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Symptoms of Musculoskeletal Disorders Among Ammunition Factory Workers in Turkey

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ABSTRACT. The aim of this study was to assess the prevalence of symptoms of work-related musculoskeletal disorders (MSDs) and to determine the risk factors among ammunition factory workers in Turkey. This cross-sectional study was performed on 955 ammunition factory workers. Potential risk factors were investigated with a questionnaire and multivariate logistic regression analysis was performed. During the previous year, 39.3% of ammunition workers experienced symptoms of work-related MSDs. Logistic regression analysis showed smoking (odds ratio [OR] = 1.372), chronic diseases (OR = 1.795), body mass index (BMI; overweight) (OR = 1.631), working year (OR = 1.509), cold temperature (OR = 1.838), and work load (OR = 2.210) were significant independent risk factors for the development of symptoms of MSDs. It was found that both work-related conditions and personal and environmental factors are important for the development of occupational MSDs.

KEYWORDS: occupational diseases, risk assessment, Turkey, work-related musculoskeletal disorder, worker

Work-related musculoskeletal disorders (MSDs) are among the most important occupational health problems in both developed and developing countries.[1,2] The proportion of all MSDs that are attributable to work is approximately 30%.[1] Back injuries (eg, lower back pain, ischiadics, disc degeneration, herniation) have the highest proportion (approximately 60%) among MSDs. The second most commonly affected site is neck and upper extremities, followed by knee and hip.[2] Occupational musculoskeletal pain is caused by multiple factors. The most frequent symptom of MSDs is pain.[1,3,4,5] Various mechanical factors have been associated with pain in different body parts. It is believed that working conditions and workload are the most important factors for the development and continuance of these disorders.[2] Work-related risk factors for MSDs are generally divided into 4 categories: (1) personal (gender, age, smoking, education, body mass index [BMI], chronic diseases, hobbies); (2) physical (heavy lifting, vibration, nonergonomic body postures, twisting and bending of the trunk); (3) psychosocial (monotonous work task, job status); (4) environmental (cold temperature).[2,6,7,8–18]

Musculoskeletal disorders affect workers' quality of life and lead to a considerable cost for the public health system.[1,2,6,7] MSDs are a main cause for absence from work leading to considerable workers' compensation and disability payments.[2,7–10] Currently 40% of the worldwide work-related health cost is attributed to MSDs.[6,19,21] It was reported that workers' compensation costs for back injuries exceeded 128 million USD between 1998 and 2003 in Washington state.[21] The annual cost of MSDs in the Nordic countries is estimated

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to vary from 2.7% to 5.2% of the gross national product.[1] This is the amount to be gained by prevention of work-related MSDs. The estimated total cost of these MSD cases relative to workers' productivity was 171.7 million USD, representing around 0.2% of Colombia's gross domestic product for 2005.[22] The real burden of work-related MSDs and their impact on workers' productivity are not known in most of the developing countries due to the fact that only workers' disability are recorded.[22] To our knowledge, there are no published data about economic impact of MSDs in Turkish workers.

Ammunition factory is considered to be a branch of the metal industry. In Turkey, 10.3% (904,097 workers) of total employees (8,802,980 workers) work in 90,008 metal enterprises.[23] Ammunition work requires intensive use of hands and hand tools, forceful muscle contractions, heavy lifting, bending or twisting the back, working in the same position or in an awkward position. Some of the ammunition workers are also exposed to vibration.

Picoloto and da Silveira investigated the prevalence of MSDs among metal industry workers in Brazil and they found that the prevalence was 75.2%.[24] We found only one study about MSDs in metal industry workers in Turkey. This study showed that the prevalence of back pain among gun factory workers was 22.0%.[25] On the other hand, the importance and extent of MSDs among Turkish workers have not been studied adequately. Furthermore, those studies did not investigate the economic impact of MSDs.[25–27] Therefore, we assessed the prevalence of symptoms of MSDs among ammunition factory workers, investigated the occupational and personal factors associated with symptoms of MSDs, and evaluated the economic impact of MSDs in Turkey

METHODS

Study population

This cross-sectional study was performed in January 2007 in the Ammunition Section of Kirikkale Gun Factory in Turkey. This factory manufactures conventional guns, and is considered as a branch of metal industry. The factory had 986 workers at the time of study. Seven workers did not accept to be enrolled into the study, and 24 workers could not be contacted. Therefore, the remaining 955 workers (96.9%) were included in the study. Participants were informed of the study via the health center of the factory 2 weeks prior to the data collection.

Investigators explained the aim of the study and the contents of the questionnaire before the administration of the questionnaire. To maintain confidentiality for minimizing information bias and to ensure that workers do not avoid disclosing sensitive information, all questionnaires were completed anonymously. The workers were reassured that the data will be used for research purposes only and their answers will not be shared with the factory management. No member of factory management was present during the administration of the survey.

We evaluated workers in 2 groups according to employment status. Employees that are physically working in production process were named as blue collar; those working in the offices were named as white collar.

Study instrument

Investigators interviewed all participating workers and completed a 4-page questionnaire composed of 32 questions. The questionnaire included personal informa-tion (smoking, BMI, chronic disease, work year) and physical (heavy lifting, vibration, nonergonomic body postures, twisting and bending of the trunk), psychosocial (work load, job status), and environmental (perception of workers towards workplace temperature) factors.

We use National Heart, Lung, and Blood Institute BMI for the evaluation of our study group. According to this index, people were grouped as follows: underweight, $\leq$18.5 kg/m^2; normal weight, 18.5–24.9 kg/m^2; overweight, 25–29.9 kg/m^2; and obese, $\geq$30 kg/m^2.[28] In our study, chronic diseases included hypertension, coronary heart diseases, diabetes mellitus, and chronic obstructive lung diseases.

The following 3 questions in the MSD symptoms part of the question-naire were asked for 9 different anatomic sites (neck, shoulder, upper back, lower back, elbow, wrist/hand, hip/thigh, knee, feet): "During the last 12 months, have you had a job-related ache, pain, discomfort? Or seen a physician for this complaint? Or missed any workday due to this condition?"

Other questions included "What did you do for the symptoms, how long did the symptoms last, how frequently did they recur, what kind of diagnostic and therapeutic actions were performed by the physician, and whether there was a relief of complaints?" Characteristics of pain were also sought in detail. The nature of pain was regarded as inflammatory if it was decreasing with movement in the morning, and as mechanical if it was decreasing with rest and increasing with movement. Back pain referring to legs was regarded as discopathy or radiculopathy. Any pain lasting less than 3 months was considered as acute, and more than 3 months as chronic.

The calculation of economic burden was based on medical records of the workers in the health center. The number of patients admitted to the health center due to MSDs, the number of prescriptions, the number of referrals, and absent days were all recorded. Economic costs of all activities were calculated in the prices of 2007. The numbers of drug use without prescription as well as the hospital costs were not included in the calculation of economic burden. Conditions caused solely by acute or accidental injuries (such as lacerations, fractures, etc) were not included in this study.

Statistical analysis

Prevalence of symptoms of MSDs for each of the 9 body sites was determined by dividing the number of "yes"

responses by the total number of participants. Percentages and means were calculated for demo-graphics, job factors, and leisure activities. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated by stepwise logistic regression for multivariate modeling. All data were analyzed with SPSS statistical software version 11.0 (SPSS, Chicago, IL, USA). Any p value less than 0.05 was considered statistically significant. Multivariate logistic regression analysis was performed with backward linear regression method. Potential risk factors having p value equal to or less than .25 in univariate analysis were taken into multivariate analysis. We combined the 0–5 and 6–10 years of work groups into a single group due to the small size of the subgroups. We also put slim and normal BMI into a single group for the same reason. We include age, BMI, education, alcohol consumption, smoking, systemic diseases, employment status, working years, work type, heavy lifting, vibration, climate of workplace, working posture, work load, and leisure activities as covariates in logistic regression analysis.

RESULTS

A total of 986 ammunition factory workers were eligible for the study and 955 actually participated (96.9%). There were 932 male (97.6%) and 23 female (2.4%) workers. The mean ± *SD* age was 42.27 ± 6.91 years (range, 18–68 years). Ammunition workers worked in the factory for an average of 21.17 ± 7.04 years. Their employment status was blue collar in 79.9% ($n = 763$) and white collar in 20.1% ($n = 192$). The demographics of the ammunition workers were summarized in Table 1.

Thirty-nine percent of the ammunition workers ($n = 375$) claimed that they experienced symptoms of work-related MSDs in at least 1 of the 9 anatomical sites, and 9.4% ($n = 90$) reported symptoms of work-related MSDs in more than 1 anatomic site. During the previous year, low back was the area with the highest preva-lence of symptoms of MSDs (22.1%), followed by knee (10.3%) and neck (6.4%) (Table 2).

Table 1.—Demographics of Ammunition Factory Workers (*N* = 955)

Parameters	Mean	SD
Age	42.27	6.91
Body mass index (kg/m^2)	26.42	2.85
Education year	11.40	1.82
Working year	21.17	7.04
Weekly working hour	43.99	2.00
	Number	%
Gender		
Male	932	97.6
Female	23	2.4

Symptoms according to the sociodemographic features of the workers were also evaluated (Table 3). The most common symptoms were observed in ages of 46 years and above (43.2%). The difference between age subgroups was statistically significant ($p = .034$).

Symptoms of MSDs were found in 39.4% of males (367/932) and 34.8% of females (8/23). There was no significant difference between gender and symptoms of MSDs ($p = .656$)

A significant correlation was found between BMI and symptoms of MSDs ($p = .001$); 42.3% of overweight and 52.0% of obese workers had more symptoms. We also evaluated the relation between BMI and regions of symptoms. Workers with back pain ($n = 211$) were slim ($n = 1$), in normal weight ($n = 53$), overweight ($n = 132$), and obese ($n = 25$). There was no correlation between BMI and back pain ($p = .206$). Fifty-nine of 98 workers (60.2%) with knee symptoms were overweight and 21 (21.4%) were obese. Knee symptoms were higher in overweight group ($p = .0001$). There was no significant correlation between other body locations and BMI.

Forty-nine and a half percent of workers graduating from elementary school and 39.4% graduating from apprentice school had symptoms, and there was a significant correlation between education status and symptoms of MSDs ($p = .025$).

Alcohol use (both social and daily intake) was 38.2% among workers with symptoms, and we found no correlation between alcohol use and symptoms of MSDs ($p = .782$). However, there was a significant correlation between smoking and symptoms of MSDs (42.9% of smoking workers had symptoms; $p = .002$). One hundred and eleven workers (59.6%) with back pain were smokers ($p = .034$), and 60.7% ($n = 37$) of smokers had neck pain ($p = .019$). However, there was no significant correlation between other regions and smoking status. Fifty-two percent of workers with chronic diseases had symptoms of MSDs ($p = .0001$).

Job factors associated with prevalent symptoms of musculoskeletal disorders were evaluated (Table 4). There was a significant correlation between working duration and symptoms of MSDs ($p = .003$). Longer duration of work (16 years or more) increased the risk of MSDs 1.5-fold.

We did not find any significant correlation between body position during work (standing or sitting) and symptoms ($p = .269$). There was no correlation between back pain and standing or sitting position during work ($p = .172$). Back pain was observed in 23.4% ($n = 149$) of standing and in 19.5% ($n = 62$) of sitting workers. There was a statistically significant difference between workers with and without heavy lifting history in terms of symptoms of MSDs ($p = .034$). We found a significant correlation between heavy lifting and back pain ($p = .013$) and hand/wrist pain ($p = .026$). We did not find any significant correlation between heavy lifting and pain in any other body part ($p > .05$). We also found a significant relation between symptoms and working posture ($p = .001$). Awkward postures caused back pain in 58.5% and neck pain in 13.8% of workers.

Table 2.—Prevalence of Symptoms of Musculoskeletal Disorders in Ammunition Workers, Stratified by Anatomic Site

	Gender				Employment status					
	Male		Female		Blue collar		White collar		Total	
Symptoms*	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Yes	367	39.4	8	34.8	307	40.2	68	35.4	375	39.3
No	565	60.6	15	65.2	456	59.8	124	64.6	580	60.7
Total	932	100	23	100	763	100	192	100	955	100
Anatomic sites*										
Neck	61	12.6	—		50	12.1	11	13.8	61	6.4
Shoulder	24	4.9	—		21	5.1	3	3.8	24	2.5
Upper back	33	6.8	—		26	6.3	7	8.8	33	3.5
Low back	206	42.5	5	1.0	181	43.8	30	37.5	211	22.1
Elbow	18	3.7	—		15	3.6	3	3.8	18	1.9
Hand/wrist	27	5.6	—		19	4.6	8	10.0	27	2.8
Hip/thighs	14	2.9	—		14	3.4	—		14	1.5
Knee	95	19.6	3	0.6	81	19.6	17	21.3	98	10.3
Feet	7	1.4	—		6	1.5	1	1.3	7	0.7
Total	485		8		413		80		493*	

*Some workers presented with more than 1 complaint.

Symptoms of MSDs were seen in 69.0% of workers exposed to vibration. There was a significant relation between exposure to vibration and symptoms ($p = .001$). Most frequent symptoms were back pain (35.0%) and wrist pain (30%).

Symptoms were found in 62.7% of workers with heavy workload, and there was a significant relation between workload and symptoms ($p = .0001$).

Symptoms were present in 49.8% of workers who perceived the temperature as cold and 46.7% of workers who perceived the temperature as hot ($p = .001$).

The most frequent leisure activities were walking ($n = 74$), football ($n = 38$), volleyball ($n = 20$), and tennis ($n = 6$). Symptoms were seen in 37.0% of workers having leisure activities during rest periods or after hours; however, there was no significant association between leisure activities and symptoms ($p = .226$).

The back pain was acute in 64.0% and chronic in 36.0% of the workers. The nature of back pain was inflammatory in 17% ($n = 36$), mechanical in 71.6% ($n = 151$), and suggestive of discopathy or radiculopathy in 11.4% ($n = 24$).

Two hundred and seventy-two (55.2%) workers with symptoms of MSDs presented to the health center. The most frequent symptom for admission was back pain (12.6%), followed by knee pain (5.3%) and neck pain (3.8%). Workers were more likely to miss work due to knee symptoms (2.3%) and upper back symptoms (1.7%). The 12-month prevalence of symptoms of MSDs, admission to physician, and missed workday are shown in Table 5.

Sixty-four workers did nothing for their complaints, whereas 272 workers sought medical advice, 92 workers took painkillers by themselves (without prescription), and 65 workers used traditional methods such as alternative medicine. Among workers who sought medical advice, 206 (75.7%) had drugs, 53 (19.5%) had physiotherapy, 13 (4.8%) had surgery, and 31 (11.4%) had both medicine and physiotherapy.

Symptoms were continuous in 31.5%, once in 15.5%, more than once per week in 7.7%, more than once per month in 25.1%, and more than once per year in 20.2% workers.

A number of workers were previously diagnosed with herniated disc of lumbosacral vertebrae ($n = 94$), myalgia ($n = 37$), osteoarthritis ($n = 50$), cervical disc herniation ($n = 11$), siatalgia ($n = 6$), meniscus tear ($n = 5$), varicosis of leg ($n = 2$), and osteoporosis ($n = 1$). One hundred and sixty-nine workers did not have any previous diagnosis.

A total of 160 working days were missed. The most frequent reason for missing workday was back pain (6.6%; 63 days). There was no significant difference between employment status (blue collars, 84 days; white collars, 76 days) and missing workday.

The total inpatient applications to workplace health center due to symptoms of MSDs were 731 (427 blue collars, 304 white collars) in 2007, and a total of 1267 boxes of medicines (764 blue collars, 503 white collars) were prescribed. The total cost of prescriptions was 7768 Turkish liras (TL) (4,739 TL for blue collars; 3,029 TL for white collars) (approximately US $6,473). Total workday loss cost was 10,240 TL (US $8,530) (8 TL/hour × 160 × 8 hour/day).

A total of 378 workers (236 workers, 142 office workers) with symptoms of MSDs were referred to orthopedics and 118 (60 blue collars, 58 white collars) to physical therapy. Workers who were referred to the hospital (orthopedics [$n = 378$], physical therapy [$n = 118$]) for symptoms

Table 3.—Sociodemographics of Ammunition Factory Workers (*N* = 955) and Symptoms of MSDs

	Prevalence of symptoms within the previous 12-month period				
Variables	Yes	%	No	%	*p* values
Age groups					
18–25 years	5	35.7	9	64.3	$\chi^2 = 8.672$
26–35 years	48	29.6	114	70.4	$p = .034$
36–45 years	173	39.9	261	60.1	
46 years and above	149	43.2	196	56.8	
Gender					
Male	367	39.4	565	60.6	$\chi^2 = 0.199$
Female	8	34.8	15	65.2	$p = .656$
Education					
Primary school	47	49.5	48	50.5	$\chi^2 = 11.140$
Apprenticeship school	13	39.4	20	60.6	$p = .025$
High school	139	34.6	263	65.4	
Vocational high school	135	43.7	174	56.3	
University	41	35.3	75	64.7	
BMI					
Slim	1	25.0	3	75.0	$\chi^2 = 21.864$
Normal	83	29.0	203	71.0	$p = .000$
Overweight	240	42.3	327	57.7	
Obese	51	52.0	47	48.0	
Smoking					
Current smoking	219	44.0	279	56.0	$\chi^2 = 9.676$
Never smoked	156	34.1	301	65.9	$p = .002$
Alcohol consumption					
Yes	50	38.2	81	61.8	$\chi^2 = 0.077$
No	325	39.4	499	60.6	$p = .782$
Chronic disease					
Yes	128	52.2	117	47.8	$\chi^2 = 23.274$
No	247	34.8	463	65.2	$p = .000$
Hobbies (leisure activities)					
Yes	143	37.0	244	63.0	$\chi^2 = 1.464$
No	232	40.8	336	59.2	$p = .226$
Total	375	39.3	580	60.7	

Table 4.—Job Factors in Relation With Prevalence of Symptoms of Musculoskeletal Disorders

	Prevalence of symptoms within the previous 12-month period				
Job factors	Yes	%	No	%	*p* values
Job status					
Blue collar	307	40.2	456	59.8	$\chi^2 = 1.494$
White collar	68	35.4	124	64.6	$p = .222$
Years worked					
0–5 years	7	38.9	11	61.1	
6–10 years	36	27.9	93	72.1	$\chi^2 = 13.917$
11–15 years	6	20.0	24	80.0	$p = .003$
16 years and above	326	41.9	452	58.1	
Body position during work					
Standing	258	40.5	379	59.5	$\chi^2 = 1.224$
Long-lasting sitting	117	36.8	201	63.2	$p = .269$
Heavy lifting					
Yes	46	49.5	47	50.5	$\chi^2 = 4.491$
No	329	38.2	533	61.8	$p = .034$
Vibration					
Yes	20	69.0	9	31.0	$\chi^2 = 11.061$
No	355	38.3	571	61.7	$p = .001$
Temperatures perceived					
Normal	200	33.2	402	66.8	$\chi^2 = 25.067$
Cold	161	49.8	162	50.2	$p = .000$
Hot	14	46.7	16	53.3	
Working posture					
Neutral posture	310	37.1	525	62.9	$\chi^2 = 12.776$
Awkward posture	65	54.2	55	45.8	$p = .000$
Physical Work load					
High	64	62.7	38	37.3	$\chi^2 = 26.395$
Low	311	36.5	542	63.5	$p = .000$
Total	375	39.3	580	60.7	

of MSDs spent a whole day in the hospital, which was not counted as absenteeism. If we take such hospital referral days into account for absenteeism, the total workday loss would be 656 days (160 + 496) and the cost of total work loss would be 41,984 TL (US $34,987) (8 TL/hour × 656 days × 8 hours/day). This cost does not include hospital expenses, such as medications and medical care, and medications used by workers without prescription.

Smoking, cold temperature of workplace, high work load, BMI, systemic diseases, and working year were independent risk factors for the development of symptoms of MSDs. Age, education, employment status, heavy lifting, and working posture were significant factors in chi-square test, as they were not significant in multivariate analysis. Although vibration was not significant ($p = .082$), it was not excluded from the model because of a trend (Table 6).

COMMENT

We performed this study on 955 workers at a major ammunition factory. MSD symptoms were present in 39.3% of ammunition workers in at least 1 of 9 anatomical sites during the pre-vious year. In the current study, low back was the area with the highest prevalence of symptoms of MSDs (22.1%), followed by knee (10.3%) and neck (6.4%). Detailed analysis showed that certain work conditions, such as high work load, cold temperature of workplace, and working years, and personal factors, such as BMI, systemic diseases, and smoking, are independent risk factors for the development of symptoms of MSDs. Other potentially important risk factors, such as gender, leisure activities, employment status and work type, were not statistically significant factors for the development of MSDs in our study. However, age, education, heavy lifting, and work posture were significant parameters only in univariate analysis.

Musculoskeletal pain was the most frequent work-related health problem (work-related fractions, 49%–74%), comparable to other studies.[29] Picoloto and da Silveira found the prevalence of MSD among metal industry workers in Brasil as 75.2% during the past 12 months.[24]

Table 5.—Prevalence of Symptoms of Musculoskeletal Disorders in Ammunition Factory Workers (*N* = 955) Within the Previous 12-Month Period

	Prevalence of symptoms within the previous 12-month period*		Prevalence of seeking medical advice within the previous 12-month period		Prevalence of missing work within the previous 12-month period	
Anatomic site	*n*	%	*n*	%	*n*	%
Neck	61	6.4	36	3.8	11	1.2
Shoulder	24	2.5	9	0.9	5	0.5
Upper back	33	3.5	16	1.7	16	1.7
Low back	211	22.1	120	12.6	63	6.6
Elbow	18	1.9	11	1.2	13	1.4
Hand/wrist	27	2.8	12	1.3	10	1.0
Hip/thighs	14	1.5	11	1.2	12	1.3
Knee	98	10.3	51	5.3	22	2.3
Feet	7	0.7	6	0.6	8	0.8
Total	493*		272		160	

*Some workers presented with more than 1 complaint.

Accurate data on the incidence and prevalence of MDSs are difficult to obtain and official statistics are not comparable across countries.[4] The International Labour Organization (ILO) reported that the proportion of all musculoskeletal diseases that are attributable to work is thought to be approximately 30%.[2]

Age has been previously reported to be an important factor for symptoms of MSDs.[10,11,15,19] Older adults most frequently complain from symptoms of MSDs possibly due to increasing degeneration of the tendons and development of osteoarthritis in the joints. Age limits varied across studies, such as 37 for neck and shoulder pain[8] and 35 for shoulder pain.[15] Many authors reported somehow older ages, such as the 45 years limit for symptoms of MSDs.[9,10] In our study group, older workers also reported more complaints of symptoms of MSDs. Symptoms of MSDs in our cohort are most commonly expressed in ages 36 and over (83.1%). Although univariate analysis showed such a correlation between age and symptoms of MSDs ($p = .034$), multivariate analysis did not.

Table 6.—Results of Multivariate Logistic Regression Analysis

Variables	*p*	OR	95% CI
Smoking	.025	1.372	1.040–1.811
Workplace temperature	<.001		
Cold	<.001	1.838	1.371–2.465
Hot	.274	1.548	0.707–3.388
Work load			
High	.001	2.210	1.403–3.484
BMI	.001		
Overweight	.003	1.631	1.185–2.245
Obese	.001	2.288	1.400–3.737
Chronic diseases	<.001	1.795	1.317–2.446
Work year	.035		
0–15 years	.377	0.639	0.237–1.724
16+ years	.047	1.509	1.006–2.264
Vibration	.082	2.117	0.909–4.932
Constant	.548	1.204	

Increased symptoms of MSDs with increased working years were also evident in our study ($p = .003$). We found that 41.9% of workers working more than 16 years had symptoms of MSDs. This might be coincidental with aging body. As age increases, natural degeneration within the body contributes to MSDs.

Lower education level has been shown to be associated with knee pain in some studies, but not in others.[10,11] Our univariate analysis yielded education as an important risk factor for development of symptoms of MSDs, and primary school graduates were in the highest risk group, whereas high school graduates were in the lowest risk group.

Several studies have shown that smoking is associated with an increase in the risk of low back pain and herniated disc.[1,8,14,16,17,30,31] However, some studies did not show any significant positive association between smoking and low back pain.[32] There is no obvious mechanism for association of smoking with musculoskeletal disorders.[16] However, one of the proposed mechanisms is that smoking causes reduced perfusion and malnutrition of tissues in or around the spine and cause them to respond inefficiently to mechanical stress.[33] Our study showed that smoking is an independent risk factor for symptoms of MSDs in both univariate and multivariate analyses ($p = .002$). Smoking has a significant impact on low back ($p = .023$) and neck ($p = .003$) pain in our study; however, there was no significant correlation between symptoms of MSDs in other body locations and smoking.

Overweight and obesity have been previously proven to be an important risk factor for MSDs, especially back and

knee pain.[7,10,11,15,34–36] BMI is an independent risk factor for symptoms of MSDs in both univariate and multivariate analyses in our study ($p = .001$) and obese group complained more frequently (52.0%) of symptoms of MSDs. BMI above 25 kg/m^2 has been previously reported to be associated with increasing risk of lumbar disc degeneration and back pain.[36–38] However, we could not find such a correlation ($p > .05$) in our group. Although age and gender have been shown to have an inconsistent effect on low back disorders in other studies,[12] they were not associated with low back symptoms in our study.

Musculoskeletal tissues are affected by systemic diseases, such as rheumatoid arthritis, gout, lupus, and diabetes.[7] Presence of important systemic chronic diseases was associated with increased risk of MSDs ($p = .0001$) in our study.

Activities outside of work, such as sports and hobbies, may also influence the prevalence of musculoskeletal problems. These activities can be physically stress-ful and may contribute to the development of symptoms of MSDs.[10,15,39] Although some studies pointed out the negative impact of nonoccupational risk factors on MSDs, our study did not show any correlation. We also did not found any correlation with any amount of alcohol intake and MSDs. Previous literature data also support our finding.[40]

One other important risk factor for development of symptoms of MSDs is heavy physical work load.[7,9,12,13,15] There is no objective definition of heavy physical workload. It is subjective and workers' perception is taken as reference. We identified significant association between high perceived workload (strenuous work, intensified workload) with symptoms of MSDs ($p < .001$). It is also an independent risk factor in the multivariate analysis.

Vibration may cause deterioration of blood circulation in extremities and become an important risk factor for symptoms of MSDs.[1,6,12,41] We detected increased symptoms of MSDs in presence of vibration; however, it was not an independent risk factor in multivariate analysis.

Awkward postures cause forceful muscle contraction and cause symptoms of MSDs.[6,14,15] Although it was not an independent risk factor in our study, it is important in univariate analysis ($p = .0001$).

Heavy weight lifting has been previously reported to cause symptoms of MSDs.[6,34] We also found a significant correlation with heavy lifting and symptoms of MSDs only in univariate analysis, including back ($p = .013$) and hand ($p = .026$) pain. There is no such correlation with other body sites.

Environmental factors, such as cold temperature of work place, are associated with symptoms of MSDs.[3,20] Our findings are consistent with previous reports that symptoms of MSDs are seen 1.83-fold higher in people working in a cold place.

Back pain was the most frequent symptom (22.1%; 211/955) in our study. Ulu and Cakmak found the prevalence of back pain among gun factory workers in Turkey as 22.0%.[25] Previous studies in the literature also showed back pain as the most frequent symptom and one of the leading causes of time lost from work.[29] About 80% of people experience low back pain during their lifetime, and it is one of the most important causes for short- and long-term disability in all occupational groups. Worldwide, 37% of low back pain was deemed attributable to occupational risk factors. Moreover, back pain was shown to be associated with high costs and psychosocial and disabling effects.[1,6,29] In our study group, workday lost was also due to primarily back pain and the most frequent reason for seeking medical advice was also back pain (12.6%).

Many clinical and epidemiological studies have shown that prolonged sitting is associated with increased rates of lower back pain.[42] The primary disadvantage of sitting is increased stress on the spine. However, we could not identify any correlation with body position during work with back pain in our group ($p = .172$).

The prevalence of knee pain varies from 10% to 60%, depending on age, occupation, and the definition of knee pain.[10,29,34] Studies have shown a positive association of knee symptoms with heavy physical loading, heavy lifting, obesity, overweight, and different sport activities.[10,15,34,35,43–45] In our study, knee is the second most frequent site of symptoms of MSDs (10.3%), followed by back pain. Body mass index seemed to be only important risk factor for incident knee pain ($p < .001$) in our study. Other potential risk factors, such as smoking, heavy lifting, standing during working, and leisure activities, do not have any effect on knee pain.

Currently 40% of worldwide work-related health costs are attributed to MSDs.[19] MSDs are a main cause for absence from work. Thus, the respective share amounts in one third of industrialized countries cause considerable costs for public health.[46–48] Blue collar workers were at a higher risk of sickness absence due to MSDs.[19] In our study, a total of 160 workday loss was evident, blue collar workers had 84 days and white collar workers 76 days. There was no significant difference between those 2 groups.

There are several limitations in this study. In most of the cases, it is not possible to point to one causal factor for musculoskeletal diseases. This study is a cross-sectional study, therefore, cause and effect can-not be established. The outcomes in this study are self-reported symptoms and were not based on clinical diagnosis. Self-report of work-related health problems may yield different prevalence estimates from data obtained by more objective clinical examinations.

In conclusion, both work-related conditions and personal characteristics seem to be important for occupational symptoms of MSDs. Besides personal morbidity and disability due to MSDs, economic burden is also an important topic for the individuals and community. It is obvious that nearly all proven risk factors we have shown in this study are preventable. Smoking, obesity, work place temperature, and workload can be effectively adjusted. These results suggest

a large potential for the prevention of MSDs by reduction of known risk factors in the workplace.

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