



RESEARCH ARTICLE

The Prevalence of Work-Related Musculoskeletal Disorders (WRMSDs) and Related Factors among Occupational Disease Clinic Patients

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Abstract

Background: Work-related musculoskeletal disorders (WRMSDs) are one of the common health problems of employees. WRMSDs are impairments of bodily structures such as muscles, joints, tendons, ligaments, nerves, bones and the localised blood circulation system, that are caused or aggravated primarily by work and by the effects of the immediate environment in which work is carried out.

The aim of this study is; to determine the prevalence of work related musculoskeletal disorders and the related factors such as socio-demographic characteristics and working conditions among occupational disease outpatient clinic patients.

Methods: The files of 396 patients who applied to a Occupational Diseases Outpatient Clinic were examined retrospectively.

Results: 216 (54%) patient had at least one occupational disease and 78 patients (19.7%) had at least one kind of WRMSDs. Employees' informations, such as age, gender, marital status, educational status, smoking and alcohol consumption, height, weight, body mass index, working sector, job history, total working time (years), musculoskeletal complaints, psychosocial risk factors, were evaluated. Having at least one psychosocial risk factor (such as excessive workload, monotonous work, role ambiguity, role conflict, etc.) increases the frequency of WRMSD development. In addition, WRMSDs is more common in the petrochemical and metal metallurgical sector than in other sectors.

Conclusion: In order to prevent WRMSDs, a systematic and analytical ergonomic risk assessment approach should be developed and implemented.

Keywords

Work-related, Musculoskeletal diseases, Psychosocial risk factors

Abbreviations

WRMSDs: Work-Related Musculoskeletal Disorders; EU-OSHA: European Agency for Safety and Health at Work; BMI: Body Mass Index

Introduction

According to the Protocol of 2002 to the Occupational Safety and Health Convention, 1981, the term "occupational disease" covers any disease contracted as a result of an exposure to risk factors arising from work activity [1]. In Turkey, according to Social Insurance And General Health Insurance Law "occupational disease is a temporary or permanent illness, physical or mental disability conditions that the insured has been subjected to because of the nature of the work or the work being done due to a repeated reason or due to the execution conditions of the work". In order to legally diagnose occupational disease in our country, the employee must apply to the Social Security Institution and get referral document from this institution. Then the employee must apply to the occupational diseases hospitals, education and research hospitals and the state university hospitals.

Increasing health disparities, among countries or in



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different regions and social groups in the same country, attract attention of researchers. The working class, which is one of these groups, constitutes a large part of the society. Regardless of the working status; working conditions, chemicals, physical, biological and psychosocial factors can lead to health problems [2]. When all these factors are considered, work-related musculoskeletal disorders (WRMSDs) are one of the common health problems of employees. European Agency for Safety and Health at Work (EU-OSHA) has defined that WRMSDs are impairments of bodily structures such as muscles, joints, tendons, ligaments, nerves, bones and the localised blood circulation system, that are caused or aggravated primarily by work and by the effects of the immediate environment in which work is carried out [3]. In recent years, the dramatic increase in the incidence and cost of WRMSDs in industrialized countries; this has attracted the attention of the employees, employers, governments, health care systems and insurance companies, and studies on ergonomics programs and rehabilitation approaches, including risk factors, ergonomics training and ergonomic initiatives, have accelerated [4]. The prevalence of WRMSDs has been increasing over the last 20-30 years. In Europe, one out of every four employees complains of back (24.7%) and muscle pain (22.8%) [5].

Although the definition of WRMSDs has been in use since the early 18th century and there are a lot of studies in the literature in this regard, especially the issue of determining ergonomic risk factors is insufficient [6]. WRMSDs in working life caused by repetitive physical movements such as bending, stretching, gripping, holding, rotating, compressing and reaching, causing damage to the muscles, nerves, tendons and other soft tissues [7]. Working with improper postures, prolonged static posture, repetitive movements, manual material handling, using vibrating tools are the most common risk factors of WRMSDs. Also physical factors (such as vibration, temperature of work environment), psychosocial factors (such as insufficient work organization, high job demand, lack of control over work, low job satisfaction, time pressure, lack of support from colleagues and managers, stress, shift work), physical capacity, age, fitness deficiency, high BMI and smoking are also effective in the development of WRMSDs [8]. In addition, work stress, lack of job satisfaction, habits are also related to WRMSDs [9]. WRMSDs not only affect the individuals' physical and mental well-being, but also lead to temporary or permanent disability. Which in turn brings serious losses in the workforce. In addition to labor loss and disability, WRMSDs creates an economic burden. In Germany, work-related diseases are responsible for about 27% of production interruptions. The costs of these disorders are about 24.5 billion € for the workforce and about 38 billion € for the total population [10].

WRMSDs occur within weeks, months or even years, due to repeated difficulties, rather than acute injury emerge after a sudden strain and severe challenge. It is also called cumulative trauma disorders, repetitive strain injuries, repetitive movement disorders. Due to perform ergonomic risk analysis, MURI method can be used which predicts that the working of existing equipment and employees above their normal capacities will adversely affect the production efficiency. While MURI analysis is being performed, scoring is done by analyzing the movements in the posture analysis table, which include nine incorrect movements: Lower back flexion, lower back rotation, working arms above shoulder level, knee flexion, elbow rotation, working with extending arms, walking distance, weight of carried material, size of working area [11].

In addition to occupational reasons, all of the pathologies that cause musculoskeletal pain should be well recognized by the doctor in order to evaluate the WRMSDs [12]. Despite being seen frequently; WRMSDs can not be easily detected due to the multifactoriality of its etiology and the inability to show the causal relationship. The most important characteristics of WRMSDs are that employees can be largely protected from them and these diseases occur as a result of long-term exposure.

The aim of this study is; to determine the prevalence of work related musculoskeletal disorders and the related factors such as socio-demographic characteristics and working conditions among occupational disease outpatient clinic patients.

Methods

Study design

In this study, the files of 396 patients who applied to the Occupational Diseases Outpatient Clinic between November 2015 - June 2018 were examined retrospectively. Anamnesis form of the patients who applied to the outpatient clinic was used. The form included informations such as age, gender, marital status, educational status, smoking and alcohol consumption, height, weight, body mass index (BMI), working sector, job history, total working time (years), musculoskeletal complaints, psychosocial risk factors. Patients were divided into five groups for age; < 25 years, 25-34 years, 35-44 years, 45-54 years, ≥ 55 years. Patients were divided into three groups for educational status: 1) Primary or middle school, 2) High school, 3) Graduate and over. Patients for BMI were divided into three groups: 1) Underweight or normal, 2) Overweight, 3) Obese. We used ergonomic evaluation matrix for the assessment of ergonomic risk factors, which included nine incorrect movements: lower back flexion, lower back rotation, working arms above shoulder level, knee flexion, elbow rotation, working with extending arms, walking distance, weight of carried material, size of

working area. Employees were also questioned about prolonged standing, working at desk, pushing or pulling heavy loads. The assessment of psychosocial risk factors was questioned for the presence of any of these exposures: Excessive workload, monotonous work, role ambiguity, role conflict, bad subordinate associations, poor colleague relationships, long work, shift work, lack of job security, verbal or physical violence, mobbing. If the patient was exposed to at least one of these, he/she was considered to have a psychosocial risk factor. All patients with musculoskeletal complaints were evaluated in the Physical Therapy and Rehabilitation outpatient clinic and diagnosed by the physicians of this clinic. The affected body region was grouped as follows: Neck, shoulder, elbow, wrist, lomber, knee, ankle, multiple affected regions.

Statistical analysis

Data forms were entered into the statistics program (SPSS Software version 18.0). It was analyzed with the same program. Descriptive statistics were carried out for all subjects to assess exposure risks and demographic information. The relation between having WRMSDs and risk parameters was analyzed using the chi-square (χ^2) test. A logistic regression model was used for mul-

tivariate analyses. p-value of < 0.05 were considered as significant. Findings were interpreted in comparison with literature.

Results

396 patients' data, who were referred to Ege University Medical Faculty, Occupational Disease outpatient clinic, were analyzed. Among patients, 26 (6.6%) were female, 370 (93.4%) were male employees. 216 (54%) patient had at least one occupational disease and 78 patients (19.7%) had at least one kind of WRMSDs (discopathy, karpal tunnel syndrome, lateral epikondilitis etc). This prevalence was found to be 36% when the frequency among the workers diagnosed with occupational disease was evaluated. The age of patients ranged from 18-74. The average age of all employees was 40.1 years, 40 years for patients with WRMSDs and 40.3 years in patients without WRMSDs ($p = 0.082$). The average BMI value of all employees was 27.15 kg/m², 27.34 kg/m² for patients with WRMSDs and 26.39 kg/m² for patients without WRMSDs. No statistically significant results were found regarding BMI ($p = 0.778$). Demographic items of both groups have been shown in [Table 1](#). There was a statistically significant difference between female

Table 1: Demographic items of study groups.

Variables	Patients without WRMSD (n = 318)	Patients with WRMSD (n = 78)	p-value
Gender			< 0.001
Female (26)	14	12	
Male (370)	304	66	
Age Group			0.406
< 25 years (n = 12)	11	1	
25-34 years (n = 95)	77	18	
35-44 years (n = 182)	146	36	
45-54 years (n = 91)	69	22	
≥ 55 years (n = 16)	15	1	
Marrital status			0.464
Single (n = 70)	54	16	
Married (n = 326)	264	62	
Education			0.241
Secondary school and less (n = 222)	173	49	
High school (n = 130)	106	24	
University (n = 44)	39	5	
Smoking history			0.737
Smoker (n = 202)	164	38	
Ex-smoker (n = 103)	80	23	
Non-smoker (n = 91)	74	17	
BMI category			0.163
< 25 kg/m ² (n = 116)	88	28	
25-29.99 kg/m ² (n = 191)	153	38	
≥ 30 kg/m ² (n = 89)	77	12	

and male employees in terms of the prevalence of WRMSDs ($p < 0.001$). No significant association was found between other demographic factors and diagnosed WRMSDs.

When the affected body regions were evaluated, the most common pathology was found in the lumbar region (32.2%) (Table 2). 12 patients had multiple affected region. For example, one patient had supraspinatus tendinitis, lumbar discopathy and also servical discopathy. When the patients were evaluated individually; fourteen patients had WRMSDs in the neck region, twelve patients had WRMSDs in the shoulder region, twelve patients had WRMSDs in the elbow region, ten patients had WRMSDs in the wrist region, thirty-seven patients had WRMSDs in the lower back region, eleven patients had WRMSDs in the knee region, one patient had WRMSD in the ankle region. 32% of WRMSDs were accompanied by at least one occupational disease (Table 3).

Considering the relation between WRMSD and working conditions showed that, there is no significant relationship between shift work and having WRMSD ($p = 0.70$). But significant relation was found between WRMSDs and having at least one psychosocial risk factor such as excessive workload, monotonous work, role

ambiguity, bad colleague relationship, lack of job security, mobbing, workplace violence ($p = 0.002$). The most frequently indicated psychosocial risk factors by employees were shift work and excessive workload.

Employees were mostly from the cement-ceramics industry, metal-metallurgy and mining sectors, respectively. When the relationship between the employees' sectors and the WRMSD incidence was examined, a statistically significant difference was observed ($p < 0.001$) (Table 4).

When the nine incorrect movements evaluated in the ergonomics evaluation matrix were examined in the employees in manual processes, there was no difference between the employees with and without WRMSDs. The most frequently indicated ergonomic risk factors by employees were prolonged standing and carrying heavy load.

As a result of multivariate logistic regression analysis after entering demographic data into the mod-

Table 2: Affected body regions of patients with WRMSDs.

Affected Body Region	Number of patients
Lomber	25 (%32.2)
Multiple affected regions	12 (%15.4)
Neck	10 (%12.8)
Shoulder	8 (%10.2)
Wrist	8 (%10.2)
Knee	8 (%10.2)
Elbow	6 (%7.7)
Ankle	1 (%1.3)
Total	78 (%100)

Table 3: WRMSDs and concomitant occupational diseases.

Occupational Diseases	Number of patients
Only WRMSDs	53 (%68)
WRMSDs and concomitant occupational diseases	25 (%32)
Hearing loss	15
Occupational asthma	2
Psychiatric disorder	2
Pneumoconiosis	1
Contact dermatitis	1
Hearing loss and pneumoconiosis	1
Hearing loss and contact dermatitis	1
Hearing loss and occupational asthma	1
Hearing loss and psychiatric disorder	1
Total	78 (%100)

Table 4: WRMSDs' risk factors and patients' working sectors.

Variables	Patients without WRMSD (n = 318)	Patients with WRMSD (n = 78)	p-value
Sector			< 0.001
Cement, ceramic (n = 230)	204 (%88.7)	26 (%11.3)	
Metal-metallurgy (n = 40)	24 (%60)	16 (%40)	
Mines (n = 26)	23 (%88.5)	3 (%11.5)	
Petrochemistry (n = 20)	12 (%60)	8 (%40)	
Construction (n = 15)	13 (%86.7)	2 (%13.3)	
Agriculture and Farming (n = 6)	4 (%66.7)	2 (%33.3)	
Others (n = 59)	38 (%64.4)	21 (%35.6)	
Shift work			0.70
No (n = 237)	189 (%80)	48 (%20)	
Yes (n = 159)	129 (%81.2)	30 (%18.8)	
Having psychosocial risk factor			0.002
No (n = 107)	97 (%91)	10 (%9)	
Yes (n = 289)	221 (%76.5)	68 (%23.5)	

Table 5: Multivariate logistic regression analysis for working sector, gender and psychosocial risk factors.

Variable	B	SE	OR	%95 CI	p-value
Sector					
Cement, ceramic	0.80	0.93	2.24	(0.36-13.87)	0.38
Mines	0.03	0.65	0.96	(0.26-3.50)	0.96
Metal-metalurgy	1.64	0.39	5.19	(2.41-11.16)	< 0.001
Construction	0.008	0.79	1.00	(0.21-4.75)	0.99
Agriculture and Farming	1.31	0.53	3.70	(1.30-10.53)	0.14
Petrochemistry	1.15	0.37	3.16	(1.53-6.52)	0.002
Gender	0.91	0.48	2.50	(0.98-6.52)	0.056
Having psychosocial risk factors	0.97	0.37	2.65	(1.27-5.55)	0.009

SE: Standard error; OR: odds ratio; 95% CI: 95% confidence interval.

el, only working sector and having psychosocial risk factors had significant impact on WRMSDs. WRMSDs were more common in the metal-metalurgy and petrochemical industries compared to other sectors. ($p = 0.001$ for metal-metalurgy and $p = 0.002$ for petrochemical industry). In the other hand, demographic factors (including gender) and shift work didn't have significant impact on WRMSDs (Table 5).

Discussion

We wanted to determine the prevalence of WRMSDs and related factors in patients applied to Ege University Faculty of Medicine Occupational Diseases outpatient clinic. 19.7% of the total applicants were diagnosed with WRMSDs. However, this prevalence was found to be 36% when the frequency among the workers diagnosed with occupational disease was evaluated. In 2017, according to Turkey's Social Security Institution's data, among the employees who were diagnosed with occupational disease, 1569 people were diagnosed with WRMSDs, which accounted for 30% of the total number of patients who had diagnosed with occupational disease. WRMSDs are the most common work-related problem in Europe. Almost 24% of the workers report suffering from backache and 22% complain about muscular pains. Both conditions are more prevalent in the new Member States, 39% and 36% respectively [13].

In our study, 46% of female employees and 17.8% of male employees were diagnosed with WRMSDs. Similarly, previous studies have shown that WRMSDs and related pain are more common in female employees than male employees [9,14]. In European Union, male employees have a risk 1.3 times higher to new WRMSDs than female employees [15]. But in logistic regression analysis, we found no difference between gender and having WRMSDs. This may be due to the low number of female patients. Because most of the employees had been working in the ceramics, metal-metalurgy and mining sectors. In these sectors the employment of women is very low [16] and in Turkey, women's employment in the mines is prohibited by law. When we evaluate employees according to their marital status, there

was no statistically difference between married and single individuals. Although some studies have found no association between marital status and WRMSDs like in our study [17], in most studies, marital status was associated with WRMSD, and it was suggested that married workers should also work to support their families [18,19].

In this study we did not find significant relationship between age and WRMSDs. But in studies, In European Union working population, the prevalence of WRMSDs increases with age. At the age 55-64 years it is 1.7 times higher than at the age 25-34 years [15]. Similarly we did not find any significant relationship between smoking history, body mass index, education and WRMSDs. Studies evaluating the relationship between WRMSDs and individual risk factors stated that some risk factors such as rheumatologic diseases, obesity, smoking history, education may be effective in these disorders' occurrence [20,21].

In our study, WRMSDs was highest in lower back ($n = 37$) region, followed by neck region ($n = 14$). Although no significant relationship was found between the ergonomic risk factors and the affected body area, it was determined that the most common risk factor was prolonged standing for all employees. Previous studies have shown that the lower back, neck and knees were mostly affected regions [9], while standing employees reported higher pain intensity at the leg region, sitting employees reported higher pain intensity at the upper region [22].

Working sectors

In our study, WRMSDs were found in 40% of the employees who work in the metal-metalurgy and petrochemical sectors and these findings were statistically significant. Compared to other sectors, WRMSDs is 5.19 times higher in the metallurgical industry employees and 3.16 times higher in the petrochemical industry employees. In a recent study, for men, working in "construction" and "manufacturing" had the highest risk for WRMSDs; for women, working in "hotel and restaurants" and "healthcare sector" had the highest risk for WRMSDs [23]. But in Turkey, employees in public ser-

vants status cannot be diagnosed occupational disease legally because of legal regulations. Since most of the healthcare employees work in public hospitals and clinics and they are working in public servant status, these employees could not be included in our study.

Psychosocial risk factors

In our study, employees were questioned whether they were exposed to one of the following at work: Excessive workload, monotonous work, role ambiguity, role conflict, bad subordinate associations, poor colleague relationships, long work, shift work, lack of job security, verbal or physical violence, mobbing. We found that, having at least one psychosocial risk factor at workplace is related with WRMSDs. In the formation of WRMSDs, the role of work-related physical and psychosocial factors has been scientifically proven. Many factors other than work activities also participate in the formation of these diseases. In recent years, psychosocial factors have been shown to play a role in the development of WRMSDs. Inadequate organizational factors such as job dissatisfaction, monotonous work, time pressure, inadequate supervisor and colleague support, lack of adequate rest breaks play a role in the development of these disorders. Recent studies showed that high quantitative and emotional demands, work pace, influence on work organisation, long hours at work, work content, low control/influence and role conflicts were found to be associated with WRMSDs [24,25]. Also demand was shown to be related to higher distress in employees, and distress to a higher incidence shoulder and lower back complains [26].

Limitations

There were some limitations in our study. First of all, because of legal difficulties and lack of public awareness, employees who came to our occupational diseases clinic were patients with symptoms and only those employees were evaluated. Self-employed workers and public servants could not included. Therefore, the results could not be generalized in terms of all employees. Second, the number of patients from some sectors was low or none. In addition, due to the low number of patients in sectors, no evaluation was made for the affected body area. Finally, in Turkey, occupational diseases specialists do not have the legal permission to observe the workplaces, we did not have the chance to evaluate the risk factors described by the employees in the workplaces.

In conclusion, it was determined that WRMSDs were frequently seen in the studied patients. Having at least one psychosocial risk factor (such as excessive workload, monotonous work, role ambiguity, role conflict, bad subordinate associations etc.) increases the frequency of WRMSD development. Negative working conditions explain a significant portion WRMSDs. In this context, it is necessary that work-

place conditions are arranged in a way that prioritizes employee health and safety. In addition, WRMSDs is more common in the petrochemical and metal metallurgical sector than in other sectors. When the results are evaluated as a whole, a systematic and analytical ergonomic risk assessment approach should be developed and implemented, especially in sectors where the incidence is higher, in order to prevent WRMSDs. To reduce musculoskeletal disorders in the workplace, regulations that reduce ergonomic and psychosocial risk factors should be considered in the forefront. In order to overcome the difficulties in diagnosing occupational diseases, necessary legal arrangements should be made and the level of knowledge of the employees, employers and physicians on this subject should be increased.

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References

1. ILO (2002) Recording and notification of occupational accidents and diseases and ILO list of occupational diseases. 90th ILC session, Geneva.
2. Türkkan A (2009) İşe bağlı kas-iskelet sistemi hastalıkları ve sosyoekonomik eşitsizlikler. *Uludağ Üniversitesi Tıp Fakültesi Dergisi* 35: 101-106.
3. European Agency for Safety and Health at Work (2010) European Risk Observatory Report.
4. Kesiktaş N, Özcan E (2007) Mesleki kas iskelet riskleri değerlendirmesinde güncel teknikler ve quick exposure check (QEC). *Turkish Journal of Occupational Health and Safety* 29: 33-36.
5. Parent-Thirion A, Biletta I, Cabrita J, Vargas O, Vermeylen G, et al. (2016) Sixth European Working Conditions Survey - Overview Report. European Foundation for the Improvement of Living and Working Conditions.
6. Durmaz B, Öncü J (2005) Endüstride çalışan işçilerde boyun ve üst ekstremité ağrıları ve risk faktörleri ile ilişkisi. *Turkish Journal of Occupational Health and Safety* 24: 34-41.
7. Bernacki EJ, Guidera JA, Schaefer JA, Lavin RA, Tsai SP (1999) An ergonomics program designed to reduce the incidence of upper extremity work related musculoskeletal disorders. *Journal of Occupational and Environmental Medicine* 41: 1032-1041.
8. Da Costa BR, Vieira ER (2010) Risk factors for work-related musculoskeletal disorders: A systematic review of recent longitudinal studies. *American Journal Of Industrial Medicine* 53: 285-323.
9. Hossain MD, Afzal Aftab, Mahmudul Hassan Al Imam, Ilias Mahmud, Imran Ahmed Chowdhury, et al. (2018) Prevalence of work related musculoskeletal disorders (WRMSDs) and ergonomic risk assessment among readymade garment workers of Bangladesh: A cross sectional study. *PLoS ONE* 13: e0200122.
10. Thieoff R (2002) Economic significance of work disability

- caused by musculoskeletal disorders. *Orthopäde* 31: 949-956.
11. Ayan B (2015) Montaj hattında ergonomik risk unsurlarının incelenmesi: Otomotiv sektörüne yönelik bir uygulama. Turkish Ministry of Labor and Social Security, Occupational Safety Specialist Dissertation.
 12. Oğuz AK, Kaymak B (2011) Mesleki kas iskelet sistemi bozuklukları. *Hacettepe Tıp Dergisi* 42: 165-172.
 13. EU-OSHA (2007) Factsheet 71: Introduction to work-related musculoskeletal disorders.
 14. Celik S, Celik K, Dirimese E, Taşdemir N, Arik T, et al. (2018) Determination of pain in musculoskeletal system reported by office workers and the pain risk factors. *International Journal of Occupational Medicine and Environmental Health* 31: 91-111.
 15. Eurostat Yearbook (2003) The statistical guide to Europe, Data 1991-2001. (8th edn).
 16. Bureau of Labor Statistics (2018) Labor Force Statistics from the Current Population Survey.
 17. Koyuncu N, Karcioğlu Ö (2018) Musculoskeletal complaints in healthcare personnel in hospital: An interdepartmental, cross-sectional comparison. *Medicine* 97: e12597.
 18. Soe KT, Laosee O, Limsatchapanich S, Rattanapan C (2015) Prevalence and risk factors of musculoskeletal disorders among Myanmar migrant workers in Thai seafood industries. *International Journal of Occupational Safety and Ergonomics* 21: 539-546.
 19. Nag A, Vyas H, Shah P, Nag PK (2012) Risk factors and musculoskeletal disorders among women workers performing fish processing. *Am J Ind Med* 55: 833-843.
 20. Cabeças JM (2006) Occupational musculoskeletal disorders in Europe: Impact, risk factors and preventive regulations. *Enterprise and Work Innovation Studies* 2: 95-104.
 21. Leino-Arjas P (1998) Smoking and musculoskeletal disorders in the metal industry: A prospective study. *Occup Environ Med* 55: 828-833.
 22. Roseni AA, Jafri Mohd Rohani, Aini Zuhra Abdul Kadir, MatRebi Abdul Rani, Ademola James Adeyemi, et al. (2015) Musculoskeletal disorders in body regions and its associated risk factors among electronics workers in Malaysia. *Proceedings 19th Triennial Congress of the International Ergonomics Association, Melbourne*.
 23. Park J, Kim Y, Han B (2017) Work sectors with high risk for work-related musculoskeletal disorders in Korean men and women. *Safety and Health at Work* 9: 75-78.
 24. Freimann T, Pääsuke M, Merisalu E (2016) Work-related psychosocial factors and mental health problems associated with musculoskeletal pain in nurses: A cross-sectional study. *Pain Res Manag* 2016: 9361016.
 25. Jacukowicz A (2016) Psychosocial work aspects, stress and musculoskeletal pain among musicians. A systematic review in search of correlates and predictors of playing-related pain. *Work* 54: 657-668.
 26. Wixted F, Shevlin M, O'Sullivan LW (2018) Distress and worry as mediators in the relationship between psychosocial risks and upper body musculoskeletal complaints in highly automated manufacturing. *Ergonomics* 61: 1079-1093.