ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2024 Volume 12 Number 2 (December)
http://doi.org/10.9770/s7399839685

Publisher
http://jssidoi.org/esc/home

ECONOMIC CONSEQUENCES OF WORK-RELATED DISORDERS*

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Received 5 August 2024; accepted 6 November 2024; published 30 December 2024

Abstract. The paper aims to point out the high incidence level of musculoskeletal disorders (MSDs) in society and their related costs, which have an impact on different involved entities. Highlighting the leading cause of MSDs in developed countries could change attitudes and ways to solve this issue. The primary method employed herein is the literature review, supported by the secondary data provided by national and supranational institutions. The costs of MSDs mean a significant burden on society. MSDs belong to one of the most frequent occupational disease categories. Mainly, indirect and intangible costs affect workers, their families, employers, and society, although they are not as apparent as direct costs at the beginning when MSD occurs. Discovering an actual cause should lead to a solution. If most MSDs were work-related, workplaces would have to be changed. The strict application of ergonomics standards could reduce the incidence rate and decrease the total costs of MSDs. The unsolved issue is that employers must be more motivated to apply ergonomic standards fully because they share only a part of the total costs. Work-related musculoskeletal disorders are negative externalities whose reduction has to be enforced by the government.

Keywords: direct, indirect, intangible costs; ergonomics; productivity loss; economic burden; work-related disorders; musculoskeletal disorders (MSDs)

Reference to this paper should be made as follows: Camska, D., Svecova, L., Kralova, P. 2024. Economic consequences of work-related disorders. *Entrepreneurship and Sustainability Issues*, 12(2), 210-224. http://doi.org/10.9770/s7399839685

JEL Classifications: M20, J28, I1

1. Introduction

It should be emphasised already at the beginning that musculoskeletal disorders (MSDs) belong to a costly disease category with a significant impact on society. Van Tulder et al. (1995) claim it is the fifth most expensive category regarding work absenteeism and disablement. Lindgren (1998) proved musculoskeletal disorders were the most costly category in 1991, accounting for 23% of the total illness costs. Lee (1994) marks the costs of musculoskeletal disorders as an escalating problem. These diseases are more relevant because of the ageing population (Oh et al., 2011; Davis et al., 2014; Soltes & Gavurova, 2015).

It is even estimated that 14.5% of adults have symptoms of musculoskeletal diseases (Clarke & Symmons, 2006), the prevalence of this kind of disease ranges from 6.6% to 20.7% (Jordan et al., 2007), and that 10% of

* *This research was co-funded by the state budget by the Technology Agency of the Czech Republic and Ministry of Industry and Trade under TREND Programme. It is the project "Development of a system for monitoring and evaluation of the selected risk factors of the physical burden of work operations in context of Industry 4.0" under the grant number FW03010194.*

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http://doi.org/10.9770/s7399839685

working-age adults have a work-related musculoskeletal condition (Morse et al., 1998). It should be pointed out that it is very difficult to distinguish which musculoskeletal disorders have occurred as work-related and which are non-work-related (Lipscomb et al., 2009). Although not all musculoskeletal disorders are connected to work (Baldwin, 2004), the burden of work-related disorders is significant from many perspectives (Stefko et al., 2016). Fasanya and Shofoluwe (2019) warn about the amount of work-related musculoskeletal disorders (WMSDs). US Data (U.S. Bureau of Labor & Statistics, 2004) prove that musculoskeletal disorders occupy 34% of all work-related injuries and illnesses. In comparison, the worldwide estimate reached 31% of all occupational diseases (Leigh et al., 1999), and therefore, MSDs were classified as the most frequent occupational diseases. Dombeková and Tuček (2018) state that the diseases caused by local muscular load are the most frequent occupational diseases in the Czech Republic. Minks et al. (2014) point out the specific repetitive strain injuries such as Carpal tunnel syndrome. This disorder occurs due to the carpal tunnel or a gap in the lower hand to the wrist narrowing. Minks et al. (2014) indicate that it is the most common mononeuropathy and the most frequent occupational disease. The occupational musculoskeletal disorders are the main factor of work disability (Gatchel, 2004).

Without distinguishing between work-related and non-work-related musculoskeletal disorders, they are the leading cause of absenteeism, disability (van Tulder, 1995; Almonacid et al., 2018), and pain (Almonacid et al., 2018), and they contribute significantly to the payments of sick leave in the developed countries (van der Zee-Neuen et al., 2015).

The paper aims to conduct the synthesis based on fragmented information and start a forthcoming scientific discussion about the role of employers and ergonomics in avoiding or at least reducing work-related musculoskeletal disorders. The primary method employed herein is the literature review based on published research papers on musculoskeletal disorders from different points of view, such as costs, involved and affected entities, the role of occupational ergonomics and employer in the process and their common impact on work-related musculoskeletal disorders. The literature review is accompanied by desk research based on the secondary data provided by national and supranational institutions.

The paper is structured into the following parts. The introduction is followed by a short literature review addressing the topic of costs. Emphasis on the literature review also continues in subsequent parts, such as Results and Discussion, because the paper type is a review paper. Conclusions summarise the main findings and possible role of employer and occupational ergonomics in work-related musculoskeletal disorders.

2. Theoretical background

The economic burden of MSDs seems remarkable according to the following numbers. Estimated costs of back pain reached 1.7% of the gross national product (GNP) in the Netherlands in 1991, and the costs of back pain covered approximately one-third of the costs of musculoskeletal diseases (van Tulder et al., 1995); therefore quantified the total cost of MSDs could even reach over 5% of GNP. Yelin and Callahan (1995) came to the estimate of 2.5% of gross domestic product in the case of MSDs in the USA. However, the total costs of musculoskeletal disorders were estimated to be 3.4% of gross domestic product in Canada in 1994 (Coyte et al., 1998). Swedish estimate reached a comparable 3.14% of the gross domestic product in 1994, according to the note of (Oh et al., 2011). American Academy of Orthopaedic Surgeons (2008) finished with one of the highest estimates of 7.7% of gross domestic product. There are also studies which could be positioned on the other side of the scale, such as Oh et al. (2011) estimating the costs reaching 0.7% of GDP in Korea in 2008 or Piedrahita (2006) coming to 0.2% of GDP in Colombia in 2005.

Different factors could cause detected differences in estimated costs among countries. It is always a question of methodology, disease classification, and the type of data used (van Tulder et al., 1995; Lindgren, 1998). Studies also differ according to the costs which are involved, which can cover direct, indirect, and specific modern category intangible costs (Dagenais et al., 2008). The topic of costs will be developed further in the Discussion. Organisations and institutions of healthcare, social welfare, and insurance systems would impact the value of estimated direct and indirect costs (van Tulder et al., 1995; Lindgren, 1998). Cultural differences would

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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seriously influence intangible costs and how people perceive the severity of complaints and pain. Some countries, especially developing ones, struggle with a lack of data and statistics, as emphasised in Piedrahita (2006), which could lead to national underestimations.

In spite of improvement contributing to early diagnoses declared by Gcelu and Kalla (2015) and the decreasing rate of non-fatal cases in the category musculoskeletal disorder injuries and illnesses in the USA since 2011 till 2020 published by National Safety Council (n.d.) percentage of disability-adjusted life years (DALYs) had increased comparing years 1990 and 2019 in the categories low back pain and other musculoskeletal disorders percentage according to data provided in Vos et al. (2020). This is consistent with warnings of the Burden of Global Disease 2010 Study that musculoskeletal disorders impose new challenges on health systems worldwide (Murray et al., 2012). Many governments are aware of this rising burden and acknowledge the issue of musculoskeletal disorders (Weinstein, 2000).

All studies consider musculoskeletal disorders to be a severe and expensive issue regardless of the estimated cost value. Some research works focus exclusively on work-related musculoskeletal disorders, concluding that they are the most or second most costly occupational diseases in the USA, Canada (Baldwin, 2004; Weahrer et al., 2005), and European countries (Eurogip, n.d.).

3. Research objective and methodology

The research objective is to start a forthcoming scientific discussion about the role of employers and ergonomics in avoiding or at least reducing work-related musculoskeletal disorders. The primary method employed herein is the literature review, which synthesises information fragmented in previously published research papers on musculoskeletal disorders from different points of view. These points of view cover costs, involved and affected entities, the role of occupational ergonomics and employer in the process and their common impact on work-related musculoskeletal disorders. The own desk research verifies the statements detected in the literature review conducted.

The research is based on the secondary data provided by national and supranational institutions. The aim is to prove that musculoskeletal disorders belong to the most or second most frequent occupational disease category. According to the literature review, significant differences between individual countries could be expected; therefore, the research also focuses on intercountry comparison.

4. Results

The results focus on verifying some statements provided in the literature review. These statements pointed out that musculoskeletal disorders belong to the most or second most frequent occupational disease category and that there could be differences between individual countries.

Table 1 shows significant differences in incidences of WMSDs reported by individual European countries. Although Eurostat collects the data and national authorities' discrepancies among data should follow, the identical methodology could hardly be explained. Factors could be cultural differences in the perceived severity of musculoskeletal conditions and pain (van Tulder et al., 1995), differences in the population age structure leading to higher chronicity and overall incidence, and differences in the amount of filled compensation claims.

It has to be admitted that it is very demanding to distinguish between work-related and non-work-related back pain (Baldwin, 2004) and all MSDs (Lipscomb et al., 2009) because there is uncertainty and lack of evidence to prove it. Some previous research papers conclude that employees do not fill out compensation claims for various reasons, although they have the right to do so. Morse et al. (1998) came with presumptuous estimates that 10% of workers have a work-related musculoskeletal condition, but only 10% claim workers' compensation. This could be supported by Rosenman et al. (2000), who announced that only one-quarter of affected workers filled the claim. The specific case of American carpenters shows that they tended to cover even work-related MSDs with private insurance instead of workers' compensation claims (Lipscomb et al., 2009).

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Statistics on occupational diseases in some countries have achieved a current level of excellence because of well-defined categories, consistent reporting, and governmental enforcement. Scandinavian countries such as Finland and Sweden are supposed to have very high standards in occupational health and safety (Piedrahita, 2006). Countries with the highest share of WMSDs in the workforce are Finland, Austria, Sweden, and Norway, confirming previous research findings about high occupational health and safety standards. The general conclusion could be that less developed countries entering the European Union later report a lower share of WMSDs. Polish data in 2020 seems distorted because such a high number was not achieved in any other country in the sample and hardly in countries with comparable historical and economic conditions.

Table 1. Incidence of work-related musculoskeletal disorders in European countries

Year	2007	2013	2020	2007	2013	2020
Country	Share of WMSDs on workforce in %			Share of WMSDs on all work-related health problems in %		
European Union - 27 countries	7.7	5.1	5.9	54.8	62.4	62.8
Austria	11.1	10.5	9.0	68.0	67.7	67.2
Belgium	7.3	4.6	4.9	58.1	55.9	56.1
Bulgaria	1.8	2.0	1.9	40.0	40.8	55.5
Croatia	4.4	4.1	3.7	53.1	50.0	59.9
Cyprus	5.2	4.0	2.7	58.8	67.1	73.1
Czechia	3.9	3.9	4.2	48.4	70.7	75.1
Denmark	6.6	3.6	3.5	61.3	63.7	53.7
Estonia	5.3	5.1	3.8	57.5	65.8	64.0
Finland	13.5	15.4	13.7	66.0	71.7	64.7
France	24.2	6.6	4.2	47.9	59.6	58.1
Germany	4.2	5.5	5.1	75.1	65.9	57.0
Greece	3.7	3.5	1.6	54.9	55.9	63.6
Hungary	3.5	2.6	1.6	61.6	47.5	58.5
Ireland	1.8	0.8	1.5	57.0	54.5	50.0
Italy	3.7	3.0	3.6	50.8	57.7	67.8
Latvia	N/A	4.1	3.4	N/A	58.7	74.2
Lithuania	1.8	1.8	1.2	43.5	66.3	63.4
Luxembourg	2.7	2.5	4.0	64.6	42.5	39.2
Malta	3.5	2.3	0.9	59.6	67.7	40.1
Netherlands	6.5	N/A	2.9	57.7	N/A	43.9
Poland	13.7	10.1	26.1	63.5	69.4	71.1
Portugal	1.7	2.9	3.4	49.4	52.9	61.8
Romania	2.0	0.9	1.8	40.6	49.9	60.9
Slovenia	5.4	3.2	2.4	57.9	57.8	56.8
Slovakia	3.7	6.6	5.1	59.6	67.4	72.2
Spain	3.4	2.7	3.6	60.8	58.4	59.8
Sweden	7.0	9.9	7.4	60.2	58.3	46.9
Non-members of EU						
Iceland	4.5	N/A	2.6	67.3	N/A	34.4
Norway	6.8	7.0	6.1	68.2	72.3	63.9
Switzerland	N/A	6.3	6.1	N/A	56.7	55.9

Source: authors based on data published by Eurostat n.d.

The numbers displayed in Table 1 depend on the way of measurement and reporting. Countries and employers implementing high ergonomics and safety standards will likely avoid at least some WMSDs and reduce associated costs and negative impacts on society. The reporting of such countries tends to have a higher share of WMSDs in the workforce because WMSDs are just at the centre of interest. According to the European data presented in Table 1, the Colombian incidence reported rate was several times lower than the incidence rate of Sweden or Finland (Piedrahita, 2006), which confirms the relationship between high standards in developed economies and higher reported rates of (W)MSDs.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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The time development of WMSDs in Table 1 is more illustrative because no general European trends can be detected. Contrariwise, the last three columns of Table 1 prove that WMSDs are the most significant work-related health problems because almost every country reports a share exceeding 50%. These findings support the view that WMSDs significantly burden society, and it is worth continuing the research in this area.

Not all work-related issues require hospitalisation or immediate homestay, causing time off work. Eurostat does not publish the data connected with individual diagnoses; therefore, Table 2 is based on some assumptions. When MSDs are the most often work-related health problem, as proved in Table 1, then general data would mainly depend on this disease category. The rate of employees out of work could be multiplied by the share of WMSDs on all work-related issues, and the rate of employees having WMSDs staying out of work is received. Values of this indicator are displayed in the second column of Table 2. It is also possible to calculate the share of workers having WMSDs continuing to work, the numbers of which are included in the third column of Table 2. The last column shows the sum of the previous two indicators. This sum should equal the share of WMSDs in the workforce in 2020, included in Table 1. The previous simplification caused a slight data discrepancy. This data discrepancy is relatively small and verifies that the accepted assumptions do not distort data quantified.

Table 2. Time off work of persons reporting WMSDS in European countries

Country	Percentage of persons reporting WMSDs resulting in time off work	Percentage of persons reporting WMSDs no resulting in time off work	Percentage of persons reporting WMSDs
European Union - 27 countries (from 2020)	2.82	2.86	5.68
Austria	5.33	3.42	8.75
Belgium	3.34	1.80	5.14
Bulgaria	0.52	1.07	1.59
Croatia	1.21	2.61	3.82
Cyprus	1.15	1.14	2.29
Czechia	2.31	1.58	3.89
Denmark	2.23	1.44	3.67
Estonia	2.25	1.43	3.68
Finland	1.24	14.56	15.80
France	2.84	1.49	4.33
Germany	2.46	2.06	4.52
Greece	0.92	0.81	1.73
Hungary	0.97	0.51	1.48
Ireland	0.90	0.41	1.31
Italy	1.55	1.53	3.08
Latvia	2.19	1.35	3.54
Lithuania	0.93	0.22	1.15
Luxembourg	3.39	0.98	4.37
Malta	0.37	0.27	0.64
Netherlands	2.09	0.89	2.98
Poland	8.81	16.35	25.16
Portugal	2.26	1.38	3.64
Romania	1.39	0.32	1.71
Slovenia	1.77	1.29	3.06
Slovakia	2.64	2.46	5.10
Spain	2.41	1.39	3.80
Sweden	3.10	4.66	7.76
Non-members of EU			
Iceland	2.41	0.63	3.04
Norway	4.45	2.76	7.21
Switzerland	3.50	3.06	6.56

Source: authors based on data published by Eurostat n.d.

It can be admitted that the Polish data would increase the European average, but still, the average shows that 2.82% of persons reporting WMSDs were off work temporarily in the EU in 2020. Generally, employees at home or even at the hospital incur higher costs of WMSDs than employees who continue working. This

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disproportionality could be observed in Finish numbers because many affected workers continue working and do not take time off. In this case, such disproportionality is also a consequence of a higher reported share of workers reporting WMSDs than other countries. Contrariwise, it could be discussed if the person staying at work did not tend to have a higher risk of chronicity. This establishes a base for different cost categories to be involved, and increased attention should be paid to the relevant cost categories. The following text is focused on the structure of total costs related to MSDs.

5. Discussion

The results of the previous part confirmed that WMSDs belong to the most frequent occupational disease categories in the European Union; therefore, it can be assumed that their economic impact on society is significant. The impact estimated in papers introduced in the part of the Literature review depends on the costs involved in the specific studies. The literature, such as Dagenais et al. (2008) and Tarricone (2006), mainly distinguishes three main cost categories: direct, indirect, and intangible. Figure 1 presents the detailed cost structure of MSDs according to these three categories.

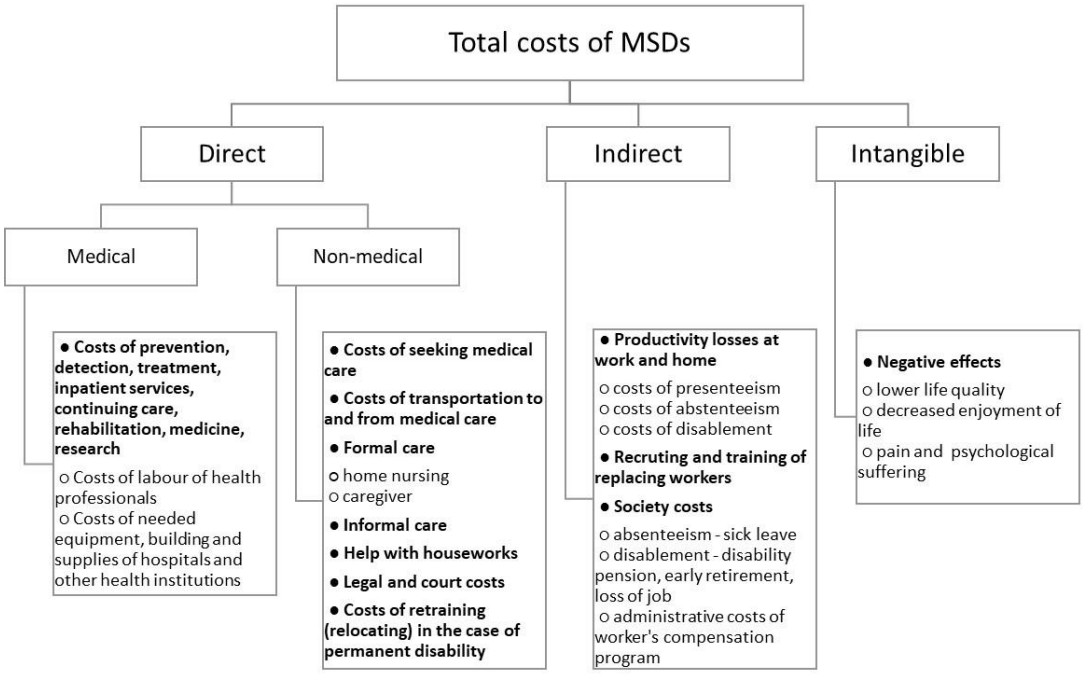

Figure 1. Division of total costs of MSDs

Source: authors based on literature review (van Tulder et al. 1995; Baldwin 2004; Piedrahita 2006; Dagenais et al. 2008; van den Akker et al. 2012)

Although direct costs seem apparent, they do not represent most of the overall costs (van Tulder et al., 1995; Dagenais et al., 2008). In some real cases non-medical costs outweigh medical costs of MSDs. Intangible costs remain in many studies omitted (Dagenais et al., 2008; Oh et al., 2011) because it is very complicated to measure and quantify them even for one single case; therefore, the estimation for the whole society is difficult to reach. Intangible costs remain very subjective (Oh et al., 2011) because affected persons should be asked according to their willingness to pay (Gafni, 1991; O'Brien & Gafni, 1996) for a hypothetical treatment that would care for their disorder. An alternative method applied by van den Akker et al. (2012) would be for respondents to be asked about their quality of life, which is translated into utility scores and related costs. The subjectivity of measurement still stays. This leads to a consequence in which the emphasis is mainly on indirect costs.

The estimated production losses influence indirect costs. For this kind of quantification, the human capital approach is often used in studies (Dagenais et al., 2008). This approach assumes that the worker cannot work and that the evaluation will follow the lost employees' wages and salaries. However, employers will tend to

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replace employees who are absent and restore business productivity to the initial level as soon as possible. If the employer can replace the worker, the productivity will not be lost. Companies also hardly plan to utilise their capacity at 100% because of their risk management strategies; therefore, they can react even in the very short run and not lose 100% of the productivity provided by that given single diseased worker. Only a part of productivity is lost due to the absence because the remaining employees partially compensate for this loss. The long-run period would be influenced if the company could hire a new worker soon and provide sufficient training to this person who should have skills and abilities comparable to the diseased employee. Financial consequences would depend on the business situation. Important factors that should be considered are location, belonging to industry sectors, level of competition, labour market, and overall economic situation. Some companies can incur negligible additional costs when replacing workers, which can harm some companies. It should be pointed out that nowadays, many European economies are facing a lack of manpower in many fields and professions (Poór et al., 2021; Spadavecchia & Yu, 2021; Stefko et al., 2020) as well as accompanied by the aging population in the developed countries worldwide (Ivankova et al., 2022; Gavurova et al., 2020a,b; Oh et al., 2011; Davis et al., 2014; Coyte et al., 1998). This could serve as one motivating factor for businesses to comply with ergonomic rules, decreasing and avoiding MSDs.

Total costs of diseases estimated using the human capital approach could seem overestimated because, in fact, productivity is not entirely lost due to workers' disability. The human capital approach was widely used in studies focused exclusively on back pain, such as Ekman et al. (2005), Hansson and Hansson (2005), van Zundert and van Kleef (2005), Stewart et al. (2003) and job stress, such as Chang et al. (2022). The generation gap between workers (Šakytė-Statnickė et al., 2023) and the existence of a high-performance work system can also cause stress for workers (Cizrelioğulları & Babayiğit, 2022). Other problems such as poor working conditions, lower wages, long working hours, low motivating factors, high employee turnover (Devkota et al., 2023) and the socioeconomic conditions of countries (Navickas et al., 2022) can also cause stress and might increase health problems of workers. Migrant workers can be more vulnerable because of facing more restrictions (Přívarová et al., 2022). However, technological development has made employees work remotely (Andrade et al., 2023), which might decrease their stress. Stress can also be minimised by travel intention (Abou-Shouk et al., 2023), networking activities (Rozsa et al., 2022) and workshops (Ključnikov et al., 2022a). Reducing stress causes also increases the number of workers and stimulates the development of some industries (Matijová et al., 2023). Various researchers have also applied the human capital approach concerning firms' brand value (Plaikner et al., 2023) and digital transformation (Krajcik et al., 2023). The digital transformation process is also substantial for workers' problems since it enables businesses to implement innovative organisational strategies to react to changing conditions (Civelek et al., 2023a). This innovative attitude positively contributes to the sustainable development of companies (Civelek et al., 2023b). Firms that satisfy the needs of their workers and motivate them can also increase their reputation. In this regard, they can also become more likely to hire well-experienced and talented workers who can improve their innovation performance (Civelek & Krajčík, 2022) and success in the internationalisation process (Ključnikov et al., 2022b).

An alternative to the human capital approach could be called the friction period approach. This approach works with the previous description that the newly hired employee can replace the disabled worker. The friction method is more similar to the way in which businesses experience their workers' sick (Koopmanschap et al., 1995). Productivity is lost only during the friction period. The friction period should be assumed to be a long time. This question cannot be answered generally because the friction period will differ according to professions and business locations influenced by labour supply and elasticity. Study Bonnen et al. (2005) worked with a friction period of 22 weeks. Some research papers such as Walker et al. (2004), Hutubessy et al. (1999), Maniadakis and Gray (2000) tried to combine the human capital approach and friction period approach. Dagenais et al. (2008) concluded that, on average, the friction period approach provided estimates lower by 56% compared to the human capital approach. This confirms that the business losses do not reach such high values, and employers are less motivated to comply fully with ergonomic standards.

Another already emphasised issue is the ageing population, which could make it more complicated to find a new workforce in the case of productivity restoration. However, the ageing population has yet to be discussed because it influences current workers' age structure. Research papers coincide with significant implications for

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businesses and society in relation to elderly workers. Although older employees have more experience and practice, which tends to lower rates of injury, according to Burton and Spieler (2001), they burden the system with more lost work days and wage compensation (Peele et al., 2005). Many industries have been hit by the increasing costs of work-related MSDs with age (Davis et al., 2014). Despite no significant difference in medical care costs between different age groups (Peele et al., 2005), older workers suffer chronic disorders and comorbidities (Burton & Spieler, 2001). The literature on chronicity in MSDs seems limited (Baldwin, 2004). It could be concluded that chronic cases of back pain contribute to significant indirect productivity losses (Frank et al., 1996; Williams et al., 1998), and therefore, chronic disorders tend to have relatively high indirect costs (Baldwin, 2004). It has to be admitted that chronic conditions have become the most significant burden on the healthcare systems in developed countries (Osborne et al., 2007), and chronic disorders have an impact not only on individuals but also on society.

Attention should be turned to entities affected by MSDs. Unfortunately, not only individuals and employers are negatively influenced. The economic burden on society is also relevant. However, the breakdown of costs for different entities should be explained. Figure 2 is the repetition of terms included in Figure 1, but it points out which groups and how they are affected. Impact on entities is essential when motives of their behaviour and power of actions of individual interested parties are analysed, explained, and anticipated. Baldwin (2004) points out that transfer compensation payments represent "only" re-allocating society's resources and do not cause any actual loss of resources. Including both – productivity losses and compensation payments – in cost estimations would be double counting. Figure 2 addresses four main groups – individuals, family members, employers, and society. The previous text has already focused on some of these groups.

The role of family members stays overlooked chiefly. They are responsible for informal care, whose importance can be significant in the case of severe injuries. Asfaw et al. (2015) warn that occupational injury can also impose a health burden on family members. Family members are exposed to the increasing risk of MSDs, taking care of the injured workers. The impact on family budgets is unambiguous when the income of affected workers mainly significantly decreases (Leigh et al., 1999; Brown et al., 2007; Boden et al., 2001). Family members can even be forced to reduce their work hours (Weil, 2001) when the injured person's care is needed to such an extent. Unfortunately, family consequences do not end with financial impacts and physical health issues. The family members can also experience emotional problems (Adams et al., 2002), resulting in divorce, separation (Keogh et al., 2000), and mental health issues (Adams et al., 2002). The findings of Asfaw et al. (2015) support the need to focus also on the secondary effects of occupational injuries and MSDs. Not only are the individual workers influenced, but there could also be a severe impact on their family members, which is also emphasised in Figure 2.

The amount of MSDs is remarkable, and some sources even state that there is still an increase in work-related musculoskeletal disorders (Fasanya & Shofoluwe, 2019), which cannot be confirmed by European data presented in Table 1. Employers should indisputably pay attention to this issue. Some findings prove different tendencies of employers. 52% of workplaces analysed exceeded local muscular load's health and safety limits (Dombeková & Tuček, 2019), which could lead to repetitive strain injuries. One of the most significant disadvantages of chronic disorders is that they have relatively high indirect costs (10). Employers tend to disregard some critical aspects of the job Fasanya and Shofoluwe (2019). The issue also addressed in Figure 2 is that the burden of an individual employer is lower than the costs to society (Meltzer, 2001). Employers need to see the effects clearly because social impacts and estimates do not solely change their behaviour, attitude, and working conditions. Quintana and Pawlowitz (1999) point out that management could be motivated to change the work methods and invest money into technological ergonomic solutions and preventive actions only if the estimated loss caused by work-related MSDs is beyond a tolerable threshold. Considering the economic perspective, Alder et al. (1997) explain that employers cannot be expected to implement all needed beneficial measures without legal incentives and government enforcement. State authorities creating political and legal environments contributing to the social environment play an essential role.

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2024 Volume 12 Number 2 (December)
http://doi.org/10.9770/s7399839685

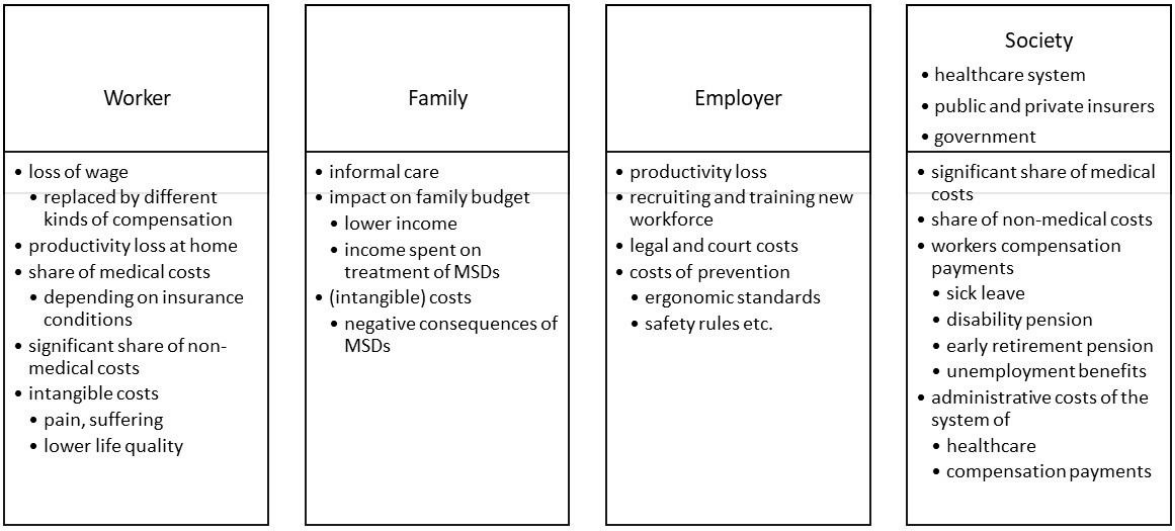

Figure 2. Cost impact on individual interested parties

Source: authors

Employers should clearly see the direct impacts of WMSDs. They have to be forced to their avoidance when employers' economic incentives are weaker than societal incentives. The scientific discipline that should be majorly contributed to is called ergonomics. Ergonomics is the discipline dealing with humans and their behaviour in the working process affected by the working environment and machines using tools (McCormick, Sanders 1982). The aim is to understand interactions among humans and other system elements to optimise human well-being and overall system performance (IEA, n.d.). Ergonomics should provide an employer with an effective way to "prevent and correct negative effects of the way of organising work" (Dul & Ceylan, 2011). Applying ergonomic concepts should improve work life quality, reduce musculoskeletal disorders, increase productivity (Afroz & Haque, 2021), and avoid serious human errors (Pavlovic-Veselinovic, 2014). The human aspect is observed in employee satisfaction and better health conditions, which would decrease the burden on society. Contrariwise, the employer viewpoint is presented by the cost reduction stemming from fewer injuries and occupational diseases (Rowan & Wright, 1995), business profitability (Zink & Fischer, 2018), manufacturing productivity, and employee loyalty (Dombeková & Tuček, 2019).

6. Conclusion

The key to solving any issue is to find an actual cause. This concept has been applied in economics and management since the 1960s when Ishikawa (1976) contributed to quality management. According to the numbers presented previously, the amount of MSDs and their economic burden is remarkable. Although it is very difficult to distinguish between work-related and non-work-related MSDs (Lipscomb et al., 2009; Baldwin, 2004), many sources state that work-related MSDs account for a significant part of occupational injuries and illnesses, and they impose noteworthy high costs on health, insurance systems, individual entities etc.

If the trigger of MSDs is the workplace itself, the workplace will have to be changed according to the fulfilment of ergonomic standards. The goal of society and governments is to develop high ergonomic standards to avoid acute and especially chronic MSDs. The government should enforce these ergonomic standards. From the economic point of view, employers will tend to remove only part of WMSDs because complete avoidance would cost more than it would create net effects for the employers. However, the impact on all involved entities, such as workers, family members, employers, and society, would be indisputably more significant and could outweigh the costs employers pay. This could only work with state interventions because employers' economic incentives are lower than societal incentives to avoid MSDs. It can be concluded that WMSDs are negative externalities of the work process.

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Funding: This research was co-funded by the state budget by the Technology Agency of the Czech Republic and Ministry of Industry and Trade under TREND Programme. It is the project "Development of a system for monitoring and evaluation of the selected risk factors of the physical burden of work operations in context of Industry 4.0" under the grant number FW03010194.

Author Contributions: Conceptualisation: *Svecova*, *Camska*; methodology: *Camska*; data analysis: Camska, *Svecova*, writing—original draft preparation: *Camska*, writing; review and editing: Kralova; visualisation: Camska. All authors have read and agreed to the published version of the manuscript.

ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2024 Volume 12 Number 2 (December)
http://doi.org/10.9770/s7399839685

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