The Lumbar Musculoskeletal Disorders in the Factory of Auto Parts Production and Assembly

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Abstract: *Introduction:* The outbreak of musculoskeletal disorders is a widespread phenomenon among human, and it usually occurs in the back, lumbar, neck, and upper limbs of human. In this study, we have tried to investigate the factors affecting the lumbar disorders in a factory of auto parts production and assembly. In terms of aim, the present study is functional. To gather data, a Nordic questionnaire has been used. This questionnaire was distributed by census method among *Ghareh Sabz* factory personnel. The total number of the distributed questionnaires was 160. Of these, 148 complete questionnaires were received. 12 questionnaires were incomplete and rejected. In order to investigate the research assumptions, statistical tests were exploited by the use of the software SPSS. *Related works:* According to the results, smoking has a positive and meaningful relation with backache. Exercise and backache have a negative and meaningful relationship together. There is a positive and meaningful relationship between work experience and backache and between age and backache. But there was not found any meaningful relationship between height and backache and between weight and backache.

Keywords: Musculoskeletal Disorders, Backache, Human Resources

1. Introduction

The new philosophy of human resource management and its structure and organization in the current form all are the results of the interaction among the set of events and developments that has been launched with the advent of industrial revolution in England (around 1760) and continues to this day. In the overall assessment of the consequences of the industrial revolution, it should be said that the industrial revolution has had negative economic effects and positive social effects; because in that period, disregarding the emotional aspects and ethical principals was rampant in factories. Finally, the labor union organizations caused the balance of power between employees and employers, and this "Industrial Democracy" made profound social changes in the industrial societies. Thereafter, other movements including scientific management movement by Taylor (the father of scientific management), which included scientific research of work such as move measurement, time measurement, determination of production standards, and function based on them, were formed [8]. Meanwhile, the labor force was being viewed as a tool that tried to increase sales and employer's interests, and their physiological and psychological needs were not being received any special attention. Therefore, experts and scholars decided to exert the concepts such as industrial psychology and ergonomics into the world of work, and according to the science of human relations, they concerned the labor force in physiological and psychological terms, since a country and an organization are recognized by their citizens and employees, respectively, and enhancement of an organization depends on the health and wellness of its employees.

In this study, the scholars have tried to address one of the problems that many workers in factories were faced with it. This very important problem that is ignored by many factories in the country is the musculoskeletal disorders. The

musculoskeletal disorder is one of the common factors of occupational injuries and disability in the industrialized countries and developing countries [13]. The musculoskeletal disorders form nearly 48% of all illness caused by working. In the US, this type of injuries cause the loss of working time of over 600 thousands of people and the cost of 45 billion dollars in the year [11].

In the conducted researches, physical, psycho-social, and organizational and environmental factors, wrong designation of tools and work environment, and individual factors have been identified as the risk factors for the musculoskeletal disorders. Inappropriate physical activities during the work such as bending, rotating the neck, sitting down, standing up, and doing manual activities are of the most important activities of these cases. Also the importance of relaxing in breaks during the long work and the use of the existing equipments and facilities in terms of the prevention of occupational injuries can help to increase the productivity of human resources. Furthermore, managers' more attention to ergonomic considerations and their commitment in this area can play an important role in the optimal exploiting of the existing resources through providing a healthy environment for the work [11]. The musculoskeletal disorders are related to the different factors, and in general, these factors are divided into four groups: genetic, morphological, psycho-social, and biomechanical factors; that the first two factors are impossible to manipulate, and psychosocial and biomechanical factors could be manipulated to prevent damages. Job dissatisfaction, anxiety, lack of rest, and fatigue are of psychological disorders affecting musculoskeletal disorders. On the other hand, there is a significant relationship between some individual physical parameters such as person's age, weight, and body size and the musculoskeletal disorders, and also the prevalence of back pain is significantly increased with age [13].

The risk of musculoskeletal disorders occurs in a wide range of workplaces such as hospitals, hotels, and administrative and service work. This disease is a controversial issue in manufacturing industries, such as automotive, transportation, and heavy industries. In a study conducted among actors it is shown that psychological (30.9%), social (27.5%), physical (17.4%), environmental (16%), and other factors (5%) have impact on musculoskeletal disorders of the actors. The actors who have constantly been exercising have been less likely to develop these diseases compared to those who do not exercise. Women are 1.542 times more likely than men to suffer from these disorders in their hands, wrists, and fingers. Women are 1.717 times more likely than men to suffer from leg pain. Those with work experience more than 10 years are 1.605 times more likely to suffer from these disorders compared to those with work experience less than 5 years. Smokers are 1.243 times more likely than non-smokers to suffer from these disorders [7].

Among the variety of disorders, Low Back Disorders (LBD) is the most common, and in itself causes major social and economic problems. One way to prevent or reduce the risk of this problem among the workers is to use the Quick Exposure Check (QEC). QEC is a method for evaluating the work risk relating to muscles or work-related musculoskeletal disorders [1].

In the United States, the total annual cost for back pain is more than 100 billion dollars. But studies show that physical and psychological factors can contribute to the development of low back pain. Studies imply that individual factors such as gender, education level, smoking, lack of sleep and long-term driving, the use of computer, sitting down for more than half a working day in a an inappropriate state, and mental health problems such as high stress, low job satisfaction, low social support, and effort-reward imbalance, clinical factors such as low strength of contact muscles, weak lumbar stabilization, and abnormal body movements contribute to increase the risk of low back pain [9].

The studies show that the risk of low back pain in smokers is about 50% more than that in non-smokers. These findings correspond with the similar studies conducted in America. In this regard, there are 3 theories that could explain why smokers are suffering low back pain more than non-smokers: 1) the first theory states that an increase in smoking leads to a severe cough, and as a result, patents might receive the risk of lumbar disc; 2) the second theory suggests that smoking have impact on reducing the blood flow to discs and vertebrates; 3) the third theory considers the relation of decreasing the bone mineral density due to smoking [2]. A research has been conducted by Mohammadi [5] among high school teachers in which the relationship between musculoskeletal disorders by three factors of the number, duration, and intensity of pain has been investigate. According to this study, of participants, totally 35% of men and 15% of women have used sick leave due to musculoskeletal disorders. This absence from work can lead to decrease productivity and increase direct and indirect costs to the organization. Another study has been conducted by Mohammadi in 2010 [3] that have studied the prevalence of musculoskeletal symptoms among the administrative staffs of the band in Kerman. This study showed that more woman than men complained of this problem, and the prevalence of this disease has been very common among the study population. On the other hand, the relationship between smoking and low back pain has been higher in men than women. Men in different age groups are more likely to have low back pain. However, this study suggests that obesity has an effect on the spine and low back pain increase. Also, regular exercise can reduce the risk of low back pain [2]. Exercise stimulates the production of pain-controlling natural hormones, and by increasing the pain threshold, it have a preventive or decreasing role in the incidence of low back pain [6]. Also, a study conducted among football players suggests that new players have greater law back pain experience [12]. However, a study conducted in the recent years on slaughter workers shows that of the main factors affecting the lumbar musculoskeletal disorders relates to the work repeating [4].

According to the research that was done in the year 2014

in the *Ghareh Sabz* factory (the population examined in this study) in relation to the upper limb musculoskeletal disorders in computer users, it has been shown that almost 68% of people complain of musculoskeletal disorders [10].

Based on the above cases, research hypothesis can be written as following:

H_1: There is a positive and significant relationship between smoking and low back pain.

H_2: There is a negative and significant relationship between exercise and low back pain.

H_3: There is a positive and significant relationship between work experience and low back pain.

H_4: There is a significant relationship between physical factors and low back pain as following:

H_{4a}: There is a positive and significant relationship between age and low back pain.

H_{4b}: There is a negative and significant relationship between height and low back pain.

H_{4c}: There is a positive and significant relationship between weight and low back pain.

2. The Research Methodology

The present study is functional in terms of the aim and is of scanning and correlation analysis branches in terms of data collection. Nordic questionnaire was used to collect the data. This questionnaire was distributed among the *Ghareh Sabz* factory workers by the census method. The total amount of the distributed questionnaire is 160. Of these, 148 complete questionnaires were received. 12 questionnaires were incomplete and rejected. In order to investigate the research hypotheses, the statistical tests were exploited with the help of SPSS.

Stability. In order to investigate the stability of the questionnaire questions, Cronbach's alpha was used. The coefficient of Cronbach's alpha for the total questions of the questionnaire is 0.87; and since this value is greater than 0.7,

the stability of the questions can be confirmed.

Validity. To investigate the content validity of the questions, the view of the supervisor, managers, and experts in the *Ghareh Sabz* factory were used; and finally, after expert analysis and questions editing, the questionnaire was available to employees.

3. Results and Discussion

3.1. Demographic Information of Data

In this study, we examine the demographic questions of the questionnaire. In the chart, the members of the sample have been classified by type of job.
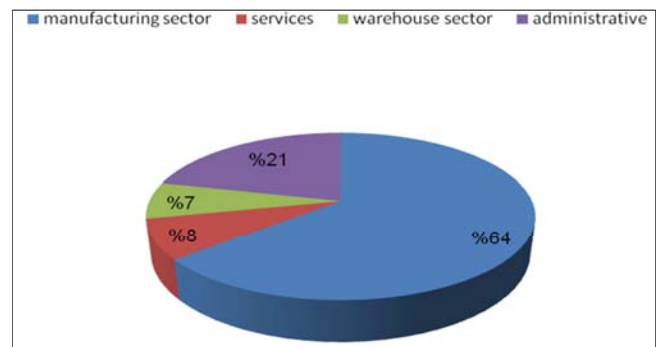

Figure 1. The classification of members by type of job.

According to the Figure (1), 64% of the sample members have been working in the manufacturing sector; 21, 8, and 7 percent have been participating in the administrative, service, and warehouse sectors, respectively.

In the table 1, the sample members have been investigated based on the work experience, age, eight, height, and exercise.

Table 1. The classification of the sample members based on the demographic variables.

Demographic variables	Classification	Frequency	Frequency percent
Work experience	Less than 5 years	30	22%
	Between 5 to 15 years	94	69%
	Between 15 to 30 years	11	8%
	Above 30 years	2	1%
Age	Less than 25 years	8	6%
	Between 25 to 35 years	89	64%
	Between 35 to 45 years	37	26%
	Above 45 years	6	4%
Weight	Less than 60 kg	9	6%
	Between 60 to 75 kg	69	49%
	Above 75 kg	63	45%
Height	Less than 160 cm	11	8%
	Between 160 to 180 cm	108	78%
	Above 180 cm	20	14%
Exercise	Athlete	83	60%
	Non-athlete	57	40%

According to the table (1), it could be concluded that the majority of the participants in the research have had the work experience between 5 to 15 years, the age between 25 to 35 years, the weight above 60 kg, and the height between 160 to 180 cm, and about 60 percent of them, according to their expressions, were athletes.

3.2.Inferential Analysis of the Research Data

In this section, the inferential analysis of the research and hypothesis testing are discussed. It should be noted that in this study, the researcher have used the intensity and frequency components of low back pain to investigate it; and chi-square test has been recognized as the best test to assess the correlation between variables. If the significance value (sig) is less than 5 percent, then the meaningfulness of the variables can be approved at a confidence level of 95 percent. Table 2 shows the research hypotheses with the chi-square test and the result of the test assumptions.

Table 2. The research hypotheses test.

Assumptions			Chi-square	Degree of freedom	sig	Result
Smoking and low back pain	-	Intensity	15.895	11	0.014	confirmed
	-	Frequency	10.208	11	0.005	confirmed
Exercise and low back pain	-	Intensity	-7.818	11	0.043	confirmed
	-	Frequency	-10.844	11	0.045	confirmed
Work experience and low back pain	-	Intensity	27.102	33	0.031	confirmed
	-	Frequency	22.684	22	0.042	confirmed
Physical factors and low back pain	height and low back pain	Intensity	23.43	22	0.378	Rejected
		Frequency	15.217	22	0.853	Rejected
	Age and low back pain	Intensity	22.684	33	0.031	confirmed
		Frequency	33.611	33	0.042	confirmed
	Weight and low back pain	Intensity	11.851	22	0.96	Rejected
		Frequency	15.043	11	0.181	Rejected

According to table 2, it can be concluded that:

- Between smoking and low back pain, since the amount of sig in the both assumptions (smoking and frequency of low back pain, smoking and intensity of low back pain) is less than 0.05, the significant and positive relationship between variables is confirmed. Hence, smoking has a significant and positive relation with frequency of low back pain and intensity of low back pain, and generally, with low back pain.
- Between exercise and low back pain, since the amount of sig in the chi-square test in the both assumptions (smoking and frequency of low back pain, smoking and intensity of low back pain) is less than 0.05, it can be concluded that there is a significant and positive relationship between work experience and frequency of low back pain, intensity of low back pain, and generally, low back pain.
- In this study, three indexes have been used to investigate the physical factors. These indexes are: height, age, and weight.
- Since in the relation between height and low back pain, the amount of sig in the both assumptions (height and frequency of low back pain, height and intensity of low back pain) is higher than 0.05, it can be concluded that there is not any significant relationship between heights of the sample members and frequency of low back pain, intensity of low back pain, and generally, low back pain. In the other hand, since in the relation between age and low back pain, the amount of sig in the both assumptions (age and frequency of low back pain, age and intensity of low back pain) is less than 0.05, it can be said that there is a significant and positive relationship between ages of the sample members and frequency of low back pain, intensity of low back pain, and generally, low back pain. And finally, since in the relation between weight of the sample members and low back pain, the amount of sig in the both assumptions (weight and frequency of low back pain, weight and intensity of low back pain) is higher than 0.05, it can be concluded that there is not any significant relationship between weights of the sample members and frequency of low back pain, intensity of low back pain, and generally, low back pain.

4. Conclusions

This study was performed with the aim to investigate the factors affecting the lumbar disorders in an auto parts production and assembly factor. Therefore, the present study is functional in terms of the aim and is of scanning and correlation analysis branches in terms of data collection. To gather data, a Nordic questionnaire was used. In order to investigate the research hypotheses, the statistical tests were exploited with the help of SPSS.

The results of the analysis of demographic data showed that the majority of participants (64%) have been working in the manufacturing sector; have work experience between 5 to 15 years, and most of them have been in the age between 25 to 35 years; about 70 of them have been between 60 to 75 kg; and the majority of them have height between 160 to 180 cm; however, 60 percent of them are athletes. The results of the hypotheses test and the chi-square test showed that there is a positive and meaningful relationship between smoking and low back pain. The obtained results correspond with the results of the researches conducted by Janvantankul [9] and Park et al. [7]. Smokers are 1.243 times more likely to suffer from low back pain problems compared to non-smokers. On the other hand, the studies show that the risk of low back pain in smokers is 50% higher than that in non-smokers. These findings correspond with the similar studies conducted in the US [2]. In general, it can be said that among smokers in the studies sample, low back pain is common.

The other output of this study showed that there is a significant and negative relation between exercise and low

back pain. This result is consistent with the result of the study conducted by Park et al. [7]. According to them, people who have been exercising regularly are less likely to develop this disorder compared to those who have been exercising. On the other hand, research has shown that exercise stimulates the production of pain-controlling natural hormones, and by increasing the pain threshold, it have a preventive or decreasing role in the incidence of low back pain [6]. Also, regular exercise reduces the risk of low back pain [2]. In general, this result of the study shows that in the survey sample, people who have been exercising regularly have experienced less low back pain. However, it was determined that according to the research conducted by Park at al. [7], there is a positive and meaningful relationship between work experience and low back pain. In their view, those with work experience more than 10 years are 1.605 times more likely to suffer from these disorders compared to those with work experience less than 5 years. This means that in the study sample, those with higher work experience are more susceptible to low back pain.

In this study, a significant and positive relation was found between age and low back pain. This finding is consistent with the results of the research conducted by Ziaee et al. [13]. This means that low back pain is more common among older people. In the present study, a meaningful relationship was found between height and low back pain, and weight and low back pain. While according to Alkharaief's et al. [2] report, obesity has an effect on the spine and increasing the low back pain, and in general, according to the research of Ziaee et al. [13], there is a significant relationship between some individual physical parameters such as person's age, weight, and body size and the musculoskeletal disorders, and also the prevalence of back pain is significantly increased with age.

References

[1] Ayu Bidiawati J. R, Eva Suryani. (2015). Improving The Work Position of Worker's Based on Quick Exposure Check Method to Reduce the Risk of Work Related Musculoskeletal Disorders, 496–503.

[2] Fahad Alkherayf, Eugene K Wai, Eve C Tsai, Charles Agbi. (2010). Daily smoking and lower back pain in adult Canadians: the Canadian Community Health Survey.

[3] Ghorbanali Mohammadi. (2010). Musculoskeletal Disorders Among Bank office Employees in Kerman, Iran, The International Conference on Industrial Engineering and Business Management 201(ICIEBM2010), Yogyakarta, Indonesia.

[4] Ghorbanali Mohammadi. (2012). "Risk factors for the prevalence of the upper limb and neck work- related musculoskeletal disorder among poultry slaughter workers", Journal of Musculoskeletal Research, Vol. 15. No. 1. pp.

[5] Ghorbanali Mohammadi. (2013). "Musculoskeletal complaints among high school teachers" Journal of Musculoskeletal Research, Vol. 16 (2) pp.

[6] Mohseni Bandpei Mohammad Ali; Fakhri Molud; Ahmad Shirvani Marjan; Bagher Nasami Masoumeh; Khalilian Alireza. (2006). "The comparative assessment of exercise training and ergonomic recommendations for the therapy of low back pain: a randomized clinical study".

[7] Moon-Hee Park, MA, Ham-Gyum Kim, PhD, Jae-Hwan Cho, PhD. (2015). Risk Factors for Musculoskeletal Symptoms Among Korean Broadcast Actors.

[8] Perech Mehrdad; Yousofi Amiri Mazaher; Imani Hosein. (2013). The book "Statements about human resource management".

[9] Prawit Janwantanakul, Praneet Pensri, Patriya Moolkay, Wiroj Jiamjarasrangsi. (2011). Development of a risk score for low back pain in office workers – a cross-sectional study.

[10] Rezaei, Mohammadi, and Dolati Rad. (2014). "The investigation of the upper limbs musculoskeletal disorders in the computer mouse users". Ghare Sabz factory.

[11] Rokni Mohammad; Abdi Mohammad Hassan; Saremi Mahnaz; Mir Mohammadi MirTaghi. (2016). "The frequency of the musculoskeletal disorders and its relation with the ergonomic knowledge and environmental factors in nursing".

[12] Wayne Hoskins, Henry Pollard, Chris Daff, Andrew Odell, Peter Garbutt, Andrew McHardy, Kate Hardy, George Dragasevic. (2010). Low back pain in junior Australian Rules football: a cross-sectional survey of elite juniors, non-elite juniors and non-football playing controls.

[13] Ziaee Mansour; Izadpanah Sonia; Sharafi Kiomarth; Barzgar Shengel Akbar; Izadi Lybidi Marzieh. (2013). "The prevalence and risk factors of musculoskeletal disorders in sub-city and city taxi drivers", the city of Andisheh.