European Agency for Safety and Health at Work

Musculoskeletal disorders and psychosocial risk factors in the workplace — statistical analysis of EU-wide survey data

Executive Summary

European Agency for Safety and Health at Work

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Executive summary

Background

- **A major challenge for health at work: finding ways to tackle musculoskeletal disorders**

Musculoskeletal disorders (MSDs) are the primary work-related health problem in the EU. The most recent publicly available data from the ad-hoc module on 'Accidents at work and other work-related health problems' (2013) of the European Union Labour Force Survey (EU-LFS) indicate that 60 % of all workers with a work-related health problem identified MSDs as their most serious issue, while 16 % pointed to stress, depression and anxiety (EU-OSHA, 2019)([1]). Recent trends in the labour market, in particular digitalisation, the increase in computer use and the reduction in physical labour, even in industry, have resulted in faster and more complex work, more repetition and more work in prolonged static positions and when adopting bad postures, for instance while working from home at an unadjusted workstation. These trends may be associated with an increase in mental health problems, such as stress and mental exhaustion, as well as physical health problems, including MSDs. This is the basis for the two main questions of this study: the first question is whether and how these two health concerns are linked and the second is what preventive strategies are implemented to tackle the problem of MSDs in workplaces across the EU.

- **Definitions of the core concepts: musculoskeletal disorders, wellbeing, biomechanical factors and psychosocial factors**

The study centres around two health outcomes: MSDs and wellbeing. **MSDs** refer to periarticular diseases of the limbs and spine, and to a range of multiple or localised pain syndromes. More specifically, work-related MSDs of the limbs and/or spine are painful diseases of the periarticular soft tissues (muscles, tendons, vessels) and peripheral nerves that are caused by occupational overstraining. MSDs can arise suddenly and be short lived (fractures, sprains and strains) or evolve into lifelong conditions associated with ongoing pain and disability. In this report, three different types of MSDs are studied: backpain, MSDs of the upper limbs and neck, and MSDs of the lower limbs.

Mental **wellbeing** is defined by the World Health Organisation (WHO) as a 'state of well-being in which the individual realizes his or her own abilities, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to his or her community' (WHO, 2005, p. 19). It is a broad concept that encompasses feelings of burn-out, emotional distress, symptoms of depression, somatic symptoms, cognitive symptoms, and symptoms of energy and vitality.

The study also distinguishes two main types of factors associated with health outcomes: biomechanical factors and psychosocial risks. MSDs may be caused by **biomechanical factors** in the physical work environment, in particular **biomechanical stress**, which refers to stress caused by hazardous work positions and to physical stress on the body. It includes lifting heavy loads or people, maintaining a bad posture and prolonged sitting (which also has an important cardiovascular effect). However, despite the natural relationship between such strains and MSDs, few studies to date provide strong evidence of direct links, probably because multiple conditions, including biomechanical factors, psychosocial factors and worker characteristics, together determine whether or not an individual will develop an MSD.

Psychosocial risks are defined by the European Agency for Safety and Health at Work (EU-OSHA) as those aspects of the design, organisation and management of work, and its social and environmental context, that can cause psychological, social or physical harm. The International Labour Organisation (ILO) employs the job demands-resources framework, referring to work-related (mental) stress as being 'determined by psychosocial hazards found in: work organization, work design, working conditions, and labour relations … It becomes a risk to health and safety when work exceeding the worker's capacity, resources and ability to cope is prolonged'.

([1]) For an overview report, see EU-OSHA (2019). *Work-related musculoskeletal disorders: prevalence, costs and demographics in the EU*. European Agency for Safety and Health at Work. https://osha.europa.eu/en/publications/work-related-musculoskeletal-disorders-prevalence-costs-and-demographics-eu/view

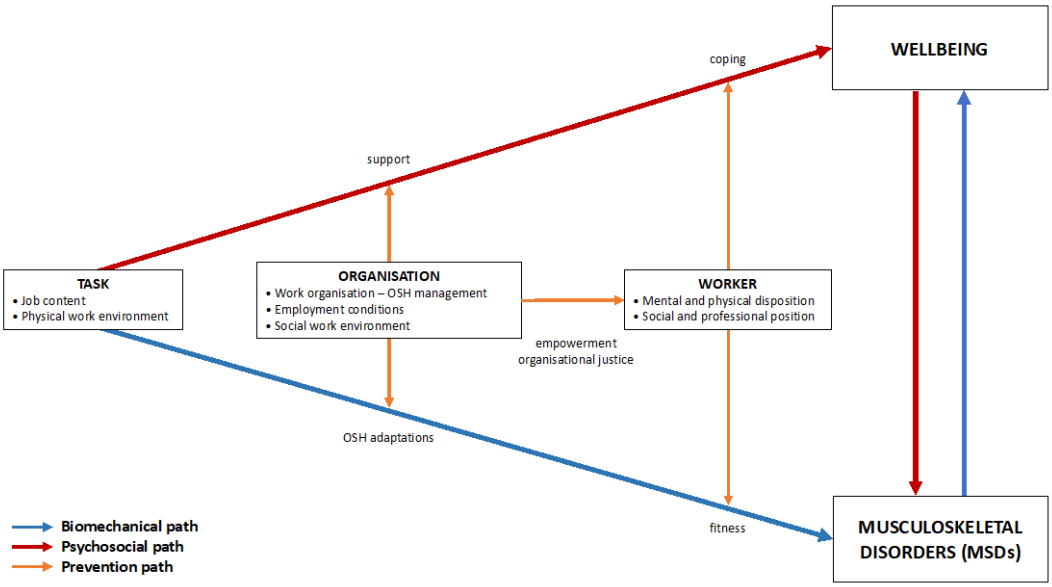
Conceptual model

A conceptual model for work-related mental and physical health risks

The **conceptual framework** adopted in this study (Figure 1) is built on the literature and runs in two directions, explaining MSDs on one hand and wellbeing on the other. This model depicts three paths of interest:

- The **biomechanical path** between physical strains at work and wellbeing relates to factors such as repetitive movements or lifting heavy loads. In this pathway, wellbeing is partly explained by MSDs, which are caused by physical health risks at work.
- The **psychosocial path** goes from psychosocial strains at work to MSDs. Here, MSDs are partly explained by wellbeing, which may be caused by psychosocial factors. In addition to aspects relating to job content and social work environment, various aspects of work organisation are also considered psychosocial factors that may affect the risk of developing MSDs.
- The **prevention path** represents the different ways in which psychosocial factors (e.g. supportive management, autonomy empowering workers to cope with high demands), worker characteristics (e.g. fitness levels) and occupational safety and health (OSH) management practices to activate them (e.g. OSH training) influence the above relationships.

Figure 1: Conceptual framework for analysing work-related risks for MSDs and wellbeing



Source: Authors' elaboration

A multi-method, multi-survey examination

Several quantitative methods were used to examine the research questions (cluster analyses, multivariate analyses). In addition, qualitative feedback was gathered from experts at focus group meetings to verify the findings and add to their interpretation.

For the statistical analyses, large sample data covering the 27 EU Member States (EU-27) from the sixth wave of the European Working Conditions Survey (EWCS, 2015) ([2]) and the third European Survey of Enterprises on New and Emerging Risks (ESENER-3, 2019) ([3]) were used. The EWCS involves asking workers for information on job characteristics and health outcomes. In ESENER,

([2]) Eurofound (2015). *Sixth European Working Conditions Survey*. Available at: https://www.eurofound.europa.eu/surveys/2020/european-working-conditions-survey-2020
([3]) EU-OSHA (2019). The Third European Survey of Enterprises on New and Emerging Risks. Available at: https://visualisation.osha.europa.eu/esener/en/survey/overview/2019

establishments are the basic units and information on management practices is registered. The two datasets have been linked using sector, country and firm size as identifiers.

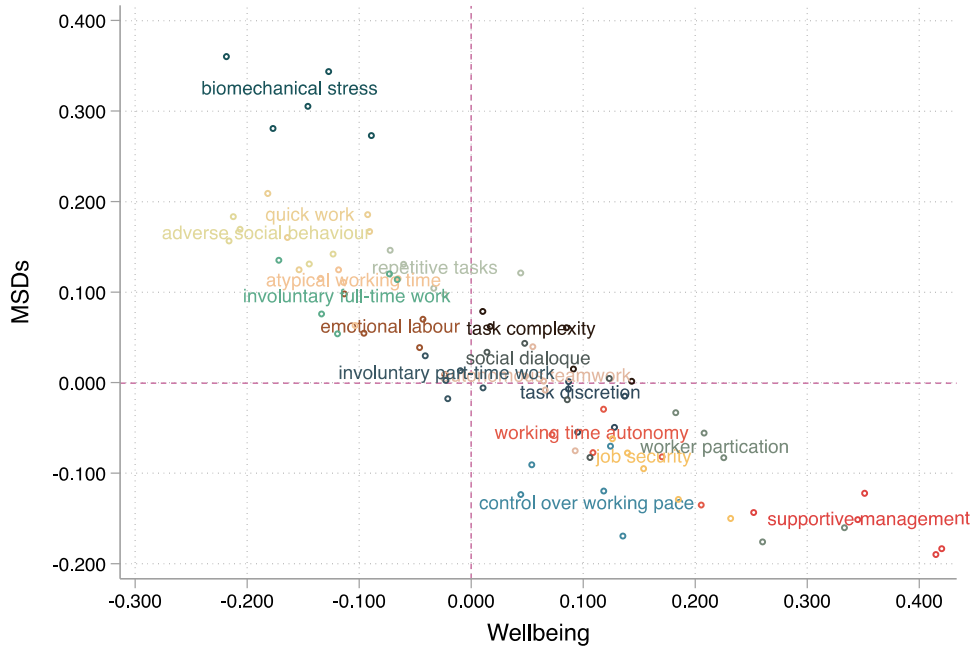
Findings

- **Musculoskeletal disorders and wellbeing have opposing relationships with the same job characteristics**

At the job level, specific job characteristics can have an influence on the wellbeing of the employee and on the MSD-related risks that the employee is confronted with. Figure 2 presents the associations between job characteristics and wellbeing and MSDs. Four main conclusions can be drawn:

1. Job characteristics that have a strong positive correlation with wellbeing (e.g. supportive management) have a strong negative correlation with MSDs, and vice versa (e.g. biomechanical stress).
2. With respect to MSDs, working conditions and in particular biomechanical factors have the strongest effect, while, with respect to wellbeing, employment conditions such as working time-related factors and psychosocial factors related to the social work environment have larger effects.
3. The estimated correlations in different regions of the EU are fairly comparable. The exceptions are for job security and worker participation, for which the correlations are noticeably stronger in the eastern, Baltic and Balkan Member States. This may be due to wider variation with respect to these aspects in regions with a lower degree of labour market institutionalisation.
4. Job characteristics corresponding to job demands tend to be positively associated with MSDs and negatively associated with wellbeing, while job characteristics that are resources are favourable, being negatively associated with MSDs and positively associated with wellbeing.

Figure 2: Cross-country comparisons of correlations between job characteristics, MSDs and wellbeing



Notes: Estimated correlations for five different regions (western Member States, Nordic Member States and Ireland, southern Member States, Baltic and Balkan Member States, and eastern Member States) are marked in the same colour.

Source: Authors' compilation based on EWCS sixth wave (2015) data

▪ Psychosocial factors are associated with musculoskeletal disorders

While biomechanical stress is an important factor in relation to MSDs, as the correlations above suggest, psychosocial factors are also unambiguously connected to MSDs. Moreover, the combined effect of biomechanical and psychosocial factors is substantial and larger than the effects of economic factors (sector, occupation), worker characteristics (gender, age, education, origin) or country.

Table 1 (left-hand columns) shows the associations found between job characteristics and MSDs, thus exploring the evidence for the psychosocial pathway. The restricted model includes the job characteristics, economic factors and country effects; the full model adds controls for worker characteristics and the mediating variables from the conceptual framework (wellbeing and MSDs, as well as work-life balance and general health). It demonstrates that there is a clear direct adverse impact of working time-related variables. By including mediating and control variables in the 'full model', it is found that this effect is only partly mediated by a poor work-life balance, which is one consequence of excessive or irregular working time, leaving room for another consequence that is known to be detrimental for health: exhaustion or a lack of recovery time. Furthermore, there are strong favourable effects of worker participation, supportive management and perceived job security. The beneficial effect of the final two factors is likely to be due to their contribution to wellbeing. This underlines the importance of organisational justice, worker recognition and social support. Contrary to expectations, autonomy-related factors do not have any clear or significant effect.

In terms of the sociodemographic groups, country groupings and the economic categories, differences regarding MSDs have been observed in descriptive analyses (e.g. more MSDs are reported by women, migrant workers, workers in elementary occupations or larger firms); however, when included in the multivariate model, their contribution is minor and the initial differences appear to be due to differences in terms of job characteristics, as well as intermediary outcomes such as general health, work-life balance and wellbeing. In other words, the kind of work that people do and the way that work is organised matter more than who is doing the job. This is not withstanding the fact that individual variation — for example some workers being mentally or physically tougher than others or receiving more social support outside work — may be important; instead, the level of detail in the analyses permits only the conclusion that, in the main, MSDs cannot be explained simply in relation to sociodemographic characteristics.

Table 1: Associations between job characteristics and MSDs and wellbeing, providing evidence for the psychosocial and biomechanical pathways (ordinary least squares regression)

Job characteristic/background variables	MSDs		Wellbeing	
	Restricted model	Full model	Restricted model	Full model
Biomechanical factors				
Biomechanical stress	•••	•••	•••	ns
Repetitive tasks	ns	ns	••	••
Quick work	•••	ns	•••	ns
Job content				
Emotional labour	ns	ns	•	ns
Task complexity	•••	•••	ns	•
Autonomy				
Task discretion	•••	•••	ns	•
Control over work pace	ns	ns	••	ns
Autonomous teamwork	ns	ns	ns	Ns

Employment conditions				
Atypical working time	••	•	•••	ns
Working time autonomy	ns	ns	ns	ns
Involuntary part-time work	••	••	•	•
Involuntary overtime work	•••	•••	•••	•••
Job security	•••	ns	•••	•••
Social work environment				
Adverse social behaviour	•••	•••	•••	•••
Supportive management	•••	ns	•••	•••
Social dialogue	••	•	•••	•••
Worker participation	•••	•••	•••	•••
Worker and firm characteristics				
Gender – female/male (reference: male)		•••		•••
Education – low (reference)				
Educational level— mid/low		•		ns
Educational level — high/low		•••		ns
Age under 25 (reference)				
Age — 25-34/under 25		ns		ns
Age — 35-44/under 25		ns		ns
Age — 45-54/under 25		•••		ns
Age — over 55/under 25		•••		••
Migrant origin		ns		ns
Company size — under 10 employees (reference)				
Company size — 10-249 employees		ns		ns
Company size — over 249 employees		ns		ns
Mediating and control variables				
Wellbeing/MSDs		•••		•••
Work-life balance		•••		•••
General health		•••		•••
Constant and fixed effects				
Constant	•••	•••	•••	•••
FE occupation	Yes	Yes	Yes	Yes
FE sector	Yes	Yes	Yes	Yes
FE country	Yes	Yes	Yes	Yes

Model fit				
R^2	0.187	0.296	0.200	0.344
N	23,550	22,523	23,542	22,523

Notes: • unfavourable relationship, correlating positively with MSDs/negatively with wellbeing.
• favourable relationship, correlating negatively with MSDs/positively with wellbeing.
•p < 0.05; ••p < 0.01; •••p < 0.001
FE, fixed effects, i.e. controlling for occupation, sector and country; ns, not significant; R2, coefficient of determination. The restricted model includes the job characteristics, economic factors and country effects; the full model adds controls for worker characteristics and the mediating variables from the conceptual framework (wellbeing and MSDs, as well as work-life balance and general health).
Source: Authors' compilation based on EWCS sixth wave (2015) data

- **Biomechanical factors are associated with wellbeing, but psychosocial factors are the main driver**

The right-hand side of Table 1 confirms that biomechanical factors are associated with wellbeing, and is derived in the same way as above. However, psychosocial factors are the dominant direct driver, mainly in the domain of the social work environment, where all variables have a highly significant effect on wellbeing. In addition, in terms of employment conditions, involuntary overtime work has a strong direct effect, and atypical working time appears to affect wellbeing by distorting work-life balance. Similarly, biomechanical factors appear to cause MSDs, as in the previous models, and, at the same time, MSDs are correlated with (worse) wellbeing, confirming the importance of biomechanical pathway in influencing wellbeing.

Furthermore, as for the previous models explaining MSDs, the variation between workers is not captured by sociodemographic factors or economic factors such as industry, occupation or company size. Instead, the job characteristics selected for this analysis appear to be decisive.

- **Establishments can be categorised into six types based on occupational safety and health risks and strategies**

At the organisational level, establishments can be categorised based on the types of risks (physical, psychosocial, digital) that employees are confronted with in the organisation and the strategies employed to deal with these risks (participatory, procedural). By using cluster analysis, an OSH typology was developed that divides establishments into six OSH types (Table 2) based on ESENER-3 (2019) data. By linking these ESENER-3 data to the EWCS (2015) data, the different OSH types can be evaluated in terms of health outcomes, such as MSDs and wellbeing. Descriptive analyses suggest that the risks are mainly derived from the sector of economic activity, while the strategies to address them are linked to the size of the company/establishment. The six OSH types can be described as follows:

1. **High risk-high agency (HR-HA).** These establishments can be described as having a high-risk environment, albeit with adequate prevention strategies, including training, in place. In this cluster, employees are nearly always involved in dealing with risks (participatory strategies). This is the largest cluster in terms of the number of employees (accounting for 46 % of employees), but accounting for only 18 % of all establishments, meaning that therefore large establishments are found in this cluster. Despite the presence of OSH management practices in these enterprises, the high risks mean that outcomes in terms of wellbeing and MSDs are unfavourable.
2. **Physical-procedural (PH-PR).** Employees in these establishments are exposed to moderately high levels of biomechanical stress, with average scores for psychosocial hazards and a fairly high degree of preventive practices in place (procedural strategies), but formal worker representation and workers' participation are found less often. This appears to be a cluster with establishments meeting formal requirements but often foregoing employee participation. This cluster accounts for 14 % of employees and 17 % of establishments, and outcomes in terms of both wellbeing and MSDs are worse than in the other clusters.
3. **Psychosocial-procedural (PS-PR).** Employees in establishments in this cluster are exposed to very low levels of biomechanical stress, but some degree of psychosocial risks, and have low levels of formal and informal representation. Instead, there is a clear emphasis on psychosocial risk prevention and on health awareness programmes, but not on training. In terms of

employment, this is a small cluster, covering 6 % of workers in 11 % of establishments. It has favourable outcomes in terms of wellbeing and MSDs.

4. **Digitalisation-low agency (DI-LA).** In this cluster, average biomechanical stress and fairly high psychosocial risks are paired with a high degree of digitalisation. OSH assessments are carried out, but further prevention practices targeting psychosocial risks and health awareness are rare. There is, however, some degree of formal and informal worker participation. This is also a small cluster, covering only 6 % of workers and just 7 % of establishments. In line with the two roles that digitalisation can play, i.e. either relieving or enhancing stress among workers, this cluster has average to slightly unfavourable health outcomes.
5. **Psychosocial-participatory (PS-PA).** This group of establishments faces similar challenges to those in cluster 3 (PS-PR), but responds differently to these challenges. While mainly psychosocial risks are present, companies in this cluster put a strong emphasis on formal worker participation and workers' participation, but undertake a limited number of actions. Establishments in this cluster take action only when called upon to do so by employees. This cluster accounts for 16 % of employees in 19 % of establishments, meaning that these establishments are relatively small in size. This cluster is associated with favourable outcomes in terms of wellbeing and MSDs.
6. **Psychosocial-low agency (PS-LA).** Enterprises in this cluster are the opposite of those in cluster 1 (HR-HA): the cluster has low scores on nearly all dimensions, does not involve employees in dealing with potential biomechanical and psychosocial risks, and undertakes nearly no action to mitigate those risks. This cluster accounts for only 12 % of employees, but represents the largest proportion of establishments (27 %). Although few interventions in the workplace are taken in this cluster, the outcomes in terms of wellbeing and MSDs are favourable. This illustrates the paradoxical correlation that is often found between OSH strategies and (the extent of) worker representation on the one hand and health outcomes on the other: outside legal obligations, interventions usually take place only if and when problems are identified. This leads to the observation of worker participation and representation (related to higher awareness of OSH issues) being associated with unfavourable job outcomes.

Table 2: Prevalence of risks and strategies for the six OSH clusters and their shares (%)

Risks and strategies	Cluster					
	1 HR-HA	2 PH-PR	3 PS-PR	4 DI-LA	5 PS-PA	6 PS-LA
OSH risks†						
Biomechanical stress	69	77	4	45	23	29
Psychosocial risks	66	50	47	60	44	44
Digitalisation	41	18	23	100	2	1
Participatory strategies†						
Formal employee representation	97	9	0	33	72	0
Workers' participation	73	16	14	38	75	0
Procedural strategies†						
OSH assessments	83	56	45	36	18	20
General OSH risk prevention	71	68	4	10	7	0
Psychosocial risk prevention	72	55	98	25	29	0
Health awareness programmes	74	54	54	10	44	23
OSH training	38	45	1	2	2	0
Shares (%)						
Establishments	18	17	11	7	19	27
Employees	46	14	6	6	16	12
Relationship to outcomes‡						

Risks and strategies	Cluster					
	1 HR-HA	2 PH-PR	3 PS-PR	4 DI-LA	5 PS-PA	6 PS-LA
MSDs	- -	-	+ +	-/+	+	+
Wellbeing	- -	-	+ +	-/+	+	+ +

Notes: †Cells for the risks and strategies are coloured blue (low) to red (high), with numbers referring to the share (%) of establishments in the cluster with scores above the median for each of the risks or strategies dimensions (e.g. the numbers in the biomechanical stress row refer to the share of establishments in the cluster that falls within the group of 50 % of establishments with the highest biomechanical stress risks overall).
‡Favourability ratings are ranked as highly unfavourable (- -), unfavourable (-), mixed (+/-), favourable (+) or highly favourable (+ +).

Source: Authors' compilation based on ESENER-3 (2019) data

Conclusions

This study has focused on the characteristics of the jobs of individual workers, including biomechanical and psychosocial factors on the one hand, and on OSH management practices in establishments on the other, exploring how these factors are related to MSDs and wellbeing. The results suggest that substantial improvements in MSDs and wellbeing can be accomplished at the workplace level. Importantly, the main contributing factors are job characteristics and not sociodemographic factors or aspects related to country or economic (industry, occupation and company size) factors.

While some workplace characteristics may be more difficult to disentangle from the nature of the job, psychosocial factors that have a strong influence on MSDs or on wellbeing, including adverse social behaviour, atypical working time, job security, supportive management and worker participation, can be assessed and then addressed, eliminated or reduced. In contrast, when it comes to job autonomy, which was shown in previous research to reduce work-related stress, the preventive action may not be straightforward. This is because, although greater job autonomy may empower workers, it may also be related to poorer work-life balance, overwork or perhaps even isolation. The findings of the multivariate analyses suggest that latitude at individual level (task discretion, control over the work pace), collectively (autonomous teamwork) or in terms of employment conditions (working time autonomy) do not lead to favourable outcomes with respect to with MSDs or wellbeing.

Moreover, workplace risk assessments focusing on negative health outcomes should take into account that the relationship between MSDs and wellbeing goes in two directions, so a holistic approach to risk assessment is most likely to be successful. Further development of guidelines and the exchange of best practices between companies on how to prevent psychosocial risks and create a healthy company culture are needed.

Future research could invest in linking employee-employer data to combine individual level and workplace level information, and examine in more detail the interaction effects between the various biomechanical and psychosocial factors. Using a longitudinal panel design is advised to determine the direction of causality of the relationship between psychosocial factors and MSDs and between OSH interventions and health outcomes.

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