



Research Article

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MSDs and Lumbar Spine as Occupational Diseases in the EU and other Countries and Possible Solutions



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Abstract

This contribution presents one of the partial outputs of a research project titled "Research on Key Factors of MSD and Lower Back Issues, Prevention Possibilities, and Remedial Measures with a Focus on Ergonomic Solutions in Work Systems." It addresses the issue of MSD and lower back problems as occupational diseases in the EU and other countries, within the context of existing legislation, available professional literature, and the results of the author's own research activities. The research and relevant findings gathered have demonstrated the severity of lower back disorders and their causal relationship with work and profession. The contribution also examines the possibilities of preventive and corrective measures in the areas of human resource management, occupational health and safety, work hygiene, work environment, and ergonomics. The article also discusses the differences in the legislative approach to the suspicion and recognition of lower back occupational diseases in selected countries.

Key words: MSD; Lower Back; Ergonomics; Physical Strain; Mental Strain; Occupational Disease

Abbreviations: MSD: Musculoskeletal Disorders; NCZI: National Health Information Centre; SSWPs: Safe Systems of Work Plans

Introduction

Every company, alongside other essential prerequisites for its operations, must primarily address the well-being of its employees, both in terms of their work and health, which are crucial for good performance. Nowadays, it is not easy to find a well-rounded employee, nor is it easy to retain them. Decisions regarding job changes, whether initiated by the employee or the employer, are often compelled by medical assessments related to changes and deteriorations in the employee's health. Work ability and the sustainability of long-term health capacity (both physical and mental), as well as the ability of each worker to perform their job for as long as possible, should be a priority for every employer. All steps and measures should be directed towards this goal, particularly in the application of ergonomic principles in the workplace, the work environment, and the elimination of medically compelled termination of employment due to the long-term deterioration of an individual's health. Spinal injuries are considered the most costly economic professional health damage. Despite current possibilities to eliminate heavy physical

labor, paradoxically, the number of spinal issues is increasing. One of the main explanations for this undesirable condition, besides excessive physical strain, is dissatisfaction with work caused by psychosocial and other factors. Of course, personal predispositions and the detection of significant spinal problems in the past through medical history are also important factor [1].

Objective and benefits of the study

The study addresses the issue of MSD (Musculoskeletal Disorders) and lumbar spine diseases. It is part of a project aimed at researching the factors of lumbar spine disorders and the possibilities of prevention and corrective measures, focusing on ergonomic solutions. The methodology involves a questionnaire survey in relevant organizations in selected EU countries and others. As part of our own research, a survey was conducted to gather information on how lumbar spine diseases are assessed in different countries, whether they are included in the list of occupational diseases (if such a list exists in the given country), and how and by whom it is determined whether the criteria for

recognizing lumbar spine disease as an occupational disease are met. We decided to distribute an electronic questionnaire to specialists from 21 countries. The data obtained shows that lumbar spine diseases are assessed differently in each country. Therefore, there is no unified methodology that all countries follow when assessing lumbar spine disease as an occupational disease. The aim of the study was to identify and compare the systems of occupational lumbar spine diseases in EU countries and other countries, and its benefit lies in the possible solutions for MSD in workplaces.

Human Strain in the Work Process and Optimization of Working Conditions

The issue of working conditions encompasses a complex set of processes and procedures, particularly in the fields of work psychology, ergonomics, hygiene, as well as occupational medicine and sociology. It involves the optimization of workplaces, work activities, information flows, occupational safety, corporate culture, leadership and management styles, interpersonal relationships, workload, work-rest regimes, stress prevention, and opportunities for personal development and self-realization in the work process.

Equally important are the factors of processes and conditions that help maintain activity and interest in high-quality job performance and its continuous improvement. An individual's

attitudes within the work system are shaped by a variety of factors. The effort and ability to perform the required work activities over the long term with full attention and care, not overlooking any important source of information, overcoming feelings of fatigue, and remaining calm in challenging situations largely depend on how a person feels in the work environment and the conditions created for them to perform their work efficiently and reliably. Working conditions play a decisive role in how worker's abilities and qualifications are utilized. Unsatisfactory working conditions can negatively impact worker's health over time, including their ability to maintain safe behaviour, leading to errors, accidents, injuries, or disasters.

A key factor in human performance and reliability in the workplace is the physical and mental strain, which always operates in synergy, with these types of strain sometimes compensating for each other and sometimes synergistically adding up. The term most used for the overall response of the organism is psychosomatic strain. It is very important to understand the difference between demands and strain when assessing the latter [2]. From the perspective of physical strain and its assessment in terms of potential consequences (pain, discomfort, inability to work), the key influences are the nature of the work, working conditions, and the individual characteristics of the person in the work process (Figure 1).

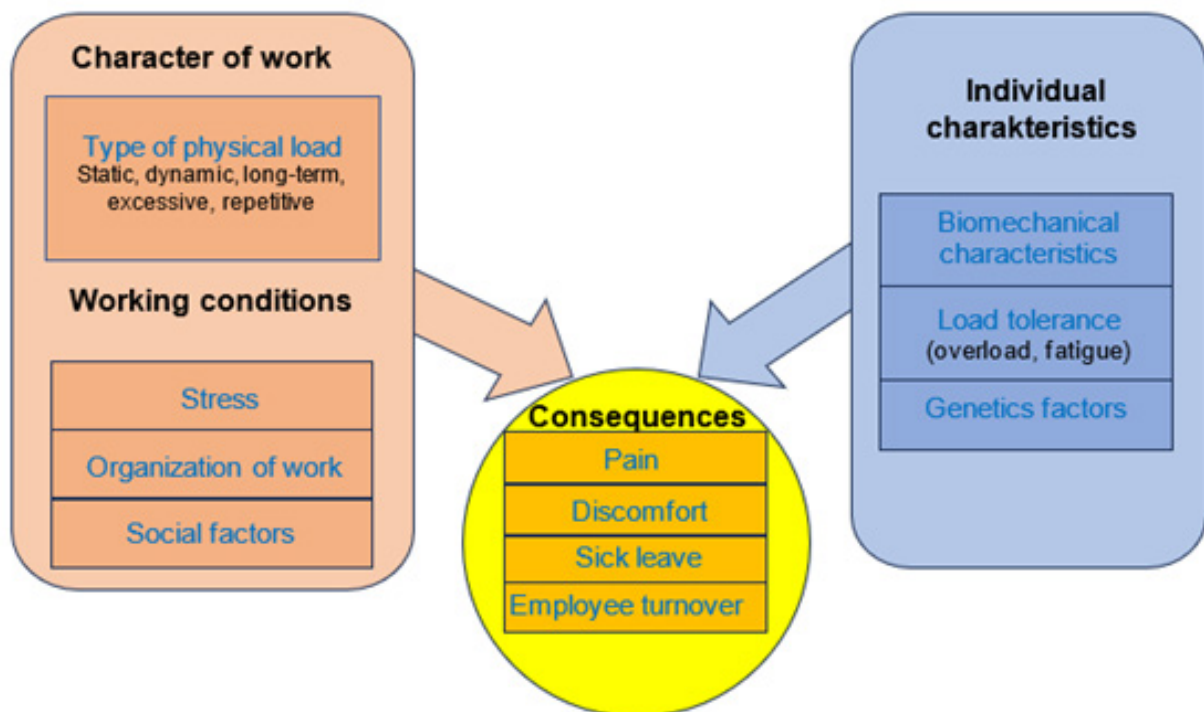


Figure 1: The influences of the nature of work, working conditions, and individual characteristics of a person on the potential consequences of physical work (adapted from [2]).

Ensuring a healthy and safe workplace and minimizing health and safety risks are logical concerns for corporate management. Unfortunately, this approach is often underestimated by individual managers within the company [3]. Any improvement in the work process must respect ergonomic principles of work rationalization, and it must be based on systematically designed methodological procedures. These improvements should primarily focus on enhancing human participation in the work process. Placing humans at the forefront when defining the basic factors of work process rationalization is not coincidental. It specifically reflects the importance of the human role in rationalization activities, where the person is not only the object but also the subject of rationalization. Workload can be defined as the sum of external conditions and demands within the work system that affect a person's physiological and psychological state. When the human stress factor reaches a level that disrupts an individual's well-being, we speak of overload [4].

In relation to the quality of the work environment, there is a concept known as 'work environment comfort.' This refers to the state in which a worker is capable of delivering optimal performance. Fatigue is closely associated with human work as a natural consequence of intense physical and mental activity. Fatigue can manifest as a subjective feeling or an objective state of the body—such as slowed perception, headaches, muscle pain, tachycardia, sweating, and other possible symptoms depending on the individual's physical and psychological dispositions. Generally, fatigue leads to a decline in the functioning of the musculoskeletal and vegetative systems of the body, as well as impaired attention and concentration. Fatigue develops rapidly during work with a higher proportion of static elements (unilateral load and enforced

working posture), due to unfavourable hygienic factors of the work environment, inappropriate work tools, and subjective factors such as a negative attitude towards work, lack of sleep, and poor lifestyle habits.

While physical work can be interrupted when the worker feels tired, mental work cannot entirely interrupt further brain activity even after it has been formally paused or stopped. It continues to occupy the person's mind, sometimes so intensely that, despite increased effort of will, the person cannot detach from the previous activity [5]. The longer and more intense the work activity, the more pronounced and rapid the onset of fatigue. This is related to the so-called 'sustainable performance threshold,' which maintains a balance between the demands of work performance and the ability of a person to carry it out within the required time and quality. In higher types of production, the strain on the organism shifts from the physical to the psychological domain. In this case, the dominant cause of fatigue is psychological strain from monotonous, repetitive work in short intervals [6].

The work and rest regimen, or its modification, cannot be based solely on the demands and requirements of the work process; it must primarily respect the biological, physiological, and psychological factors that influence and condition the human organism's readiness for work activity and affect its physical and mental activity. An individual's performance also depends on the biological circadian rhythm, which peaks around 9 a.m. and again in the afternoon or evening around 9 p.m. The lower boundary (negative peak) of performance is around 3 p.m. and 3 a.m. Resistance to fatigue and the safe execution of individual work operations are also directly proportional to the course of human performance (Figure 2).

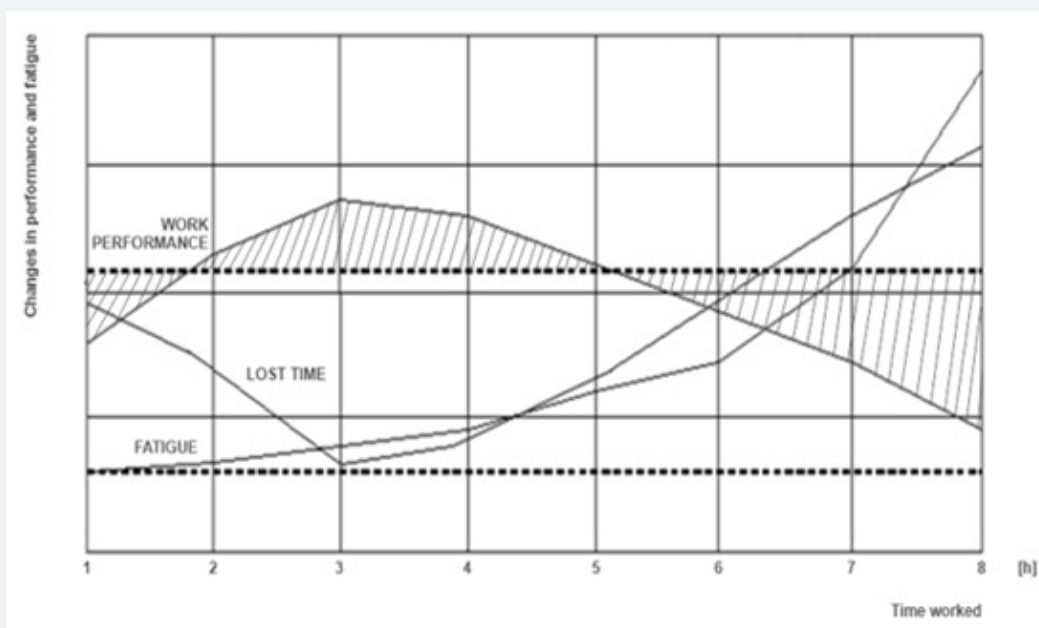


Figure 2: Decline in performance and increase in fatigue (adapted from [5]).

Musculoskeletal Disorders

Musculoskeletal disorders, or diseases, are the most common work-related health problems. These disorders can affect the spine, neck, shoulders, and upper and lower limbs. They encompass a wide range of health issues, from minor to more severe conditions that may require work absence, surgery, treatment, long-term rehabilitation, and even potential disability, regardless of a person's age. The majority of musculoskeletal disorders develop gradually, and most are not caused by a single causal relationship. In most cases, they result from a combination of physical, biomechanical, organizational, psychosocial, and individual risk factors. Individual risk factors can include, among other things, previous medical history, physical capabilities, level of mental resilience and stability, lifestyle, and habits (such as alcohol consumption, smoking, and physical activity).

Among the physical and biomechanical risk factors, the handling of heavy loads is particularly noteworthy. This includes simultaneous bending and twisting of the torso, static and unnatural postures, and intense or repetitive movements during work activities. Other factors may include exposure to vibrations, working at a high pace, inadequate lighting, unsuitable microclimatic conditions in the workplace, and prolonged sitting or standing in the same position. Among the organizational and psychosocial factors that significantly negatively impact the development of musculoskeletal disorders are high work

pace, low levels of autonomy, limited opportunities to change working positions, shift work, night work, harassment, bullying, discrimination, mobbing, low job satisfaction, and inadequate interpersonal communication. Delayed or insufficient essential information about the work can also be problematic.

In terms of preventing the development of MSDs, the aforementioned working posture is of considerable importance, as it directly influences physical strain. It is evident from practice that the same work can be performed in different positions, each of which may trigger a different level of exertion for the worker. The impact of work activity is directly related to the combination of working positions and work movements. Work activity within the work process consists of a certain number of individual movements, which accumulate and form a cohesive structure developed during the training process. The training, coaching, and orientation processes are of fundamental importance concerning ergonomic principles, their optimization, rationalization, and the effectiveness of repetitive movements [7].

Lumbar spine

The lumbar spine, as part of the cylindrically arranged vertebrae, the most rigid section of the spine. Its limited mobility is due, on one hand, to the shape of the vertebrae and, on the other hand, to strong ligaments. The lumbar section of the spine consists of five vertebrae, which are labelled with the letter L and the associated numbers from 1 to 5 (Figure 3).



Figure 3: Fused lumbar vertebrae, lateral view from the left (modified from [14]).

The main function of the lumbar spine is to support and distribute the body's weight through the pelvis. Because the body requires this part of the spine to be as stable as possible, natural movement in this area is very limited. However, even this minimal movement is essential for the proper functioning of the spine and the body. Unlike the cervical and thoracic spine, the spinal cord passes through the hips minimally. From the second lumbar vertebra, it branches into two strong nerve bundles that transmit impulses to the lower part of the body. The muscles surrounding the lumbar spine are responsible for stabilizing the torso, which is a very demanding function that the spine is not relieved of by human behaviour. The overloading of the lumbar spine and the muscles involved in stabilizing the body is primarily caused by poor sitting posture and overall body posture of the worker. This subsequently leads to pain. In the human body, everything is interconnected. With this in mind, it is clear that pain in the lumbar spine and surrounding muscles sometimes indicates problems in other areas as well. It may involve overstrained muscles in another part of the body or diseases of internal organs.

Low back pain is the most common and economically burdensome work-related musculoskeletal disorder. Statistics show that up to 80% of the adult population experiences low back pain during their active life, with the majority of these pains being related to working conditions [8]. From a clinical perspective, work-related low back pain can be categorized into:

- Degenerative changes in the lumbar spine, 138 - Low back pain from overload
- Low back pain from hyper lordosis (increased curvature) of the lumbar spine
- Low back pain due to dysfunction of the sacroiliac joint
- Other causes of low back pain

As previously mentioned, the most serious clinical issues are degenerative changes in the intervertebral discs, specifically the so-called radicular syndromes due to disc herniation, which compresses nerve roots. Biomechanically, intervertebral disc damage is negatively affected by compressive, torsional, and tensile forces [8]. Low back pain from overload is mainly associated with prolonged static loading, such as standing or sitting, and its occurrence is influenced by overall poor posture, weak muscles, or ligament insufficiency [9].

Diseases and injuries of the lumbar spine

Due to its 'S' shape, the spine is capable of absorbing a certain amount of deformational energy within its individual components. The spine is composed of vertebrae connected by discs and pairs of facet joints. Together with short and long ligaments, these passive connections determine the mutual mobility of the vertebrae relative to each other. The structural integrity of the axial system is influenced throughout life by various factors, both biological (genetics, developmental defects, hormonal changes,

nutritional factors, and infections) and mechanical (load, external forces). The axial system has a supportive and protective function (for the spinal cord), dampens vibrations and shocks, and ensures body and girdle movements [10].

Painful conditions of the cervical spine are particularly characteristic of managerial staff, assistants, secretaries, and academic workers. In contrast, professions that primarily experience pain in the lumbar spine include construction and industrial workers, drivers, and nurses. Besides the occupation itself, a person is also influenced by psychosocial factors (high work demands, limited time for tasks, workplace relationships, etc.) [9].

The dominant musculoskeletal disorders in the lumbar spine area primarily include:

- Acute lumbar sprain (lumbago), which mainly manifests as painful restriction of lumbar spine mobility, usually in rotation and straightening.
- Herniated intervertebral disc, which primarily presents with unpleasant radiating or shooting pains in the lumbar spine area, extending into the buttocks or lower limb.

In terms of weight limits and overcoming various distances and obstacles in performing specific work tasks, the handling of heavy loads has a decisive impact on the musculoskeletal system and lumbar spine damage. This activity also puts stress on the supporting joints, muscles, ligaments, and even the cardiovascular system [8].

Improper handling of loads by inadequately qualified and unverified workers accelerates degenerative changes in the lumbar spine. The adverse effect of load handling is due to the combined weight of the load and the person's body weight. Excessive pressure on the spine leads to damage to the delicate cartilaginous lining of the joint surfaces. In work activities involving carrying loads on the shoulders, degenerative changes in the cervical area of the thoracic spine are more common. Degenerative changes in the intervertebral discs most commonly affect the L5/S1 segment (Figure 4).

This is a consequence of the transmission of all forces and pressures during bending, tilting, rotations, and lifting in this area. During handling, the deformation of the intervertebral discs increases with the weight of the lifted load and the degree of movement away from the neutral position of the spine in the direction of bending or tilting [4]. The risk factors that negatively impact potential spinal injuries can generally be divided into those occurring in the workplace and those related to non-work activities. A more detailed breakdown of workplace risk factors is provided in the table (Table 1) [11].

From the content of the professional literature, inorganic (psychosocial) factors have a more significant impact on returning to work than organic factors.



Figure 4: Example of potential damage to the L5/S1 segment under load from lifting a 34 kg weight (modified from [14]).

Table 1: Risk factors causing spinal injuries (modified from [1]).

Work factors	Physical factors of work	Heavy manual labor
		Lifting and carrying loads
		Work in a forced position (twist, bend, static position, rotation)
		Whole body vibration
	Psychosocial factors	Weak or missing social support
		Lack of job satisfaction
	Work organization factors	Poor work organization
		Insufficient workload
Defective loading of the lumbar spine during non-work activities		
Competitive factors		

Lumbar spine as an occupational disease in the EU

Occupational diseases arise from the adverse effects of chemical, physical, biological, or other harmful influences. In some countries, the recognition of these diseases depends on the conditions listed in the occupational diseases registry. An occupational disease is typically one that is recognized by a specialized institution if it has developed in direct connection with work performance. From the data obtained through a questionnaire survey as part of our own research, it is evident (Table 2) that there is no unified system of criteria, procedures, and methodology for recognizing lumbar spine disorders as an occupational disease across different EU countries and in some others.

Regarding the situation in Germany: After the reunification of Germany in 1992, it became necessary to unify the legal framework for the recognition and compensation of occupational diseases. Since spinal damage at work had been compensated in the former GDR since the 1950s, it was decided to amend the occupational diseases list with three items: 2108, 2109, and 2110. Item 2108 includes 'lumbar spine discopathy due to long-term lifting and carrying of heavy loads or activities involving extreme trunk

flexion.' Item 2109 covers 'cervical spine discopathy resulting from long-term carrying of heavy loads on the shoulders.' Item 2110 represents 'discopathy after prolonged (typically 10 years) exposure to predominantly vertical whole-body vibrations while seated (3-5 Hz).'

In addition to Germany, lumbar spine disorders are also listed as occupational diseases in Belgium, Denmark, Estonia, France, Italy, Cyprus, Lithuania, Latvia, Hungary, and Spain. Whole-body vibrations as a cause of intervertebral disc damage in the lumbar spine are recognized in Belgium, Denmark, France, Italy, Lithuania, Latvia, Germany, the Netherlands, Slovakia, and Spain. In Croatia, Cyprus, and Austria, vibrations are recognized as the sole possible cause of professional lumbar spine disease. In the Netherlands, there are no fixed lists of occupational diseases, but lumbar spine disease can still be recognized as an occupational disease due to a so-called 'open item.' This means that any disease that arises in connection with work can be assessed and subsequently recognized as an occupational disease [12]. This is in contrast to Slovenia, which also does not have a list of occupational diseases, but these diseases cannot be recognized there because it does not have an open item.

Table 2: Basic Data for the Evaluation of the 'Professional Lumbar Spine Disease' Questionnaire (Own Research).

Country	List of Occupational Diseases		Does Your List of Occupational Diseases Include These Items?			
	YES	NO	Lumbar Spine Disease	MSD	Back Pain	Free Item
Australia	X		No	No	No	No
Belgium	X		Yes	Yes	No	No
Denmark	X		Yes	Yes	Yes	No
Estonia	X		Yes	Yes	Yes	Yes
Finland	X		No	Yes	No	Yes
France	X		Yes	Yes	Yes	Yes
Croatia	X		No	Yes	No	No
Italy	X		Yes	Yes	No	No
Cyprus	X		Yes	Yes	No	No
Lithuania	X		Yes	Yes	No	No
Latvia	X		Yes	Yes	Yes	No
Hungary	X		Yes	Yes	No	Yes
Germany	X		Yes	Yes	Yes	No
Netherlands		X	No	No	No	Yes
Norway	X		No	No	No	No
Poland	X		No	Yes	No	No
Austria	X		No	No	No	No
Slovakia	X		No	No	No	Yes
Slovenia		X	No	No	No	No
Spain	X		Yes	Yes	No	No
Czech Republic	X		Yes	Yes	No	No

Methodology for Recognition of Occupational Diseases		
Exact instructions, specific methodology (tables)	11	Belgium, Czech Rep., Denmark, France, Italy, Latvia, Germany, Netherlands, Norway, Slovakia, Spain
General procedures (medical reports, work history)	3	Australia, Estonia, Lithuania
Individual assessment	1	Finland
There is no methodology	6	Croatia, Cyprus, Hungary, Poland, Austria, Slovenia

Country	Criteria for the Assessment of Occupational Diseases of the Lumbar Spine
Austria	it is recognized only as a consequence of the vibrations of the whole body
Belgium	handling of heavy loads, vibration math assessment
Denmark	many years of handling heavy loads, inappropriate positions or vibration
Finland	spinal degeneration is not considered an occupational disease with only one exception: fighter pilots with precise criteria individual assessment
France	exact conditions for heavy loads and vibrations, given exposure time list of works causing disease
Germany	handling of heavy loads, inappropriate positions and vibrations, the given diagnosis of the disease math assessment
Hungary	inappropriate working conditions, duration of exposure to the worker. an investigation sheet is filled out individual assessment
Italy	diagnosis Lumbar disc herniation disease caused by vibration and handling of loads
Lithuania	whole body vibration and manual handling of loads, duration of exposure (vibration 5 years, loads 2 years)
Netherlands	handling loads, inappropriate working position, vibration and interaction between these factors supporting scoring system
Slovakia	excessive physical load, including working positions and handling loads, exposure to vibrations, duration of exposure longer than 5 years
Spain	repetitive vertical vibration individual assessment

In the Slovak Republic, as of January 1, 2004, the list of occupational diseases was expanded to include a new item, D-47 - other work-related health damages, which also encompasses spine diseases recognized as occupational diseases. The condition for the recognition of such an occupational disease is a demonstrable causal link between the work activity performed and the identified health impairment. Another requirement is a professional

medical assessment prepared by the national commission for the evaluation of occupational diseases. According to the official statistics from the National Health Information Centre (NCZI) of the Slovak Republic, which are published annually on the institution's website, it is evident that the development of spine damage as an occupational disease during the period 2018-2022 aligns with the content of the specified table (Table 3).

Table 3: Spine Damage as an Occupational Disease in Slovakia from 2018 to 2022 (modified).

Observed Year	Diagnosis Number	Name of the Diagnosis	Number of Cases	Total For the Year Under Review
2018	M51.1	Lumbar and other intervertebral disc damage with radiculopathy	1	3
	M51.9	Intervertebral disc damage, unspecified	1	
	M54.10	Radiculopathy in several places of the spine	1	
2019	M54.10	Radiculopathy in several places of the spine	1	1
2020	M51.1	Lumbar and other intervertebral disc damage with radiculopathy	1	2
	M54.10	Radiculopathy in several places of the spine	1	
2021	M51.1	Lumbar and other intervertebral disc damage with radiculopathy	1	1
2022	M51.1	Lumbar and other intervertebral disc damage with radiculopathy	1	2
	M54.10	Radiculopathy in several places of the spine	1	

From the data presented in Table 3, it is evident that the overall proportion of spine damage as an occupational disease (9 cases) compared to the total number of occupational diseases or threats of occupational diseases in the Slovak Republic during the evaluated period (1,857 cases) is absolutely negligible.

Lumbar spine injury as an occupational disease in the Czech Republic

In the Czech Republic, effective January 1, 2023, the list of occupational diseases was expanded to include the item: 'Chronic lumbar spine disease caused by long-term overloading from heavy physical work, associated with temporary incapacity for work due to this diagnosis, with a total duration of at least 12 months in the last 3 years.' At the same time, the conditions for an objective professional assessment of the proposal for recognition of an occupational disease were strictly and specifically declared. This development is the result of many years of effort (since 2012) and activities by the professional community to achieve recognition of chronic spinal disease resulting from long-term activities such as lifting and carrying heavy loads, frequent bending and rotation of the torso, and whole-body vibrations as risk factors in the work environment as an occupational disease.

Criteria for recognizing severe lumbar spine damage as an occupational disease:

- ✓ The illness must have resulted in at least 12 months of

sick leave, according to the patient's medical records.

- ✓ The disease must have been examined and evaluated by a neurologist as at least a moderately severe chronic lumbar spine disease, and other diagnoses, such as injury-related or congenital spine disorders, must be clearly ruled out. The severity of the neurological findings must reach the required number of points for the patient's age group.

- ✓ Severe findings on the lumbar spine must also be confirmed by an MRI examination, with the severity meeting the required number of points for the patient's age group.

- ✓ The patient must have worked in a high-risk job for at least three years, with a work physiologist evaluating the patient's working conditions as long-term and highly strenuous on the lumbar spine based on an investigation at their workplace.

All of the above conditions must be met for the disease to be recognized as an occupational illness. According to official statistics from the Czech Republic and the EU, it is evident that lumbar spine disease is one of the most common musculoskeletal disorders in the Czech Republic and globally, and in 2020, it was the second most common cause of work incapacity in the Czech Republic, with a lifetime prevalence estimated at 60-85%. The procedure for recognizing occupational diseases, also valid for low back diseases in the Czech Republic, is shown in (Figure 5).

The inclusion of a new item of lumbar spine disease in the list of occupational diseases in the Czech Republic brings several advantages. Scientific Approach: The diagnosis is in line with current medical and scientific knowledge. Preventive Factor: The new diagnosis on the list of occupational diseases highlights potential risks that affect both the worker and the employer. This will lead to better control of working conditions and risk factors. Compensation Possibility: Individuals who are proven to have a professional disease will be entitled to compensation, including the possibility of replacements, retraining, and reassignment to a suitable position. Harmonization and Comparison: Harmonizing the Czech list of occupational diseases with the lists of other European countries supports unity in fulfilling the philosophy of protection and safety at work in the EU.

In terms of differential diagnosis, vertebrogenic and extravertebrogenic diseases are distinguished. Vertebrogenic diseases include, for example, congenital defects of the lumbar spine, spondylolisthesis, spondylitis, tumours (MTS), osteoporosis, fractures, coccygodynia, congenital vertebral defects, idiopathic spinal canal stenosis, Paget's disease, and Bechterew's disease. Extravertebrogenic diseases include gynaecological disorders, urological disorders, gastrointestinal tract diseases, coxalgia, sacroiliac joint disorders, tumours (such as retroperitoneal), diabetic neuropathy, peripheral artery disease, aortic aneurysm, neuropathy, and psychosomatic disorders [13].

Ergonomic Checklists in the Czech Republic as a Screening Tool for Lumbar Spine Overload

Ergonomic checklists serve as an effective screening tool for assessing ergonomic risks in workplaces. They include important parameters of the workplace that help identify potential health risks. In connection with the possibility of recognizing chronic lumbar spine disease as an occupational disease in the Czech Republic, the priority was to create a functional screening and preventive tool for employers within a research project. This tool is specifically focused on the occurrence of potential occupational risks that could lead to this disease.

In the creation of a functional ergonomic checklist, the process was based on the professional materials of the National Institute of Public Health of the Czech Republic. From the entire set of ergonomic checklists, those that met the needs for creating a screening tool were selected—specifically, those focused on load handling and the evaluation of trunk working positions. A two-phase verification process was conducted in several selected companies' workplaces, where in the first phase, shortcomings in the original ergonomic checklists were evaluated, and in the second phase, the updated documents were tested.

Study of checklists and their verification in practice

This phase focused on the study of existing and selected checklists from the document: "Ergonomic Checklists and New Methods of Work in the Evaluation of Ergonomic Risks", published

by the National Institute of Public Health in 2007. The initial analysis of the existing checklists revealed the need to consider the current needs of practice and incorporate the requirements of companies in accordance with applicable legislation. To obtain the necessary data, ergonomic audits were conducted in May and June 2023 at the three companies. Each checklist was audited by a supervisor and an industrial engineer under the supervision of an ergonomics specialist. The goal was to determine whether workers in industrial environments, particularly in manufacturing companies, understand the questions in the above checklists, can use the checklists for auditing a workplace/worker, and can evaluate the conclusions that result from the audit using the checklist. Among the key findings from the first phase of practical verification were deficiencies in the formulation of questions, the absence of illustrative graphical representations, missing definitions of the terminology used, and the lack of reference to limit values according to applicable legislation. There was also noted user confusion and complexity.

Verification of the proposed updated checklists in the corporate environment

After the proposed updated version of the checklists was created, reaudits were conducted again in November 2023 in three companies. The reaudits were once again conducted with the same team composition: a supervisor and an industrial engineer. In two companies, the same supervisors and industrial engineers audited both the existing and the updated checklists. To verify the checklists with individuals not familiar with the subject matter, was selected one from company, where the updated checklists were once again tested by an industrial engineer and a supervisor.

Final version of the updated checklists

Based on the data obtained from the audits, further adjustments were made to the checklists, resulting in the creation of the Checklist for Ergonomic Evaluation of Work Activity and Workplace with regard to Lumbar Spine Overload. This screening tool enables quick ergonomic evaluation of work activity and workplace concerning back injuries and the handling of loads. The checklist can identify both unsuitable working conditions and inappropriate working postures related to load handling that may lead to spine damage.

Preventive Measures and Ergonomic Solutions

In every life and work situation, it has always been and will continue to be true that prevention is a more appropriate and cost-effective solution than suppressing and eliminating potential consequences of undesirable conditions. This is especially true concerning ensuring the protection and safety of individuals during their work activities and related situations. Where do the sources of potential spinal and musculoskeletal problems lie? Every person who is a parent or grandparent has experienced or continues to experience how their children or grandchildren often carry heavy bags and backpacks to and from school. Filling the

daily schedule with school, extracurricular activities, and other obligations often causes the first and repeated stressful situations.

Looking further, how effective is the system of initial preventive medical examinations provided by healthcare facilities for children and adolescents, especially in the context of assessing the health status of applicants for study at vocational schools and training programs, which form the basis for preparing a qualified workforce? Are there currently clinics for children and adolescents linked to specific schools and educational institutions? If so, how are the rules and criteria set for assessing the health eligibility for a specific type of vocational training? A young person is still developing, and it is crucial to pay attention to whether their physical and mental abilities are in line with the future demands and requirements of the school during their preparation for a future profession.

Among the fundamental conditions defined for establishing an employment or similar relationship is the assessment of health eligibility for work, based on evaluating the health risks from exposure to work factors, the working environment, and the results of a preventive medical examination in relation to the specific job. In this context, and to comprehensively strengthen

the fulfilment of the employer's general obligations, it is necessary that:

- When assigning a worker to a specific workplace and type of work, the abilities, age, qualifications, and professional competence of the individual must be respected to ensure safety and health protection at work.
- No work should be performed that does not correspond to the worker's health condition, especially concerning the results of the health eligibility assessment, abilities, qualifications, and proof of professional competence.
- Health supervision, including preventive medical examinations related to specific work activities, should be ensured at regular intervals, considering the nature of the work and working conditions at the workplace, even if the employee personally requests it.

Any work activity is carried out within a system involving humans, technology, and the environment. This is expressed in the traditional concept of the ergonomic system: human - machine - working conditions (Figure 6).

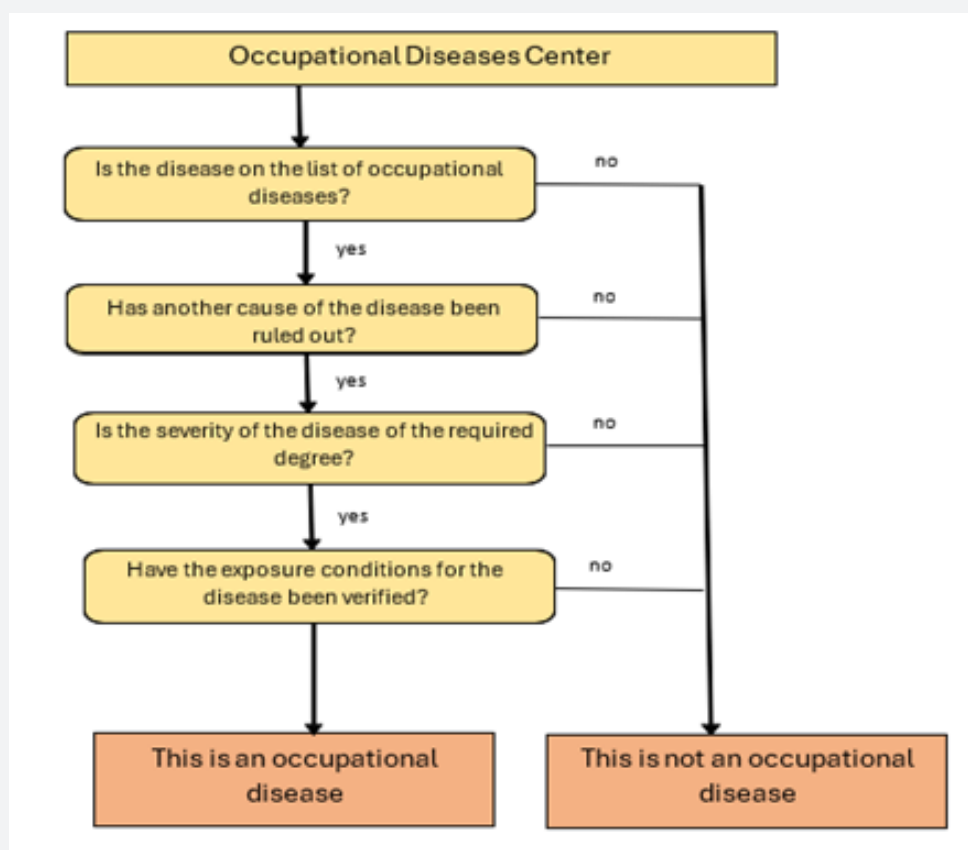


Figure 5: Algorithm of the process of recognizing lumbar spine disease as an occupational disease in the Czech Republic (adapted from [16]).

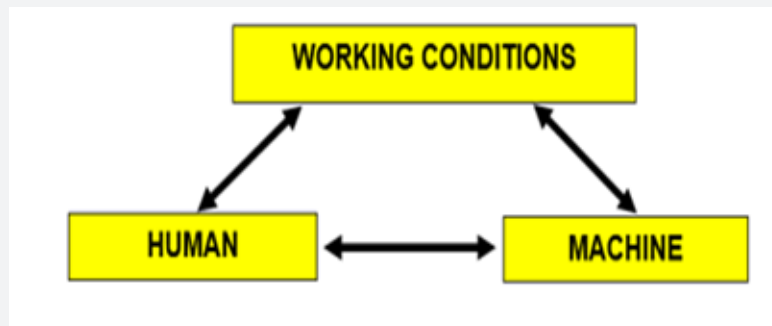


Figure 6: Ergonomic System: Human - Machine - Working [1].

The formulation of this model is associated with the emergence of ergonomics as an interdisciplinary field focused on optimizing working conditions and their interactions with the other two components of the system. The term 'working conditions' is understood here as a complex of factors and conditions that influence the course and outcomes of work activities. It therefore includes both the work environment, defined primarily by technical, ergonomic, hygienic, and aesthetic characteristics, and other broader conditions under which work is performed, particularly organizational, social, psychological, and cultural conditions. Applied ergonomics systematically addresses the improvement of working conditions by integrating knowledge from work psychology, work physiology, occupational medicine, hygiene, and occupational safety. It employs proven and tested methods for enhancing the quality and productivity of work. It focuses on reducing excessive work strain and the adverse effects of working conditions on workers' health [2].

Periodic increases in employee work performance are among the fundamental and dominant tasks and goals of every company manager. In addition to organizational prerequisites and the influence of human resource management, the ergonomic system is a cornerstone of improving work performance. This system not only contributes to cost optimization through more efficient work tasks but also, importantly, respects and supports an individual approach to workers in terms of:

- Biological performance readiness (individual's disposition and condition).
- Psychological performance readiness (individuality of each person).
- Respecting the system of rest breaks.
- Personal factors (age, strength, gender).

A key aspect of adhering to and respecting the principles and criteria of occupational safety and health is that the human subsystem holds a priority position within the ergonomic system. The other two subsystems (machine-equipment, work environment) must be adapted and subordinated to the human

subsystem. From a long-term perspective, the impact of ergonomics on work productivity is very significant, if not dominant, in terms of employee turnover, absenteeism, satisfaction or dissatisfaction, and, importantly, the incidence, occupational representation, causal relationship, and development of occupational diseases. How to address health disorders caused by excessive physical and mental strain? An American research team identified a total of five groups of risk factors for the potential occurrence of musculoskeletal health problems (disorders), based on which 32 corrective measures were proposed to eliminate or mitigate the consequences:

Repetition of work tasks and operations

- Expand the content of work activities to achieve greater variety
- Use mechanical aids
- Introduce job rotation
- Automate certain tasks
- Distribute work evenly throughout the shift
- Restructure work activities
- Increase the number of rest breaks

Force/mechanical stress

- Increase friction between the handle and the hand
- Reduce the weight of tools/containers and parts
- Improve mechanization
- Optimize the size and shape of handles and grips
- Balance tools and containers that the worker handles
- Select appropriate work gloves to minimize impact on performance
- Use cushioning pads
- Use torque control devices
- Expand space at edges and corners

Work posture

- Change position relative to the tool to avoid bending the wrist
- Place and design the workstation to eliminate or reduce the occurrence of unnatural postures
- Move any handled part closer to the worker
- Design tools and equipment according to the specific workstation

Vibration

- Design the work process to minimize the machining of surfaces and edges
- Design tools with minimal vibration levels
- Use insulating protection for tools operating above the resonance point
- Use mechanical aids
- Adjust the speed of tools to eliminate resonance
- Use damping for tools that resonate

Psychological stress

- Allow workers more control over the course of their work
- Broaden the scope of tasks
- Eliminate blind electronic monitoring
- Minimize imposed work pace
- Include appropriate micro-breaks

In connection with the risks defined above and the associated potential corrective measures, it is necessary to emphasize and point out two essential aspects. First, changes related to current habits and procedures should be continuously consulted, preferably during their development and before their implementation, with those directly affected. The second crucial issue in applying corrective measures and related changes is to conduct ongoing and random checks to ensure that workers are adhering to the principles and criteria of the individual processes, by asking for their possible observations, suggestions, and findings.

The Irish guide for managing musculoskeletal disorders in the workplace outlines the main elements of prevention, which are:

- Policy on the prevention and management of MSDs in the workplace.
- Risk assessments and safe systems of work plans (SSWPs).
- Training.

- Accident and near miss reporting and investigation.
- Injury management (retention, rehabilitation and return to work); and
- Internal auditing. [14]

There is no unified system for preventing potential health damage to employees in the work process. Each case is specific, individual, and embodies potential risks and possible problems. However, there is a way to identify so-called 'friction points.' This involves an ergonomic analysis—step-by-step procedures in which the activities of a qualified person in the field of ergonomics focus on the workplace and work environment, such as:

- Ceiling height, air space, and floor area.
- Reach distances.
- The 20-40-60 rule (main activity - frequently used - occasionally used).
- Height of the work surface.
- Space for legs (pedipulation space) - work while sitting and work while standing.

Work activities and associated posture and load:

- Work posture with a focus on the torso, head - neck, arms, legs, and other body parts.
- Overall physical load and associated hygienic limits of energy expenditure and average shift heart rate.
- Handling and transportation of loads.
- Local muscle load - estimate of the maximum average per shift.

The prevention of possible back pain naturally lies in lifestyle changes for the individual and ergonomic measures. From a lifestyle perspective, it involves ensuring regular physical activity, selecting sports activities that do not strain the back (swimming, cycling and brisk walking), eliminating smoking, reducing stressful situations to decrease muscle tension, and maintaining a healthy body weight.

A multi-year study of hospital nurses with an average age of 46 years and an average employment duration of 11 years in shift work confirmed that Neuromuscular exercise no more often than once a week for 24 weeks combined with five sessions of back care counseling is a feasible and effective program for reducing back pain in female healthcare workers. These workers are at high risk for chronic low back pain and increased sickness absence due to their physically strenuous work for the lower back. [15]

In the field of ergonomics, it is desirable to ensure that the work environment is adapted to the worker. It is important to maintain proper posture, ensure that the worker bends as little as possible, and if necessary, lifts loads from a squat rather than

bending their back. When sitting, use the chair's backrest, take breaks to interrupt prolonged sitting or standing, and arrange the work desk to avoid unnecessary stretching, twisting, or leaning.

Conclusion

Lifting and carrying heavy loads, frequent bending, trunk rotation, and whole-body vibrations are significant risk factors in the work environment that often lead to excessive wear and tear of intervertebral discs during work, resulting in subsequent back pain. In this context, psychosocial factors at work (job satisfaction or dissatisfaction) should not be overlooked, as they significantly influence the duration of work incapacity [1].

In the assessment of health problems related to spinal injuries and the potential recognition of associated occupational diseases, it will be necessary to identify the spontaneous occurrence of discopathy in the general population as well as in selected potentially high-risk professions. The dominant issue in evaluating the professional nature of the condition remains the expert assessment of the degree of spinal damage, considering the individual's age. Despite the open labor market within the EU and beyond, there is no unified system, standards, guidelines, or recommended practices for recognizing the professional nature of spinal injuries due to work activities or directly related conditions [16-18].

Regardless of the diversity of opinions and the interest or willingness to introduce and gradually expand the lists of occupational diseases at the level of individual EU member states, the European Commission has adopted its recommendation concerning the Treaty on the Functioning of the European Union, specifically Article 292 of that treaty. The Commission recommended that member states implement a set of measures to update and improve various aspects of their policies related to occupational diseases. Among other things, it was recommended that EU countries incorporate the European list contained in the annex to the recommendation into their national legal and administrative provisions as soon as possible, concerning scientifically recognized occupational diseases eligible for compensation and subject to preventive measures. In the context of lumbar spine damage as an occupational disease, this specifically refers to diseases caused by physical factors, particularly item 2.502: Diseases of the intervertebral discs of the lumbar spine caused by repeated vertical effects of whole-body vibrations.

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