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Relationship between Job Stress and Ergonomic Behavior with Musculoskeletal Disorders in an Auto-part Production Company

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Background & Aims of the Study: Worker's behaviors, uncontrolled job stress, psycho- social factors and non-ergonomic principles, lead to risk of musculoskeletal disorders. This rsearch was done conducted to analyze relationship these factors in an auto-parts production company in Qom province, Iran in 2015.

Materials and Methods: This study was a cross-sectional one conducted on all workers (n=113). To measure the ergonomic behavior, behavioral sampling checklist was used. Researcher-made demographic and Nordic questionnaire beside valid HSE job stress questionnaire were used. Data analysis was done with SPSS V20 using Poisson regression method.

Results:: Age's average of studied workers was 26.76±4.6 and work history was 3.49±3.36 years. Eighty nine ones (%66.9) experienced at least musculoskeletal pain at one part of their body. Highest rate of pain was reported in low back pain (58.42%). Among 1792 observed behavior, 49.61% of behaviors were ergonomic. The manual handling behavior with 76.19% as the rate was the worst. Mean (±SD) of occupational stress score was measured 95.72 (±14.25). According to Poisson regression musculoskeletal disorders among men were significantly less than women (38.3%) (P=0.04). With one unit, increasing in ergonomic behavior, disorders were decreased 3.35 times (P <0.001). Also, accompanied with increasing the demand score, we would be experienced a 50% reduction in musculoskeletal disorders.

Conclusion: Based on our finding, studied workers were in high degree risk of job stress. In addition, stress and behavior were correlated with musculoskeletal disorders prevalence.

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Background

Job has critical role in people's lives and has significant impacts on their life's quality. From the 1960s, a huge amount of people's lives pased in the workplaces and finding jobs and employment is as a vital challenge for men or women. However, jobs are an important stress source in our world (1). Occupational stress has negative effect on healthy status of people and the chance of more work-related accidents is increased (2). Job related stress is a sort of stress that is in relation with the occupation. Occupational or job stress usually resulted from unforeseen duties that is not in line with capability of people to manage it. This kind of stress will have a rise when staffs do not experience any baking by mangement and/or

coworkers, or when sense lower levels of control on their duties (3). Occupational kind of stress can rise by different effects of work environment. The place, sex, climate, and various factors have role in stress. Experts have different points of view around importance of employees' quality and work environment in stress (4). In one of the categories were taken on stressors at work three major categories can be observed: physical agents (inflexible rest regime, repetitive and simplified tasks), psychological factors (lack of authorization to perform tasks, lack of accountability of management to the concerns of employees) and environmental factors (including unsafe working conditions, excessive noise and lack of adequate working environment) (5). Continuous industrial growth and workers improvement has been caused to increasing in occupational diseases rate (7,6). Diseases caused by ergonomic and mechanical factors are of principal sorts of disorders (8). Ergonomic factors can bring out tension injuries, stress and mental load and also productivity and quality loss of work. Musculoskeletal disorders are included to ergonomic related factors job disease (9). Musculoskeletal disorders is a prevalent reason for disability in developing countries (6,7).

Individuals' unsuitable behaviors and lack of notice to ergonomic principles while working lead to different problems in different areas of the body. Application of ergonomic principles can be seen in ergonomic behaviors (10).

Consequently, aided by the ergonomic behaviors we can prevent from many damages and injuries known as ergonomic injuries are known named Cumulative Trauma Disorders (CTD). This principle is expressed to different behavior, such as about manual handling behavior ergonomic principles can be stated: bending the knees, keep the load close to the body and lifting a right weight. If persons follow these principles, their behaviors are considered as ergonomic behavior and if these principles are not follow, behaviors are considered non-ergonomic behavior (11). In fact, the ergonomic behaviors are behaviors that directly linked to ergonomics; behaviors such as proper manual handling, good posture when working and talk to colleagues about ergonomic principles or challenges are examples of ergonomic behaviors (11). Unlike many occupational diseases that may arise from exposure to a hazardous substance, often musculoskeletal disorders are multifactorial (12-14). Various risk factors participate in injuries and musculoskeletal disorders. These risk factors can be categorized to physical factors (awkward posture, heavy loads lifting and carrying and activities with repetitive movements), psychological and personal factors (15,16).

Although, factors such as physical work, repetitive tasks and awkward posture can result in CTD, but in recent decades the role of stress in CTD is well documented (17). Because stress is a consequence of complex effects of a huge system of related variables, there are different psychological theories and models that say about occupational stress. In many models Psycho-social factors are regarded as initiator of stress. Person Environment Fit Model, Job Characteristic Model, Diathesis Stress Model, Jobs Demand Resource Model and Effort Reward Imbalance Model are examples. It seems that psycho-social factors increase risk of disorder related to non-ergonomic behaviors (3, 18). Regarding to the prevalence of CTD among countries, especially developing countries, reduction and prevention has been raised as a key priority at the global level.

Aims of the study:

Therefore, the present study was developed aimed to evaluation relationship between job stress and ergonomic behavior with musculoskeletal disorders in an auto-part production company in Qom province, Iran in 2015.

Materials & Methods

This was a cross-sectional study done on all workers (n=113) working in an auto-part Production Company located at Qom province. To evaluate the ergonomic behavior, behavioral sampling was used. Minimum number of needed observations was acquired based on a pilot phase. Then the total numbers of needed observations were obtained regards to the ergonomic and non-ergonomic behaviors (19,20). Equation 1 was applied to calculate. In this equation P was non-ergonomic behavior possibility, P-1 was an ergonomic behavior possibility and e desired accuracy. After doing the pilot study (n=100), the proportion of non-ergonomic acts was calculated to be around 53% With 5% accuracy and 99% confidence level; the total observations was 1792.

$$\begin{cases} N = \dfrac{\left[Z^2_{1-\frac{\alpha}{2}}(1-P)P\right]}{e^2} \\ \alpha = 0.05\,,\ Z_{0.95}{\sim}2 \\ e = 0.03 \end{cases} \qquad \text{(Eq. 1)}$$

Ergonomic behavior sampling should be done in random. This was obtained when all observation time was selected randomly from all the workday time. Therefore, in the next stage the observations were done in a random manner. It means that each observed workers (113 workers) and observations frequency were picked randomly. Getting it in the mind that the behavior of workers might experience changes from time to time, the observation duration is really important in accuracy of the results. This duration is needed to be short to observe and elaborate the behaviors. In our research, the duration average was three seconds. Non-ergonomic behaviors were carefully gathered in a time limit of three seconds. The observer did the observations randomly, meanwhile the subjects were not concious of the fact that they were being observed. A specific list was used for each day. Ergonomic behaviors were also observed using valid and reliable checklist (11). Detail design of behavioral sampling and list of behaviors could be seen in our previous work (11). In summary, three main behaviors including carrying, posture and lifting were assessed.

A researcher developed demographic questionnaire was used in line with the objectives of the study, including gender, age, work history, marital status, education level and work system (shift working or day working). An also valid job stress questionnaire (HSE) was used with seven subscales. This questionnaire was presented and validated on a 1–5 Likert scale, ranging from “always” to “never”. More score means more stress (21-25). Also, Nordic questionnaire was considered to assessing the musculoskeletal disorders (26). This questionnaire is focused on the issue that musculoskeletal disorders in which the body organs are centralized (27). Nordic questionnaire is categorized human body into anatomical areas. All questionnaires were completed as self-reported with semi-supervision intervention. Data analysis was done with SPSS V20 and using Poisson regression, in significance level of 0.05.

Results

In this study total workers (n=133) were selected including 112 males (84.2%) and others females. Among participants (40.6%) were single and others were married. The mean age of studied workers was 26.76±4.6 years and work history was 3.49±3.36 years. Detailed information regarding demographic variables was shown in Tables 1 and 2.

Mean job stress score was calculated equals to 95.72. Descriptive information about total job

stress score and its subscales was listed in Table 2.

Table 1) Qualitative demographic factors description (n=133)

Factor		Frequency	%
Gender	Male	112	84.2
	Female	21	15.8
Marital status	Married	79	40.6
	Single	54	59.4
Education	lower Diploma	63	47.7
	Diploma	49	36.8
	Associate's degree	7	5.3
	Bachelor	14	10.5
Shift working	Yes	53	39.8
	No	80	60.2
WRMSD*	No	44	33.1
	Yes	89	66.9

* Work Related Musculoskeletal Disorders

Questionnaire reliability was assessed via internal consistency. Cronbach's alpha coefficient was measured as 0.75. This value indicates the acceptable reliability of the questionnaire.

For ergonomic behavior based on the primary pilot test (n=100) had been shown that 53% of total observed behaviors were ergonomic. Among 1792 observed behaviors, 49.61% of behaviors (n=889) were ergonomic and 50.39% of total behaviors (n=903) were non-ergonomic. The manual handling behavior with the rate of 76.19% had been the worst. In the other hand behavior named carrying of the proper load weight with the rate of 5.1% had been the best (Table 3).

Table 2) Description of occupational stress and demographic factors (n=133)

Variables	N	Minimum	Maximum	Mean	Std. Deviation
Age	133	18	40	26.79	4.601
Work experience	132	.08	19.00	3.5175	3.36313
Total stress	133	66	131	95.72	14.259
Demands	133	9	35	21.72	5.380
Control	133	6	26	17.25	4.507
Managerial support	133	5	22	13.06	4.050
Peer support	133	4	18	9.59	3.555
Role	133	5	22	9.36	3.665
Change	133	3	15	8.02	2.795
Relationships	133	7	20	16.71	2.922

Among studied workers 89 ones (%66.9) experienced at least musculoskeletal pain at one part of their body. Highest rate of pain was reported for low back pain (58.42%), wrist (40.45%) and neck (37.01%). Lowest rate of pain was reported for back of left hand (3.37%), back of right hand (4.5%) and right thigh (5.61%). Also using by Poison's regression relationship between job stress subscales and ergonomic behaviors with musculoskeletal disorders was assessed. Obtained data about this model is revealed in Table 5.

According to Poisson regression model results (Table 5) musculoskeletal disorders among men were significantly less than women (38.3%) (P=0.04). On the other hand, with the one unit, increasing for ergonomic behavior, disorders were decreased 3.35 times (P<0.001). Also, accompanied with increasing the demand score, we would be experienced a 50% reduction in musculoskeletal disorders. For other studied factors were not observed correlation with musculoskeletal disorders statistically (P>0.05).

Table 3) Frequencies (%) of the observed total and ergonomic behaviors

	Lifting					Posture						Carrying						
total	**proper load weight**	**load close to body**	**use of legs while lifting**	**moving feet**	**proper grip of load**	**neck**	**Upper arm**	**Lower arm**	**wrist**	**trunk**	**leg**	**proper load weight**	**load close to body**	**distance of carrying**	**proper grip of load**	**carrying on dry, clean, even floor**	**symmetric carrying**	
1792	51	41	21	87	62	207	222	216	219	206	212	51	44	39	40	46	58	**total**
889	41	25	5	21	23	56	87	163	106	81	117	38	37	29	14	22	24	**Ergonomic**
49.6	80.4	61	23.8	24.1	37.1	27	75.5	77.6	39.3	49.9	55.2	73	84.1	74.4	35	47.8	41.4	%

Table 4) Relative frequency of the MSD in different body part

Body part	Number		%	
	R/L		**R/L**	
	Right	**Left**	**Right**	**Left**
Shoulder	10	11	11.23	12.35
Upper arm	7	7	7.86	7.86
Lower arm	10	9	11.23	10.11
Wrist	36	36	40.45	40.45
Back of the hand	4	3	4.5	3.37
Palm	8	8	8.98	8.98
Hand fingers	30	27	33.7	30.33
Hip	9	9	10.12	10.12
Thighs	5	6	5.61	6.74
Leg	16	16	17.97	17.97
Trunk	52		58.42	
Neck	33		37.01	
Back	14		15.73	

Table 5) Poison's regression Model results for Stress, behavior and WRMSD

Parameter	β	Std. Error	Sig.
(Intercept)	1.680	0.9238	0.069
Gender	-0.383	0.1867	0.040
Marital status	-0.054	0.1556	0.730
Education/lower diploma	0.296	0.2619	0.258
Education/diploma	0.336	0.2650	0.205
Education	0.038	0.3989	0.925
Shift working	-0.236	0.1667	0.157
Training	0.146	0.1748	0.404
Posture behavior	-3.347	0.5817	0.000
Lifting behavior	-0.516	2.3051	0.823
Carrying behavior	0.151	1.6732	0.928
Demands	0.050	0.0155	0.001
Control	0.036	0.0185	0.054
Managerial support	-0.007	0.0247	0.771
Peer support	-0.014	0.0217	0.506
Role	0.033	0.0229	0.152
Change	-0.056	0.0347	0.110
Relationships	-0.033	0.0257	0.202
Age	-0.015	0.0186	0.408
Work experience	0.016	0.0233	0.482

Discussion

Nowadays work related musculoskeletal problems as a world challenge have crossed countries and has become an international issue. Based on this fact, ergonomic disorders are most serious outcomes caused by work load that will lead to motion restriction, loss of work time and quality as well as disabilities (27). Musculoskeletal pain such as low back pain or neck pain would affect negatively on quality of work life (28). Musculoskeletal problems are obvious among people in various occupations, for example in industrial settings, organizations and health care systems. In many countries ergonomic disorders more than other occupational diseases brought out absence or disability (29). Ergonomic disorders besides non-occupational have occupational risk factors. Activities such as sports, driving (30) along with the stresses as well as behaviors at home or workplaces could influence on ergonomic pains and injuries. Also demographic and socio-economic state and psycho-social factors have effect on injury severity. Job stress as a multifactorial element is critical in occupational health and safety plans. It is estimated that from any four people, one experienced this challenge in occupational environments (31). Many researches have been done about the relation between stress and musculoskeletal disorders (32-34). However, many limitations could be fined about occupational stress management techniques and musculoskeletal disorders reduce and it seems that there is not enough transparency in these fields (31).

However, we cannot forget the effect of behaviors on workers' health status. Behavior that is directly related to ergonomics, such as correct manual handling, correct posture, carrying or repetitive motion is defined as ergonomic behaviors (11). Attention to workers' behaviors and behavior's outcome on physical and mental health of workforces is crutial. Regards the before mentioned, we designed and conducted a research for integration of stress, behavior and ergonomic disorders.

Respects to the obtained results, studied subjects had little work history (3-4 Years). The pain arising from musculoskeletal diseases based on the Nordic Questionnaire (Table 4) showed that about 66.9% of individuals had experienced pain at least in one limb of their bodies. Since rising of work experience and age will lead to a negative impact on musculoskeletal systems, this finding indicates that the ergonomic condition in the studied workplaces is detrimental. Back with the rate of about 58.42% was in the top list than in wrist and neck regions, respectively in the next level. Our results are lower than other researches.

Choobine et al. showed that 84.4% of the participated nurses in the study had pain in at list one areas of their bodies (35). Low age and work history of the persons in this study can result in this differentiation. Most problems were reported in the back in this study, wrist and neck and that was similar to previous researches in this field (35-38). Although in past studies, differences between male and female in the view points of musculoskeletal disorders was not been reported (39), in our research, women had experienced more problems than men. Women in different jobs have been encountered with different risks than men. This issue can be seen for this difference. Because dispersion distribution of women work forces among different industries it is suggested that similar research done in major industries with significant numbers of women workers.

Considering the results that were revealed in Table 2 Mean (±SD) of occupational stress score was measured equals to 95.72 (±14.25). This level of job stress is considered medium to high. Also, using OSIPOW questionnaire in complicated jobs depicted stress in high points (40).

The negative impacts of work-related stress are included consequences such as fatigue, anxiety, depression, sleep disturbances, job rotation, intention to leave, dissatisfaction, poor commitment, weak cooperation, loss in productivity, absenteeism and difficulty in making decision (41-43). In addition, stress accompanied with poor posture as well as unsafe behaviors (44). Our data was revealed that about 50% of total sampled behaviors were non- ergonomic. Data analysis resulting from Poisson regression analysis which is in line with other works (41,45) has revealed that job stress and musculoskeletal disorders were significantly related ($P < 0.05$). Also, behaviors as previously described (11) was associated with the musculoskeletal disorders. Organizations can by improving safety climate and occupational stress management help their staff to promote safe/ergonomic behaviors (44).

Conclusion

Based on our finding, studied workers were in high degree risk of job stress. In addition, stress as well as behavior was correlated with musculoskeletal pain prevalence. Developing and applying comprehensive occupational stress management plan and suitable training all around the job behaviors (with focuses to women) can lead to safer work, better posture, higher productivity and lesser musculoskeletal disorders and increase in workers' health and safety status. Also similar comparable researches in major industries with significant numbers of women workers are recommended.

Footnotes

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Conflict of Interest:
The authors declared no conflict of interest.

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