26 participants were included in the final analysis, which 16 were women and 10 were men. MSD of severity of >5 which we identified as moderate severity were calculated out to identify the most common MSD. These values used in all statistical formula calculation.

This thesis was a research based quantitative thesis which used statistical analysis to obtain result from data gathered. The data collecting tools were demographic form and Cornell Musculoskeletal dis-comfort Questionnaire (CMDQ). Cornell Musculoskeletal Discomfort questionnaire (CMDQ) is a tool for collecting information for musculoskeletal disorders and it is for research screening purpose not for diagnostic purpose. On this questionnaire a body map with twenty areas of body is shown which evaluate the frequency, intensity and the effect of the musculoskeletal disorders on individual's work ability during the last week (Figure 3).

On demographic form, we collected data regarding personal information such as sex, age, weight, height, years of working experience, previous work, average daily working hours, average sport or physical activity doing (hours per week) and type of exercise will be gathered.



The diagram below shows the approximate position of the body parts referred to in the questionnaire. Please answer by marking the appropriate box.	During the last work week how often did you experience ache, pain, discomfort in:					If you experienced ache, pain, discomfort, how uncomfortable was this?			If you experienced ache, pain, discomfort, did this interfere with your ability to work?		
	Never	1-2 times last week	3-4 times last week	Once every day	Several times every day	Slightly uncomfortable	Moderately uncomfortable	Very uncomfortable	Not at all	Slightly interfered	Substantially interfered
Neck	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Shoulder (Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Shoulder (Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Upper Back	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Upper Arm (Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Upper Arm (Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Lower Back	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Forearm (Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Forearm (Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Wrist (Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Wrist (Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Hip/Buttocks	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Thigh (Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Thigh (Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Knee (Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Knee (Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Lower Leg (Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Lower Leg (Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Foot (Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Foot (Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Pic. 2. Cornell Musculoskeletal Discomfort Questionnaire (CMDQ).

The diagram above is the questionnaire for the musculoskeletal disorders of the participants Cornell Musculoskeletal discomfort Questionnaire (CMDQ). Reason using this questionnaire was because it had been used in other thesis analysis for MSD (Shakerian et al., 2016). The answer from each body part in the musculoskeletal disorders' questionnaire will be converted to numbers and

multiplied with each other to obtain the number for pain severity. For the data on the amount of pain in a week, we convert 0 times a week to 0, 1-2 times a week to 1, 3-4 times a week to 2, once every day to 3 and several times a day to 4. For the level of uncomfortable, slight uncomfortable will be 1, moderately uncomfortable will be 2 and very uncomfortable will be 3. If the answer was none for frequencies of pain, the converted number would be zero. No further calculation was used from the data because there was no condition observed. In the correlation between sex and MSD, the pain severity for all joints were added with each other. The results from each questionnaire was used for calculating correlation. There was a statistical correlation calculation between musculoskeletal disorders with age, MSD with work duration and MSD with sex.

The statistical analysis that used was Pearson correlation to determine the relationship between the age with each musculoskeletal disorders and MSDs with work duration. However, when we determined there was weak linear relationship but were still correlated with each other after calculating, Spearman calculation used to determine if there was an order scale between it (Schober et al., 2018). For MSDs with sex we used relative contingency coefficient formula. With the result from the correlation, it was easier to obtain the causation of their MSD. The causation obtained from scientific literature with the correlation in mind.

7.1 Pearson Correlation Coefficient

Pearson correlation coefficient is a method of statistical analysis and is widely used in science. Pearson Correlation coefficient is agnostic to the type data; the data set may present astronomy, biology, economics; the only limitation being that the elements must belong to real numbers ($\mathbb{R}$) and linear correlation appearing from the data is a meaningful thing to expect, knowing the nature of data. For example, if the elements of the data are expected to be inversely proportional or otherwise spread non-linear then searching for linear correlation is a wrong premise. Before conducting the calculation for the Pearson correlation, the researcher should first think, is the data expected to correlate linearly in the first place, is it logical that it will do that and what does it mean if it indeed does so. What does it tell from the data if there is no correlation? If the premise of looking for linear correlation is logically sound, the data set is adequate but still no correlation is found, then it’s safe to assume no underlaying correlation exists.

When the analyzed data set is population it has become a custom to use ρ – the Greek letter rho – as a symbol for Pearson correlation coefficient. Pearson correlation measures the linear correlation between two variables such as $\boldsymbol{X}$ and $\boldsymbol{Y}$ in a given data set. For any given set of real variables Pearson correlation returns a value from -1 to 1. The sign of ρ marks the direction of the correlation – negative or positive – and absolute value of ρ marks the strength of correlation. Negative correlation means that $\boldsymbol{Y}$ gets lesser in function of $\boldsymbol{X}$, positive correlation means that $\boldsymbol{Y}$ gets higher in function of $\boldsymbol{X}$. The strongest possible correlation is found when $\rho = \pm 1$, which is the case when all members of the given data set lay on a straight line. On the other hand, the closer ρ is to zero the further the data set is from forming a straight line. (Rumsey, 2009)

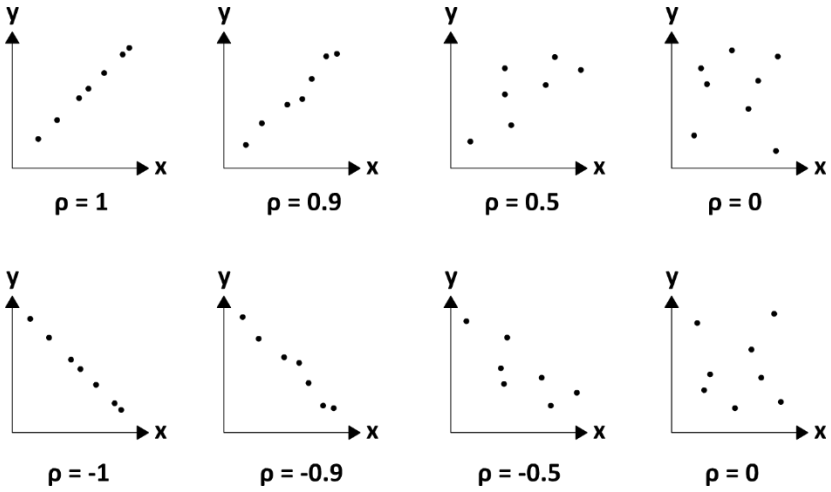


Figure 3. Examples of data sets with their Pearson correlations

Pearson correlation coefficient is derived from covariance $cov(\boldsymbol{X}, \boldsymbol{Y})$ with the mean values $\mu_{\boldsymbol{X}}$ and $\mu_{\boldsymbol{Y}}$, the standard deviations $\sigma\boldsymbol{X}$ and $\sigma\boldsymbol{Y}$ and the statistical expectation $E[X]$.

$$\rho_{X,Y} = \frac{cov(\boldsymbol{X}, \boldsymbol{Y})}{\sigma\boldsymbol{X}\sigma\boldsymbol{Y}}$$

$$E[X] = \sum_{i=1}^{k} x_i p_i$$

Where x_i is the element of index i and p_i is the probability of x_i.

Covariance can be expressed by using the expectation $E[X]$:

$$cov(\boldsymbol{X}, \boldsymbol{Y}) = E[(\boldsymbol{X} - \mu_{\boldsymbol{X}})(\boldsymbol{Y} - \mu_{\boldsymbol{Y}})]$$

Thus, a practical formula for Pearson correlation can be formed:

$$\rho_{X,Y} = \frac{E[(\boldsymbol{X} - \mu_{\boldsymbol{X}})(\boldsymbol{Y} - \mu_{\boldsymbol{Y}})]}{\sigma \boldsymbol{X} \sigma \boldsymbol{Y}}$$

The question whether a certain data set is showing correlation will not always have a straightforward answer. The correlation must be interpreted in respect to the size of the data set; the weaker the correlation is the larger must the data set be in order to make a definitive conclusion whether the data is correlating. If the data set is large enough to conduct a meaningful study, then by getting correlation $|\rho| > 0.5$ is a definitive sign for strong correlation. However, if data set is inadequate even moderate correlation such as $0.3 < |\rho| < 0.5$ might be due to natural randomness and the existence of the underlying correlation can be put to question. The table below demonstrates how correlation values can be interpreted broadly.

Correlation value	Interpretation
$\rho = 1$	Perfect positive correlation
$1 > \rho \geq 0.5$	Strong positive correlation
$0.5 > \rho \geq 0.3$	Moderate positive correlation
$0.3 > \rho > 0$	Week positive correlation
$\rho = 0$	No correlation
$0 < \rho < -0.3$	Week negative correlation
$-0.3 \leq \rho < -0.5$	Moderate negative correlation
$-0.5 \leq \rho - 1$	Strong negative correlation
$\rho = -1$	Perfect negative correlation

One way to calculate Pearson correlation coefficient is by using the previously mentioned formulas and typing the values into a pocket calculator. Faster and less error prone way is to use a mathematical software such as Matlab. With Matlab one simply creates two arrays of equal length and inputting a short console command:

Calculating correlation coefficients with Matlab
1. Create array from your data and name it for example: **arrayX** 2. Create another array from your data and name it for example: **arrayY** 3. Input console command: correlationCoefficient = corr2(arrayX, arrayY)

7.2 Choosing Pearson correlation

In the thesis there were research hypothesis that MSDs correlates with age and work duration. A premise that rough physical work rather causes more symptoms than lessens them seem natural and sound. Therefore, the correlation between work duration is expected to be direct and not inversely proportional. Another question is whether the correlation is linear or non-linear. Pearson correlation is a good tool to find answer into these questions.

The other research hypothesis was whether age correlates with the symptoms. This question is fundamentally same type as the other one, so Pearson correlation will be used again. However, it's important to notice that these two hypotheses are not entire independent from each other; work duration is dependent on age since one cannot accumulate the other without the other. However, the connection between those two research hypotheses will be ignored in the research.

7.3 Spearman correlation

Spearman correlation is a rank-based method for evaluating a dataset of two variables such as $\boldsymbol{X}$ and $\boldsymbol{Y}$. Spearman correlation is agnostic to the distribution of the data, which means that the values of individual elements do not matter – only how they are ranked in respect to each other's matter. Like Pearson correlation, Spearman correlation also returns values between -1 and 1.
In a sense Spearman correlation simplifies data which makes it less informative compared to Pearson correlation. However, Pearson correlation is only able to detect linear correlations which makes the method unusable when dataset is correlating in non-linear manner. Spearman correlation will also detect correlation in cases where the dataset is distributed in non-linear manner.

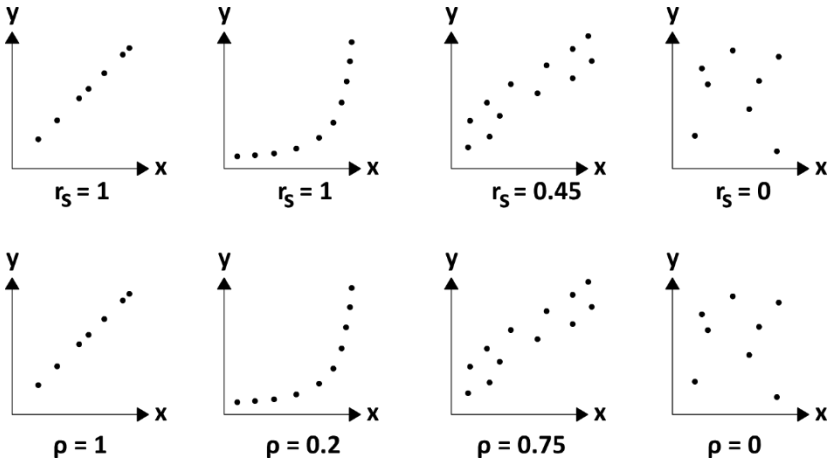


Figure 4. Differences between Spearman correlation r_s and Pearson correlation ρ.

The Picture 3 demonstrates the differences between Pearson and Spearman correlation. Pearson correlation is always perfect – returns value 1 or -1 – when elements lay on a straight line. Spearman correlation on the other hand returns 1 if each element is higher than the one before. On the other hand, if each element lower than the one before, correlation is again perfect and returns value -1.

The Spearman correlation is Pearson correlation between the rank variables. Therefore, the formula for Spearman correlation – symbol is r_s – can be conducted from the Pearson correlation formula introduced before:

$$r_s = \rho_{rg_X, rg_Y} = \frac{cov(rg_X, rg_Y)}{\sigma_{rg_X}\sigma_{rg_Y}}$$

Where ρ denotes Pearson correlation, rg_X is the rank of variable $\boldsymbol{X}$, rg_Y is the rank of variable $\boldsymbol{Y}$, σ_{rg_X} is the standard deviation of rg_X and σ_{rg_Y} is the standard deviation of rg_Y.
If all ranks for each observation n is a distinct integer the formula can be deducted into a simple form:

$$r_s = 1 - \frac{6\sum d_i^2}{n(n^2-1)}$$

Where $d_i = rg(\boldsymbol{X}_i) - rg(\boldsymbol{Y}_i)$, in other words d_i is the difference between the ranks of variable $\boldsymbol{X}$ and $\boldsymbol{Y}$ in the observation i. (Rumsey, 2009)

7.4 Using spearman correlation

In this research the main data analyzing method was Pearson correlation coefficient, because it seems natural that MSD would correlate linearly in relation to attributes like age and work duration. However, MSD may accumulate because pain in the body may lead to unpreferable working postures and habits which could lead to further MSDs. This would break the linearity in the correlation. This is why Spearman correlation was taken as an addition to analysis toolbox.

8 Results

The highest MSD percentage with moderate severity are right knee and right wrist being 15% followed by left wrist at 12%, left knee 8% while neck, upper back, left upper arm, lower back, right forearm, left forearm, right thigh, right lower leg, left lower leg and left feet at 4%. The results are obtained by first identifying the joints with higher MSD severity than 5. The participants with joints MSD of higher than 5 will be added together and divided by the total participants joints and the percentage are obtained from it. It is done repetitively for all joints.

Results for statistical correlation of MSD with age are shown in table 1 and table 1.2. In table 1, Pearson formula are used to find the linear correlation of MSD with age while in table 1.2 Spearman formula are used. Spearman formula for both feet based on the scatterplot data, it is shown that there is order correlation but not in a linear form.

As it can be seen from table 1, there is no correlation of MSD for all joints except both feet and age. This indicate that age does not corelate of joint pain, younger or older person will have the same MSD severity or lack except for feet. The value of interpretation for both feet indicate moderate negative correlation of MSD with age. After observing the scatterplot data, Spearman formula was used for further interpretation to determine if there is order correlation which is not linear.

In table 1.2, the number indicate that there is moderate negative correlation of MSD with age. It means that younger people are more likely to have pain in their feet than older people. Although the number shows as such, the authors decide not to use this interpretation as the final indication of correlation for MSD of feet and age. This is in due fact after observing the graph, scatterplot data and information from demographic questionnaire, there are many factors that are yet unexplored which could alter the interpretation value. These factors are further explained in the discussion section of the thesis. Furthermore, the values are barely within the area of moderate correlation, it is therefore not a strong indication of moderate correlation.

Body part	Pearson correlation of pain in relation to age	p-value (2 sided)	p-value (1 sided)
Neck	-0.2558	0.2072	0.1035
Right shoulder	-0.2090	0.3056	0.1528
Left shoulder	-0.1658	0.4181	0.2091
Upper back	-0.1181	0.5655	0.2828
Right upper arm	-0.2389	0.2399	0.1199
Left upper arm	-0.1825	0.3722	0.1861
Lower back	-0.0594	0.7732	0.3866
Right forearm	-0.1419	0.4891	0.2446
Left forearm	-0.1030	0.6167	0.3084
Right wrist	-0.1206	0.5572	0.2786
Left wrist	-0.2456	0.2264	0.1132
Butt	-0.2689	0.1840	0.0920
Right thigh	-0.2257	0.2676	0.1338
Left thigh	-0.2330	0.2520	0.1260
Right knee	-0.1681	0.4117	0.2058
Left knee	-0.1902	0.3521	0.1761
Right lower leg	-0.2868	0.1554	0.0777
Left lower leg	-0.2868	0.1554	0.0777
Right foot	-0.3168	0.1148	0.5740
Left foot	-0.3126	0.1200	0.0600

Table 1 show the Pearson coloration of MSD and age.

Body part	Spearman correlation of pain in relation to age	2 sided p-value
Right foot	-0.4385	0.0250
Left foot	-0.4284	0.0290

Table 1.2 shows Spearman correlation of MSD of the feet and age.

Table 2 results indicate that there is no correlation of work duration with MSDs except for right feet. It is done using Pearson formula. It indicates people do not get MSDs either from working long or short duration in the laundry company. It was decided to use Spearman for both feet based on the results in the scatterplot to identify if it is orderly correlated but not linear.

The results in table 2.2 show moderate negative correlation with lower work duration with MSD of feet. Although it is a good correlation indicator of participants who work for shorter duration are more likely to have feet pain. However, most of participants in the data work for a very short duration of time. Therefore, there is more participant with feet pain from shorter work duration,

it is because there is more shorter work duration participant in general. It is further explained in the discussion section of the thesis. Due to this reason, the authors decided that there is no correlation of MSD and work duration. There is no other MSD correlation with work duration.

Body part	Pearson Correlation of pain in relation to work duration
Neck	-0.1109
Right shoulder	-0.1686
Left shoulder	-0.0929
Upper back	0.0446
Right upper arm	-0.1600
Left upper arm	-0.0658
Lower back	0.0703
Right forearm	-0.2032
Left forearm	-0.1176
Right wrist	-0.2360
Left wrist	-0.2358
Butt	-0.1614
Right thigh	-0.1578
Left thigh	-0.1571
Right knee	-0.2849
Left knee	-0.1544
Right lower leg	-0.1974
Left lower leg	-0.1974
Right foot	-0.3331
Left foot	-0.2621

Table 2 shows the Pierson correlation of MSD and work duration.

Body part	Spearman Correlation of pain in relation to work duration
Right foot	-0.6773
Left foot	-0.5649

Table 2.2 shows correlation of MSD with work duration using spearman formula.

Another matter to be addressed is the sign of the correlation in tables 1 and 2; as it was conjectured in chapter 7.2 the correlation between MSDs and age and MSDs between work duration is expected to be positive. However, throughout the data the correlation is negative – the only exception being upper and lower back. This may be due to the premise in the conjecture being false. Since the logic behind the idea of MSDs accumulating in function of age and work duration still seems reasonable, it is needed to address other possible explanations.

As the sample size is relatively small, the possibility of the natural randomness affecting the results rises. However, there might be a deeper underlaying reason behind the data: second possibility is due to way of collecting data; questionnaire as a source of data rather tells about the perception of pain rather than pain itself. Since work duration and age are connected variables and perception of pain is a subjective perception. It is plausible that longer work duration has toughened the workers mentally. The idea in a nutshell is following: 0°C temperature feels freezing cold in autumn but warm in late winter. In this case workers would suffer the worse symptoms in their early carrier. Third possibility is that the bodies of the workers slowly adapt to the physically demanding work. As guitar players get thicker skin into their fingertips so would workers at Mankeli due to similar physical stress factors.

For the MSDs with sex, the results from relative contingency coefficient are 0.594. The results show moderate correlation with women having more MSDs than men. This indicates that women are more likely to have general MSD than men. The result here are moderately strong partly because there are more women participants than men. There might also be a cultural issue that men are less likely to identify MSDs as compared to women.

9 Discussion

The most MSDs which laundry staff have faced are knees and wrists, especially on the right side. The reason can be most employees are right-handed and human usually tend to work more with the dominate side of body. Most laundry tasks required to be done in standing position for long hours and according to Abdul Aziza (2015) studies employees who are in standing position feel more pain in their lower legs (Abdul Aziza et al, 2015) , moreover, constant posture accompany with long time contrasting muscles insert pressure on lower body (Messing, Tissot, & Stock, 2008).

Almost all task in laundry needed to be done by hands which wrist is part of it. Tasks which engage hands include grasping, pulling, holding, handling materials. Too much hands working as well as long period of working make tendency of getting wrist MSDs.

9.1 Discussion of individual risk factors and MSDs

Due to small sample size and study design it could not be drawn any conclusion about the correlation between age and MSDs. As a result, authors are not able to make classification for age and generalize the result.

There was no correlation between work duration and MSDs, except feet joint. Data showed laundry employees who worked for short duration of time had more feet pain compared to employees who worked for a long duration of time. The reason might be new employees do not have experience and not used to work in standing posture for long hours each day, and half of the employees who worked temporary in laundry service were young. This claim approved by European Agency for Safety and Health at Work, which young employees are usually hired in physical demanding job section and since they are physically and psychology immature with lack of experiences, they are exposed at risk of MSDs (European Agency for Safety and Health at Work, 2007).

A moderate correlation found between sex and MSDs, in a way that women had higher MSDs compared to men. In this thesis the number of women employees were more than men. Therefore, our result does not provide convincing evidence women are in higher risk of MSDs than men.

Moreover, women detect pain in an early stage and tend to report a stimulus as being painful (Ellermeier & Westphal, 1995).

A bigger sample size is recommended for future study as this present thesis is limited by its small sample size. Different big age gap and a greater number of women than men limited the possibility of establishing relationship between MSDs and age, MSDs and sex.

Societal and personal culture too might have affected the results. The participants might not feel comfortable to answer honestly due to multiple reasons and there are also very little participants, these will affect the outcome of the results. Some of them might say they have low pain even though it is high and vice versa. These should be taken into consideration for future studies, future authors should increase the number of participants.

9.2 Discussion of type of exercises for laundry employees

There are about 9 different tasks in Pohjolan tekstillipalvelu company. Performing different laundry tasks required distinct set of body mechanics, and the same task could be performed differently in another laundry company because of different machines and equipment. For accurate result it is important to define and examine the identified tasks and subtasks performed by laundry employees in the company. In this group of laundry employees, the highest identified common MSDs were knee and wrist especially on the right side due to long standing hours and repetitive hand movements. Some repetitive task like grasping, pulling and holing material from big laundry carts, hanging up, sort out, packaging and put in their own places, needed to use a lot of hands and fingers' force.

Even though ergonomic intervention, equipment and workplace policy modification are invented and equipment handling are taught, it seems they are not enough to compensate the risks of MSDs. In the laundry company with a tight schedule and fairly high physical demands a physical exercise between break times can be effective in reducing/preventing the risks of MSDs. Short break time schedule and work environment restrict for designing a poster exercise which can be done at break times that is why the focus of the poster exercise is on the knee and wrist exercises which some exercises can be done at home without necessity of equipment.

In some studies showed to performed work-related physical intervention programs needed 20-40 min daily or multiple days a week (Lindqvist ,2019). Hence, this kind of exercise program would not be appropriate for the laundry workplace. The poster exercise takes approximately 15 min to execute and it can be separated into smaller sections, in a way that in each break time few of exercises would be performed and the rest of them in another break time or at home. It would be interesting to know if the poster of exercise program would have effect on preventing MSDs, postural control or has positive effect on the workability.

9.3 Conclusion

The most common MSD here are the right knee and right wrist followed by left wrist. There is no correlation between MSD and age and work duration except for feet. Both feet show minor correlation of feet and age and work duration, it shows that younger people and people with shorter work duration are more likely to have MSD than their counterparts. Women have more MSD in general than men.

Other influencing factors and limitation are present and not looked into in this thesis are the societal and personal culture, small sample size, much higher number of women and most employees are young and just started to work. These limitations should be looked into in the future.

9.4 Development of professional competences

In the beginning of the thesis process it was difficult to make specific objectives and narrow our topic. Especially, there were two authors who worked on thesis, it leaded to expand the content of thesis in order to have enough study workload for both. The thesis was concentrated on authors personal favorite health and well-being promotion field and commission party was interested to know whether its employees had faced MSDs and employees willed to know whether there would be any sex difference with MSDs.

Since the author comprehended the nature of work can cause serious physical health problem for herself and for other employees, furthermore, the high number of MSDs prevalence, made the authors realize that more emphasis regarding the physical activity would be needed in work place and in their people' life.

There were many ways to prevent/reduce MSDs like changing work layout, using adjustable equipment, gender friendly and providing ergonomic work environment, but authors were looking for a way which promote also employees' general physical health. Because of this, two products created for this research; one was the poster and the other an information package. Creating posters and information package refined authors understanding of health promoting physical activity and health wellbeing, beside knowledge of anatomy and instructing skills. The exercise poster contained some exercises with simple or no equipment which could be performed in the break times or if time is an issue, to be performed at the participants free time. Type exercises that is effective for MSDs and fits in the participant busy schedule, brought another thought for authors. It was expected only one poster would be needed to provide according to the main common MSDs in laundry service, but the result of data analyzing showed two common MSDs in the same rate. Thus, authors created two posters beside an information packaged and all products delivered to commission party to be used as work well-being.

Competences in pedagogy and instructing gained by using different teaching methods in products. The authors included text, pictures with description of exercise to improve the learning of the readers.

This research caused authors to gain knowledge and experiences and combined with their own skills and competences which they had achieved during the study in Sport Management degree. Experiences which authors achieved during the thesis process contained how to search for finding reliable sources, websites and tool measurement on the Internet. Following the structure and framework of thesis and writing in academic way was another achievement. The process of theoretical foundation has expanded the professional vocabulary and helped to understand the principles of thesis making.

In addition, authors gained ethical competences by working in ethical principles. The principles of ethic were followed by informing participants the result would be published by keeping their

names and personal information anonymous as well as confidential. The result of analyzing the data and all compiled information were mentioned in the thesis without any changes.

In summary, knowledge acquired during the thesis process and studying in Kajaani University of Applied Science was great value for our development as a sport instructor and professional in the sport field. New knowledge improved our competences in health promotion especially one of the authors who like to work in well-being and sport therapy field.

10 Suggestions for future thesis

Student can use this questionnaire for other laundry services in Finland and to explore prevalence musculoskeletal disorders among employees' laundry.

Students can use provided information package and poster as a product and see the effectiveness on musculoskeletal disorders among employees' laundry.

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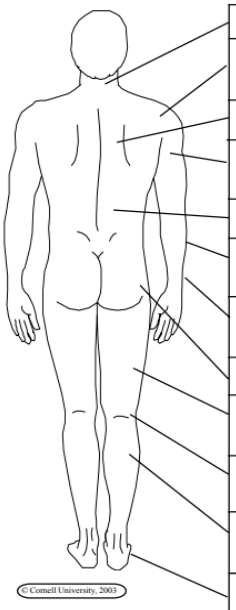
Appendix

Demographic Form in English (appendix1):

sex: Female ☐ Male ☐	Age:	Weigh:
Height:	How many years/months do you work in laundry company?	What is your average daily working hours?
What was your previous work?	How many hours a week do you do exercise?	What kind of exercise do you do?

Cornell Musculoskeletal dis-comfort Questionnaire (CMDQ) in English language (appendix 2):

The diagram below shows the approximate position of the body parts referred to in the questionnaire. Please answer by marking the appropriate box.



	During the last work week how often did you experience ache, pain, discomfort in:					If you experienced ache, pain, discomfort, how uncomfortable was this?			If you experienced ache, pain, discomfort, did this interfere with your ability to work?		
	Never	1-2 times last week	3-4 times last week	Once every day	Several times every day	Slightly uncomfortable	Moderately uncomfortable	Very uncomfortable	Not at all	Slightly interfered	Substantially interfered
Neck	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Shoulder (Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Shoulder (Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Upper Back	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Upper Arm (Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Upper Arm (Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Lower Back	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Forearm (Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Forearm (Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Wrist (Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Wrist (Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Hip/Buttocks	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Thigh (Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Thigh (Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Knee (Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Knee (Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Lower Leg (Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Lower Leg (Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Foot (Right)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Foot (Left)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Demographic Form in Finish (appendix 3):

Opiskelen Kajaanin Ammattikorkeakoulussa liikunnanohjaajaksi. Minä teen päättötutkielmani pesulan työntekijöiden fyysisestä kunnosta. Tutkielmani pohjalta, teen harjoitusjulisteen, joka tulee henkilökunnan käyttöön. Kaikki tiedot käsitellään luottamuksellisesti. Vastaamalla näihin kysymyksiin autatte parantamaan pesulan henkilökunnan hyvinvointia. Jos teillä on kysyttävää, voitte ottaa yhteyttä: delaram.jamshidi@yahoo.com , puhelin: 045 209 4007

Sukupuoli: Nainen☐ Mies ☐	Ikä:	Paino:
Pituus:	Kuinka monta vuotta/kuukautta olette työskennellyt pesulassa?	Kuinka monta tuntia työskentelette päivittäin?
Mitä työtä teitte ennen pesulatyötä?	Kuinka monta tuntia viikossa harjoittelette?	Mitä liikuntaa harrastatte?
Käytättekö lisäravinteita? Mitä?	Mikä on yleisin työtehtäväsi? Valitse 2 vaihtoehtoa. Mankeli Mankelin vastaanotto Lajittelija Viikkaaja Apupakkaaja Takkien laittaja froteentekijä	Onko teillä vammoja? Missä?

Cornell Musculoskeletal dis-comfort Questionnaire (CMDQ) in Finish language (appendix 4):

Kuvasta näet ruumiinosien sijainnin. Merkitse viereiseen taulukkoon, kuinka usein tunnet kohdassa kipua.

		Kuinka monesti teillä oli särkyjä viime viikolla?					Jos teillä oli särkyjä, kuinka epämiellyttäviä ne olivat?			Häiritsivätkö säryt työkykyäsi?		
		Ei koskaan	1-2 kertaa viikossa	3-4 kertaa viikossa	Kerran päivässä	Monta kertaa päivässä	Hieman	Kohtalaisen	Erittäin	Ei koskaan	Satunnaisesti	Usein
Niska		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Olkapää	Vasen	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Oikea	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Yläselkä		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Olkavarsi	Vasen	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Oikea	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Alaselkä		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Kyynärvarsi	Vasen	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Oikea	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Ranne	Vasen	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Oikea	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Sormet	Vasen	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Oikea	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Lonkanseutu		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Reisi	Vasen	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Oikea	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Polvi	Vasen	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Oikea	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Sääri	Vasen	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Oikea	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Nilkka ja jalkaterä	Vasen	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Oikea	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐