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Work-Related Musculoskeletal Disorders, Occupational Stress, and Their Associations with General Health in Working Populations in Various Industries

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Background: Work-related musculoskeletal disorders (WMSDs) have been documented in various occupational groups in Iran. However, there is a gap in the studies regarding the prevalence of WMSDs, occupational stress, and general health in workers. The present study aimed to investigate the correlations between WMSDs, occupational stress, and general health.

Methods: This cross-sectional study was conducted on 455 workers selected from various industries in 10 cities in Iran. Data were collected using self-reported measures to evaluate the body map, HSE management standards indicator tool, and general health questionnaire (GHQ).

Results: In total, 455 questionnaires were completed and analyzed. The mean differences were compared using the Kruskal-Wallis test. The results of Spearman's correlation-coefficient indicated a significant, positive correlation between WMSDs and occupational stress. In addition, negative correlations were observed between general health, WMSDs, and occupational stress.

Conclusion: Some of the recommendations based on the findings are modifying the workplaces of individuals who perform long-term, static tasks, periodic identification of the individuals with musculoskeletal problems and taking measures to correct their posture, designing proper physical exercises for the individuals with hard work postures, and cognitive-behavioral education to raise awareness regarding the complications of mental health problems.

1. Introduction

Work-related musculoskeletal disorders (WMSDs) are among the main causes of incapacity at work [1], which is a worldwide health concern in industrialized and industrially developing countries [2-4]. In the past decade, work-related activities have been considered to be a major cause of WMSDs [5, 6]. The imbalance of occupational demands with the ability to work have contributed to the high prevalence of WMSDs, which may develop gradually within days, weeks, months or even years after exposure to unfavorable working conditions [7-9]. Some of the main risk factors for WMSDs are workplace activities such as manual handling, bending, twisting, work pace, repetitive tasks, heavy load lifting, awkward posture, and seated static postures. Furthermore, individual characteristics and cognitive and psychosocial factors are considered to be the important predictive variables in this regard [1, 4, 10, 11].

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Among various psychosocial factors, occupational stress has been reported to have a more significant association with the incidence of WMSDs. According to the literature, occupational stress negatively influences the progression of WMSDs, and the majority of these cases pose significant risk to the physical and mental health of individuals [12-14]. According to Karasek Jr (1979) the demand-control model revealed that increased work-related psychological demands without a corresponding increase in job control leads to higher occupational stress, causing adverse health outcomes. The World Health Organization (WHO) has defined health as a state of complete physical, psychological, and social wellbeing and not merely the absence of illnesses [14-17].

A gap in the studies in this regard is that none have been focused on the association of health-related outcomes with occupational stress and WMSDs in working populations. The present study aimed to explore the associations of WMSDs with occupational stress and general health in the Iranian working populations in various industries of several cities.

2. Materials and Methods

2.1. Study Design, Samples, and Data Sources

This cross-sectional study was conducted on various workers employed in eight industries, including drilling projects, bridge construction, highway construction, water diversion projects, railway construction, tunneling construction, build power plants, and building construction in 10 cities in Iran. These industries were selected since they are classified as high-risk industries with a substantial number of occupations, each of the eight industries should have high efficiency, and it is possible to compare the study parameters in various industries and professions.

A step-by-step design was used with the randomly selection of the number of the occupations in each industry in 10 cities. The selected individuals were classified based on eight industrial sectors (drilling projects: 55, bridge construction: 15, highway construction: 37, water diversion projects: 73, railway construction: 98, tunneling construction: 28, build power plants: 28, and building construction: 121). The sample population consisted of 455 Iranian adults (100% male) with different occupations aged 22-72 years, who had been employed for a minimum of one year. The inclusion criteria of the study were willingness to participate in the study, absence of psychotherapy, drug addiction, and alcohol consumption, and a minimum work experience of one year in the current position [18]. Despite sample stratification, the objective of the study was not to make comparisons between the occupations and selected cities. The researchers liaised with the participants in each industry to obtain the required permit for accessing the occupations. With the permission of the unit managers, the researchers approached the individuals who were employed in the units in order to request their participation. The objectives of the study were explained face-to-face, and copies were distributed among the individuals who were willing to partake.

Data were collected using five instruments. The first section of the questionnaire included the demographic characteristics of the participants. In addition, the standardized body map questionnaire for musculoskeletal symptoms was used to determine the prevalence of musculoskeletal symptoms by assessing 27 body segments [19]. Another data collection tool was the HSE management standards indicator tool, which is a framework covering six domains that might cause stress in employees at work. The items in this questionnaire are scored based on a five-point Likert scale (Strongly Disagree-Strongly Agree). Each item refers to a management standard; items 3, 6, 9, 12, 16, 18, 20, and 22 refer to 'demands', items 2, 10, 15, 16, 19, 25, and 30 refer to 'control', items 7, 8, 23, 24, 27, 29, 31, 33, and 35 refer to 'support', items 5, 14, 21, and 34 refer to 'interactions', items 1, 4, 11, 13, and 17 refer to 'roles', and items 26, 28, and 32 refer to 'changes'.

The indicator tool could be used to analyze the viewpoints of individuals toward their working conditions and stress levels. The questionnaire responses are numbered 1-5. Based on the reliability test results, the items in this questionnaire have significant correlations and have been extracted from factor analysis. The reliability of the items that were extracted from the HSE questionnaire was 0.92, 0.73, 0.75, 0.63, 0.87, 85, and 0.22 for the items regarding demands, control, managerial support, peer support, interactions, roles, and changes, respectively. In addition, reliability was estimated at 78% and 65% using the Cronbach's alpha and split-half method, respectively [20].

Another data collection instrument was the general health questionnaire (GHQ), which is used to identify psychiatric disorders in the general population within the community or non-psychiatric clinical settings. Moreover, GHQ assesses the current state of the respondent to determine the differences with their common state. To test the reliability of this scale, its internal consistency was assessed using the Cronbach's alpha coefficient (≥ 0.70), which considered satisfactory [21]. It is notable that GHQ is easily administered and consists of 12 items. The response ranges are 'better/healthier than normal', 'same as usual', 'worse/more than usual', and 'significantly worse/more than usual'. The exact wording depends on the particular nature of each item. In this study, we applied Goldberg's original scoring method, in which the response categories are determined with the scores of zero, zero, one, and one, respectively (score range: 0-12) [22, 23].

2.1. Statistical Analysis

Data analysis was performed in SPSS version 23. The descriptive data were expressed as mean, standard deviation (SD), and percentage. In addition, the Kruskal-Wallis test was used to examine the significant differences between the industries and occupations. The Kruskal-Wallis test is a non-parametric method to determine whether samples originate from the same distribution and is used for the comparison of two or more independent samples of equal or different sample sizes. The correlations between the WMSDs, occupational

stress, and general health were evaluated using the Spearman's correlation-coefficient.

3. Results and Discussion

In total, 473 questionnaires (response rate = 93.0%) were completed and returned. Among these, 18 questionnaires were less than partially completed and eliminated from further analysis. The remaining questionnaires (n = 455) were used for analysis. The characteristics of the employees in eight industries (mean age, marital status, education level, work experience, and employment status) are presented in Table 1. All the participants in the present study were male. The job category distribution in the eight industries was shown as the percentage of the respondents (Table 2). The results of stress and general health in the eight industries are summarized in Table 3.

According to the findings, the prevalence of occupational stress was higher in the employees of highway construction, drilling projects, industrial power plants, building construction, and railway construction compared to the employees of bridge construction, water diversion projects, and tunneling construction. Furthermore, the obtained results indicated that the level of general health was higher in the employees of tunneling construction, bridge construction, water diversion projects, and railway construction compared to the employees of drilling projects, building construction, highway construction, and industrial power plants.

The findings regarding stress and general health in different job categories are presented in Table 4. The highest prevalence of stress was observed in HSE managers, project managers, executive directors, installation maintenance supervisors, and HSE supervisors. The lowest prevalence of stress was observed in welders, cooks, workers, and caretakers. In addition, the highest level of general health was denoted in workers, cooks, caretakers, welders, and light machinery drivers, while the lowest level of general health was observed in HSE managers, quality assessment managers, project control directors, electrical supervisors, and project managers. Mean demographic variables in terms of stress and general health is shown in Table 5.

The comparison of the mean WMSDs, stress, and general health in the eight industries (P MSDs < 0.001 , P stress < 0.001), indicating statistically significant differences between each job category (P MSDs < 0.001, P stress < 0.001). Moreover, the results of Spearman's correlation-coefficient in the jobs in eight industries demonstrated a significant, positive correlation between WMSDs and stress (r = 0.242), as well as negative correlations between WMSDs and general health (r = - 0.494) and occupational stress with general health (r = - 0.361). Recently, there has been growing research regarding stress, and special attention has been paid to the association of mental state and physical disorders.

Table 1: Sample characteristics

Variable	Industrial															
	Drilling project (N = 55)		Construction (bridge) (N = 15)		Construction (high way) (N =37)		Water diversion project (N = 73)		Times New Roman (Headings CS)		Construction (industrial-power plant) (N = 28)		Construction (building) (N = 121)		Construction (rail way) (N = 98)	
	%	Mean (SD)	%	Mean (SD)	%	Mean (SD)	%	Mean (SD)	%	Mean (SD)	%	Mean (SD)	%	Mean (SD)	%	Mean (SD)
Age																
≤ 42	92.7	33.98	60	39.27	83.8	36.19	82.2	35.95	71.4	37.96	85.7	34.96	80.2	35.17	75.5	36.49
43-52	4	(5.80)	33.3	(9.81)	13.5	(8.18)	15.1	(7.4)	21.4	(9.07)	14.3	(6.58)	17.4	(8.57)	21.4	(8.06)
≥ 53	0.0		6.7		2.7		2.7		7.1		0.0		2.5		3.1	
Marital status																
Married	72.7		86.7		78.4		83.6		71.4		85.7		75.2		82.7	
Single	27.3		13.3		21.6		16.4		28.6		14.3		24.8		17.3	
Education																
≤ diploma	49.1		40.0		27.0		58.9		64.3		32.1		50.4		62.2	
Bachelors	36.4		60.0		70.3		34.2		35.7		60.7		38.8		31.6	
Masters	14.5		0.0		2.7		6.8		2.5		7.1		10.7		6.1	
Work experience																
1-10	67.3	8.18	46.7	12.81	48.6	11.0	63.0	9.59	60.7	11.61	60.9	9.57	68.6	9.41	59.2	9.89
11-20	30.9	(5.26)	40.0	(9.10)	43.2	(6.62)	28.8	(6.52)	17.9	(8.76)	17.7	(5.58)	20.7	(7.75)	33.7	(6.57)
21-37	1.8		13.3		8.1		8.2		21.4		21.4		10.7		7.1	
Employment Status																
Contractual	100		100		91.9		97.3		100		96.4		94.2		89.8	
Official																
Temporary					8.1		1.4				3.6		5.8		2.0	
Contract							1.4								8.1	

Table 2: Percentage of job categories in eight industries

Job categories	Industrial							
	Drilling project %	Construction (bridge) %	Construction (high way) %	Water diversion project %	Construction (tunneling) %	Construction (industrial-power plant) %	Construction (building) %	Construction (rail way) %
Executive Director	--	6.7	--	--	--	--	--	--
Executive Supervisor	7.3	20.0	8.1	11.0	32.1	--	8.3	21.4
Conservator	3.6	--	2.7	4.1	--	7.1	19.8	6.1
Cook	1.8	--	2.7	1.4	--	--	--	1.0
Care Taker	1.8		5.4	4.1	--	--	0.8	1.0
IT Clerk	1.8	--	--	1.4	--	3.6	2.5	2.0
Project Control Director	3.6	--	--	--	--	--	0.8	1.0
HSE Manager	--	--	--	--	--	3.6	1.7	--
HSE Supervisor	--	--	--	--	--	3.6	0.8	1.0
HSE Officer	--	--	2.7	4.1	--	7.1	0.8	2.0
Concrete Lab Supervisor	23.6	--	--	--	--	--	-	1.0
Concrete Lab Technician	14.5	--	--	--	--	--	--	--
Electrical Supervisor	--	--	--	--	--	14.3	0.8	--
Technical Office Supervisor	7.3	20.0	18.9	9.6	--	10.7	7.4	1.0
Mechanic Man	1.8	20.0	5.4	--	--	3.6	2.5	4.1
Foreman	1.8	--	5.4	2.7	--	3.6	--	4.1
Welder		--	--	2.7	--	--	--	--
Digger Operator	27.3	--	--		3.6	--	--	--
Worker	1.8	6.7	--	9.6	32.1	3.6	11.6	8.2
Material Supervisor	1.8	6.7	5.4	1.4		7.1	9.9	4.1
Light Machinery Driver	--	20.0	5.4	20.5	32.1	--	1.7	26.5
Heavy Machinery Driver	--	--	2.7	2.7	--	3.6	--	2.0
Project Manager	--	--	--	--	--	--	2.5	--
Quality Assessment/ Quality Control	--	--	--	2.7	--	3.6	--	1.0
Installation	--	--	--	--	--		--	
Maintenance Supervisor						3.6		2.0
Machinery Maintenance Supervisor	--	--	5.4	1.4	--	--	--	---
Surveyor	--	--	2.7	4.1	--	--	3.3	2.0
Office Clerk	--	--	27.0	16.4	--	21.4	24.8	8.2

The present study provided a novel theoretical combination regarding the correlations between musculoskeletal disorders, occupational stress, and general health. According to the obtained results, the industries with the highest stress levels represented the lowest general health levels in the employees.

Comparison of the status of occupational stress in the participants based on work experience indicated that the prevalence of occupational stress was higher in the individuals with 11-20 years of work experience (mean = 3.02 ± 0.551 years) compared to those with 1-10 (mean = 2.97 ± 0.543 years) and 21-37 (mean = 2.88 ± 0.0604 years) years of experience. This could be due to the fact that increased work experience is often associated with higher stress levels, while increased work experience to more than 20 years causes individuals to adapt to working conditions, thereby reducing occupational stress. Comparison of the general health status of the employees based on work experience indicated that the level of general health was almost similar in these individuals.

Comparison of the status of occupational stress in the employees based on their professional status indicated that the level of occupational stress was higher in the individuals with temporary contracts (mean: 3.31 ± 0.529). Previous studies in this regard have investigated the correlations between the parameters studied in the current research, such as the dimensions of occupational stress and their correlations with musculoskeletal disorders, denoting a significant association between the physical isometric load dimension the physical

isometric load dimension and musculoskeletal discomfort [24].

The findings of Kim et al. (2013) and Almeida et al. (2017) demonstrated a significant, positive correlation between occupational stress and occurrence of WMSDs. In the research by Kazemi et al. (2016), WMSDs had a profound effect on general health, and general health had a significantly, negative correlation with occupational stress. Similarly, Finney et al. (2017) reported a significant association between multisite peripheral joint pain and poor general health [25-28]. The aforementioned findings are consistent with the results of the present study.

Table 3: Means and standard deviations for Stress and General Health in industries

Industrial	Variables	
	Stress Mean ± SD	General Health Mean ± SD
Drilling project	3.14 ± 0.454	1.71 ± 0.455
Construction (bridge)	2.81 ± 0.43)	2.2 ± 0.554
Construction (high way)	3.22 ± 0.417	1.62 ± 0.305
Water diversion project	2.7 ± 0.697	2.07 ± 0.708
Construction (tunneling)	2.53 ± 0.573	2.25 ± 0.669
Construction (industrial-power plant)	3.08 ± 0.409	1.65 ± 0.435
Construction (building)	3.05 ± 0.48	1.65 ± 0.511
Construction (rail way)	3.02 ± 0.513	2.06 ± 0.611

Table 4: Means and standard deviations for Stress and General Health in job categories

Job categories	Variables	
	Stress Mean ± SD	General Health Mean ± SD
Digger Operator	2.86 ± 0.531	1.85 ± 0.526
Executive Supervisor	3.15 ± 0.438	1.83 ± 0.57
Conservator	3.01 ± 0.481	1.54 ± 0.309
Cook	2.42 ± 0.628	2.39 ± 0.787
Mechanic Man	3.19 ± 0.632	1.68 ± 0.434
It Clerk	3.10 ± 0.182	1.80 ± 0.635
Project Manager	3.60 ± 0.428	1.46 ± 0.223
Concrete Lab Supervisor	3.29 ± 0.275	1.86 ± 0.655
Concrete Lab Technician	3.21 ± 0.42	1.64 ± 0.339
Care Taker	2.54 ± 0.644	2.22 ± 0.552
Worker	2.5 ± 0.582	2.55 ± 0.516
Material Supervisor	2.86 ± 0.592	1.93 ± 0.721
Technical Office	3.12 ± 0.456	1.88 ± 0.478
Foreman	2.7 ± 0.454	1.92 ± 0.802
Electrical Supervisor	3.24 ± 0.297	1.47 ± 0.204
Light Machinery Driver	2.79 ± 0.492	2.17 ± 0.692
Executive Director	3.56 ± 0.001	1.67 ± 0.002
Quality Assessment	3.09 ± 0.48	1.41 ± 0.338
HSE Officer	3.09 ± 0.529	1.65 ± 0.365
Welder	1.93 ± 0.751	2.21 ± 0.757
HSE Supervisor	3.44 ± 0.344	1.59 ± 0.675
HSE Manager	3.64 ± 0.072	1.4 ± 0.144
Heavy Machinery Driver	2.68 ± 0.38	1.82 ± 0.438
Installation Maintenance Supervisor	3.48 ± 0.0954	1.53 ± 0.556
Office Clerk	3.09 ± 0.534	1.58 ± 0.382
Machinery Maintenance Supervisor	2.61 ± 1.06	1.72 ± 0.553
Surveyor	3.19 ± 0.5	1.55 ± 0.226
Project Control Director	3.20 ± 0.198	1.48 ± 0.413

Table 5: Means and standard deviations of demographic variables for stress and general health

Demographic Variables	Stress Mean ± SD	General Health Mean ± SD
Job Experience		
1-10	2.97 ± 0.543	1.85 ± 0.605
11-20	3.02 ± 0.551	1.86 ± 0.57
21-37	2.88 ± 0.604	1.94 ± 0.657
Job Status		
Contractual	2.87 ± 0.554	1.87 ± 0.605
Official	3.06 ± 0.413	1.65± 0.397
Temporary Contract	3.31 ± 0.529	1.92 ± 0.53
Age		
≤ 42	2.98 ± 0.538	1.84 ± 0.592
43-52	2.99 ± 0.607	1.95 ± 0.619
≥ 53	2.71 ± 0.526	2.06 ± 0.640

4. Conclusion

According to the results, WMSDs and occupational stress were significantly correlated in the industrial employees. Furthermore, a significant, positive correlation was observed between WMSDs and occupational stress, and significant, negative associations were denoted between WMSDs, occupational stress, and general health. The current research also denoted significant, positive associations between musculoskeletal disorders, work-related fatigue, and job burnout, as well as significant, negative associations between job satisfaction and musculoskeletal disorders, work-related fatigue, and job burnout.

In conclusion, the following recommendations are proposed:

•Modifying the workplaces of the individuals who perform long-term static tasks;

•Periodic identification of the individuals with musculoskeletal problems and taking measures to correct their posture;

•Designing proper physical exercises for the individuals with hard work postures;

•Cognitive-behavioral educational interventions to raise awareness regarding the disadvantages of mental health problems.

Authors' Contributions

Kh. A., designed the study, E. A., conducted the field work and Z. J., analyzed the data and wrote the manuscript.

Conflict of Interest

The author report no conflict of interest.

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