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Relationship between workload and low back pain in assembly line workers

Original Article

Reza Kalantari[1]*,Shirazeh Arghami[2], Elham Ahmadi[3], Ehsan Garosi[1], Ahmad Zanjirani Farahani[1]

1. Department of Occupational Health Engineering, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran.
2. Department of Occupational Health Engineering, Zanjan University of Medical Sciences, Zanjan, Iran.
3. Department of Occupational Health Engineering, School of Public Health, Shahid Beheshti University of Medical Sciences, Tehran, Iran.

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***Corresponding Author**:
Qods St., Poursina St. No.1 Building, Faculty of Health, Department of Occupational Health Engineering, Tehran University of Medical Sciences, Tehran, Iran.
Tel: +98 9125420218

Email:
kalantari_r@razi.tums.ac.ir

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Abstract

Introduction: Work pressure and excessive workload can jeopardize and impair the people's health. One of these impairments is musculoskeletal disorders. Among these disorders, low back pain is the most common and most costly problem. The purpose of this study was to investigate the relationship between workload and prevalence of low back pain in assembly line workers of a car manufacturing factory.
Methods: This cross-sectional study was conducted on 69 workers working in the assembly line of a factory. Data collection tools included three questionnaires: demographic questionnaire, NASA Task Load Index (NASA-TLX) and Cornell Musculoskeletal Discomfort Questionnaire (CMDQ). Data were analyzed by descriptive and inferential (T-test and One-way ANOVA) statistics.
Results: Of the workers, 72.5% were female. The average total workload was 71.42% and the prevalence of musculoskeletal disorders in low back was 43.37%. The results of the analysis of relationship between workload and the prevalence of low back pain showed a significant relationship between physical/ mental workload and the incidence of low back pain ($P<0.05$).
Conclusion: The more is the workload on the person, the greater is the risk of low back pain. Measures such as increasing the number of workers to distribute the workload, slowing the work pace, having work-rest periods for workers, improving psychological conditions of work, etc. can be useful in this regard.

Introduction

Workload is the amount of all works to be done by a person or group of persons at a certain time interval (1). Over the last few decades, many studies have been done on workload. Workload is a key issue in investigating and developing the human-machine interactions which lead to comfort, efficiency, and safety in workplace. These are the aims of ergonomics (2). Workload is not just specific to any job/duty, it is specific to each individual. This discussion includes individual capacity and motivation for work. In other words, it includes physical and psychological factors (3, 4).

Work pressure and excessive workload can jeopardize the health (5). One group of injuries are musculoskeletal disorders which are considered the main health problems associated with the industrial workers (6). In fact, the imbalance between job requirements and individual abilities can lead to musculoskeletal disorders (7).

Among these disorders, low back pain is the most common and most costly problem that has entangled the workers of industrial countries (8). Many factors can affect the risk of low back pain (9), and work-related low back pain has become a very important concern in recent years (10). According to reports, 22% of the 1.2 million occupational injuries and accidents in the United States leading to loss of working time are related to the low back pain (8). The total annual cost of low back pain in the United States is about 100 billion dollars (9).

Effective factors involved in the problem of work-related low back pain are varied and include personal, psychological and biomechanical factors (8, 11). Various occupational groups are at risk of different risk factors. According to these factors, the incidence of low back pain is different (12). Physical workload has been discussed as one of the risk factors of low back pain in recent decades (13, 14). On the other hand, high work pace and physical factors in assembly line (such as awkward posture, repetitive movements, etc.) can create excessive workload (7, 15). There is evidence indicating a dose-response relationship between physical workload and low back pain of longer duration (14). Because of the impact of workload on the workers' health, conducting this study seems important.

The purpose of this study was to investigate the relationship between workload and prevalence of low back pain in assembly line workers of a car manufacturing factory.

Materials and Methods

This study was conducted at the assembly line of a car manufacturing factory in 2014. The samples were

selected from among the workers who worked in the assembly line and did not have a history of chronic low back pain, lumbar disc surgery, and underlying problems in the lumbar area. A total of 69 out of 85 workers of this factory were eligible for inclusion in the study.

Data were collected using three questionnaires. The first questionnaire collected demographic information such as age, sex, height, weight, marital status, work experience and education level. The second questionnaire was NASA Task Load Index (NASA-TLX) which measures the workload from six aspects. Xiao et al tested the reliability and validity of NASA-TLX scale on 1268 workers from various kinds of occupations. Cronbach's alpha coefficient was more than 0.80, showing NASA-TLX was a valid and reliable tool (16). The six aspects of NASA-TLX include mental demand, physical demand, temporal demand, effort, performance, and frustration level. There are several ways to estimate the total workload. In this study, the samples answered 6 general questions and 15 questions which compared the mentioned items.

Cornell Musculoskeletal Disorders Questionnaire (CMDQ) was the third tool of collecting data used to determine the amount of prevalence, frequency, severity and impact of pain on workers. Afifzadeh et al distributed the CMDQ among 100 workers. The Cronbach's alpha coefficient for the three sections of frequency of discomfort, severity of discomfort and interference scales were reported to be 0.95, 0.96, and 0.96, respectively. The results showed that CMDQ is a valid and reliable tool (17). The pain repetition rate (1-2 times a week, 3-4 times a week, once a day, and several times a day), the pain intensity (low, medium and high) and the impact of the pain on the worker (inert, low impact, high impact) were measured by the third questionnaire.

Data were analyzed by SPSS 22 software using descriptive and inferential statistics. T-test was used to determine the relationship between demographics and prevalence of low back pain and workload, and one-way ANOVA test was used to assess the relationship between the workload and demographics.

In this study, ethical considerations for data collection were completely taken into account. First, the researchers got permission from the manager of the factory. Data were collected only from volunteer workers. Furthermore, name, characteristics and other information of the workers remained confidential. The manager asked the researchers not to publish the name of the plant.

Results

Having analyzed the demographic questionnaire, it was found that 50 samples (72.5%) were female and the rest were male. The means and standard deviations for age and work experience were 27.174 ± 3.64 and 2.4 ± 2.01 years, respectively, respectively. These data indicated that the studied population was young and had relatively little work experience. Of samples, 73.9% were single and 26.1% were married. Further, 5.8% held the secondary education, 30.4% had diploma, and the rest (63.8%) held an academic degree. The activities were done during the day, and nobody was a shift worker. The means and standard deviations fro the height and weight of workers were 165.72± 9.89 cm and 64.87 ± 12.71 kg, respectively.

All the subjects worked 8 hours a day and 48 hours a week. The NASA-TLX was used to determine the amount of workload. This scale measures the six aspects of workload. The results are presented in Table 1.

The mean total workload was calculated to be 71.42%, indicating a high level of workload among the study subjects. The average performance of 86.23% was the highest rate among the other items. Temporal demand, mental demand, physical demand, frustration and effort were placed in the next categories, respectively.

Table1. The mean and standard deviation of various aspects of workload

Workload	Mean and Standard deviation
Mental	66.66 ± 13.57
Physical	64.78± 17.70
Temporal	80.86± 14.92
Performance	86.23± 11.38
Effort	56.52± 17.55
Frustration	58.98± 21.08
Total	71.42± 9.92

The prevalence of low back pain among these patients was 43.37%, showing 43.37% (32 people) of the population felt a little pain at the waist at least 1-2 times a week.

With regard to the questions of the questionnaire, pain repetition, pain intensity and the impact of pain on the individuals were measured. The relevant data are shown in Table 2.

Table2. Repetition, intensity and the impact of pain among the individuals suffering from low back pain

Pain repetition		Pain intensity		impact of pain	
Times of repetition	Frequency (%)	Intensity	Frequency (%)	Impact	Frequency (%)
1-2 times a week	10 (31.25%)	Low	5 (15.62%)	Ineffective	8 (25%)
3-4 times a week	8 (25%)	Medium	16 (50%)	Low	9 (28.12%)
once a day	6 (18.75%)	High	11 (34.38%)	High	15 (46.87%)
Several times a day	8 (25%)				

The analysis of the relationship between workload and demographic characteristics revealed that women reported more workload than men (P-value =0.024). No significant relationship was found between other demographic characteristics and workload.

Investigation of the relationship between demographic characteristics and prevalence of low back

pain indicated that the prevalence of the lumbar disorders had a significant relationship with work experience (P-value =0.026) and marital status (P-value =0.009). Also, a significant relationship was found between pain repetition and work experience (P-value = 0.049) and marital status (P-value =0.039). Also, Pain intensity was significantly correlated to height and work experience (P-values = 0.045 and 0.047, respectively).

The study of the relationship between workload and prevalence of low back pain revealed a significant correlation between physical and mental demand and incidence of low back pain (P-value = 0.037 and P-value = 0.049, respectively). Also, there was a significant relationship between pain intensity and mental demand (P-value = 0.029) as well as between the impact of pain on the job and frustration (P-value = 0.033). There was no significant correlation between the occurrence of pain and the six aspects of workload.

Discussion and conclusion

The purpose of this study was to investigate the relationship between workload and low back pain in assembly line workers of a car manufacturing plant. The mean workload was found to be 71.42% and the incidence of pain was calculated to be 43.37%. The maximum and minimum levels of workload were reported for performance (86.6%) and effort (56.52%), respectively.

The results showed that the amount of physical workload had a significant relationship with the prevalence of low back pain, which is consistent with the findings of previous studies (11, 18). Dijken et al found that the prevalence of low back pain in workers was 41%. This result is in accordance with the prevalence of low back pain in this study. They also acknowledged that people with low back pain often suffered heavier physical workload (9). High levels of physical activity during working can increase the incidence of low back pain (10). There is a U-shaped association between physical activity and low back pain. If there is very low or very high levels of physical activity, a person is more prone to low back pain. (11)

The study showed that the individuals' work experience had a significant correlation with the incidence, intensity and repetition of low back pain, which is in line with the results of previous studies (11, 18). Hartvigsen et al found a significant association between workload and low back pain in the individuals with more work experience. The researchers also reported a dose-response relationship between workload and low back pain over a long time (14), and that these were cumulative injuries (6). Based on this relationship, people who have done heavy work in childhood are more prone to low back pain (11). Moreover, there was a significant correlation between the pain intensity and individuals' work experience.

The means of age and work experience of individuals were 27.17 and 2.4, respectively. The prevalence of low back pain was found to be worrying because the study population was young and had less work experience. The studies have shown that the early stages of low back pain, which are related to work, usually occur within the first year of work (11).

Women in comparison with men have less stamina because of the anthropometric differences. This factor has led to higher workload in women. Also, the tall people are more prone to low back pain injuries. A significant relationship was found between the intensity of low back pain and height in this study.

Moreover, a significant correlation was found between low back pain and marital status in this study. Different factors can cause low back pain, job being one of them (10). Various occupational groups include different risk factors. According to these factors, the incidence of low back pain is different. The worker's sex is one of the factors. Several studies have found that the prevalence of low back pain in women is more than men (9). Also, aging reduces the tolerance of intervertebral discs and makes the person more prone to low back pain (10). Weight, body mass index, physical activity, lifestyle, nutrition, smoking, etc. are other risk factors.

The participants in this study worked 8 hours a day and 48 hours a week. Studies have shown that the working time is one of the factors affecting the rate of work-related low back pain (11).

The mean of temporal demand was 80.86%, but no significant relationship was found between temporal demand and low back pain. In a study, Krause et al reported an incidence rate of 63% for low back pain, 75% of workers said that they had to work very fast, and 66% did not have enough rest in their rest time, or they ignored it (18). Lack of rest leads to fatigue and will ultimately harm the person (6).

The mean mental demand reported by the workers was 66.6%, which had a significant relationship with the incidence of low back pain. Studies have confirmed that the psychological factors beside the physical factors in adults affect low back pain (11).

The results of this study indicated a relationship between some certain components of the workload and low back pain. Among the factors influencing the job, we can refer to improper posture, high speed of the work, improper workstation, and repetitive movements during working as risk factors.

The incidence of low back pain achieved in this study has some differences with other studies (6, 10, 19). The results were justifiable because of the variety of job duties, work experience, workload, etc.

In general, we can say that one of the causes of low back pain injuries is the workload imposed on the person (especially physical workload). The more workload exerted on the person, the greater is the risk of low back pain. Accordingly, such measures as increasing the number of workers to distribute the workload, slowing the work pace, creating proper work-rest periods for workers, improving the psychological conditions of work, etc. can be useful.

Besides, efforts such as restricting the manual tasks, reducing the working hours, applying job rotation programs, designing appropriate workstations and training the can reduce the prevalence of low back pain in workers.

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