Research Paper

Correlation of Postural Abnormalities and Musculoskeletal Disorders With Work Experience and Body Mass Index of Car Repairmen

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ABSTRACT

Purpose: In the profession of car repairmen, incorrect working and sitting positions for a long period are common, which increases the possibility of musculoskeletal disorders and postural abnormalities. Accordingly, this study aims to investigate the relationship between musculoskeletal disorders and postural abnormalities with work experience and body mass index (BMI) in car repairmen.

Methods: A total of 60 car repairmen with more than 1 year of experience from Tehran Province and Alborz Province, Iran were selected and evaluated. The New York test with photography was used to determine postural abnormalities and the Nordic questionnaire was used to determine the prevalence of musculoskeletal disorders. The chi-square test was used to evaluate the prevalence and the Spearman test was employed to investigate the relationship between abnormalities and musculoskeletal disorders with work experience and BMI (P≤0.005).

Results: The results showed that forward head posture abnormalities (75%), torticollis (73.3%), and uneven pelvis (66.7%), had respectively the highest prevalence. The lowest prevalence was related to abnormalities of scoliosis and slight chest depression (3.3%). In addition, musculoskeletal disorders in the lumbar area (56.7%) as well as upper back and knee (36.7%) are the most common disorders, and the lowest disorders are related to the ankles (11.7%) in car repairers. A significant relationship was found between work experience and uneven pelvis and forward shoulder abnormalities (P=0.004). Also, there was a significant positive correlation between BMI and the abdomen protruding (P=0.001). A significant relationship was found between work experience and knee pain (P=0.041); however, no significant relationship was found between BMI and any of the musculoskeletal disorders.

Conclusion: According to the results, there is a relationship between BMI and work experience with common musculoskeletal disorders and postural abnormalities in car repairmen. However, no relationship was detected between BMI and musculoskeletal disorders. Therefore, it is important to improve the level of awareness in this population group regarding proper posture during and before starting their work.

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Highlights

•The prevention of musculoskeletal disorders has become a national priority in many countries.

• No evidence was found regarding the prevalence of postural abnormalities in car repairmen.

• There is no strong evidence of the relationship between musculoskeletal disorders of car repairmen and work experience and body mass index.

Plain Language Summary

In the profession of car repairmen, incorrect working and sitting positions for a long period are common, which increases the possibility of musculoskeletal disorders and postural abnormalities. There is a large community of jobs involved in car repairing, considering that no research has investigated postural and musculoskeletal disorders and their relation with body mass index and work experience. Therefore, the present study aims to investigate the relationship between musculoskeletal disorders and postural abnormalities with work experience and body mass index in car repairmen.

Introduction

Musculoskeletal disorders (MSDs) are the consequences of injuries in the body, nerves, ligaments, joints, and cartilage [1]. These disorders are one of the causes of occupational injuries and disability in industrial and developing countries [2, 3]. They comprise about 1.3% of work-related disorders [4]. Accordingly, the prevention of MSDs has become a national priority in many countries [5]. MSDs are the consequence of excessive biomechanical load and are one of the causes of disability and absenteeism; therefore, it has a significant socio-economic impact [6]. Among the important factors for the occurrence of such disorder, age, gender, work experience, high weight, occupational and non-occupational factors, work environment factors, and psycho-social factors can be mentioned [7-9]. According to studies, 45% of people suffer from upper back pain, 37% of the neck, and 18% of the lumbar area. Therefore, the minimum absenteeism due to diseases and back pain was 8.3% and 6%, respectively; also, the prevalence of absenteeism was 24% and 5% [10]. Different jobs are negatively affected owing to the lack of information about the standard work positions and the correct performance of muscles in sitting, standing, bending, and lifting objects. Also, the decline of exercises (that have a preventive and corrective aspect) will respectively have detrimental effects [11]. According to the National Institute for Occupational Safety and Health (NIOSH) in USA, MSDs related to work after respiratory diseases are in the second terms of prevalence, severity, and prevention [12]. Unlike the expansion of mechanized and automatic processes, work-related skeletal disorders are a major factor in the loss of work time, increased costs, and human damage [13].

Regarding the profession of auto mechanic repairmen, there is a possibility of musculoskeletal discomfort due to work activities in constant and sitting positions, wrong work positions, repetitive movements, long duration of work, and moving loads. This makes it possible to consider body posture analysis as an assessment to determine the risk of absence because of MSDs [14]. If these positions and daily postures are repeated and continued for a long time, it puts a lot of pressure on the joints in the neck, shoulders, wrists, back, knees, and ankles, which are associated with gradual pain and discomfort [15].

According to research that investigated MSDs and their occupational risk factors in employees of one automobile industry in Tehran City, Iran, the prevalence of the disorder in the neck (17.9%), elbow (7.6%), hands (1.33%), upper back (1.44%), waist (7.51%), hips (7.9%), knees (3.19%) and feet (4.32%) was reported [16]. In another study that investigated the extent of muscle damage and its relation with posture at work, they concluded that mechanic repairmen suffered from wrist (43.07%), neck (18.4%), shoulder (8.33%), waist (8.53%), and ankle (7.27%) disorders [17]. Experienced employees are faced with a high risk of MSDs than others, considering their habitual behaviors [18]. Gerr et al. (2002) investigated MSDs in the upper limbs of computer users and concluded that with the increase in the age and work experience of the employees, the prevalence of disorders intensify in the hands, arms, shoulders, and neck [19].

Body mass index (BMI) is a quality measure for weight status in adults. BMI is calculated by dividing weight (kg) by the square of height (m²) [20]. High weight is one of the factors causing MSDs. In 2016, the World Health Organization reported that 18.2% of people are overweight (16.7% among men and 19.3% among women) and 4.3% (2.5% among men and 5.6% among women) are obese [21].

Moradi et al. investigated the ergonomic evaluation of car repair workers in Kermanshah City, Iran, using the rapid body assessment method. The results showed that this group of the population has the most muscular injuries in the lower back (62.6%) and the most complaints were related to the wrist (64.4%) [3]. Yarmohammadi et al. investigated the occupational risk assessment of manual cargo carrying using the key index method called Kim in Kermanshah City, Iran among car repairmen. The results showed that the most discomfort during work was in the upper back and lower back muscles [22]. Yaqoubi et al. investigated the ergonomic assessment of dental students' working conditions. The results showed that students' posture was at an average high level (94.2%) during working [23]. Roquelaure et al. investigated the risk factors of MSDs of the upper limbs in male and female workers. The results showed that MSDs related to work in the male occupation group were related to various risk factors, such as demanding work, high repetitions, activity at the shoulder level or above the shoulder height, and for the female occupation group too much wrist flexion were the most important biomechanical risk factors [24].

In the profession of car repairmen, incorrect working and sitting positions for a long period is common, which increases the possibility of MSDs and postural abnormalities. There is a large community of jobs involved in car repairing, and considering that no research has investigated postural and musculoskeletal disorders and their relation with body mass index and work experience, the presentation aims to investigate the relationship between MSDs and postural abnormalities with work experience and BMI in car repairmen.

Materials and Methods

This cross-sectional descriptive study was conducted in 2021 in branches of Iran-Khodro Company in Alborz Province and Tehran Province, Iran. A total of 60 people were randomly selected from a list. Before participating in the research, the objectives of the study were explained to the subjects and they were assured that their information would remain confidential and

that participation in the study was voluntary. They also completed the informed consent form before participating in the research. The inclusion criteria in the research were having at least 1 year of work experience while the exclusion criteria were having congenital MSDs and musculoskeletal injuries caused by accidents and having a second job (other than being a repairman). The Nordic questionnaire and the New York test were employed in this study. At first, demographic characteristics, including work experience, average hours of sleep per night, and type of work activity, along with exercise and injury history were collected. To calculate BMI, the height and weight of the subjects were measured by using meters and digital scales. After the measurement, the BMI was calculated by the formula.

Subsequently, to determine MSDs, the Nordic questionnaire was used. This tool was designed in 1987at the Finnish Institute of Occupational Health (FIOH). This questionnaire includes questions regarding whether there has been any discomfort or problem in the neck, shoulders, elbows, wrists, upper back, waist, hips, thighs, knees, and ankles in the last 12 months or the last 7 days. Also, it was asked whether these disorders caused them to quit their job. Some questions were also about the physical and psychological needs of the job [25, 26]. Accordingly, this questionnaire can be used to examine MSDs as a suitable parameter to analyze work environment, workstations, and tool design, along with examining the degree of adaptation between the worker and the job or the tool [16, 27]. The Nordic questionnaire does not have a total score and is used to measure the results of epidemiological studies in musculoskeletal disorders. It determines the frequency of injuries. Regarding the results of the reliability and validity of the Persian version of this questionnaire, the internal consistency of 0.8 and repeatability of kappa >0.7 and P<0.001 was reported [28].

Also, people's pictures were taken in 3 different views at a distance of 254 cm from the camera tripod and the New York test was completed based on the taken pictures. In this test, 13 different body postures are evaluated from the front, back, and side views behind the checkered board. Finally, the image that was most similar to the person's physical condition was selected in each section and scored accordingly. The score for severe malformation, mild malformation, and normal posture was 1, 3, and 5, respectively [29]. They have reported high reliability (r=0.94) and high reproducibility in repeated measurements [30, 31].

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The statistical analysis of the obtained data was done using the SPSS software, version 22 at a significance level of 0.05. To investigate the prevalence of postural abnormalities and MSDs from descriptive statistics and the chi-square test, and for the relationship between abnormalities and MSDs with work experience and BMI, the Spearman statistical test was used.

Results

In this research, 60 people were statistically analyzed as a sample. The studied subjects had an average age of 34.9±1.7 years, an average work experience of 11.55±9.2 years, an average weight of 75±13.3 kg, an average height of 174.1±6.9 cm, an average BMI of 24.7±3.8, average working hours of 9.5±0.8 h, and 78.3% of people with working hours more than 10 h, an average type of work activity of 2.8±0.3, in addition to 86.7% people with sedentary and permanent work activities. The results of examining the prevalence of abnormalities showed that the forward head (75%) had the highest rate of prevalence compared to other abnormalities in this research, followed by, torticollis (73.3%) and uneven pelvis (66.7%). Other results related to the prevalence of abnormalities are provided in Table 1 and Figure 1.

According to Table 2, the results of the Spearman correlation test showed a significant positive correlation between work experience and uneven pelvis and forward shoulder abnormalities (P=0.004). Also, according to Table 2, there was a significant positive correlation between BMI and abdomen protruding abnormality (P=0.001).

By examining the prevalence of MSDs related to work using the Nordic questionnaire in car repairmen, the results showed that at least in the last 12 months, 56.7% of repairmen were showing MSDs in the lumbar. Also, after the lumbar, the upper back (36.7%), knee (36.7%), neck (35%), shoulder (28.3%), and wrist (21.7%) were respectively reported with MSDs. The lowest prevalence was reported in the hip and thigh (15%), the elbow (13.3%), and the ankle (11.7%).

According to Table 3, the results a significant positive correlation between work experience and knee disorders (P=0.041). Also, no significant relationship was found between BMI and any kind of MSD.

The results of the chi-squared test showed a significant difference in the prevalence of postural abnormalities (χ_2=236.8) and MSDs (χ_2=142) in different parts of the body related to the work.

Table 1. Prevalence of postural abnormalities in different parts of the body

Postural Abnormalities	NO. (%)	
	People Who Have the Given Postural Abnormalities	People Who Do Not Have the Given Postural Abnormalities
Forward head	45(75)	15(25)
Torticollis	44(73.3)	16(26.7)
Uneven pelvis	40(66.7)	20(33.3)
Ankle pronation	36(60)	24(40)
Hyperlordosis	18(30)	42(70)
Abdomen protruding	11(18.3)	49(81.7)
Backward trunk deviation	5(8.3)	55(91.7)
Hyperkyphosis	34(56.7)	26(43.3)
Uneven shoulder	38(63.3)	22(36.7)
Sagging chest	2(3.3)	58(96.7)
Forward shoulder	33(55)	27(45)
Flat foot	15(25)	45(75)
Scoliosis	2(3.3)	58(96.7)

PHYSICAL TREA↑MENTS

Table 2. The results of the Spearman correlation test on the relationship between postural abnormalities with work experience and body mass index

Postural Abnormalities	Results			
	Work Experience		Body Mass Index	
	Correlation coefficient	Sig.	Correlation coefficient	Sig.
Forward head	0.196	0.133	0.171	0.191
Torticollis	0.116	0.379	-0.097	0.462
Uneven pelvis	0.371**	0.004	0.004	0.975
Pronation foot	0.076	0.565	0.064	0.628
Hyperlordosis	0.040	0.761	0.165	0.208
Abdomen protruding	0.210	0.108	0.455**	0.001
Backward trunk deviation	0.010	0.937	-0.028	0.833
Hyperkyphosis	0.171	0.190	-0.045	0.735
Sagging chest	0.059	0.635	0.172	0.190
Uneven shoulder	0.166	0.204	-0.214	0.101
Flat foot	-0.054	0.685	0.047	0.723
Scoliosis	0.129	0.326	0.247	0.057
Forward shoulder	0.371**	0.004	0.083	0.527

**P<0.05 significant difference.

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Discussion

In this article, we investigated the results of examining the prevalence of MSDs and it was shown that the forward head (75%) had the highest prevalence rate compared to the other abnormalities examined in this research; torticollis (73.3%) and uneven pelvis (66.7%) were respectively common in the research samples af-

ter forward head. The lowest rate of prevalence was related to the abnormalities of trunk deviation backward (10%), sagging chest, and scoliosis (3.3%). Also, the most common MSD was in the lumber (56.7%) and the lowest prevalence was in the hips and thighs (15%), elbows (13.3%), and ankles (11.7%) in car repairmen. The results of the present research are also consistent with the results of Soori et al., which reported lumbar
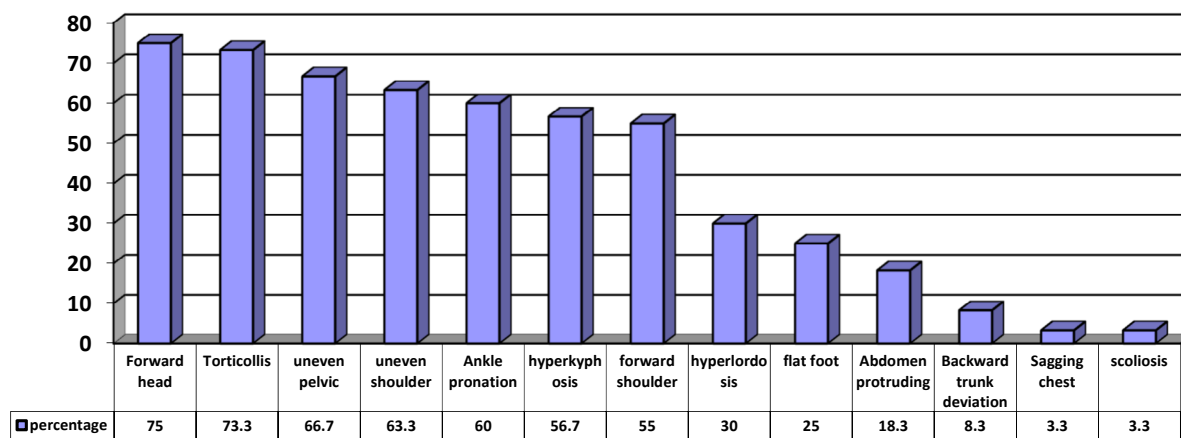

	Forward head	Torticollis	uneven pelvic	uneven shoulder	Ankle pronation	hyperkyphosis	forward shoulder	hyperlordosis	flat foot	Abdomen protruding	Backward trunk deviation	Sagging chest	scoliosis
percentage	75	73.3	66.7	63.3	60	56.7	55	30	25	18.3	8.3	3.3	3.3

Figure 1. Results related to the prevalence of abnormalities

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Table 3. The results of the Spearman correlation test of the relationship between musculoskeletal disorders with work experience and BMI

Musculoskeletal Disorders	Results			
	Work Experience		BMI	
	Correlation Coefficient	Sig.	Correlation Coefficient	Sig.
Neck	0.138	0.294	-0.011	0.933
Shoulder	-0.102	0.439	-0.046	0.728
Elbow	0.035	0.788	-0.089	0.498
Wrist	-0.060	0.650	-0.169	0.196
Upper back	-0.024	0.855	-0.025	0.850
Lumbar	0.095	0.468	-0.117	0.375
Pelvic and hip	-0.134	0.308	0.084	0.526
Knee	0.264**	0.041	0.149	0.257
Ankle	0.170	0.194	0.172	0.190

**P<0.05 significant difference.

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disorders as the most common abnormality in the car industry [32]. In a study conducted by Moradi et al. the results showed that the most prevalent MSD in car repairmen in Kermanshah City, Iran was related to the upper back (62.6%) and lumbar (64.6%); meanwhile, car repairmen suffer from neck pain (39.9%), shoulder (42.5%), wrist and hand (54.5%), upper back (62.6%), lumbar (64.6%), and knee pain (49.5%) in the last 12 months [3]. Therefore, the highest prevalence of MSDs among the subjects of the study in the back and lumbar is consistent with our studies. According to Eskandari et al. 82.3% of the surveyed people who were working in car companies in Tehran City, Iran, have suffered from one of the MSDs in at least one of their 9 body parts in the last 12 months [16]. Accordingly, the prevalence of MSDs among individuals working in the field of car repair has high percentage. The study by Piri et al. showed that hyperlordosis and lumbar disorders are among the most common MSDs among ship workers [33]. According to the research of Salehi Sadati et al. the most common MSDs are observed in the lumbar and knees while the least affected areas are the wrists and hands [34], which is consistent with the results of our findings in this study. According to the study by Nasaruddin et al. which aimed to determine the relationship between risk factors and the prevalence of MSDs among car repair mechanics in Klang Valley, Malaysia, the most complaints were in the shoulder (69.1%), followed by the leg and knee (67.5%), and neck and lumbar (66.5%). Among 2594 people, 96% of the subjects suffered from musculoskel-

etal pain in the spinal area [27]. The results of the study by Yarmohammadi et al. showed that in every analyzed subject of car repairmen, one of the MSDs related to work has a high prevalence [22]. According to a study conducted in India, aimed at investigating occupational injury patterns along with investigating work stressors related to injury among car mechanics, car repairmen have a high prevalence of MSDs. Various factors such as poor working environment, the characteristics of machinery and tools, the low level of health, and psychosocial stress were related to the occurrence of disorders among car repair workers [35]. Ranas conducted a study on 1488 taxi drivers in Norway and the results showed that the prevalence of disorders in car drivers was higher than in drivers who were employed by a company. The prevalence of abnormalities in the first group was in the lumber (59.9%), neck (57.8%), and shoulder (52.4%), while in the second group, the abnormalities were in the lumber (53.2%), neck (48.1%), and shoulder (47.2%) area, respectively [36]. According to the study of Mokhtarinia et al. many work-related factors cause MSDs; however, one of the most important and prominent factors is the improper body posture of employees during work [37]. In a study that examined the head and shoulder posture of 20-35-year-olds and the effect of the duration of smartphone utilization, the results showed that forward head and rounded shoulders are common disorders in young subjects and the longer time of using a mobile phone comes with the greater severity of disorders [38]. The present results showed a significant

relationship between work experience and MSDs in the knee joints, which is consistent with the results of Gerr et al. in which the prevalence of MSDs increased with the increase of work experience [39]. Bahrami [40] and Rahimi Moghadam [41] showed a significant relationship between increasing work experience and the prevalence of these disorders, which confirms the findings of the present study. Therefore, the onset of musculoskeletal disorders is gradual and with the increase of work experience, the disorders appear gradually. The results showed that BMI has a significant negative relationship with neck (0.045), shoulder (0.077), wrist (0.142), upper back (0.064), and lumbar (0.168). Moreira-Silva et al., who investigated the relationship between BMI and MSDs in-store workers in Portugal, concluded that with an increase in BMI, the incidence of disorders increases 2.12 times [42, 43] which is consistent with the findings of the present study. Ghanbary-Sartang et al., who evaluated MSDs in computer users concluded that MSDs increase with age and work experience, which confirms the findings of the present paper [44]. The results of another study showed that with an increase in BMI, the rate of disorders and the general health of people are placed in unfavorable conditions [42]. Hooshyar et al. in a study conducted on the workers of Anjiristan Village, Iran, showed that with the increase in work experience and age, the occurrence of MSDs, including disorders in the knee joints, increases [45].

Conclusion

The findings of this research showed that disorders in the lumber, upper back, and knee joints, as well as forward head abnormalities, torticollis, and uneven pelvic, are common in car repairmen. The practical importance of these findings in the prevention of disorders and abnormalities, familiarity with the principles of ergonomics, preventive techniques, and corrective movements along with training and awareness of car repairers seems necessary to improve working conditions. Also, with the increase in work experience, uneven shoulders and uneven pelvic are more common in repair workers, and the increase in BMI is related to the abnormality of the abdomen protruding. There is a significant relationship between work experience and knee disorders; therefore, regarding the correct methods of doing work and the correct placement of suitable postures, early identification of MSDs and reduction of abnormalities in this group of employees should be prioritized.

Ethical Considerations

Compliance with ethical guidelines

Funding

Authors' contributions

Data collection and investigation: Maryam Shirzad and Fatemeh Sazegar; Data analysis and writing–review & editing: Mohammad Rahimi and Fatemeh Khanvirdi.

Conflict of interest

The authors declared no conflict of interest.

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