

WORK-RELATED MUSCULOSKELETAL DISORDERS AND ERGONOMIC INTERVENTIONS

SABINA MATAJN, MARJETA MIRKAC, NEJC PLANINC, GREGOR ROJ, URŠKA ŠAJNOVIČ, ALENKA ŠKERJANC

University Medical Centre Ljubljana, Clinical Institute of Occupational, Traffic and Sports Medicine, Ljubljana, Slovenia

ABSTRACT

The work-related musculoskeletal disorders are disorders to which environment and performance of work significantly contribute. They refer to disorders of the muscles, nerves, tendons, ligaments, joints, cartilage and intervertebral discs. Ergonomic work-related factors pose a risk of musculoskeletal disorders and ergonomic recommendations are used to alleviate them. The objective of this paper is to help trainees and specialists in occupational medicine to assess ergonomic risk factors for musculoskeletal disorders with the aim to prevent work-related diseases. Literature on ergonomics and work-related musculoskeletal disorders was reviewed in order to assess and eliminate work-related factors that pose a significant risk. The literature review suggests that proactive approach to the reduction of work-related musculoskeletal disorders is extremely important. However, in Europe, there are neither uniform methodological guidelines nor criteria for recognition of musculoskeletal disorders as occupational diseases. Moreover, related bonuses such as reimbursement, vocational rehabilitation or workplace adjustments have not been standardized yet, either. Over the past two decades the efforts to reduce musculoskeletal disorders in European countries have not led to encouraging results yet. It is expected that by implementing proactive ergonomic programmes in the work environment, a large part of the working population could be involved in the reduction of musculoskeletal disorders. A unified reporting system should be introduced to monitor and compare the effects of interventions.

KEY WORDS: work-related musculoskeletal disorder, proactive action plan, preventive measures, ergonomic improvements, compensation.

Corresponding author: Alenka Škerjanc
UKCL – KIMDPŠ
Grablovičeva ulica 42
SI 1000 Ljubljana, Slovenia
E-mail: alenka.skerjanc@gmail.com
Phone: +386 31624162

Received: 1st October 2019, revised version on 12th November 2019
Accepted: 30th November 2019

ABBREVIATIONS

ACGIH - American Conference of Governmental Industrial Hygienists
CEPROSS – Cede Electrónica de la Seguridad Social
CDC – Center for Disease Control and Prevention
MALPROF - Malattie Professionali
MMH - Manual Material Handling
MSDs - musculoskeletal disorders
NIOSH – The National Institute for Occupational Safety and Health
OccWatch - Occupational Diseases Sentinel Clinical Watch System
OSHA - The European Agency for Safety and Health at Work
PISP - Pesticide-Related Illness and Injury Surveillance
RAF - Recirculating Aquaculture System
RNV3P - Réseau national de vigilance et de prévention des pathologies professionnelles
SIGNAAL - Signalering Nieuwe Arbeidsgerelateerde Aandoeningen Loket
THOR - The Health and Occupation Research
TLVs - Threshold Limit Values
WRDs – Work-related Diseases

INTRODUCTION

Ergonomics is the science of fitting workplace conditions and job demands to the capabilities of the working population. Effective and successful "fits" assure high productivity, avoidance of illness and injury risks, and increased satisfaction among the workforce (Cohen et al., 1997).

Work ergonomics is a branch of ergonomics that deals mainly with professional work and studies interactions between physical and psychical capabilities of workers and working conditions, job demands and requirements of the workplace. Its aim is to assess whether the

workers are exposed to health risks at work and if the risks can be alleviated or eliminated. Organizations also benefit of healthy workplaces because compensation costs for sickness absence are reduced. Ergonomic measures at workplace are also expected to reduce the frequency of musculoskeletal disorders (MSDs) and seriousness of the diseases, sickness absence and disability (Dodič et al., 2016).

MSDs can affect the body's muscles, joints, tendons, ligaments and nerves. Most work-related MSDs develop over time and are provoked either by the work itself or by the employees' working environment. Typically, MSDs affect the back, neck, shoulders and upper limbs; less often they affect the lower limbs (Slovenian Ministry of Labour, Family, Social Affairs and Equal Opportunities, 2007). Lifting, repetitive movements, extreme hot and cold working environment pose a risk of MSDs. Stress, high pace of work, noise, vibrations, obesity and age are also risk factors contributing to the development of MSDs. There are different physical and biomechanical, organizational, psychosocial and personal conditions that independently or in interactions aggravate MSDs (Slovenian Ministry of Labour, Family, Social Affairs and Equal Opportunities, 2007).

The objective of this paper is to help trainees and specialists in occupational medicine to assess ergonomic risk factors for MSDs with the aim to prevent work-related diseases.

METHODS

The paper presents the summary of the relevant literature for the final specialist assessment in occupational medicine on ergonomic risk factors for MSDs. The specialists of occupational medicine from Central European countries were asked to present the criteria for recognition of four musculoskeletal disorders as occupational diseases. Following the literature and its suggestions, the key factors and guidelines to assess MSDs related to work are suggested.

RESULTS

MSDs remain the most common occupational disease in the European Union and workers in all sectors and occupations can be affected (Slovenian Ministry of Labour, Family, Social Affairs and Equal Opportunities, 2007). Almost one quarter of the European workers complain of backache and more than one fifth complain of muscular pains. MSDs are associated with high costs to employers such as absenteeism, lost productivity, and increased

health care, disability, and worker's compensation costs (Slovenian Ministry of Labour, Family, Social Affairs and Equal Opportunities, 2007). Due to high prevalence, negative effects on the workers and their ability to work and the costs they cause, MSDs are an important public health problem (Cohen et al., 1997; Slovenian Ministry of Labour, Family, Social Affairs and Equal Opportunities, 2007; OSHA, 1999).

There are differences among the European member states in the classification of MSDs as occupational diseases. A study including ten European member states presented the differences (Kieffer, 2016). All the states except Sweden have their diseases recognized as occupational diseases stated in a List of occupational diseases. To recognize any disease as occupational one, all possible contributing risk factors are carefully studied like work exposure, private life exposures, sport activities, etc. Age, gender, body weight, previous illnesses are also taken into account. There are exceptions in France, Italy and Spain where the presence of the diagnosis of the disease on the List of occupational diseases satisfies the need if the certain association between the workplace risk factors and the disease has been proven. Even if the disease is not on the List it could be recognized as occupational disease in nine European member states with the exception of Spain (Kieffer, 2016).

The cases of recognizing MSDs as occupational diseases are presented in *Tables I/a – I/d*. (Kieffer, 2016, Central European specialists in occupational medicine collaboration 2019) and *Table II*. The right to compensate which differs in European member states is also presented.

There are differences in the amount of MSDs reported per 100,000 employees and in the amount of recognized MSDs per 100,000 employees and their share regarding all recognized occupational diseases – this is presented in *Table II*. There are some states that assure financial compensation for occupational diseases like payment of professional rehabilitation or the workplace adaptation while in some states the workplace adaption is the cost of the employers (Kieffer, 2016).

TABLE I/a. Differences among countries in recognition of *Carpal tunnel syndrome* as an occupational disease

COUNTRY	RECOGNITION (* Eligibility for financial compensation)
Austria	not recognized as occupational disease
Belgium	recognized as occupational disease* if arm was exposed to repetitive gripping movements, pressure on the wrist or extreme posture of the wrist
Croatia	recognized as occupational disease if a hand was exposed to repetitive movements of the wrist (more than 10 movements per minute) or fingers (more than 200 movements per minute), or exposed to the pressure on the wrist or to extreme ulnar/radial postures at the wrist for more than 4 hours during the 8 hours working shift
Czech Republic	The diseases of peripheral nerves of the upper limbs of ischemic or strait neuropathies when working with vibrating tools and equipment, damage to the upper limb nerves of the strait syndrome character with clinical signs and pathological EMG findings corresponding to at least moderate failure. Determination of at least moderate severity of isolated carpal tunnel syndrome (preliminary clinical conditions, procedure and conditions of electrophysiological examination for determination of severity of isolated CTS, electrophysiological criteria of moderate severity of isolated CTS) were published in the Bulletin of the Ministry of Health No. 10/2003. The exposure must be confirmed by a public health officer (special criteria).
Denmark	probably recognized as occupational disease* if arm was exposed to strenuous and repeated wrist movements for more than half of working time
Finland	recognition is possible,* depending on the conditions of exposure and the causal link
France	recognized as occupational disease* if the work is performed with tasks habitually involving either repeated or prolonged movements of extension of the wrist or gripping with the hand or pressing on the median nerve or prolonged or repetitive pressure on the heel of the hand
Germany	recognition is possible, depending on the conditions of exposure and the causal link
Hungary [§]	in the case of exposure that may cause CTS (repetitive wrist movements, high force, extreme positions, local pressure, vibration) and non-occupational origin (thyroid disease, diabetes, pregnancy, etc.) can be excluded
Italy	recognized as occupational disease if the work is performed with tasks non occasionally involving repeated or prolonged movements of the thumb or gripping with the hand, maintaining uncomfortable positions, prolonged pressure or repeated impacts on the carpal region
Northern Macedonia	recognized as occupational disease* if the worker was longer time exposed to local vibrations or there is long-term overload and pressure on the forearm and hand
Serbia	recognized as occupational disease jobs and tasks with long-term overload and pressure on hand and forearm with clinical presentation of carpal tunnel with morphological signs of chronic compression and functional failure
Slovakia	recognized as occupational disease* if arm was exposed to repetitive gripping movements, pressure on the wrist or extreme ulnar/radial posture of the wrist, from long-term, excessive and one-side overload
Slovenia	recognized as occupational disease* if arm was exposed to repetitive gripping movements >10 times per minute, pressure on the wrist > 45N or extreme ulnar/radial posture of the wrist
Spain	recognized as occupational disease*
Sweden	recognized as occupational disease by the complementary system*
Switzerland	probably recognized as occupational disease, depending on the conditions of exposure and the causal link

TABLE I/b. Differences among countries in recognition of *Rotator cuff tendinopathy* as an occupational disease

COUNTRY	RECOGNITION
Austria	not recognized as occupational disease
Belgium	recognized as occupational disease* if the worker's arm was above the shoulders more than 25% of working time
Croatia	recognized as occupational disease if the worker's arm was held distant from the trunk 60 or more degrees, or arm is exposed to repetitive movements of more than 2½ repetitions per minute, or held above the shoulders' level for more than half of working time during the 8 hours shift
Czech Republic	The diseases of tendons, tendon sheaths, tendon sacs or tendons of muscles or joints of limbs from prolonged excessive unilateral overloading, the protracted forms of the disease confirmed by objective examination methods leading to a significant reduction in working ability. Diseases arise during work where the structures are overloaded to such an extent that overload is, according to current medical knowledge, the cause of the disease. The exposure must be confirmed by a public health officer (special criteria).
Denmark	probably recognized as occupational disease* if arm was raised to at least 60° for more than half of working time
Finland	not recognized as occupational disease
France	recognized as occupational disease* if it is not a calcifying tendinopathy and if the tendon injuries are documented by MRI
Germany	not recognized as occupational disease
Hungary ^s	in the case of exposure that may cause rotator tendinopathy (elevated arm, repetitive movements, high force, manual lifting of loads) and non-occupational origin (e.g. sport injury) can be excluded.
Italy	recognized as occupational disease*
Northern Macedonia	recognized as occupational disease* if the worker was exposed to long-term overload and pressure on the tendon sheath over a period of at least 5 years**
Serbia	*** recognized as occupational disease jobs and tasks with repetitive and force movements and non-physiological postures of hand and wrist and long-term overload and long-term pressure on bursae (at least five years). Clinical presentation of chronic inflammation of wrist and hand synovial lining or inflammation of elbow or shoulders or prepatellar bursa with limited function of affected joint.
Slovakia	recognized as occupational disease* if the worker's arm was above the shoulders (overhead and overused) more than 30 min. from 8 hours shift, from long-term, excessive and one-side overload
Slovenia	recognized as occupational disease* if the worker's arm was above the shoulders, repetitive movements > 2.5 times per minute
Spain	recognized as occupational disease*
Sweden	recognition is possible*, depending on the conditions of exposure and the causal link
Switzerland	not recognized as occupational disease

* Eligibility for financial compensation

** Occupational disease is recognised as 1 item (diseases as a result of excessive load on the tendon sheaths)

*** In Serbian regulation of occupational diseases there is one item in the list "Chronic tenosynovitis (hand and wrist) and joint bursitis (prepatellar and olecranon) due to overload and long-term pressure" which covers epicondylitis and rotator cuff. Rotator cuff is not explicitly mentioned but from the criteria it is clear that the regulation includes it.

TABLE I/c. Differences among countries in recognition of *lumbago* as an occupational disease

COUNTRY	RECOGNITION (* Eligibility for financial compensation)
Austria	not recognized as occupational disease
Belgium	recognized as occupational disease*
Croatia	not recognized as occupational disease
Czech Republic	not recognized as occupational disease
Denmark	not recognized as occupational disease
Finland	not recognized as occupational disease
France	recognized as occupational disease*
Germany	recognition is possible,* depending on the precise conditions of exposure throughout the working life and the causal link
Hungary [§]	in the case of exposure that may cause back pain (manual handling of heavy loads, patients) and non-occupational origin (e.g. developmental disorders) can be excluded.
Italy	recognized as occupational disease*
Northern Macedonia	not recognized as occupational disease
Serbia	not recognized as occupational disease
Slovakia	recognized as occupational disease* if there are herniation of the lumbar disc (only 1 or max. 2 discs) and positive score system (over 50 points) and if confirmed by National Committee - advisory council of Ministry of Health
Slovenia	not recognized as occupational disease
Spain	not recognized as occupational disease
Sweden	not recognized as occupational disease
Switzerland	not recognized as occupational disease

TABLE I/d. Differences among countries in recognition of *Epicondylitis* as an occupational disease

COUNTRY	RECOGNITION (* Eligibility for financial compensation)
Austria	recognized as occupational disease
Belgium	probably recognized as occupational disease*
Croatia	recognized as occupational disease if elbow was exposed to repetitive movements (more than 10 movements per minute) or exposed to pressure for more than half of the working time during the 8 hours shift
Czech Republic	The diseases of tendons, tendon sheaths, tendon sacs or tendons of muscles or joints of limbs from prolonged excessive unilateral overloading, the protracted forms of the disease confirmed by objective examination methods leading to a significant reduction in working ability. Diseases arise during work where the structures are overloaded to such an extent that overload is, according to current medical knowledge, the cause of the disease, the exposure must be confirmed by a public health officer (special criteria).
Denmark	recognized as occupational disease*
Finland	not recognized as occupational disease
France	recognized as occupational disease*
Germany	recognized as occupational disease
Hungary [§]	in the case of exposure that can cause epicondylitis (repetitive movements, high force, extreme positions, using hand tools) and non-occupational origin (e.g. sports) can be excluded
Italy	recognized as occupational disease*
Northern Macedonia	recognized as occupational disease* if the worker was exposed to long-term overload and pressure on the tendon and muscle attachments over a period of at least 5 years**
Serbia	*** recognized as occupational disease jobs and tasks with repetitive and force movements and non-physiological postures of hand and wrist and long-term overload and long-term pressure on bursae (at least five years). Clinical presentation of chronic inflammation of wrist and hand synovial lining or inflammation of elbow or shoulders or prepatellar bursa with limited function of the affected joint.
Slovakia	recognized as occupational disease* if elbow was exposed to repetitive movements, from long-term, excessive and one-side overload
Slovenia	recognized as occupational disease* if elbow was exposed to repetitive movements or pressure
Spain	recognized as occupational disease
Sweden	not recognized as occupational disease
Switzerland	probably recognized as occupational disease, depending on the conditions of exposure and the causal link

** Occupational disease is recognised as 1 item (diseases as a result of excessive load on the tendon sheaths)

*** In Serbian regulation on occupational diseases there is one item in the list "Chronic tenosynovitis (hand and wrist) and joint bursitis (prepatellar and olecranon) due to overload and long-term pressure" which covers epicondylitis and rotator cuff. Rotator cuff is not explicitly mentioned but from the criteria it is clear that the regulation includes it.

[§] Notes to Tables I/a-I/d: there is an open-list in Hungary, so any disease may be recognized as occupational if the exposure, the disease and the direct causality are proven. Decision is made by an expert committee on the basis of the labour inspectorate's investigation and the medical records case-by-case. Criteria are qualitative and not set by legislation or guidelines but takes into consideration exposure duration and the onset of the disease too. Some semi-quantitative criteria are utilised and available scientific evidences are consulted. The recognised disease entitles for compensation: rounding up the sickness benefit to 100% and free medication. If the consequential health impairment is over 13% the recognised disease entitles to disablement benefit. Further compensation is available only by bringing an action for damages against the employer at a labour court.

TABLE II. Number of reported and number of recognized musculoskeletal disorders as occupational diseases per 100,000 insured in the western European countries in 2014

Country	Reported No.	Recognized No.	% of musculoskeletal disorders in the total of recognized occupational diseases
Austria	-	1	3
Belgium	263	82	69
Denmark	257	22	16
Finland	13 - 23	10	12
France	463	332	88
Germany	13 - 23	3	3
Italy	150	64	69
Spain	-	94	75
Sweden	13 - 23	7	32
Switzerland	13 - 23	6	10

In 1997, the United States National Institute for Occupational Safety and Health (NIOSH), responsible for conducting research and making recommendations for the prevention of work-related injury and illness, published the basic elements of a Workplace programme aimed at preventing work-related MSDs. It listed 7 steps as follow (Cohen et al., 1997):

1. Looking for signs of a potential musculoskeletal problem in the workplace

Indicators that could alert the employers to potential work-related musculoskeletal problems may include workers compensation forms, complaints of undue strain, localized fatigue, discomfort or pain, job tasks involving activities such as repetitive and forceful exertions, frequent, heavy or overhead lifts, awkward work positions or use of vibrating equipment, as well as trade publications, cases of work-related MSDs found among competitors or in similar

businesses, occupational physician reports and analysis of sickness absence (Cohen et al., 1997; Dodič et al., 2016).

2. *Showing management commitment and encouraging worker involvement in problem-solving activities*

Company policy statement indicates the degree of an employer's commitment to health and safety. Occupational safety and health literature recognizes management as a key and perhaps controlling factor in determining whether any of worksite hazard control efforts will be successful. Promoting workers involvement in efforts to improve workplace conditions has several benefits such as enhanced worker motivation and job satisfaction, added problem-solving capabilities, greater acceptance of changes and greater knowledge of work and organisation (Cohen et al., 1997).

3. *Offering training to expand management and worker ability to evaluate potential musculoskeletal problems*

Training has been recognized as an essential element for any effective safety and health programme. The overall goal of training is to enable managers, supervisors and employees to identify aspects of job tasks that may increase a worker's risk of developing work-related MSDs, recognize the signs and symptoms of the disorders and participate in the development of strategies to control or prevent them. Training should be understandable to the target audience and training materials used should consider the participants educational level, literacy abilities and language skills.

The European Agency for Safety and Health at Work (OSHA) issued a publication outlining the steps in the education of employees (OSHA, 1999):

- defining the type of education regarding different groups of employees,
- setting clear, direct and action-oriented goals,
- defining different teaching methods like lectures, interactive videos, demonstrations and use of different tools that help employees to acquire the desired knowledge and skills,
- implementing educational activities tailored to the language and education of employees,
- evaluating the efficiency of education by a questionnaire or even better by testing the acquired knowledge,

- continuously improving the programme if the evaluation shows that the goal has not been achieved.

4. Gathering data to identify jobs or work conditions that are most problematic

Risky jobs can be identified by observing workplaces and assessing exposure to risk factors. We should observe several employees in the same job as they can use different positions and approaches to perform the same tasks. The most important risk factors for MSDs are (Da Costa et al., 2010):

- manual handling of loads (lifting, pushing, pulling, carrying etc.),
- work in a forced position (spine, neck, shoulders, wrists and other joints are not in the neutral position),
- repeated movements,
- general and local vibrations,
- work at an unsuitable height (e.g. above shoulder height),
- work requiring the use of high muscular strength,
- direct point pressure on the body,
- work in an unfavourable thermal environment (e.g. extreme cold, heat),
- too short breaks or rest periods,
- psycho-social factors (monotonous work, time pressure, poor relationships between co-workers, lack of support from the superiors).

Based on the obtained data, the incidence and prevalence can be calculated. More than one case of MSD per 20,000 working hours or more that 2-fold increase in incidence or prevalence in one year shows the need for evaluation (Cohen et al., 1997).

5. Identifying effective controls and evaluating these approaches once they have been instituted

The programme effectiveness can be evaluated directly by looking at the indicators like lower percentage of sick leave, reduced incidence, severity and incapacity index due to MSDs, reduced number of lost working days. We can monitor data on how many employees have completed the training, how many jobs have been analysed and/or repeat the survey on the subjective problems of employees (Cohen et al., 1997).

6. Establishing health care management

Company health care management emphasizes the prevention of impairment and disability through early detection, prompt treatment and timely recovery. The employer can create an environment that encourages early evaluation by a health care provider by taking the following steps: providing education and training to employees regarding the recognition of the symptoms and signs of work-related MSDs, encouraging employees' early reporting of symptoms, giving health care providers the opportunity to become familiar with jobs and job tasks, modifying jobs or accommodating employees who have functional limitations secondary to work-related MSDs as determined by a health care provider. Employees should participate in the health care management process by following applicable workplace safety and health rules, following work practice procedures related to their jobs and reporting early signs and symptoms of work-related MSDs (Cohen et al., 1997).

7. Creating a proactive ergonomic programme

A proactive approach means that risk factors for musculoskeletal disorders are identified and are prevented when planning new work processes and operations. It is more reasonable to install appropriate equipment in the beginning than to adjust it later. This approach focuses on preventive activities and the search for balance between the work requirements and the abilities of an individual worker. It increases work efficiency as well as safety and health of employees (Cheung et al., 2007).

A proactive action plan is a key of ergonomic improvements

A proactive action plan means finding the problems around the workplace. The process includes observing jobs, making decisions on effective options and then taking action. It is important to involve workers, managers, and supervisors throughout the process. The aim of proactive action plan is to improve the fit between the demands of work tasks and the capabilities of workers (Cheung et al., 2007). There are four steps to a proactive action plan: 1. look for clues, 2. prioritize jobs for improvements, 3. make improvements and 4. follow-up.

The following assessment tools are helpful to provide an analysis of various types of manual material handling tasks:

- NIOSH Manual Material Handling (MMH) Checklist (NIOSH, 2014);

- Hazard Evaluation Checklist for Lifting, Carrying, Pushing, or Pulling (Waters et. al., 1994);
- Ergonomics Awareness Worksheet (Liberty Mutual Insurance, 2015);
- Ergonomics Checklist — Material Handling (CDC, 1997; Cheung et al., 2007).

To evaluate multifaceted problems, the following comprehensive methods have been designed: the NIOSH Lifting Equation, the American Conference of Governmental Industrial Hygienists (ACGIH) guidelines for safe lifting (ACGIH Threshold Limit Values (TLVs) for Lifting), the 3D Static Strength Prediction Program software (University of Michigan), The Ohio State Lumbar Motion Monitor and the Snook's Psychophysical Tables (Cheung et al., 2007).

When prioritizing jobs for improvements, it is important to consider the frequency and severity of the risk factors that may lead to injuries, the frequency and severity of complaints, symptoms and/or injuries, technical and financial resources at disposal, workers' ideas for making improvements and timeframe for making improvements (Cheung et al., 2007).

When a company is solving manual material handling problems, the conversation between workers, supervisors and managers is very important. It is useful if responsible persons consult companies with similar problems. They could already have solutions that could save time, efforts and money. But first and foremost, it is to include an expert for ergonomics (Dodič et al., 2016).

Accompaniment of ergonomic improvements and evaluation of their effectiveness

It is important to follow up if improvements have worked. It is necessary to evaluate each improvement separately for effectiveness. When evaluating, the following questions may be helpful: have the workers accepted the improvements; have most or all of the risk factors been reduced or eliminated; have fatigue, discomfort and/or injuries been reduced or eliminated; has the improvement caused any new risks, hazards or other problems; and has improvement caused a decrease in productivity and efficiency or a decrease in product and service quality? If improvements have not worked, it is necessary to modify them until the risk factors are reduced or eliminated (CDC, 1997; Dodič et al., 2016).

Methodologies to identify WRDs: sentinel and alert approaches

Occupational factors play a significant role in the global burden of disease. In addition, rapid changes in working conditions may give rise to new occupational health risks and WRDs. Monitoring these new WRDs is essential from the perspective of early recognition and prevention. There are four main groups of surveillance systems (Bakusic et al., 2017):

1. Compensation-based systems that are not generally designed for detecting new/emerging WRDs can be useful when they include an ‘open list’ approach that allows reporting suspected cases of WRDs that are further investigated like the Spanish compensation based system Cede Electrónica de la Seguridad Social (CEPROSS).
2. Non-compensation-related systems are primarily designed for data collection and statistics but can also be used for detecting new/emerging WRDs like the French Réseau national de vigilance et de prévention des pathologies professionnelles (RNV3P), British The Health and Occupation Research (THOR) network, Italian Malattie Professionali (MALPROF), Nordic network on Recirculating Aquaculture System (RAS) and the Spanish Surveillance System in Navarre. The suspected cases of new/emerging WRDs are evaluated by relevant experts. However, their poor link with prevention is a weak point that provides room for further improvement of these systems.
3. Sentinel systems seem to have the most suitable approach. In a suspected case of new/emerging WRDs reported in the systems it is interpreted as an alert signal, which is strengthened if work-relatedness is confirmed by highly qualified experts. In this case, preventive actions are put in place, such as the establishment of guidelines for practitioners, actions targeted at co-workers, actions directed to specific workplace risk factors for the disease in question, etc. A direct link with prevention is one of the main strengths of these systems like Signalering Nieuwe Arbeidsgerelateerde Aandoeningen Loket (SIGNAAL - Signalling New Occupational Diseases Counter), Occupational Diseases Sentinel Clinical Watch System (OccWatch).
4. Public health surveillance systems that target both workers and non-workers have a wide scope for monitoring the health of the general population and they are not generally aimed to detect new/emerging WRDs. Nevertheless, these systems can be a valuable complementary source of information to the other described systems like the French systems monitoring musculoskeletal disorders and pleural mesothelioma or the USA Pesticide-Related Illness

And Injury Surveillance (PISP) System that provide a detailed investigation of work-relatedness and follow-up for every reported case (Bakusic et al., 2017).

DISCUSSION

Ergonomic improvements are important to reduce and prevent work related MSDs (Dodič et al., 2016). Literature offers a lot of proof how certain jobs and working conditions increase the risk of MSDs and suggestions, too, how to prevent them. But despite rising efforts to reduce MSDs in European countries, ergonomic improvements did not bring encouraging results in the last two decades. Why? It happened many times that ergonomic activities at workplaces were not evaluated (Dodič et al., 2016). Namely, the consequences of the ergonomic actions must always be measured by direct and indirect indicators (Cohen et al., 1997; Dodič et al., 2016). Evaluation is the only way to estimate whether the aim has been achieved and only the evaluation provides for improvement of the programme. The programme needs to be changed and/or adopted until all the risks are eliminated (Cohen et al., 1997; Dodič et al., 2016).

Obviously, the seven key elements suggested by NIOSH should be respected in any ergonomic plan to be successful. The systematic and properly planned ergonomic programme needs to respect individual differences among workers and the groups of workplaces. The tools suggested above can be very helpful to assess the work-related MSDs (Cohen et al., 1997).

It is a very demanding process to define the proper and clear criteria for occupational MSDs and work-related MSDs. The criteria for recognition of MSDs as occupational diseases differ in European countries (Kieffer, 2016). The differences are the consequence of socio-economic and political factors. Following the current situation it cannot be expected that the problem of occupational diseases will be put on the agenda of the European Parliament. The criteria to recognize the medical diagnosis of any disease are the same all over the world – the carpal tunnel syndrome, tendinopathy of rotatory muscles, lumbago, epicondylitis are clinically diagnosed and proved the same way. But the right of recognition of the same diseases as proven occupational diseases is exclusively the privilege of the countries and their economic power and political will. It is impossible to understand how the criteria for recognition of occupational diseases cannot be unified in all the European Union market. There is a very

perplexed situation, because workers exposed to the same risk at their workplace can have occupational disease recognized in one European Union country while not in the other.

Assessing different systems reporting work-related MSDs, we can conclude that there are cases of good practice that serve to collect and assess data. They give the ability to create preventive measures and assure the general view and monitoring data to detect new work-related diseases (Bakusic et al., 2017).

CONCLUSIONS

MSDs are the most common work-related diseases in Europe. Despite many ergonomic interventions and activities, encouraging results have not been reached so far. We assess that providing proactive ergonomic programme and proactive action plan could result in reducing the number of work-related MSDs. Unified criteria for recognition of MSDs as occupational diseases and introduction of reporting system will help to plan priorities, assess success of activities and introduce the appropriate protocols.

ACKNOWLEDGEMENTS

We wish to thank all the colleagues from the Central European countries for providing the data for *Table I*. taking into account the conditions and criteria to recognize occupational diseases in their countries: Marija Bubaš, MD, PhD, Croatia; Prof. Milan Tuček, MD, PhD, Czech Republic; Ferenc Kudász, MD, Hungary; Prof. Jovanka Karadzinska Bislimovska, MD, PhD, Northern Macedonia; Prof. Petar Bulat, MD, PhD, Serbia; and Marek Varga, MD, PhD, Slovakia.

REFERENCES

BAKUSIC, J. LENDERINK, A., LAMBREGHTS, C. et al. (2017). Methodologies to identify work-related diseases: Review of sentinel and alert approaches, <https://osha.europa.eu/sl/tools-and-publications/publications/methodologies-identify-work-related-diseases-review-sentinel-and/view> accessed 05.10.2018

CDC, Center for Disease Control and Prevention (1997) The National Institute for Occupational Safety and Health (NIOSH): Elements of ergonomics programs, <https://www.cdc.gov/niosh/topics/ergonomics/ergoprimer/default.html> accessed 30.10.2018.

CHEUNG, Z., FELETTI, M., GALANTE, J., and WATERS, T. (2007). Ergonomic Guidelines for Manual Material Handling. California: California Department of Industrial Relations, pp. 8-60.

COHEN, A.L, GJESSING, C.C., FINE, L.J., et al. (1997) Elements of ergonomics programs. A Primer Based on Workplace Evaluations of Musculoskeletal Disorders, <https://www.cdc.gov/niosh/docs/97-117/pdfs/97-117.pdf> accessed 30.10.2018.

DA COSTA, B.R., and VIEIRA, E.R. (2010). Risk factors for work-related musculoskeletal disorders: A systematic review of recent longitudinal studies. *Am J Ind Med.* 53(3):285-323.

DODIČ, F.M., LIPIČNIK, K., KERMAVNAR, T., et al. (2016). Ergonomics at work. (In Slovenian.) In: Fit to work, Textbook for workplace health promotion. (D. Miklič, and E. Stergar, eds.): UKCL Ljubljana, Inštitut za medicino dela, prometa in športa, Ljubljana, pp. 165-184.

European Agency for Safety and Health at Work (1999). Work-related neck and upper limb musculoskeletal disorders, <https://osha.europa.eu/en/tools-and-publications/publications/reports/201> accessed 30.10.2018.

KIEFFER, C. (2016). Musculoskeletal disorders: What recognition as occupational diseases? A study on 10 European countries. https://www.eurogip.fr/images/pdf/Eurogip120E_ReportMSDs.pdf, accessed 30.04.2018.

Liberty Mutual Insurance (2015). Manual Handling: Evaluating and Reducing Risk. Risk Control from Liberty Mutual Insurance, <https://business.libertymutualgroup.com/business-insurance/Documents/Industries/Manual%20Handling.pdf> accessed 30.10.2018.

NIOSH – National Institute for Occupational Safety and Health (2014): Assessment Tools: NIOSH Manual Material Handling (MMH) Checklist, <https://www.dir.ca.gov/dosh/etools/08-004/tool2.pdf> accessed 30.10.2018.

Slovenian Ministry of Labour, Family, Social Affairs and Equal Opportunities (2007). Health and safety at work, musculoskeletal disorders. (In Slovenian), <http://www.osha.mddsz.gov.si/varnost-in-zdravje-pri-delu/informacije-po-temah/kostno-misicna-obolenja> accessed 3.11.2018.

WATERS, T.R., PUTZ-ANDERSON; V. and GARG A. (1994). Applications manual for the revised NIOSH Lifting Equation. U.S. Department of health and Human Services, <https://www.cdc.gov/niosh/docs/94-110/pdfs/94-110.html> accessed 30.10.2018.