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**PREVALENCE OF WORK-RELATED  
MUSCULOSKELETAL DISORDERS(MSDS)  
IN A SUPERMARKET**

Master's thesis

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**TÖÖGA SEOTUD LUU-  
LIHASKONNAHAIGUSTE ENNETAMINE  
SUPERMARKETI TÖÖLISTEL**

Magistritöö

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Ph.D., Emer. Prof.

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## **Author's declaration of originality**

I hereby certify that I am the sole author of this thesis. All the used materials, references to the literature, and the work of others have been referred to. This thesis has not been presented for examination anywhere else.

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## Abstract

**Background:** In Estonia, work-related Musculoskeletal disorders affecting the upper body and limbs are identified as one of the leading causes of pain and injury in occupational health. Because of long-lasting complications with the arm, leg, back, or spine, Estonia's work capability was limited in 2009 for 59 % of 15–64-year-old workers. In Europe, 95,000 cases of musculoskeletal ailments were reported among the working-age population in 2010, which caused the direct costs of nearly 400 million euros.

**Aim:** The aim of the research to investigate the working conditions in a supermarket and the health disturbances of the musculoskeletal system of workers.

**Methodology:** Measuring the working environment hazards, self-administered questionnaire, measurements of workplace ergonomics (the ART tool), and semi-structured interviews.

**Results:** Approximately 79% of supermarket workers reported work-related musculoskeletal symptoms in at least one body region. Low back pain is the most prevalent WMSDs among supermarket workers in Estonia after that foot pain is the second most pervasive WMSDs. Most of the workers are satisfied with their work. Apart from this, low lighting is one of the leading environmental risk factors.

This thesis is written in English and is 56 pages long, including eight chapters, six figures, and three tables.

## **Annotatsioon**

# **TÖÖGA SEOTUD LUU-LIHASKONNAHAIGUSTE ENNETAMINE SUPERMARKETI TÖÖLISTEL**

Taust: Eestis on töötervishoiuga seotud valu-ja kehavigastuste üks juhtivaid põhjusi, mis kahjustab ülakeha ja jäsemeid. Pikaajalise käe-, jala-, selja-või selgroo tüsistuste tõttu oli Eestis 2009. aastal töövõime piiratud 59%-l 15 – 64-aastastel töötajatel. Euroopas registreeriti tööealisel elanikkonnal aastal 2010 tööga seotud luu-lihaskonahaigusi 95 000, mis põhjustasid otseseid haiguskulusid peaaegu 400 000 000 eurot. Need probleemid on eriti nähtavad 40-65.aastaste naistöötajate puhul.

Eesmärk: teadustöö eesmärgiks on leida tööalased ohud, mis põhjustavad supermarketite töötajate luu-ja lihaskonna häireid ning millises kehaosas on kõige rohkem on haigusnähtude.

Metoodika: töökeskkonna ohtude mõõtmine, töötajate poolt täidetud küsimustik, töökoha ergonoomika (ART-tööriist) mõõtmine ja poolstruktureeritud intervjuud.

Tulemused: umbes 79% supermarketi töötajat teatas tööga seotud luu-lihaskonna sümptomeid vähemalt ühes kehaosas, enamik töötajaid kaebab alaselja ja jalgade valusid. Enamik töötajatest on oma tööga rahul. Madal valgustus töökohtadel on üks juhtivaid töökeskkonna riskitegureid.

Magistritöö on kirjutatud inglise keeles ning sisaldab teksti 56. leheküljel, sealhulgas 8 peatükki, 6 joonist, ja 3 tabelit.

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## **List of abbreviations and terms**

ART tool	The assessment of Repetitive Task tool
CTS	Carpal Tunnel syndrome
GBD	Global Burden of Disease
HSE	Health and Safety Executive
LBP	Low Back Pain
MSDS	Musculoskeletal Disorders
NIOSH	National Institute for Occupational Safety and Health
RA	Rheumatoid Arthritis
TOS	Thoracic Outlet Syndrome
WMSDs	Work-related Musculoskeletal Disorders

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# **1 Introduction**

Work-related musculoskeletal disorders (WMSDs) caused by frequent movements and other occupational risk factors in the workplace become one of the significant work-health problems in developing and developed countries [46]. Musculoskeletal disorders (MSDs) affecting the musculoskeletal system, including nerves, tendons, muscles, and supporting structures such as intervertebral discs [60]. MSDs affect millions of peoples globally and represent the most common source of long-term severe pain and physical damage [94]. Various disorders such as WMSDs, repetitive strain, and cumulative disorders are used to describe the types of diseases of the soft texture [56].

## **1.1 Problem statement**

Work-related MSDs affecting the upper body and limbs are identified as one of the leading causes of pain and injury in occupational health in Estonia [47], [97], [59]. Because of long-lasting complications with the arm, leg, back, or spine, Estonia's work capability was limited in 2009 for 59 % of 15–64-year-old workers. In Europe, 95,000 musculoskeletal ailments were reported among the working-age population in 2010, causing the direct costs of nearly 400 million euros. These problems are especially prevalent among women 40–65 years of age. The compensation was paid in Estonia in 2008 for 6.4 million working days, 16% of which was compensation for musculoskeletal disorders. According to the various estimates, the cost of sick leave in Estonia is 6–15% of GDP [78].

Work-related musculoskeletal disorders (MSDs) are the primary cause of the development of occupational disease in Europe and the world [71], [74], [55]. The development of MSDs within the supermarket worker is the research objects in the current study. The prevalence is given to upper limb and back pain [2], [10], [3], which are the most significant cause of incapacity for work, with direct costs amounting to between 0,5 % and 2 % of the gross domestic product in Europe [89].

Work-related musculoskeletal disorders (WMSDs) affecting the upper body and limbs are recognized as one of the leading causes of pain and disability in occupational health [26], [25], [17]. The Global Burden of Diseases (GBD) 2010 Study [44] is the most

systematic attempt to quantify musculoskeletal disorders' worldwide burden. The prevalence and risk of developing musculoskeletal diseases are high across the globe. In the US and Australia, MSDs are the most prevalent work-related disease [98], [80]. WMSDs typically develop gradually, often over the years, and their symptoms at an early stage of the disorder are nonspecific by nature [35], [38], [29]. Long-term work in a forced position, continuous stress in a single muscle type, repeated repetitive stereotypic motions, manual weight shifting are the significant causes of repetitive strain injuries overuse syndrome, and serious illnesses.

The majority of research on supermarket employees have focused on repetitive hand movements by cashiers and the checkout station layout [11], [31], [73], [77], [90]. All supermarket employees have still handled materials manually and are vulnerable to WMSD-related physical risk factors. For example, heavy garbage lift in the production department, heavy handling in meat departments, and awkward poses on back and shoulder when stocking shelves.

The impact of WMSDs on any working population may be measured through workplace compensation claims. An increased frequency or prevalence in the workforce suggests that such workers are more vulnerable to physical risk factors in the workplace.

## **1.2 Aim and objective**

The aim of the study to investigate the working conditions in a supermarket and the health disturbances of the musculoskeletal system of workers. The objective of the study was the supermarket workers (N=50). Based on the research, it is possible to foresee the hazards that can cause the health disturbances of muscles in the first stage of the illness. In this stage, it is possible to rehabilitate the workers and work ahead in the same speciality. Specialized training and physiotherapist consultation are needed.

## **1.3 Research questions**

What are the most prevalent MSDs among supermarket workers?

What are the occupational hazards which tend to cause MSDs?

What are the workers' thoughts about improving their working conditions?

## **2 Background**

This chapter will discuss the basic concept, prevalence, risk factors, and different types of WMSDs.

### **2.1 The basic concept of work-related musculoskeletal disorder (WMSDs)**

Work-related MSDs define musculoskeletal system disorders and diseases associated with chronic traumas such as repeated activity, excessive force, uncomfortable and persistent postures, extended sitting, and standing at work [19]. WMSDs may affect the extremities of the upper limbs, lower back area, and lower legs [61]. In the medical profession, musculoskeletal disorders were diagnosed for several years. In the 18th century, the Italian doctor Bernardino Ramazzini discovered the correlation between WMSDs and other musculoskeletal disorders [70].

The physiological and biomechanical strains of human tissue, particularly tendons and sheath, are linked to repetitive tasks during and after the 1960s. As a result, various guidelines were established for designing and organizing workstations and using tools and equipment to reduce WMSDs potentially [56].

WMSDs are the most prevalent occupational disease in Europe; however, musculoskeletal disorders linked explicitly to hard working conditions tend to be decreasing, whereas stress-related and work-related disorders are rising [28].

### **2.2 The prevalence of work-related musculoskeletal disorders**

Musculoskeletal disorders are the primary occupational disease in Estonia [59]. Work in awkward posture and long-term monotonous work is the leading cause of MSDs. Both office and industrial workers have musculoskeletal disorders. Manual workers, including the supermarket workers, have a high risk of developing an occupational disease. Supermarket work ranked in the top 25 occupations for injuries, including neck, rotator cuff syndrome, carpal tunnel syndrome, wrist tendinitis, and back disorders, including sciatica. [21].

Work that does not allow relaxation to compensate for hormonal changes in an individual can result in permanent injury and overload-based diseases not only in muscles, but also in tendons and joints, as well as pinched nerves (carpal tunnel syndrome), and functional disorders [22], [48], [39], [62]. Therefore, special attention should be given to muscle fatigue growth, the availability of sufficient rest breaks, key symptoms, and individual assessments of the physical workload. [76], [86], [83], [18].

Work-related musculoskeletal disorders (WMSDs) of the neck and shoulder have been associated with many forms of jobs and types of work, ranging from those identified as physically challenging, such as farm work and hospital care. To those considered relatively steady, such as dental work, work with video monitor terminals, work with sewing machine operators [8], [12], [13]. Repetitive tasks with hands can often cause the loss of work capacity in long term practice [94], [75].

The 4th European Working Conditions Survey results suggest that WMSDs currently impact approximately 60 million employees in Europe. Sciatic nerve pain thus tends to be the most common occupational health issue within the EU, accompanied by overall fatigue (22.5%) and stress (22.3%). The difference between Member States' self-reported backache rates is pretty broad. Maximum in Greece, which is 46% and minimum in the United Kingdom, which is 10% [15]. According to the 5th European Working Conditions Survey, European workers remain vulnerable to physical hazards, which means that the occupations of many Europeans also involve physical work. For instance, 33% of employees lift heavyweight for most of their working period. About 46% of employees work in an exhausted or awkward posture in 75% of their working time. [18].

In several countries in Europe, including Finland, the cause of irreversible lack of workability is due to mental illnesses in Finland [54]. Most MSDs cause local irritation, muscle stiffness, or pain; joint mobility may fail, stopping individuals from coping. Most MSDs are psychologically reactive to load, but the physical load can exacerbate the symptoms, even if the condition is not linked to work. MSDs are most often triggered in combination. The physical load, the intensity of work and working, and rest periods have, therefore, played an essential role in developing many MSDs. There is a burdensome effect of unnecessary physical load, repetition, and forced positions [82], [19]. Overwork results in a build-up of potassium and free radicals in muscle cells that

can lead to damage to muscle cell membranes and the production of mitochondrial energy [37], [86].

## **2.3 Risk factors**

A risk factor is a condition which is ultimately affecting or leading to the production of disorders by causing harm to the employee's body region. Several workplace risk factors are causing health problems to the employees; in this section, we will discuss the Physical risk factors, psychosocial risk factors, and Individual risk factors.

### **2.3.1 Physical risk factors**

Physical risk factors include repetitive movements of body parts, awkward posture, prolong work activity, cold temperature, and vibration. Duration is an external risk factor that affects all other risk factors [46]. The shoulder, neck, hand, and lower back are the most affected body region by WMSDs.

**Improper postures:** The muscles and joints involved in the activity are determined by the accepted or induced tension or force on the body, which is more stressful on the spinal disks than when the back is straight during raising, operation, or decreasing the object. Tasks involving prolonged or repeated twisting or bending of the elbows, wrists, thighs, and knees often increase stress on the joints. Prolonged or repeated work tasks can also be particularly stressful.

**Repetitive motions:** Repeated movements and extended periods frequently contribute to muscle weakness and fatigue accumulated. The muscle and tendon will recover from the strenuous efforts and stretches if the time allocated between the exercises is adequate. The impact of repetitive movements due to the performance of the same work activities may be increased during inappropriate postures and forceful exercises. Risk factors such as repeated behavior may depend on the specific act performed and the body region.



**Duration:** Duration is also the amount of time that someone is subjected continuously to a risk factor. The job activities involving long-term use of the same movements or muscles increase the risk of general and local fatigue. Typically, more rest or recovery time is needed when the duration of continuous work increases (for tasks it needs prolonged muscle contraction).

**Frequency:** The number of repetitive exercises per person is specified as a frequency over a given period. The speed of movement of the body part increases as the action is performed more often. Besides, as more physical activity is completed, the recovery duration reduces, increasing the risk of general and local exhaustion over time.

### **2.3.2 Psychosocial risk factors**

The psychosocial risk factors are work-related non-biomechanical risk factors. It is related to the worker's emotional perception. Psychosocial risk factors are connected with the content of work (e.g., the workload, the task monotony, work control, and clarity) and its organizational behavior (e.g., vertical or horizontal organization structure) and social (e.g., reputation and status in society) relationship between supervisor and workers. [61]

Nonetheless, in combination with physical risk factors, they may increase the risk of injury as observed. Therefore, if the work's psychological expectations are negative, physiological and mental stress may respond negatively. Such responses can lead to physical problems like tension in the muscles. On the other hand, workers may be performing incorrectly, such as using incorrect methods of working, using excessive force to carry out tasks, or omitting the available time to minimize their fatigue. WMSDs may occur by any of these causes. [35].

### **2.3.3 Individual factors**

The detection of personal risks may be helpful in the areas of training, regulation, and awareness-raising. The possibility of WMSDs may influence personal or individual factors [57], [58]. Depending on the research, these factors can include age, gender, smoking, physical activity, endurance, anthropometry, and previous WMSDs, as well as degenerative joint diseases [56].

### **2.3.3.1 Gender**

Carpal Tunnel Syndrome (CTS) is three times higher for women than for men [93]. Women are also affected by extreme hormonal changes during pregnancy and menopause, which contribute to decreased retention of fluid and other physiological disorders. Women are typically more at risk for CTS from 45 to 54 years of age. Instead, as men and women grow up, the risk decreases. Some studies have shown that some WMSDs in women [5], [15], [36] are more widespread, but the fact that more women are engaging in hand-intended employment may add to the increased number of MSDs identified in women's work-related MSDs.

### **2.3.3.2 Physical Activity**

Regular physical activity can cause injury. Nevertheless, lack of physical activity can increase the susceptibility to injury, and the threshold for further damage is lowered after injury. More frequent leisure time in construction workers was associated with safe, low back pain, and fewer leisure activities [41]. On the other hand, several conventional therapy procedures have shown that physical exercise can alleviate musculoskeletal symptoms.

### **2.3.3.3 Strength**

Strength is significant in physical work. The risk of back injury and strength was assessed by Chaffin et al. (1977) [14] in a second longitudinal analysis, and the chance for lower subjects was found three times higher. The same connection with physical strength was not observed in other research. In two future studies of low-back pain (or claims) documented by large blue-collar employees [4], [51], there has been no evidence to suggest the lower incidence of lower-back pain claims or episodes for the more energetic employees (defined by isometric elevation strength).

### **2.3.3.4 Smoking**

Several studies have shown that the correlation of smoking with low-back pain [30], [32], [49], [63], [71], while other studies have shown that the association between work-related musculoskeletal disorders is negative. [33], [40], [49], [73]. Several theories have been suggested for the relation between smoking and neck or back injury, neck, or

back pain increase with the increase of smoking [7] [24]. One method is that coughing from smoking induces back pain. Coughing raises the abdominal and intradiscal pressure, resulting in strain on the spine. The relationship has been found in many studies [24], [87]. Specific hypotheses include reduced blood flow to fragile tissues caused by nicotine [32] and decreased bone mineral content creating micro-fractures caused by smoking.

## **2.4 Most Common Types of Work-related Musculoskeletal Disorders**

### **2.4.1 Tension Neck Syndrome**

Pain or discomfort in the neck and shoulder region is known as Tension-Neck Syndrome. It is also a series of muscle pain. In women, the disease is more prevalent than in men. There was no way to ascertain whether this prevalence differential was due to genetically defined factors or to the susceptibility of women to multiple risk factors, both professional and unprofessional [35]. An example of a job situation is the implementation of data in computing systems, where confined arms and head postures occur at the job.

### **2.4.2 Back Injuries**

The back is the most often affected part of the body, with the extreme response being the primary cause of such accidents (22% of 1,7 million injuries). (NSC, Accident Facts 1990). Nonetheless, repeated loading of the drives caused by inappropriate lifting systems or other exertions results in many back injuries for a long time. Usually, 27% of all mechanical damage in the back is related to lifting or manual handling. Such accidents are typically recurring and occur from months or years of service. The long-term consequences are also caused by accidents that appear to be severe. The back disks are round, rubber-like pads with a thick fluid, and are used as shock absorbers. The back is very different. Such discs are continuously and repeatably squeezed by all powers that come down the spine. Sometimes, disks can rupture and bulge, resulting in back pain and pressure on the spinal nerve.

### **2.4.3 Carpal Tunnel Syndrome**

Carpal tunnel syndrome, a disorder in which the median nerve is squeezed while going through the carpal tunnel (wrist), is perhaps the most known WMSDs of hands and forearms. The carpal tunnel is a tiny space near to the bottom of the hand that accommodates the tendons and the median nerve that makes the hand sensation. In the absence of these transversal fascia bands, the ligaments will prevail while the hand is flexed and extended. As the functional cross-section of the tunnel decreases, the early phases of CTS are due to synovium swelling and decreased confined space in the carpal tunnel. The carpal tunnel cramps and compress the nerve as the synovial sheaths swell. CTS syndromes are many, but most often, the hands, fingers, and braces become numb, tingling, or bruised.

### **2.4.4 Tendinitis**

Tendinitis, a tendon sheath inflammation around the joint. Tendinitis may be a consequence of trauma or prolonged joint activity and may involve the wrist, elbow (often called 'tennis elbow'), and shoulder joints.

### **2.4.5 Tenosynovitis**

Tenosynovitis is a chronic, synovial sheath tendon injury. DeQuervain's disease is the most well-known Tenosynovitis.

### **2.4.6 Trigger Finger**

When a finger's tendon sheath becomes worse, inflammation may occur. The tendon may become trapped in the sheath by enough quantities of swelling. If the employee tries to move his finger at this stage, the effect is a movement of jerking and bouncing. This condition usually results in snapping and clicking the pointer. Such clicks occur when the fingers (or thumb) are rotated or straightened. Often a digit is closed, bent, or straightened.

### **2.4.7 Ischemia**

Ischemia is a disease that develops when a tissue is not supplied with blood. The symptoms of the condition include numbness, tingling, and weakness, depending on the level of ischemia. Compressive stress in the palm is the leading cause of ischemia.

### **2.4.8 Vibration Syndrome**

The development of vibration syndrome disorders can result in prolonged exposure to vibrational forces and cold temperatures. Repeated finger whitening events characterize this because digital arteries are entirely shut down. The fingers should be controlled thermally during long-term exposure to cold, low temperatures restrict and intensify blood circulation to their limbs.

### **2.4.9 Low Back Pain**

Low back pain, which is the most frequently identified musculoskeletal problem, is a significant burden for persons, health systems, and social services, with general indirect costs [94], [64]. In recent years, it has become a significant issue of public health for working people. Incapability, inadequate infrastructure, and absences in workplaces are the effects of this problem [43]. Musculoskeletal disorders are a disease of the body. Low back pain (LBP) is the most common disease of the body structures. The Global Burden of Disease (GBD) report of 2010 lists LBP as one of the top 10 diseases and accidents in the world for years of life adjusted to disabilities [91]. Exposure to ergonomic stressors in life, environmental (physical), psycho- and private risk factors is correlated with life-related LBP [23]. A wide variety of causes have been identified in several studies, associated with low back pain.

### **2.4.10 Rheumatoid arthritis**

Rheumatoid arthritis (RA) is a long-term, progressive, chronic inflammatory disorder that affects daily life, for example, [1]. The workforce's effect can be significant because RA patients are continuously disabled (inability to work) [6]. Apart from the impact on the employee, for example, diminished quality of life, the work disability

often contributes to high costs. The development losses are responsible for about one-third of the overall cost for RA patients [52]. The injury of output involves all missed hours of work and working days but is limited in their ability to fulfil the job (loss of productivity). Recently it has been shown to reduce performance at jobs by the most critical cost impact (effectiveness loss) for RA patients, follow up by the loss of income due to job cuts or adjustment, reduced work hours, or lost working days (health) [96]. That means that loss at work productivity is a significant issue because sick leave inadvertently reduces working hours and productivity at work in a more systemic and more meaningful way.

### **3 Materials and Methods**

This chapter explains the methods used for this research. Several research methods have been used to conduct a proper scientific investigation. First, the micro-climate environment was measured to determine the environmental hazards of the workplace. Second, the ergonomics of the workplace measured by ART tools to assess physical risk factors. Thirdly, the data were to be collected from the Estonian chain supermarket through:

- A paper-based questionnaire was given to the employees (N=65) of the supermarket among them 77% (N=50) were responded.
- Interview of two types: face to face(N=16) and via Skype (N=3).

#### **3.1 Measurements of working environment hazards**

Working Environment is essential, and a bad working environment creates a sense of discomfort. Working in a bad work environment has a negative influence on working capability and may cause health problems.

The indoor air temperature, noise, sound, and light were measured. The measurements were taken from four different rooms, like the warehouse, where employees work most, cold storage, restroom, and office room. Different parts of the room are measured. The indoor air conditions were measured using the following standards and measuring equipment' EVS-EN 12464-1:2011 'Light and lighting-Lighting of workplaces-part 1: Indoor workplaces', EVS 891:2008' Measurement and evaluation of electrical lighting in working places', [69]

The measuring equipment used for noise measurement was Velleman DVM1326; the light was measured by Testo-545, and temperature and humidity were measured by Thermo hygrometer AZ 8703.



Fig 1: A worker working in Milk storage

### 3.2 Measurements of workplace ergonomics (the ART-tool)

Workplace ergonomics is a crucial factor in developing work-related musculoskeletal disorders. In this study, an ART tool has investigated the risk level of a supermarket worker [45]. The ART tool was introduced by the Health and Safety Executive (HSE) for the upper extremities' routine activities in 2007. The ART tool's technical content is based on earlier research on repetitive operational methods [16] and the Fast Exposure Test [20]. As a result [48], the ART tool explores Twelve risk drivers grouped in 4 phases: (1) frequency and repetition of movements; (2) force; (3) uncomfortable postures (including the length of the task, recovery, work speed perceived, and other work artefacts and environments); and (4) additional factors (including the dimension of job length, healing). The task score (TS) is the sum of the four stages: A, B, C and D (Eq. 1)

$$TS = A1+A2+B+C1+C2+C3+C4+C5+D1+D2+D3 \text{ (Eq. 1) [69]}$$



If both arms are evaluated, the left arm and right arm scores should be kept separate from each other and not combined. The risk level (exposure score) can be calculated by equation 2

Task score x Duration multiplier =Exposure score (Eq. 2)

Task scores and exposure help assess which task is most relevant and which requires immediate attention. Table 1 suggests the framework for the analysis of the exposure value Interpretation of the exposure score is explained: if the exposure is 0-11, then the risk level is low; in this case, action needed to consider individual circumstances. If the exposure level is between 12 to 21, then the risk level is medium, and for the exposure score 22 or more, the risk level is high; for medium and high-risk levels, the investigation is required urgently [69].

### **3.3 Questionnaires**

The questionnaire aimed to obtain a broader understanding of job satisfaction, working environments, working conditions and culture, and microclimates of the workplace from the employees. The employees of a supermarket of all ages are taken into consideration for this research. The survey questionnaire was given to the employees in the Estonian Language. The questionnaire contains a standardized set of questions designed to measure dichotomous responses in the form of yes or no; rating types questions and the ratings were given in the 5-point scale (1-not satisfied/ very bad, 5- very satisfied/ very good). Besides, comment boxes are also present so that respondents can provide more detailed text answers if necessary.

The questionnaires were composed of 13 questions. Some of them are:

1. Are you satisfied with the working environment of your company?
2. Are you satisfied with- working conditions, work culture, the relationship between employees?
3. Are you aware of the health and safety laws at work and resulting laws on working conditions?
4. Which of the following are due to the working environments, the working conditions, and the nature of the work do you consider risk factors as the risk for your health?

5. Is your office chair comfortable?
6. Are first aid kits available to you?
7. Does your company have a working environment specialist?

### **3.4 Semi-structured Interviews**

The interviews were conducted in a semi-structured format based on purposive sampling methodology to assess the musculoskeletal pain in the body region. Interviews took place from January to April 2020; the average duration of the interview was 10 minutes. The interviews were analyzed using thematic analysis. The thematic analysis is a method in which qualitative data classify patterns or themes. The purpose of thematic analysis is to recognize topics, i.e., patterns in relevant or exciting data, to answer or say something about the research. Thematic analysis was chosen because it helps to find out the meanings and perceptions that are contained in the data. In total, 19 supermarket workers were interviewed. Five of them were male, and 14 were female. Interviews were conducted face to face (N=16) and via Skype (N=3).

## 4 Results

### 4.1 Measurements in the work environment

Poorly designed workplaces are often caused health problems at work, but they are strictly related to indoor climate conditions (comfortable micro-climatic conditions, excessive noise, inadequate lighting). The results of measurements in the work environment are shown in table 2

**Table 1: Working environment measurements results:**

Point of Measurement	Workplace	Temperature Of the air, C	Humidity %	Light, lx	Noise, dB
1	Vegetable Warehouse	19-19.9	22.5%	105-117 lx (needed at least 300 lx)	58-64
2	Main warehouse	19-19.4	22.8%	109-150	82-83
3	Milk cold storage	13.3-15.6	21%	58-183	62-64
4	Milk product cold storage	12-13.5	23.8%	30-40	77-80
5	Warehouse office	19.6	25.2%	150-200 (needed at least 300 lx)	70-72

The measurements are taken in the winter season, so humidity of the air was too low (< 25%). By the norms (EVS-EN 15251:2007), the relative humidity of 40–60% is required for the worker to feel comfortable.

Poor design lighting is one of the main risk factors. The light of the workplace is inferior; in the warehouse office room, it is good but not enough; on the other hand, in the warehouse, it is deplorable, and some cold storage lighting is deficient that is alarming. Poor lighting may cause an accident and eye fatigue and headaches of the

workers. It can be affecting the quality of the work, especially in a situation where precision is required and overall productivity.

The global temperature of the warehouse is suitable, but in the cold storages, the temperature is below 15 °C. Long time working in that condition may cause health problems. The noise level is below the risk level.

## 4.2 The assessment of the ergonomics of the workplaces (ART tool)

The results of the evaluation show the risk level. The risk scores by the ART tool.

**Table 2:** Monotonous work and static posture assessment by the ART tool

Work scenario	Left/right( L/R) part of the body	A1/A2	B	C1/C2	C3/C4	C5/D1	D2/D3	D4	Risk level
Scenario 1	L	2/2	4	1/1	0/1	0/1	1/2	1	15- medium
	R	3/3	4	1/2	0/1	0/1	1/2	1	18- medium
Scenario 2	L	2/2	4	2/2	0/1	0/0	1/2	1.2	19.2- medium
	R	3/3	4	1/2	0/1	0/0	1/2	1.2	20.4- medium

\*Standard of the risk level, low risk is 0-11, medium risk- 12-21, and high risk is 22 or above. [69]

The evaluation of the workplace in the supermarket was carried out on-site in collaboration with employees in the different departments of the supermarket. The Measurement was carried out using the ART (Table 3) method. It is estimated that employees doing their jobs should be engaged for eight hours a day. The tasks were video recorded for one minute, and the mission was observed for some time to understand more clearly.

In the case of warehouse one worker: the worker works in fruits and vegetable departments and puts the vegetables on the shelves from the box. Every 5 seconds, the worker put the vegetable to the shelves from the box. The worker does these types of tasks at a different time in the entire day. In the morning, the worker repeats this task after 10 minutes and task duration on average of 6 minutes. The employee sets their own work pace and reports they do not have difficulty keeping up with the work. The shift pattern is 8:00 – 17:00 with one hour break.

The risk level of the task was calculated by using equation 2

For right hand =  $15 \times 1 = 15$ ; medium risk level

For left hand =  $18 \times 1 = 18$ ; medium risk level

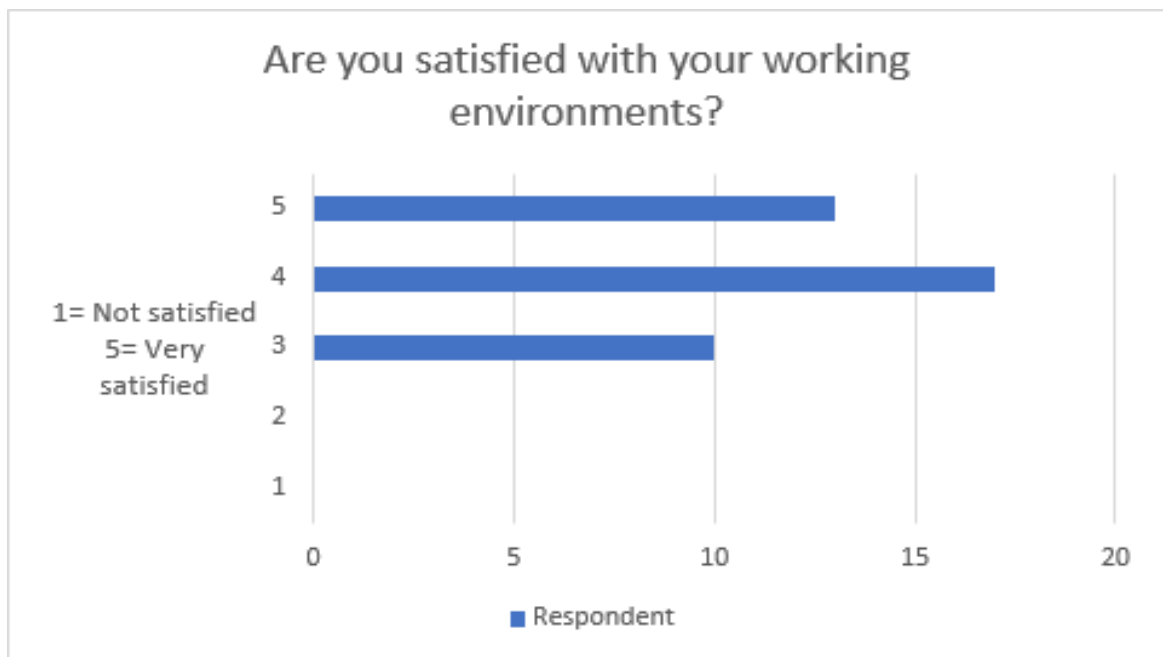
In the second case: The worker working in the drinks section, where he is putting soft and hard drinks bottles to the shelves. The worker puts a container to the shelves about every 5 seconds. Sometimes the worker needs to put the bottles to the upper shelves. The task is not very fast or very frequent. The shift pattern is 8:00 – 17:00 with one hour break. The risk level for this task is calculated by using equation 2

For right hand =  $19 \times 1 = 19$ ; medium risk level

For left hand =  $20 \times 1 = 20$ ; medium risk level

### 4.3 Responses to the questionnaire

Figure 2 demonstrates the number of participants, who stated their response to Question 1, whether they satisfied or not with the working environments of the workplace.



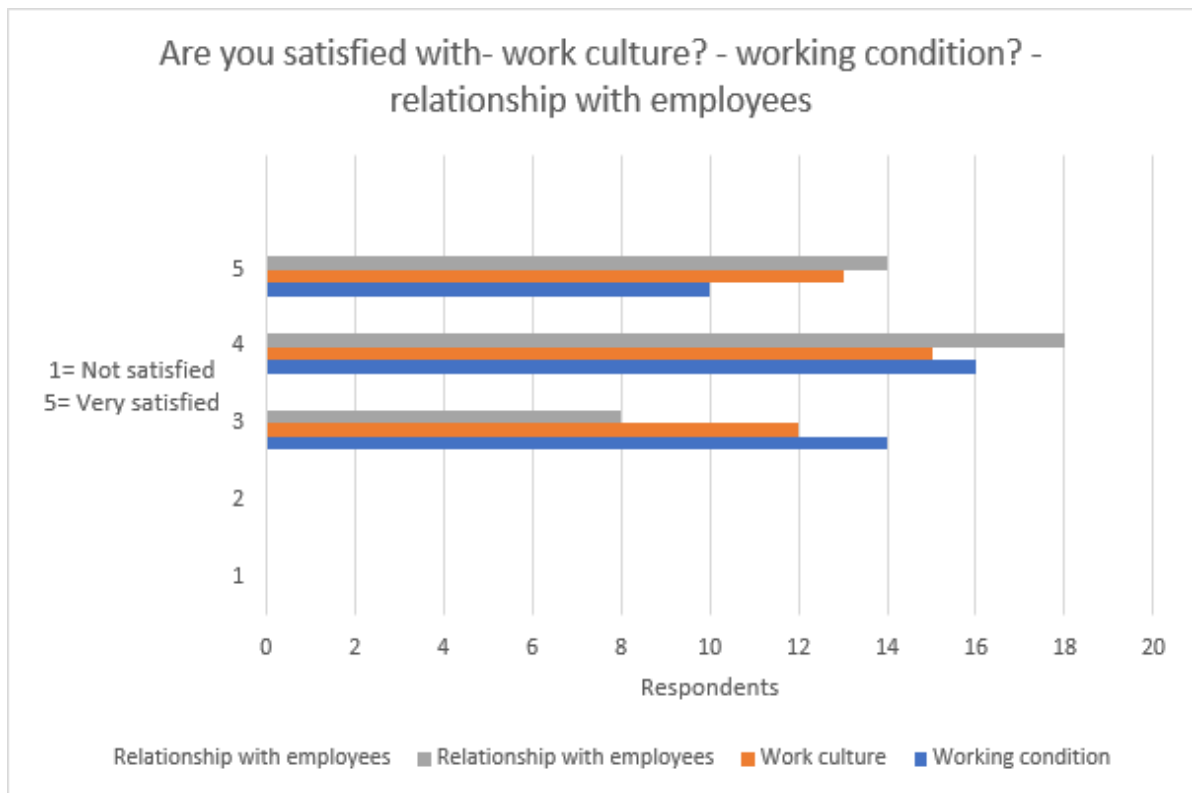
**Fig 2: Satisfaction with working environments**

It is possible to see in Figure 2 that the number of participants who satisfied with their working environments was relatively high. 32.5% of workers are very satisfied, 42.5% were moderate satisfied, and 25% were satisfied with working environments. There are no workers who are not happy with working environments.

Question 2 about how the workers satisfied with the work culture, working conditions, and relationships with other employees. In the work culture question, 32.5% of participants were very satisfied, 37.5% were moderate satisfied, and 30% were pleased with the work culture of the workplace.

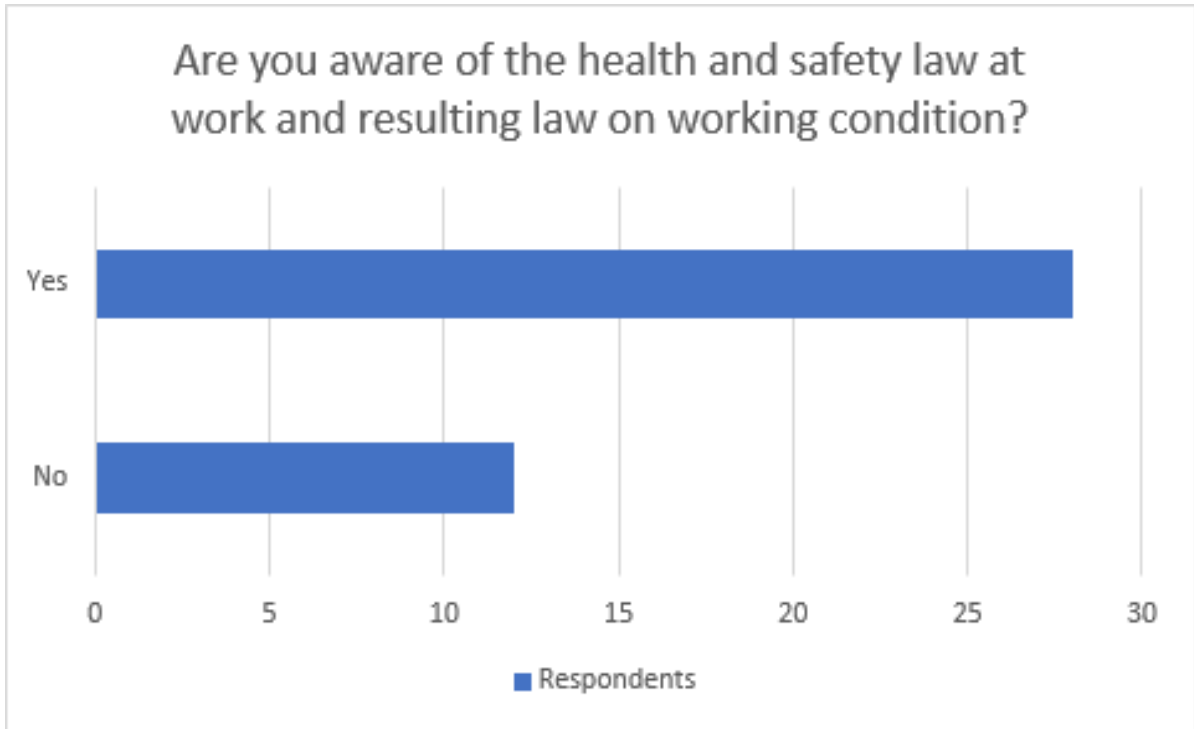
About working conditions, 25% of participants were very satisfied, 40% were moderate satisfied, and 35% were satisfied with the working condition of the workplace.

About the relationship between employees, 35% were very satisfied, 45% were moderate satisfied, and 20% were satisfied with the relation with other employees, which is illustrated below in Figure 3.



**Fig 3: Satisfaction with the culture of work, working conditions and relationships with other employees**

To Question 3 about the awareness about the health and safety law on working conditions, 70% stated yes, and 30% of participants do not become aware of the health and safety law. Which is depicted below in Figure 4

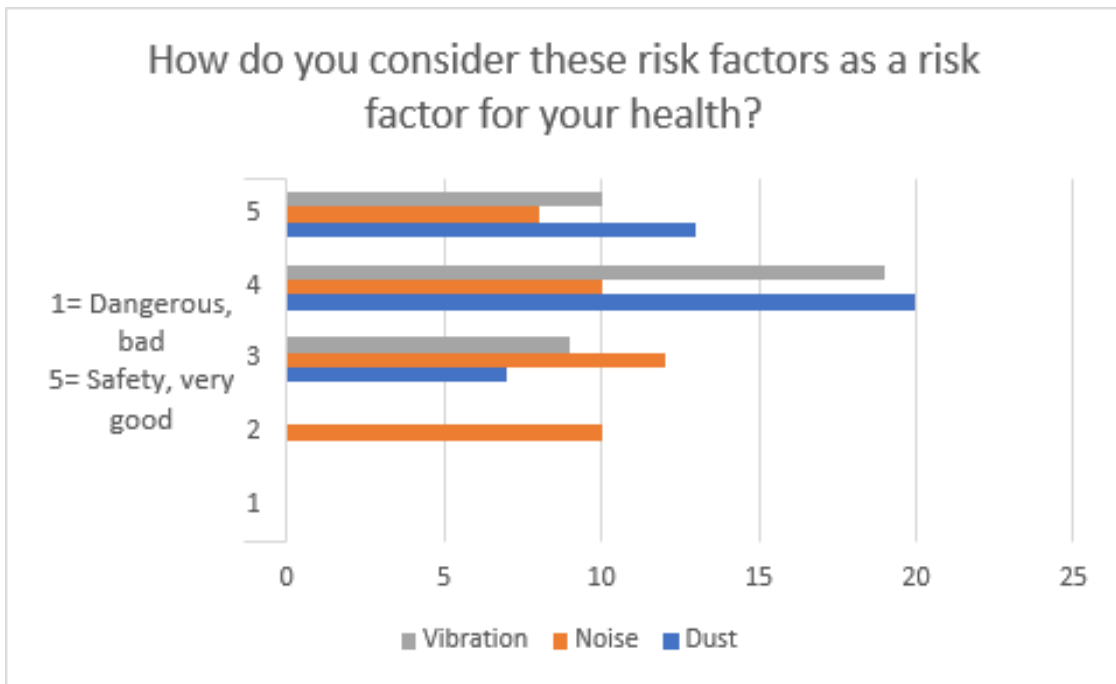


**Fig 4: Aware of the health and safety law at work and resulting law on working condition**

To question 10 about different risk factors in the workplace, in the case of noise, 45% think that sound is perfect inside the workplace, 30% stated noise is normal (not dangerous), and 25% of participants responded that noise is a little high. Those who noted that the noise is a bit high, the author investigated that they work nearly the box pressing machine, which makes loud sound and vibration.

In the case of vibration, 25% responded that they do not experience vibration at all in the working hours, 45% of participants answered that they experience vibration minimal, which can be ignorable. Moreover, 20% stated that they feel the vibration in the moderate portion, and these workers are working nearby the box pressing machine. However, this vibration is not frequent and not harmful to health. About dust, 32.5% stated that there is no dust at all, which means they did not feel any problem with dust. 50% responded that there is very little dust, which means they sometimes experienced little dust, which is not problematic, and 17.5% of workers experienced more dust than

the others, but this amount is not harmful. Which illustrated in Figure 5.1

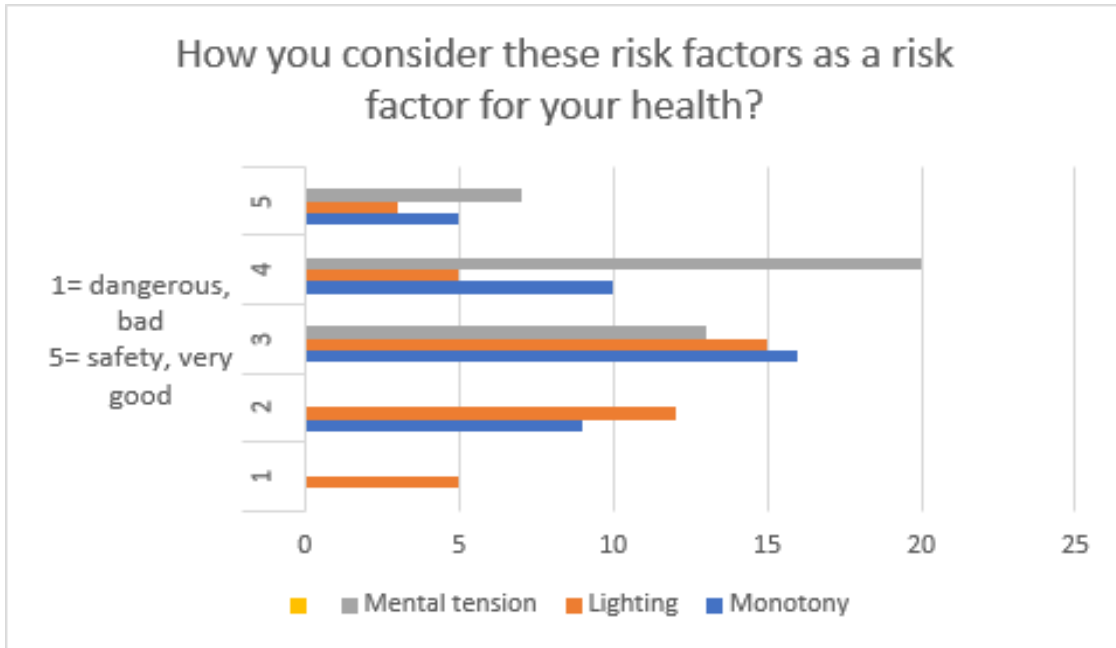


**Fig 5.1: Risk factor level of some hazards**

In monotony, 37.5% of workers stated that their work is not monotonous, 40% of them responded that their work is little monotonous, and 22.5% reported that their work is very dull. In the case of lighting, only 7.5% of worker responded that light is excellent and most of them work in the office room, 50% responded that lighting is standard and 42.5% stated that lighting is not enough and very poor, which is very problematic for health and work activity.

In the case of mental tension, 67.5% do not suffer from mental stress; on the other hand, 32.5% of participants responded that they experienced little mental stress. There is no case for severe mental tension. Which is illustrated in Figure 5.2





**Fig 5.2: Risk factor level of some hazards**

#### 4.4 Results of the interview

Interviews were conducted with 19 supermarket workers from January 2020 to April 2020 period. One interview was carried out in the form of the unstructured, informal interview as a preparatory step at the beginning of the research, and 18 interviews were carried out in the sort of semi-structured set of questions that were used as a basis to guide the discussion. Out of 19 supermarket workers involved, four were male, and 15 were female. Thereby, the results of the interviews were the following:

- Over the last year, about 79% of supermarket staff reported work-related musculoskeletal symptoms in at least one body area (In other words, they said having had pain, aches or discomfort of some sort.). (Table- 3)
- The lower back was by far the region with the most problems, as ten out of nineteen workers (52.6%) indicated that they had had a problem in that region. Among them, 10.5% (2) people who had severe pain.
- The second most problem with feet, as nine workers (47.4%) reported they had a problem in their feet, and 5.3% (1) said that they had severe pain.
- The number of people who had pain in the shoulders was 7 (36.8%); among them, 5.3% (1) felt severe pain.
- Following that, 31.6% (6) people reported neck pain.

- Less pain was reported in the elbow joints and hips/thighs: Only 5.3% (1) of people in each problem felt pain in that region.
- The number of people reporting pain in the wrists was 15.8% (3). The knees were also remarkably painful in our study group; 21 % (4) peoples felt pain in that body region.
- Furthermore, 10.5% (2) workers felt pain in the upper back area.
- Approximately 10% of employees missed work because of symptoms in the previous 12 months, with low back pain being the most frequent cause of missed work (5% of employees).

**Table 3:** Prevalence of work-related musculoskeletal symptoms during the past 12-months for all supermarket worker by interviews (N = 19). Values are presented within parentheses.

<b>Body Region</b>	<b>Work-related ache, pain, discomfort</b>	<b>Symptoms prevented daily work</b>
Neck	31.6 (6)	5 (1)
Shoulder	36.8 (7)	0
Upper back	10.5 (2)	0
Wrist/hand	15.8 (3)	0
Elbows	5.3 (1)	0
Hips/thighs	5.3 (1)	0
Lower back	52.6 (10)	5 (1)
Knees	21 (4)	0
Feet	47.4 (9)	0

## 5 Discussion

Lower back pain is the most prevalent musculoskeletal disorder among supermarket workers. The prevalence of musculoskeletal symptoms was high in this cohort of supermarket workers, with approximately 80% of study participants reporting job-related pain. Comparably, Forcier and colleagues said that nearly 83% of supermarket workers had symptoms in at least one anatomical region [11]. Similar to the other studies of supermarket workers [31], [72], [90], the low back was the anatomical region with the highest prevalence of symptoms. In a study of 3702 grocery workers, Violante et al., 2005 reported a 34.5% 12-month prevalence of low back pain [91]. These investigators found that the produce department's workers had the highest prevalence of low back pain, in contrast to the fruits and vegetable department and drinks department workers in the current study.

Studies have shown a relationship between age, gender, and back pain [19]. Back pain is second only to headaches for causing lost work time [79], and approximately 8% of current study participants missed work due to symptoms in the back and neck. However, no significant predictors were found for the association between missing work and low back pain. Worker age was the only predictor of healthcare utilization for low back symptoms, although some studies have suggested older age as a protective factor [79]. In contrast to several other studies, aching in the feet accounted for the second most prevalent work-related problem. Approximately 50% of study participants reported pain in this region compared to 14% of those surveyed by Forcier and colleagues [31] and 4.7% by Ryan and colleagues [72].

The population prevalence of foot pain has been estimated at 24% [84]. It is unclear why the prevalence was substantially higher in the current study since grocery tasks, and flooring types are mainly similar between stores. Differences among studies in the number of years working in the industry and differences in demographic characteristics, such as gender distribution among samples, could lead to variation in prevalence among studies. Besides, the high incidence of foot pain has been reported among salespersons [68] and assembly plant workers [92]. In the current study, the prevalence of foot pain was mostly higher among workers who did more standing than walking during the day, a finding similarly noted by [54]. The stress level of workers can be decreased if development strategies are applied in the working environment.

## **6 Conclusion**

The prevalence of musculoskeletal symptoms was high in this cohort of supermarket workers, with approximately 79% of study participants reporting job-related pain. Although back pain was most common, the foot was the second most commonly reported region of pain compared to other studies of supermarket workers. This unexpected finding should be evaluated in future studies of this population since risk factors for foot pain are infrequently reported in occupational health literature. Biomechanical studies have suggested a relationship between foot pain and musculoskeletal symptoms in more cranial joints such as the knee, hip, and low back. Further studies with supermarket workers could evaluate the relationship between interventions that reduce the impact of standing on hard-working surfaces (e.g., foot orthoses) and musculoskeletal complaints of other anatomical regions. Although musculoskeletal symptoms have been studied among supermarket workers for years, the results of this study suggest that little has changed despite the adoption of newer technology such as hand scanners. These findings hold relevance to the supermarket industry to develop WMSDs preventive interventions, generally for high-risk activities within a supermarket store position.

## **7 Preventive measures for work-related musculoskeletal disorder**

### **7.1 The physical activity and breaks**

The physical activity and breaks in work may prevent the development of MSDs [40], [18]. The ergonomics of workplaces could be modified, for example, utilizing exercise balls [50]. It was assumed that sitting on a training ball would boost the spine motion compared to sitting on an office chair [50]. However, the lumbar movement between the exercise ball and the chair is not substantially different.

### **7.2 Training**

Train workers to use ergonomic working practices is one way of reducing health disorders. A joint location analysis was performed using videotapes between a group of nineteen before and after the intervention. The causes of chronic illnesses are also being investigated, and the progression before disability [65], [66], [67] is being examined.

The efficient restoration system has shown that it is a feasible treatment choice for chronic lumbar disabled patients to treat chronic impairment with upper limb disorders. The meta-analysis concludes that, regardless of the site of involvement, psychosocial factors are the primary cause of constant disability growth [42]. Right instruments are needed before the permanent loss of work capability occurs, to avoid and rehabilitate these conditions.

### **7.3 Thermal mud therapy as a part of balneotherapy**

The recovery of MSDs is used by heat-and-mud treatment for balneotherapy. In the research of [88], the goal has been to detect skilled overexploitation, the effect of ambulatory mud, and spa treatments on infusion in the upper limbs. The response of the soft tissue to repeated heating is mainly due to blood flow and thermal dissipation. Mud bath therapy gives a pleasant soothing feeling. Therapeutic mud impacts the body by providing physical, mechanical, and chemical irritants. It induces changes in the skin, blood flow, metabolic processes, and nervous system. It contributes to an improvement in blood pressure, an improvement in breathing, and also increases blood supply at the

beginning of the operation. Increased agitation by warm mud in various skin receptors in the brain cortex, the retention procedures clarify the patient's sleepiness during and after the treatment. Mud treatment is distinguished by the involvement of rheumatic disorders, chronic arthritis and myositis, spine diseases, atrophy of muscles, post-traumatic and postoperative adherence to chronic skin diseases (psoriasis, eczema), chronic gynaecological diseases and chronic internal diseases. The anti-mud care measures include feverish infections, tumours, blood disorders, bleeding, grades II and III of heart failure, other infections of the liver, pregnancy, and tuberculosis. In cases of musculoskeletal disorders, there is a long history of using spa care.

## 8 Summary

This chapter presents the main results of this master thesis and draws a line under all discussed above. The aims to achieve with this thesis were to find out the most prevalent WMSDs among the supermarket workers and to investigate risk factors that cause MSDs. Measurement of work environment hazards has shown that the workplace's lighting is deficient, which is one of the risk factors which may cause the workers' health problems. The temperature of the warehouse was standard expects the cold storages where the temperature was below 15 °C. Long time working in these cold rooms may cause health problems for the workers. Air humidity was under the standard level.

The assessment of workplaces ergonomics has shown that the risk level of some specific work is medium. The results of the self-administered questionnaire have shown that most of the employees satisfied with their working environment, work culture, and working condition. The employees stated that some risk factors might cause MSDs; they claim that workplace lighting is inferior. Another risk factor, like noise and vibration, is not vulnerable. Some employees suffer from mental tension, but this number is deficient.

Furthermore, the results of the interviews showed that lower back pain is the most prevalent WMSDs among the supermarket workers after that feet pain is the second most prevalent among them. Shoulder and neck pain also mentionable problems.

In summary, it must be noted that work performed in the sense of this study has led to a better understanding of the prevalence of WMSDs in the supermarket and the risk factors behind MSDs. The conclusion of the thesis provides a clear overview of working problems, and most prevent WMSDs with supermarkets workers in Estonia. So, the research may also have a practical advantage for general informative utility and for work environment representative and supermarkets employers to be a guide for making better work practice in the future.

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# Appendix 1: Questionnaire in English

## QUESTIONNAIRE

The purpose of the study is to determine whether and to what extent employees are interested in occupational health and safety occupational safety in your company. We are interested in employees' assessment of their health in relation to the nature of the job and terms. We also want to find out how many employees they think are involved action planning, control and problem solving.

Evaluation on a 5-point scale:

Not satisfied					Completely satisfied
1	2	3	4	5	
1. Are you satisfied with the working environment of your company?					
1	2	3	4	5	
2. How satisfied are you with your business					
Work culture					
1	2	3	4	5	
Working conditions					
1	2	3	4	5	
Relationships between employees					
1	2	3	4	5	

3. Are you aware of the health and safety laws at work and the resulting laws requirements regarding working conditions?  
 Yes  No
4. Which of the following statements do you support?  
 A pleasant work environment is a prerequisite for successful operations  
 X's work environment is just a background that doesn't need to be looked at
5. To what extent does your company need to improve the working environment? Presentations?
6. To what extent does your employer pay attention to working conditions?  
 X strives to provide the best possible working conditions for its employees  
 X focuses mainly on working conditions  
 X rather is formal attention  
 X does not pay attention to working conditions
7. Does your company have a working environment representative?  
 Yes  NO
8. Is your company's work environment representative?  
 X has already mediated employee problems to the employer, has good contact with the employer  
 X is ready to do that  
 X is more formally in this position
9. If you have a problem or you are not satisfied with your working conditions, then who do you usually go to you turning?  
 Head of Unit   
 X Company Manager  
 X work environment specialist  
 X to the other employee  
 X or do something yourself.

10. Which of the following are due to the working environment, the working conditions or the nature of the work?

Do you consider risk factors as risk factors for your health?

(1-dangerous, bad; 5-safety, very good)

Dust	1	2	3	4	5
Noise	1	2	3	4	5
Vibration	1	2	3	4	5
Chemicals	1	2	3	4	5
Forced position	1	2	3	4	5
Monotony	1	2	3	4	5
Temperature	1	2	3	4	5
Lighting	1	2	3	4	5
Physical exercise	1	2	3	4	5
Mental tension	1	2	3	4	5

11. Is your office chair comfortable?

X Yes x No

12. Are first aid kits available to you?

X Yes x No

13. List 3 things you should change at your workplace?

## Appendix 2: Questionnaire in Estonian

### KÜSIMUSTIK

Uuringu eesmärgiks on välja selgitada, kas ja kui palju on töötajad huvitatud töötervishoiust ja tööohutusest oma ettevõttes. Meid huvitab töötajate hinnang oma tervisele seoses töö iseloomu ja tingimustega. Samuti soovime välja selgitada, kui palju on töötajad nende endi arvates kaastaud oma tegevuse planeerimisse, kontrollimisse ja probleemide lahendamisse.

Hindamine 5-pallisel skaalal:

Ei ole rahul Täiesti rahul

1                      2                      3                      4                      5

1. Kas olete rahul oma ettevõtte töökeskkonnaga?

1                      2                      3                      4                      5

2. Kuivõrd rahul olete oma ettevõtte

Töökultuuriga

1                      2                      3                      4                      5

Töötingimustega

1                      2                      3                      4                      5

Töötajate omavaheliste suhetega

1                      2                      3                      4                      5

3. Kas te olete teadlik töötervishoiu ja tööohutuse seadustest ning sellest tulenevatest töötingimusi puudutavatest nõuetest?

X Jah    x Ei

4. Kumba väidet pooldate?

X Meeldiv töökeskkond on eeldus edukaks tegevuseks

X töökeskkond on vaid taust, millele ei tule tähelepanu pöörata

5. Mis osas teie ettevõttes vaja parandada töökeskkonda? Ettekanded?

6. Kuivõrd pöörab teie tööandja tähelepanu töötingimustele?

X püüab töötajatele kindlustada võimalikult head töötingimused

X pöörab tähelepanu põhiliselt töötingimustele

X pigem on tähelepanu formaalne

X ei pööra tähelepanu töötingimustele

7. Kas teie ettevõttes on valitud töökeskkonnavolinik?

X Jah    X Ei

8. Kas teie ettevõtte töökeskkonnavolinik?

X on juba vahendanud töötajate probleeme tööandjale, omab head kontakti tööandjaga

X on valmis seda tegema

X on pigem formaalselt sellel ametikohal

9. Kui teil on probleeme või te pole rahul oma töötingimustega, siis kelle poole te tavaliselt pöördute?

X allüksuse juhi

X ettevõtte juhi

X töökeskkonnaspetsialisti

X teise töötaja poole

X või võtate ise midagi ette.

10. Millised järgmised töökeskkonnast, töötingimustest või töö iseloomust tulenevaid ohutegureid hindate oma tervise suhtes riskiteguriteks?

(1-ohklik, halb; 5 – ohutus, väga hea)

Tolm	1	2	3	4	5
Müra	1	2	3	4	5
Vibratsioon	1	2	3	4	5
Kemikaalid	1	2	3	4	5
Sundasend	1	2	3	4	5
Monotoonsus	1	2	3	4	5
Temperatuur	1	2	3	4	5
Valgustus	1	2	3	4	5
Füüsiline koormus	1	2	3	4	5
Vaimne pingeline	1	2	3	4	5

11. Kas teie töötool on mugav?

X Jah      x Ei

12. Kas esmaabivahendid on teile kättesaadavad?

X Jah      x Ei

13. Nimetage 3 asja, mida peaks teie töökohal muutma?