PREVENTION OF ACCIDENTS AT WORK AND OCCUPATIONAL DISEASES BY IMPLEMENTATION OF ERGONOMICS

PETRA MARKOVA, MARIA HOMOKYOVA, FILIP PRAJ, MILOS CAMBAL

Slovak University of Technology in Bratislava, Faculty of Materials Science and Technology in Trnava, Institute of Industrial Engineering and Management

DOI: 10.17973/MMSJ.2022_03_2022002

petra.markova@stuba.sk

The paper deals with the connection between accidents and occupational diseases due to the weak application of ergonomics in business practice. Applying the principles of ergonomics in the day-to-day running of companies in primary prevention makes it possible to prevent the occurrence and exacerbation of difficulties in the musculoskeletal system of the employees concerned, which can ultimately avert the development of occupational diseases and increase occupational accidents. Ergonomics primarily addresses work environment factors that are cumulatively pathogenic, so their impact on employees will only become apparent after a specific exposure time. In contrast, occupational safety and health focus primarily on thermal and traumatogenic factors of the work environment, which can cause an employee an occupational injury of varying severity or result in death. To comprehensively cover the effects of all work environment factors on employees, the work environment and the work activity itself must be assessed from both occupational health and safety and ergonomics. The observance of ergonomic principles in the solution of workplaces makes it possible to prevent many different costs related to the occurrence of accidents at work and occupational diseases. In most cases, however, these are cost-effective solutions whose effect is not immediately visible, so they are more likely to be reached by companies that apply sustainability principles or have a positive experience of the past. The article focuses on the need to implement ergonomic principles in business practice, such as preventing occupational accidents and developing occupational diseases.

KEYWORDS

work, employee, ergonomics, occupational injury, occupational disease, work environment factors, costs

1 INTRODUCTION

Every employee incurs losses to the national health care system if they fail [EU-OSHA 2021a].

Countries with inadequate occupational safety and health systems use valuable resources to deal with the consequences of preventable injuries and diseases. By using a suitable national strategy, it is possible to achieve benefits such as [EU-OSHA 2021a]:

- higher productivity due to less incapacity for work,
- decrease in health care costs,
- keeping older employees in employment,
- stimulating more efficient working methods and technologies,
- reducing the number of people who have had to reduce their working hours due to the care of a family member.

The EU Framework Directive (89/391) introduced a legal obligation for employers to protect their employees by excluding, assessing and eliminating risks to their safety and health (not to mention specific risks). These include psychosocial factors in the workplace that may cause or contribute to stress or mental and physical health problems and risk factors for musculoskeletal disorders. At the same time, the directive lays down a general obligation for employees to comply with the protection measures imposed on them by their employer [Nielsen 2021].

Work-related injuries and fatalities have a significant economic impact on individuals, employers, the state and society. Specifically, the adverse effects of poor OSH management mean costly early retirement, loss of experienced employees, absenteeism and presence in the workplace even during illness (if employees go to work even though they are unable to work) and high health care and health insurance costs. The cost to society of accidents at work and occupational diseases is estimated at 3.9% of total GDP and 3.3% of European Union GDP. Percentages vary from country to country, especially between Western Europe and other countries, relating to industry representation, legal framework and preventive measures. [EU-OSHA 2021a].

The prevention of accidents at work and occupational diseases is a goal that is now an integral part of the world economy. In practice, principles referred to as the occupational safety and health system are applied to achieve this goal. It is a system of minimum safety standards that employers are obliged to ensure for their employees. Employees and other working people are compelled to comply with them [Nemec 2017].

The scope and quality of individual security measures may vary from country to country. In general, however, the principle is that the more advanced the economy, the higher the requirements for a health and safety system. The intention to minimize the adverse effects of the work environment and work performance on the human body is a long-term challenge of modern society [Nemec 2017].

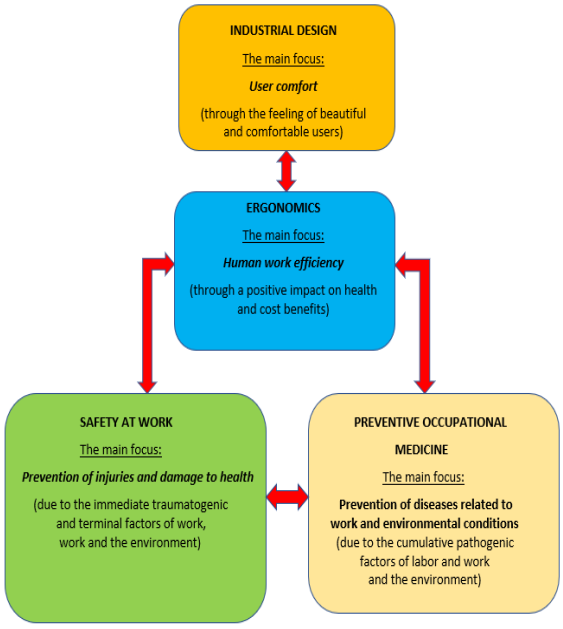

Figure 1. The concept of a full-fledged solution of the work and organizational system in terms of ergonomics, integrated health and safety [Hatiar 2015]

A positive feature in occupational health and safety management is the application of ergonomics through and ergonomic programs focused on the efficiency of human work through a positive impact on employee health and effective costs to eliminate deficiencies in health and safety programs.
The fundamental difference between occupational safety and health and preventive occupational medicine is in risk assessment. Together, however, they create a precondition for addressing human labour efficiency through the integration of occupational safety and health requirements with economic and occupational comfort requirements through ergonomics and ergonomic programs aimed at human labour efficiency through a positive health impact and a favourable cost effect as this graphically illustrated in Fig. 1 [Hatiar 2015].
The risk of work-related diseases can be reduced or eliminated only if all aspects of primary, secondary and tertiary prevention are consistently and systematically applied in practice. Appropriate ergonomic intervention against risk factors is considered effective in preventing these diseases. As a human science at work, Ergonomics pays particular attention to technical and environmental factors in the work process that endanger employees' health. However, it also pays attention to the dangerous areas of the influence of individual aspects of tertiary prevention that have the same goal - to ensure the individual's health during the work process. The secondary prevention phase usually occurs outside the work process itself during the employee's incapacity for work. While the means of primary prevention are more or less technical and organizational, the means of tertiary prevention are explicit of a medical-rehabilitation nature. Their mutual connection creates conditions for the worker's health in an ergonomically ideal working environment (Fig. 2) [Hatiar 2014].

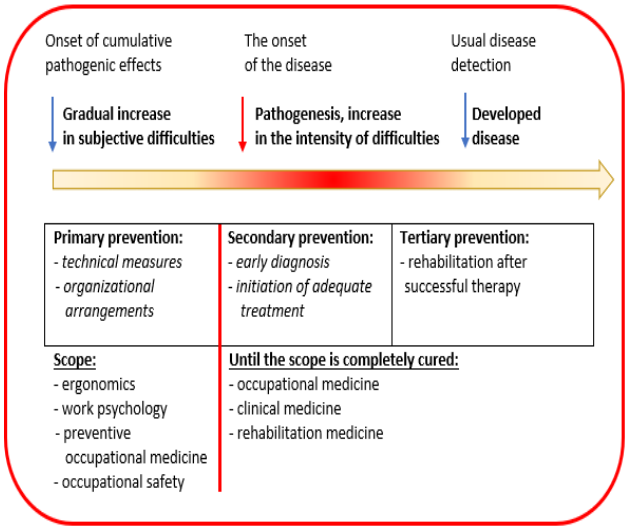

Figure 2. Ergonomic intervention against risk factors [Hatiar 2014]

Injuries, illnesses and fatalities are associated with different types of costs. First of all, ***direct costs***, such as healthcare costs, should be mentioned. Then there are the **costs *due to lost productivity and reduced outputs*.** Furthermore, there are ***costs associated with the impact on people's satisfaction***, i. j. effects on human health and life that can be quantified and included in the financial burden estimate. Regardless of whether it is an injury or illness, these elements are considered, and the sum of all costs will estimate the total workload due to the accident or illness.. This method of calculating the cost estimate, when the individual costs listed above are added together to obtain a total cost estimate, is known as the so-called bottom-up approach.

It is also possible to use the so-called top-down approach: the total costs are calculated as the entire financial burden due to injury and illness, and the part of this sum attributed to the work aspect is estimated. The costs associated with work-related injuries or diseases can then be calculated. These costs are often expressed as existing health measures, such as the calculation of disability-weighted life years (disability-adjusted life years, DALY) [EU-OSHA 2021a].

Depending on the characteristics of the social security systems in each country, the economic burden borne by each stakeholder (Table 1), namely workers, employers and the system/public sector will be different [EU-OSHA 2019].

Table 1. Main framework for estimation of the costs by stakeholder [EU-OSHA 2019]

Category	Employer	Worker	System/public sector
Direct costs	Share of formal heath care costs	Share of formal healthcare cost Informal caregiver costs Out-of-pocket costs	Share of formal healthcare cost
Indirect costs	Share of wages replaced Employer adjustment costs Presenteeism	Share of wage losses not compensated Fringe/payroll benefit losses Home production losses	Share of wage replaced Other insurance administration costs
Intangible costs		Total monetary value of health-related quality of life losses	

The number of accidents at work has fallen by 25% in the last ten years. However, work-related diseases still account for around 2.4 million deaths worldwide each year, of which 200,000 are in Europe [EU-OSHA, 2021b].

Work-related illnesses include [EU-OSHA, 2021b]:
- Musculoskeletal disorders
- Stress and mental health disorders
- Work-related cancer
- Skin diseases
- Work-related illnesses caused by biological agents

Musculoskeletal disorders (MSDs) are one of the most common work-related ailments. Throughout Europe, they affect millions of workers and cost employers billions of euros. Tackling MSDs helps improve the lives of workers, but it also makes good business sense [EU-OSHA 2021b].
Work-related MSDs affect the back, neck, shoulders and upper limbs as well as the lower limbs. They cover any damage or disorder of the joints or other tissues. Health problems range from minor aches and pains to more serious medical conditions requiring time off or medical treatment. In more chronic cases, they can even lead to disability and the need to give up work.
Most work-related MSDs develop over time. There is usually no single cause of MSDs; various risk factors often work in combination, including **physical and biomechanical factors** (handling loads, especially when bending and twisting, repetitive or forceful movements, awkward and static postures, vibration, poor lighting or cold working environments, fast-

paced work, prolonged sitting or standing in the same position) **organisational and psychosocial factors** (high work demands and low autonomy, lack of breaks or opportunities to change working postures, working at high speed, including as a consequence of introducing new technologies; working long hours or on shifts, bullying, harassment and discrimination in the workplace; low job satisfaction), and **individual factors (**prior medical history, physical capacity, lifestyle and habits (e.g. smoking, lack of exercise)) [EU-OSHA 2021b].

There is no single solution, and expert advice may occasionally be needed for unusual or serious problems. However, many solutions are straightforward and inexpensive, for example providing a trolley to assist with handling goods or changing the position of items on a desk [EU-OSHA 2021b].

To tackle MSDs, employers should use a combination of [EU-OSHA 2021b]:

- **Risk assessment:** taking a holistic approach, assessing and addressing the full range of causes (see above). It is also important to consider those workers who may be at greater risk of suffering from MSDs. The priority is to eliminate risks but also to adapt work to workers.
- **Employee participation:** include workers and their representatives in discussions on possible problems and solutions.

After completing the risk assessment, a list of measures should be made in order of priority, and workers and their representatives involved in implementing them. Actions should focus on primary prevention, but also on measures to minimise the seriousness of any injury. It is important to ensure that all workers receive appropriate information, education and training on health and safety in the workplace, and know how to avoid specific hazards and risks [EU-OSHA 2021b].

Measures may cover the following areas [EU-OSHA 2021b]:

- **Workplace layout:** adapt the layout to improve working postures
- **Equipment:** make sure it is ergonomically designed and suitable for tasks
- **Tasks:** change working methods or tools
- **Management:** plan work to avoid repetitive or prolonged work in poor postures. Plan rest breaks, rotate jobs or reallocate work
- **Organisational factors:** develop an MSD policy to improve work organisation and psychosocial environment in the workplace and promote musculoskeletal health

Prevention actions should also take into account technological changes in equipment and digitalisation of working processes and related changes of ways to organise work.

Health monitoring, health promotion and rehabilitation and reintegration of workers already suffering from MSDs also need to be considered in the management approach to MSDs [EU-OSHA 2021b].

Timely intervention is the basis for effective damage management of the musculoskeletal system. This means that it is necessary to start managing the damage to the musculoskeletal system (TSO) as soon as the problem is obvious (when the employee informs about TSO difficulties). This will ensure that the problem is caught on time and that it does not deepen. Ignoring it, the deepening difficulties could negatively affect employee health and productivity. In many cases, simple workplace changes, adjustments and support mechanisms are enough to help employees with chronic musculoskeletal problems continue to work and ensure that their health does not deteriorate due to their work [Nielsen et al., 2021]. This is precisely the subject of interest in ergonomics, the systematic application of which we can ensure timely prevention of the difficulties above of the musculoskeletal system in business practice.

2 METHODOLOGY

The contribution is based on the results of EUROSTAT surveys, EU-OSHA analyzes, the Statistical Office of the Slovak Republic, the Ministry of Health of the Slovak Republic, the Ministry of Labor, Social Affairs and Family of the Slovak Republic, the Institute for Labor and Family Research. In preparing the article, we continue to use the material collected in industrial enterprises in Slovakia. The data were collected through a particular "Nordic Questionnaire" questionnaire for monitoring and evaluating the impact of work and working conditions on employees in Slovak companies [Hatiar 2004, Kuorinka 1987]. Much of the data was obtained through the work of the Pro benefit occupational health service. Furthermore, the research material was obtained through diploma and dissertation theses of the Faculty of Materials Technology students in the study fields "Industrial Management" and "Personnel work in industrial enterprises". The obtained data were processed by epidemiological methods of a retrospective cohort and a cohort study on the incidence and intensity of PPS difficulties and diseases as indicators of workplace deficiencies and working conditions in terms of ergonomics [Hatiar 2018]. The results of research by foreign authors were also an essential source for the evaluation of outputs.

3 RESULTS

As the results of the analyses carried out at the European level suggest, the view of occupational safety and health and the solution of the issue of accidents at work and occupational diseases differ in individual countries. Table 2 illustrates that the percentage of employees working in industry and agriculture in the European region is much lower than that of employees working in services. It is necessary to create such working conditions for employees that they are willing and able to provide satisfactory work performance in the long run, regardless of the sector in which they are employed. Work in industry and agriculture is more often associated with hard physical work, with a higher probability of accidents and occupational diseases, so it is necessary to pay attention to employees working in these sectors to maintain them by improving working conditions and ergonomics.

Table 2. Country differences – sector [EU-OSHA 2019]

Country	% employed in services	% employed in industry	% employed in agriculture
EU 28	73.1	21.9	5.0
Finland	73.1	22.4	4.5
Germany	73.9	24.3	1.5
The Netherlands	82.9	14.9	2.2

The EU-OSHA project estimated the costs of accidents at work, occupational diseases, and deaths at the European level. It turned out that the availability of the criteria needed to monitor costs was diverse in selected countries of the European region, as shown in Fig. 3. The Slovak Republic was also involved in the survey. In many countries, data sources were insufficient to estimate the economic burden of accidents at work and occupational diseases. Data availability seems correct and sufficient to make a conservative estimate [EU-OSHA 2017]. The five countries with the highest total score were Germany (DE), Italy (IT), the Netherlands (NL), Poland (PL), Slovakia (SK). On the recommendation of EU-OSHA, based on

experience with previous research in those countries, Finland was, however, given preference over Slovakia [EU-OSHA 2019].
National data needed to estimate the work-related burden of disease using the top-down model are readily available in international databases, such as the WHO Global Health Estimates, the IHME database and Eurostat data. The monetisation is dependent on the preferred method. In the human capital approach, data are easily obtainable. For the other monetisation approaches, national values of willingness to pay or the value of a statistical life year may be preferred, but it is also possible to use central reference European values [EU-OSHA 2019].

DATA NEED	DE	FI	HR	IT	NL	PL	SK
Number of work-related injuries	1	2	2	2	1	2	2
Work-related diseases	2	1	1	2	1	2	1
Occupational injuries — lifetime healthcare costs of treating cases	1	0	0	0	0	0	2
Occupational diseases — lifetime healthcare costs of treating cases	1	0	0	0	1	0	1
Compensation of employees/wage employed persons	1	1	1	1	1	2	1
Payroll costs	2	2	2	2	2	2	2
Probability of employment in the paid-labour force	2	2	2	2	2	2	2
Probability of employment for long-term disabled	1	1	1	1	1	1	1
Life expectancy	1	1	1	1	1	2	1
Life expectancy for long-term disabled	0	0	0	1	0	0	0
Home production time	1	1	1	2	1	1	0
Wage rate for home production time	1	0	0	2	1	1	0
Family caregiving time	1	0	0	0	0	0	0
Wage rate for family caregiving time	1	0	0	2	1	1	1
Out-of-pocket healthcare expense	1	0	0	0	0	0	0
Social insurance administrative expenses	1	0	0	1	0	0	0
Proportion of cases covered by social insurance	1	0	0	0	0	0	1
YLL, YLD, DALY	1	1	1	1	1	1	1
Retirement age	1	1	1	1	1	1	1
Average population (1 January + 31 December/2)	2	2	2	2	2	2	2
Economically active population	2	2	2	2	2	2	2
Employed persons	1	1	1	2	1	1	2
Labour volume of employed persons (FTE)	2	2	2	2	2	2	2
Gross value added	2	2	2	2	2	2	2
GDP	2	2	2	2	2	2	2
GDP per capita	2	2	2	2	2	2	2
(adjusted) Household disposable income	1	1	1	1	1	1	1
TOTAL	35	27	27	36	29	32	32

A score of 0 to 2 was used to indicate data availability (0 being not available and 2 being fully available). The coding should be read as follow: 0/red, no data available; 1/yellow, some data available; 2/green, all data available.

Figure 3. The availability of data sources in the selected countries involved to project EU-OSHA [EU-OSHA 2019]

Focusing on the national level of monitoring the development of accidents and occupational diseases, we found relatively detailed statistics on accidents at work depending on their severity (Table 3). In the Slovak Republic, the records of occupational accidents belong to the Labor Inspectorate. The severity of an accident at work is monitored, and the sources and causes of an accident at work. On the other hand, tracking the incidence of occupational diseases falls within the Ministry of Health of the Slovak Republic. No institution would deal with this issue comprehensively, as the society-wide change in 1989 separated the development in occupational health and safety and preventive occupational medicine. Thus, there is no integrated institution of the "Health and Safety Institute" in the Slovak Republic as in developed EU countries, which causes inconsistencies and complications in improving working conditions by applying ergonomics in companies.
Workers who do not perform dependent work are a particular group that can be traced with the OSH system. These are mainly self-employed persons who are not included in the statistics on monitoring accidents at work and occupational diseases. According to Act no. 124/2006 Coll. they are also obliged to carry out their work following safety regulations so that their lives and health are not endangered. In their case, an occupational injury or work damage is not considered an occupational injury or illness under current legislation. They are not compensated under the accident insurance system, to which they cannot even contribute. In addition, these incidents are not part of the statistics on accidents at work and occupational diseases, which distorts the actual number of damage to health in connection with the performance of work in Slovakia.

Table 3. Development of accidents at work and occupational diseases in the Slovak Republic in the years 2010 – 2019 [E-BTS 2021]

Year	Average number of sickness insured employees.	Number of cases for work. injuries (PU)	Number of PUs per 100,000 employees	Number of lethal workers injuries (SPU)	Number of SUAs per 100,000 employees.	Number of occupational diseases	The number of occupational diseases per 100,000 employees.
2010	2 301 146	9 802	425,96	48	2,09	436	18,95
2011	2 341 720	9 442	403,21	40	1,71	373	15,93
2012	2 296 589	8 767	381,74	52	2,26	344	14,98
2013	2 496 319	8 577	343,59	52	2,08	301	12,06
2014	2 592 523	8 240	317,84	39	1,50	373	14,39
2015	2 722 400	9 565	351,34	57	2,09	323	11,86
2016	2 844 858	10 327	363,01	40	1,41	316	11,11
2017	2 960 788	10 928	369,09	41	1,38	354	11,96
2018	2 648 857	10 918	412,18	38	1,43	308	11,63
2019	2 738 096	10 418	380,48	31	1,13	347	12,67

As in monitoring the incidence of occupational accidents in the EU, there is a trend of decreasing occupational accidents in the last ten years, both in fatal and in ordinary occupational accidents. Fig. 4 shows a gradual year-on-year decrease in the most severe occupational accidents resulting in death. In 2019, the Labor Inspectorate of the Slovak Republic recorded 31 severe occupational accidents resulting in death (from now on "SPÚ"), which is 8 SPÚ less than in 2018 (a decrease of 20.5%). Of this number, 13 are in traffic accidents, which were investigated by the relevant body of the Police Force, and labour inspectors only checked the driving regime [E-BTS 2021].

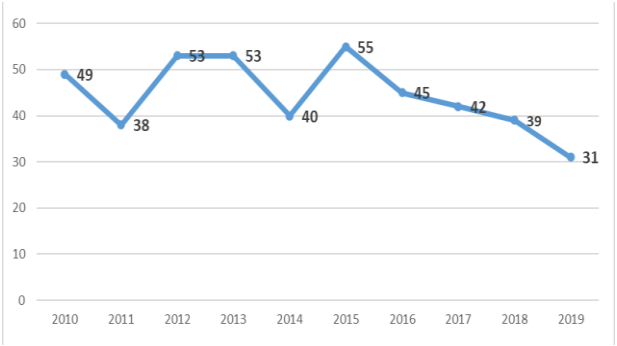

Figure 4. Development of work-related injuries [E-BTS 2021]

Looking at the fatal accidents at work in 2019, means of transport were the most common source of fatal accidents (14 SPÚ, which represents 45.2% of the total). The second most common source of SPÚ was unprofessional handling of loads, materials, falls of objects, products or materials, where 5 cases were recorded, representing 16.1% of the total number of SPÚ. Machinery, equipment and animals, other persons were the third most common source of SPÚ, where 3 cases were recorded in SPÚ, representing 9.7% for each source separately from the total number of SPÚ [E-BTS 2021].

When monitoring the incidence of occupational diseases in the Slovak Republic over the last ten years (Fig. 5), there was a more significant decline in 2013, which was not maintained or even achieved again, while in the previous year we see an increase in morbidity, which represents a negative trend. In 2019, the Ministry of Health of the Slovak Republic registered 347 occupational diseases, 39 more than in 2018 (an increase of 11.24%). It should be borne in mind that employees with an occupational illness represent a comparable loss for the employer as in the case of a fatal accident, as they are unable to work in their original job position. Ultimately, the employee needs to be reimbursed, which will incur additional costs.

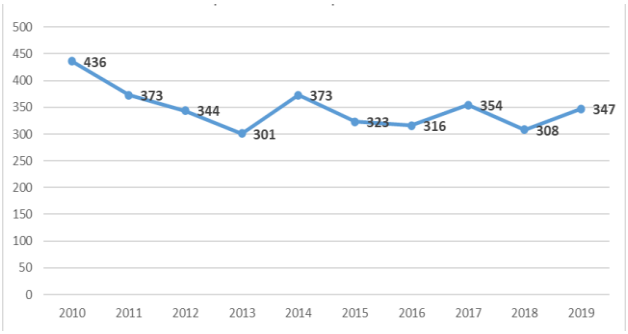

Figure 5. Development of occupational diseases in the Slovak Republic according to [E-BTS, 2021]

Unfortunately, companies in Slovakia are mostly not interested in evaluating the real impact of work and working conditions on the health of employees and the real prevention solution. At the company level, predominantly virtual methods of foreign owners are preferred and applied, which do not allow assessment of real impacts of work and working conditions on employees, which does not even create opportunities for real-time prevention of health problems and work-related difficulties [Hatiar 2017]. Problems also occur in the field of prevention of pests and diseases related to work through district or company doctors because [Hatiar 2018]:

- the employee is examined as a sick patient with an emphasis on internal medicine, without focusing on modifiable and unmodifiable factors of work and work environment (symptomatic approach instead of causal),
- absence or only a cursory examination of the symptoms of carpal tunnel syndrome, enthesopathy and the overall functionality of the musculoskeletal system,
- treatment without neurological or orthopaedic examination, symptomatic rather than causal treatment (sprays, ointments) is applied.

In Slovakia, among the most common causes of visits to the doctor and
incapacity for work includes work-related musculoskeletal disorders and diseases of the respiratory system. In terms of ergonomics, there is a continuous increase in difficulties and conditions indicating workplace deficiencies in companies [Hatiar 2018].
There is a high incidence of PPS difficulties (approximately over 70% of those examined), symptoms of work-related pain syndromes. Table 4 shows how the localization of intensive PPS difficulties developed in recent years for a total of 4,419 employees in industrial enterprises in Slovakia, which were processed in PZS Pro Benefit s.r.o., both overall and also depending on the predominant working position of the sitting and standing room. Non-overlapping confidence limits of PPS difficulties in monitored body areas in both working situations indicate highly statistically significant differences in the frequencies of occurrence of these difficulties in monitored working positions [Hatiar 2018].

Table 4. Comparison of the occurrence of the location and intensity of PPS difficulties in the work of a sitting and standing room [Hatiar, Bršiak, 2018]

Localization of musculoskeletal disorders difficulties	Working postures								Significance of differences
	Overall (n = 4419)		Work in sitting (n = 1213)			Work in standing (n = 3206)			
	Freq.	%	Freq.	%	95% conf. limit	Freq.	%	95% conf. limit	
Neck	2499	56,6	918	75,7	73,29 – 78,11	1581	49,3	47,57 – 51,03	***
Shoulders	1556	35,2	463	38,2	35,79 – 40,61	1093	34,1	32,46 – 35,74	***
Back	2067	46,8	682	56,2	53,79 – 58,61	1385	43,2	41,56 – 44,84	***
Elbows	781	17,7	146	12,0	10,18 – 3,82	635	19,8	18,42 – 21,18	***
Crosses	2734	61,9	410	33,8	31,14 – 36,46	2324	72,5	70,95 – 74,05	***
Palm / Hands	2718	61,5	657	54,2	51,40 – 57,00	2061	64,3	62,64 – 65,96	***
Hips / Thighs	680	15,4	109	9,0	7,39 – 10,61	571	17,8	16,49 – 19,11	***
Knees	1568	35,5	167	13,8	11,86 – 15,74	1401	43,7	40,67 – 46,73	***
Ankles / Feet	1697	38,4	280	23,1	20,73 – 25,47	1417	44,2	41,17 – 47,23	***

4 DISCUSSION

The information presented shows that it is complicated to monitor and quantify the costs associated with accidents at work and diseases in the Slovak Republic. The reason is the different perception of the expenses from the employee, employer, state institutions, and other entities, while each of them otherwise records or does not register them. Another reason is the incoherent (sometimes insufficient) methodology for data collection and absent real data collection, analysis and evaluation. Various independent institutions monitor data related to the issue in Slovakia. Multiple models and calculation methods are used in European countries to estimate economic impacts and determine the costs of accidents at work and occupational diseases.
The situation in Slovakia is quite complicated for the above reasons. Occupational diseases are published on an annual basis as newly diagnosed occupational diseases. From the available information sources, we cannot determine the exact number of occupational diseases that are "current", i.e. not only newly admitted, for a given year. The vast majority of occupational diseases are diseases of the musculoskeletal system, which tend to be chronic. This means that the number of people "currently" suffering from an occupational illness is multiple. By applying ergonomic principles, it is possible to obtain an overview of the occurrence of TSO difficulties and to implement appropriate corrective measures to prevent the emergence of occupational diseases related to them. Economic costs and damage are not quantified and monitored in Slovakia, neither at the national level nor for employers.
Today, Slovakia does not monitor much of the costs associated with the described issue in detail, which may contribute to underestimating the costs and losses that accidents at work and occupational diseases bring to the economy. Minimising the economic impact also results in a lower degree of willingness to invest in prevention, including the implementation of ergonomics.
The prevention of accidents at work and occupational diseases should be given priority over their compensation and compensation. It is cheaper to prevent accidents at work and occupational diseases than to compensate them economically. An important factor is the company's effort to prevent human misery and physical and mental suffering, which is largely solved by ergonomics.
In the current period, when there is a shortage of skilled labour in the labour market, periods of incapacity for work or early retirement due to an accident or an occupational disease cause apparent economic damage.
The need to improve working life in the European Union (EU) is still urgent today. In 2016, approximately 2.4 million non-fatal

accidents requiring at least 4 days of absence from work and 3,182 fatal accidents were reported in EU Member States. In addition to these accident rates, figures from 2013 show that 7.9 % of the workforce suffered from occupational health problems, of which 36% resulted in absence from work for at least 4 days [Eurostat, 2018a, 2018b].

These occupational injuries, diseases and deaths result in high economic costs to individuals, employers, governments and society. Negative effects may include costly early retirement, the loss of skilled staff, absenteeism as well as presenteeism (when employees go to work despite illness, increasing the likelihood of mistakes) and high medical costs and insurance premiums.

The situation varies considerably between the countries of the European region, depending on the industrial mix, the legislative context and preventive incentives [EU-OSHA 2019].

5 CONCLUSION

Prevention of occupational accidents and diseases by improving working conditions and increasing occupational safety and health are strategic goals enshrined in the primary documents of the European Union and the Slovak Republic focused on occupational safety and health.

The negative impact of work performance and work environment factors on human health is a complex problem requiring a constant search for new opportunities and approaches to eliminate them, becoming a significant challenge for the coming periods. The ageing of the population, ongoing technological change, the need to minimize costs and losses caused by accidents at work and occupational diseases are impulses that will need to be addressed. One of the ways to address this problem is the application of ergonomics in primary prevention directly in companies.

A system of economic incentives for employers aimed at increasing the safety of their employees and reducing the risks of occupational diseases and possible accidents at work is becoming an integral part of European social protection standards in European countries..

ACKNOWLEDGMENTS

This publication has been published with the support of the Operational Program Integrated Infrastructure within project Výskum v sieti SANET a možnosti jej ďalšieho využitia a rozvoja, code ITMS 313011W988, co-financed by the ERDF.

REFERENCES

[E-BTS, 2021] E-BTS. Accident statistics. Statistics on occupational accidents - year 2021 [online]. 2021, [cit. 18.11.2021]. Available at: z https://ebts.besoft.sk/odborne-informacie/statistika-urazov

[EU-OSHA, 2017] EUROPEAN AGENCY FOR SAFETY AND HEALTH AT WORK (EU-OSHA). *Estimating the costs of work-related accidents and ill-health: An analysis of European data sources.* Publications Office of the European Union, Luxembourg.

[EU-OSHA, 2019] EUROPEAN AGENCY FOR SAFETY AND HEALTH AT WORK (EU-OSHA). 2019. The value of occupational safety and health and the societal costs of work-related injuries and diseases. Luxembourg: Publications Office of the European Union, 2019. ISBN; 978-92-9479-138-2. doi:10.2802/251128.

[EU-OSHA, 2021a] EUROPEAN AGENCY FOR SAFETY AND HEALTH AT WORK Good safety and health at work is good for businesses [online]. 2021, [cit. 18.11.2021]. Available at: https://osha.europa.eu/sk/themes/good-osh-is-good-for-business

[EU-OSHA, 2021b] EUROPEAN AGENCY FOR SAFETY AND HEALTH AT WORK (EU-OSHA). Work - related diseases [online]. 2021, [cit. 18.11.2021]. Available at: https://osha.europa.eu/sk/themes/work-related-diseases

[EU-OSHA, 2021c] EUROPEAN AGENCY FOR SAFETY AND HEALTH AT WORK (EU-OSHA). Musculoskeletal disorders [online]. 2021, [cit. 18.11.2021]. Available at: https://osha.europa.eu/en/themes/musculoskeletal-disorders

[Eurostat, 2018a] *Accidents at work statistics (ESAW*). Fatal and non-fatal accidents at work, by sex, age groups, injury groups and NACE Rev. 2 economic sectors [hsw_mi07] (2015). [online]. [cit. 18.11.2021]. Available at: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=hsw_mi07&lang=en

[Eurostat, 2018b] *Persons reporting a work-related health problem resulting in sick leave by period off work [hsw_pb3] (2013).* [online]. [cit. 18.11.2021]. Available at: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=hsw_pb3&lang=en

[Hatiar et al., 2017] HATIAR, K., KYSELICA, O., BARAN, D. Preventive focused ergonomic program in the company. 2017.[online]. In Jurkovicova J, Stefanikova Z. (Eds.) Living conditions and health. Bratislava: Public Health Office of the Slovak Republic,2017: 325-339. ISBN 978-80-7159-229-7. [cit. 15. 11. 2021], Available at: https://zona.fmed.uniba.sk/fileadmin/lf/sucasti/Teoreticke_ustavy/Ustav_hygieny/Webpic/Zborniky/ZPaZ_2017_upr.pdf

[Hatiar, 2014] HATIAR, K. 2014. *Basics of ergonomics*. In: Sulcova, M., Kruty, F., Moricova, S.: Occupational medicine. Part I. Teaching texts for the student of the study field Public Health FZSP TU (scripts), published by FZSP TU, Trnava

[Nemec et al., 2017] NEMEC, M., RUZEK, L., NEMETHOVA, M., ZERJAVA, M., SZABOOVA, T., NEMCOVA, B., 2017. *Analysis of the possibilities and conditions for the creation and financing of a tripartite special fund intended for financing the prevention of occupational accidents and diseases. National project, Center for Social Dialogue II., Project implementation date: 06/2016 - 07/2021. ITMS project: 312031B970*

[Nielsen et al., 2021] NIELSEN, K., JORGENSEN, B. M., MILCZAREK, M., MUNAR, L., 2021. *Healthy employees, prosperous companies - a practical guide to ensuring good workplace conditions. Solving the problem of psychosocial risks and damage to the musculoskeletal system in small businesses. (EU-OSHA). Luxembourg: Publications Office of the European Union. 2021. 101 p. ISBN 978-92-9479-427-7 doi: 10.2802 / 904938*

[Hatiar et al., 2004] HATIAR, K., KOBERTICOVA, L., HAJNIK, B., 2004. Ergonomics and preventive ergonomic programs (4): Ergonomic analysis using a modified

"Nordic Questionnaire". *Safe work.* **35**(4), 20 – 28. ISSN 0322-8347.

[Hatiar et al., 2015] HATIAR, K., BENO, R., MARKOVA, P., SABLIK, J., 2015. Ergonomics as an integral part of enterprise programs focused on health and safety at work. *In: Proceedings of the XXVIII International Conference CURRENT ISSUES OF OCCUPATIONAL SAFETY, Hotel Patria, Štrbské Pleso, 18.-20. 11. 2015. Košice: TU, 2015, 10 pp., ISBN 978-80-553-2302-2.*

[Hatiar 2018] HATIAR, K., BRSIAK, V., 2018. Industrial revolution and prevention of work-related difficulties and disorders of the musculoskeletal system, In: *Jurkovicova, J,. Stefanikova, Z., Proceedings of LIVING CONDITIONS AND HEALTH 2017*, *Public Health Authority of the Slovak Republic, Slovak Society of Hygienists SLS, Institute of Hygiene, Faculty of Medicine, Comenius University, Bratislava*. Bratislava, 2018, 17, p. 195 – 211, ISBN 978-80-223-4523-1. Available from: https://www.fmed.uniba.sk/fileadmin/lf/sucasti/Teoreticke_ustavy/Ustav

[Kuorinka et al., 1987] KUORINKA, I. a JOHNSON, B., 1987. Standardised Nordic Questionnaires for Analysis of Musculoskeletal Symptoms. *Applied Ergonomics*. 18(3). 233-237. DOI: 10.1016/0003-6870(87)90010-x _hygieny/Webpic/Zborniky/ZPaZ_2018.pdf

CONTACTS:

Ing. Petra Markova, PhD.
Slovak University of Technology in Bratislava/Faculty of Science and Technology in Trnava
Ulica Jana Bottu 2781/25, Trnava, 917 24, Slovakia
+421 906 068 454, petra.markova@stuba.sk, www.mtf.stuba.sk