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Relationship between job stress and musculoskeletal disorders among the personnel of rescue groups: Structural equation modeling

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Abstract

Background: Job stress is considered as the most recognized health threatening in workers.
Objective: The present study aimed to investigate the relationship between job stress and musculoskeletal disorders among personnel of rescue groups.
Method: This descriptive analytical and cross-sectional study was conducted on 114 personnel of rescue groups including firefighters and personnel of emergency and Red Crescent in Qazvin. Data were collected using the Nordic questionnaire and job stress (HSE-Q). Structural Equation Modeling (SEM) was used to investigate the relationship between job stress and musculoskeletal disorder. The data were analyzed using the LISREL software version 8.8.
Results: Job stress related to communication was found more frequent than other domains. In assessing of musculoskeletal disorders, low back devoted more prevalent (53.5%) than the neck and shoulders. A significant correlation was found between job stress and prevalence of disorders.
Conclusions: According to the results of this study, job stress predicts 10% of the prevalence of musculoskeletal disorders among the personnel of rescue groups. Therefore, musculoskeletal disorders can be reduced 10% by management and controlling factors that affect job stress among workers.

Keywords: Modeling, stress, musculoskeletal disorders, rescue.

1. Background

Musculoskeletal disorders are major problems in the workplace (1) Over the last year, a large number of working days have been lost due to such disorders. Musculoskeletal disorders also resulted in workers' inability in the industrialized countries (2). A large number of work-related complications are related to musculoskeletal disorders, so that about 60% of them are related to back pain (3). Different risk factors have an important role in occurrence of these damages, which can be divided into biomechanical agents (awkward posture, exertion and repetitive motions), physical and environmental agents (vibration and temperature), psycho-social and organizational agents in the workplace (lack of social support, job stress and high demand for production) and personal factors (gender, age and BMI) (4).

Measures to improve working conditions include engineering measures such as workstation design, administrative measures such as correct choice of tools and equipment, rotation of work, reducing working hours, training, etc. Therefore, ergonomic interventions are considered as a means of improving working conditions. However, ergonomic interventions alone are not enough to control musculoskeletal, and psychosocial problems in the workplace should be considered including factors contributing to back pain in workers with this problem compared to workers who do not have back damage (1) .

Studies have shown that stress and mental pressure can lead to resignation, repeated work place absenteeism, reduced productivity (5), loss of creativity, being incompatible with colleagues (6), reduction of correct and on time decisions, decreased ability, skill and work commitment, sense of incompetence, depression and work fatigue (7). In Europe, 20 million euros allocate to expense resulting from stress every year. In the US, this cost is estimated around $ 350 million per year (8).

Stress is defined as the pressure resulting from too much needs and constraints (9). Job stress is one of the most important phenomena in the social life, which has serious threats to the health of workforce in the world.

Job stress is also important for safety in the workplace (10). In the study of Armon et al. (2010), conducted on apparently healthy staff, it was found that work-related stress accumulated over time can cause burnout and

consequently increase the risk of musculoskeletal disorders (11). In the study of Sorour et al. (2012), conducted on emergency nurses, it was reported that job demands and burnout are related to the prevalence of musculoskeletal disorders among nurses (12).

Rapheal and colleagues (2015) found that organizational justice is effective on white collar workers musculoskeletal syndrome and Job Demand Control (JDC) on blue collar workers' syndrome. According to the results, Effort – Reward imbalance (ERI) is also effective on both groups of workers' syndrome (13). Based on the study of Luz and peer (2015) stress existence among workers is effective in increasing musculoskeletal signs (14).

2. Objective

A few studies have been conducted in the field of occupational stress on the prevalence of musculoskeletal disorders among personnel of rescue groups and also investigation of this relations through modeling. The aim of this study was to determine the relationship between job stress and prevalence of work-related musculoskeletal disorders among the personnel of rescue groups.

3. Methods

3.1. Participants

In this descriptive-analytical and cross-sectional study, the target population is the personnel of rescue groups including firefighter, personnel of emergency and Red Crescent in Qazvin city. The sample size was estimated 114 subjects, by considering 53% prevalence of musculoskeletal disorders among firefighter based on previous studies (15) and using of formula $N = \frac{\left(z_{1-\frac{\alpha}{2}}\right)^2 p(1-p)}{(d)^2}$.

3.2. Tools and method of measurement

Data were collected using the Reliability and validity Nordic questionnaire (16) and job stress (HSE-Q). In the Nordic questionnaire, demographic data, disorders during the past year in the neck, shoulders, back and whole body (pain or discomfort at least in a part of the body) were collected. Job Stress Questionnaire (HSE-Q) contains 35 questions and 7 domains (demand, control, support of authorities and colleagues, relation, role and changes This questionnaire was a 5 optional Likert scale (never, rarely, sometimes, often and always (17).

In order to carry out the work, after arrangements with the fire station, Emergency and Red Crescent Departments, full explanation was provided to the participants on how fill out the Nordic questionnaire. Then, subjects completed the self-report questionnaires (18). People with at least one year of work experience were included in the study. People with an underlying medical condition were excluded from the study; in this case, the person was asked to not complete the questionnaire.

Structural equation modeling (SEM) was used to discover the casual relationships between latent variables of job stress and prevalence of musculoskeletal disorders. In this model, job stress was considered as the independent variable, and prevalence of musculoskeletal disorders was considered as the dependent variable. The LISREL version 8.8 was used for data analysis including estimating the model, model goodness of fit test and the causal strength. The data were described using the SPSS version 18.

3.3. Structural equation modeling (SEM)

In this way of modeling, latent variables that could not be observed and measured directly, have been obtained by statistical data and have been derived from a set of observed variables. Each LISREL model contains two submodels. Measurement model refers to the relationships between observed and latent variables so that if all of standardized path coefficients is more than 0.7, measurement mode is ok. Structural model expresses the relationships between latent variables that R^2 more than 0.3 shows good predictive power.

The structural model is used for expressing the casual effect of exogenous variables (independent) on the endogenous variables (dependent) to measure job stress latent variable, observe variables of demand control, support of authorities and colleagues, relation, role and changes and also for measuring prevalence of musculoskeletal disorders latent variable, observed variables of whole body, neck, low back and shoulder were used.

3.4. Fit indices model

Harmony and agreement of this model were assessed with tests or Chi-square statistical indicators, Non-Centrality Parameter (NCP): Basically it reflects the extent to which a proposed model does not fit the data, Root Mean Square Error of Approximation index (RMSEA): Shows how well the model fits the population covariance matrix, AIC index: AIC value of theoretical model should be smaller than that of saturated model and independent model, NFI (Normed Fit Index): Computed by relating the difference of the chi-square value for the proposed model to the chi-square value for the independence or null model, NNFI (Non-Normed Fit Index): NNFI is a simple variant of the NFI that takes into account the degrees of freedom of the proposed model and CFI (Comparative Fit Index): Logic of comparing a proposed model with the null model assuming no relationships between the measures indexed (19), path coefficients (standard operating loads) and squared multiple correlation (R^2).

4. Results

Subjects' demographic and occupational characteristics are presented in Table 1. The mean age of participants was 31.65 ± 6.5 year.

Table 1. Demographic and occupational information of the subjects (n= 114)

Variables		Mean ± SD / percent	
Age (year)		31.65 ± 6.5	
Weight (kg)		78.3 ± 9.9	
Height (cm)		177.5 ± 6.6	
Working hours (per month)		120.65 ± 110.2	
Work experience (year)		8.38 ± 5.00	
		Frequency	**Percent**
Education	Lower than Diploma	3	2.6
	Diploma	23	20.2
	Associated Degree	38	33.3
	Bachelor Degree	45	39.5
	Postgraduate	3	2.6
Job	Firefighter	34	29.8
	EMS	52	45.6
	Red Crescent	28	24.6

Assessing the prevalence of musculoskeletal disorders in some parts of the body including back, shoulders and neck showed that low back area allocated more prevalence (53.5%) in comparison with the neck and shoulders. Sixty-eight people had pain at least in one of the regions in the body (Fig.1).

As Table 2 shows, job stress related to communication was found more frequent than other domains. Also, the results of job stress were presented among three groups (firefighter, EMS and Red Crescent) in Table 2. Findings showed that firefighter have more stress in comparison with the personnel of emergency and Red Crescent. Overall, findings on job stress among the personnel of rescue groups showed that most people have little stress in their jobs.

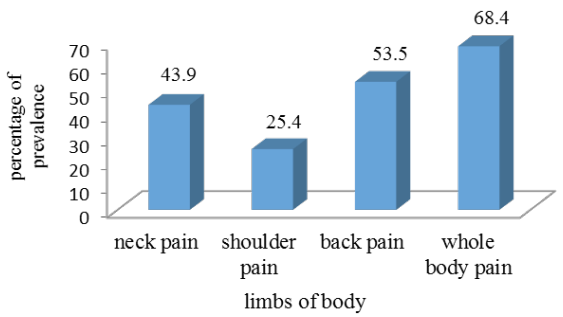

Fig.1. Frequency of musculoskeletal disorders in the whole body, neck, shoulder and low back

Table 2. Frequency and percentage of job stress in different domains

Stress amount / domain	Without stress		Low stress		Moderate stress		High stress	
	number	percent	number	percent	number	percent	number	percent
Demand	23	21.3	66	61.1	15	17.6	0	0.0
Control	47	43.5	42	38.9	17	15.7	2	1.9
Support	36	33.3	50	46.3	18	16.7	4	3.7
Relation	21	19.4	43	39.8	35	32.4	9	8.3
Role	94	87.0	11	10.2	3	2.8	0	0.0
Changes	29	26.9	48	44.4	27	25.0	4	3.7
Job stress	19	17.6	85	78.7	4	3.7	0	0.0
Firefighter	3	15.8	29	34.1	2	50.0	0	0.0
EMS	11	57.9	38	44.7	1	25.0	0	0.0
Red crescent	5	26.3	18	21.2	1	25.0	0	0.0

4.1. Structural equation modeling and fit indices model:

Path diagram of standard factors loads (the numbers outside the parentheses between latent and manifest variable and, endogenous and exogenous latent variable), errors (numbers out of manifest variable parentheses) and t-value (numbers inside the parentheses) of job stress model with prevalence of musculoskeletal disorders have been shown in Fig.1. In the standard load, relations between variables are presented in the forms of solidarity so that this issue helps to identify the relative role of independent latent variable on the dependent latent variable, observed variable and related factor. Sign and magnitude of coefficients indicate the type of relationship (positive or negative) and intensity of predicted relationship between variables. As Fig. 2 shows, some variables show relatively high correlation. R^2 is the relative amount of the dependent or endogenous variable variance, which has been explained by exogenous variable.

The obtained t-value in Fig.2. shows that the most loading factors are meaningful in 95% interval confidence (the absolute value of t-value is greater than 1.96).

As mentioned in Table 3, most fit indices are for measuring fit of whole model and they represent good fit, compatibility and agreement of whole model with experimental data.

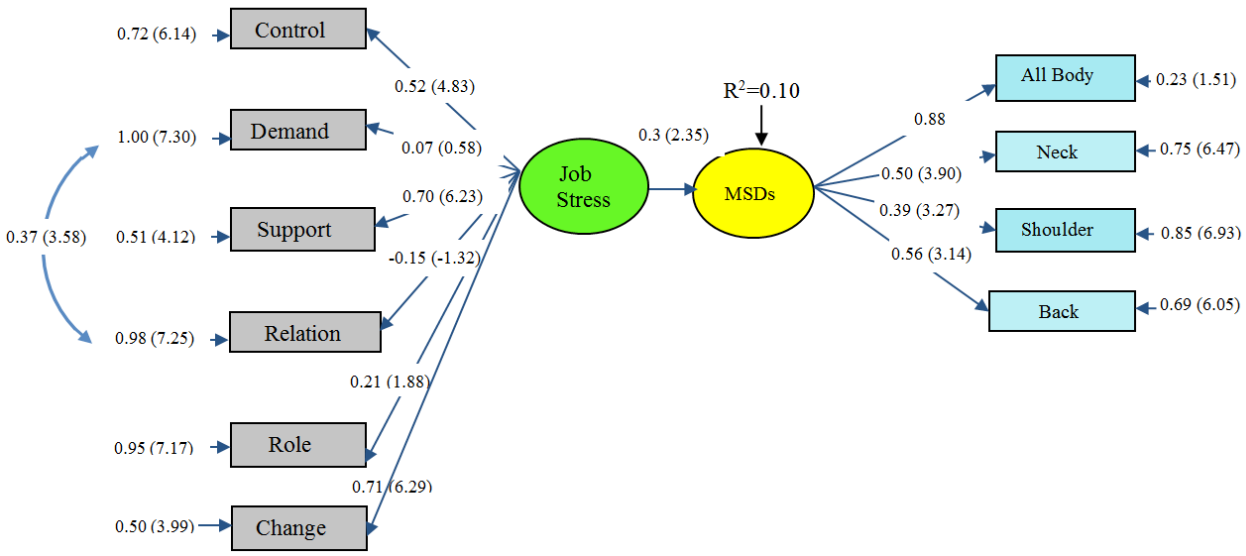

Fig.2. Structural equation modeling of job stress with prevalence of musculoskeletal disorders, standard loads, errors, t-value and variance of latent variable. Chi-Square= 35.31, df= 33, P-value= 0.35961, RMSEA= 0.026

Table 3. Threshold of fit indices and fit indices of job stress model effect on prevalence of musculoskeletal disorders

Chi-square test (χ^2) P > 0.05	χ^2/df <2 or <3 Or 2:1 or 5:1 ratio	NCP close to 0	RMSEA £0.05: good fit; <0.08: reasonable fit	Model AIC < Saturated AIC and independence AIC	NFI >0.90	NNF I>0.90
P =0.36	1.07	2.31	0.026	260.32<312.52 and 256.36	0.83	1.00
CFI>0.90 Preferably>0.95	**SRMR<0.08 Preferably<0.05**	**GFI >0.9 or >0.8**	**AGFI >0.9 or >0.8**	**PGFI >0.50**	**Measurement model assessment Standardized path coefficients > 0.7**	**Structural model assessment R2 more than 0.3**
1.00	0.066	0.94	0.90	0.56	0.07 - 0.71	0.10

5. Discussion

Approximately 65% of people in this study suffered from discomfort of musculoskeletal disorders in at least one area of the body in the past year (or at the time of the study). The results of this study are in line with studies conducted by Hasanzadeh Rangi and colleagues and Aminain et al. with the prevalence of 74.4% (18, 20). Results of the prevalence of disorders in low back, neck and shoulders also showed that the highest complaint was 53.5% in low back region. The results of Arial et al. a study conducted by with 56%. prevalence of back pain among personnel of rescue groups, Gholami et al. with mean of 43.5 among nurses, Maleki et al. with 49% prevalence among firefighters, Aminian and peers with prevalence of 48.5% and Bolghanabadi et al. with prevalence of 69.8 are in line with this study (15, 20-22). Staff of health services such as the rescue groups and nurses are at high risk of low back discomfort and musculoskeletal disorders due to pressure caused by the weight of the patients, heavy and high physical activities including carrying people during operations and emergency situations, awkward postures during doing works, long and repetitive actions (23).

Among the domains of job stress, domains of communication, changes and support devote moderate to high percentage in ration to other domains, which include 40.7, 28.7, 20.4 percent. These results are in line with the results of Gholami and colleagues study only in support aspect (22.7 percent) because other domains are not included due to different job stress questionnaires (22).

Also the results of a study conducted by Anam et al. showed high prevalence of job stress and its causes among firefighters in which the domains of support and changes are 5 and 2.51 (24). In Gomez et al. study, which evaluates stress, support domain (colleagues, supervisors and social supports) has the greatest percentage, which is in line with this study (25).

In the present study, high percentages of communication, changes and support domains of job stress indicate that factors affecting the prevalence of musculoskeletal disorders include lack of proper communication in the work place, lack of proper support from colleagues and supervisors at work and personal issues, and lack of preparation for changes in the workplace.

Obtained t-values in the present model indicate that parameters are significantly different from zero and show that manifest variables of model (whole body, neck, shoulder, low back discomfort, control and …) have relatively proper validity for the latent variables of musculoskeletal prevalence ad job stress.

Findings of this study showed that job stress predicts the incidence of musculoskeletal disorders by 10 percent; therefore, job stress is a factor affecting on the prevalence of musculoskeletal disorders. Findings of Aminian and colleagues' study about the relationship between prevalence of musculoskeletal disorders and job stress among administrative workers showed that job stress is an important risk factor for musculoskeletal disorders, which is similar with the present study (20). Also results of studies conducted by Tajiok et al., Rasolzadeh et al., and Tabatabaei et al. are in line with this study (26). Inappropriate psychosocial factors in workplace were also found contributing to back pain (1), and work-related stress among employees could result in increasing the risk of disorders (11, 14).

Among the advantages of this study, we can note to assess the relationship of job stress with the prevalence of musculoskeletal disorders among the personnel rescue groups that have been examined limitedly in previous studies. Also assessing of this relationship in a casual way and predicting the effects of stress on the prevalence of musculoskeletal disorders are other advantages of the present study.

One of the limitations of this study is not proceeding to the intermediate agents in increasing the prevalence of musculoskeletal disorders caused by job stress and other contributing factors like personal and occupational factors.

5.1. Conclusion

Given the high percentage in the communication domain, changes and support from job stress and 10% prediction of job stress based on musculoskeletal disorders, some of controlling measures can be suggested for reducing job stress in the personnel of rescue groups and subsequent decrease in the prevalence of musculoskeletal disorders. Some measures are suggested including encouraging employees by upstream officials, supporting staff by colleagues and supervisors, workplace layout for more communication between colleagues and variety in doing duties.

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Footnotes

Authors' Contribution: Payam heydari, Sakineh Varmazyar and Chia Hakimi carried out the study design, data collection and the statistical analysis and drafted the manuscript.

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