Original Article

Journal of Occupational Health and Epidemiology
Journal homepage: http://johe.rums.ac.ir

Prevalence of Musculoskeletal Disorders in Iranian Truck Drivers and Its Association with Road Accidents

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Citation: Ahmadi Asour A, Mehri F, Fassih-Ramandi F, Karimi A. Prevalence of Musculoskeletal Disorders in Iranian Truck Drivers and Its Association with Road Accidents. J Occup Health Epidemiol. 2022;11(2):106-13.

Article Info

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Article history
Received: Oct 2021
Accepted: Apr 2022

10.52547/johe.11.2.106

Print ISSN: 2251-8096
Online ISSN: 2252-0902

Peer review under responsibility of Journal of Occupational Health and Epidemiology

Abstract

Background: The association between the occurrence of road accidents and WMSD is a topic that has attracted much attention in the transportation industry. This study aimed to investigate the prevalence of musculoskeletal disorders in professional truck drivers and their impact on the occurrence of road accidents.
Materials and Methods: In this descriptive study, 200 professional truck drivers were selected by a two-stage cluster sampling method from occupational medicine centers in Tehran province, Iran in 2017. The data were collected from the two groups of with and without accident. The three-part questionnaire on ergonomics and safety of drivers was used, which included items asking about demographic characteristics, stress, job satisfaction, details of accidents, and the severity of musculoskeletal disorders in nine areas of the body. The central indices and non-parametric statistical tests (Kruskal-Wallis, Spearman) were applied to analyze the data using spss Ver 24.
Results: The highest frequency of pain was observed in drivers without and with accidents in the back, knees, and shoulders, respectively; however, the most severe pain was reported for the low back and neck. Drivers between 45 and 60 years old reported the highest number of accidents. The association correlation between the number of road accidents and stress score among drivers with accident experience was negatively significant ($P < 0.05$). However, the association between musculoskeletal disorders and accidents was not statistically significant.
Conclusion: Factors other than musculoskeletal disorders were involved in road accidents that require more investigations.

Keywords: Truck, Accident, Back Pain

Introduction

Work-related musculoskeletal disorders (WMSDs) involve a specific range of inflammatory conditions and further damage to the musculoskeletal system, including muscles, joints, nerves, tendons, and other tissues involved in motor activity due to a non-traumatic event or overuse [1]. These disorders account for 42-58% of all work-related illnesses worldwide and cause disability, absenteeism, significant health costs and economic losses at all levels of society. The UK Health and Safety Administration (HSE) reported a WMSD prevalence of 37% in 2018-2019, 498,000 out of 1,354,000 occupational diseases [2]. Musculoskeletal pains (MSP) are a major concern for many drivers, such as professional truck, trailer, and heavy truck drivers, due to risk factors such as prolonged sitting, whole-body vibration, awkward posture, and repetitive actions [3]. Drivers have the highest prevalence of MSDs compared to other jobs [4]. An important point is the association between ergonomic features and factors such as differences between anthropometric dimensions and the physical environment of drivers, including the driving mechanism (Automatic, Manual), as well as individual factors such as age, sex, weight, height, body mass index (BMI), and general health [5]. Previous studies have reported a high prevalence of musculoskeletal pains in bus (80%), truck (81%), and taxi drivers (71%) [2]. The Canadian Center for Occupational Health and Safety (CCOHS-2014) linked musculoskeletal disorders to posture, repetitive movements, locomotion, vibration, temperature, and monotonous tasks. These risk factors may not only affect the health of truck drivers but also lead to road accidents [6].

The occurrence of road accidents is another risk that threatens drivers. More than 1.26 million people worldwide die in road accidents yearly; such accidents are one of the leading causes of death and irreparable damage in developing countries [7]. Truck drivers face the highest number of accidents [6]. In Europe, Heavy goods vehicle (HGV) accidents accounted for 18% of road deaths in 2013, i.e., 4,500 deaths [7], and also in Sweden, they accounted for half of all car deaths [8]. In Finland, in 1989, 677 accidents resulted in death, and in 1990, 9,600 accidents resulted in injuries. [9]. The growing trend of road accidents of heavy goods vehicles in Malaysia leads to more than a thousand fatal accidents yearly. More than 80% have resulted in the death of other road users [6]. Unfortunately, Iran has one of the highest rates of fatalities in traffic accidents [10]. According to WHO data, road deaths are responsible for about 25% of all deaths due to injuries [11]. The number of road deaths in Iran, with a population of more than 77 million people and 27 million vehicles, was 18,000 in 2015 [12].

Driving a truck increases the risk of musculoskeletal disorders. The risk of accidents and musculoskeletal disorders is mostly attributed to factors such as humans, vehicles, working conditions, and other variables [14].

Numerous studies have been conducted on the occupational hazards of truck drivers, most of which focus on the prevalence of musculoskeletal disorders caused by work-related factors. However, the impact of other variables such as drivers' health and job status is not considered important factors in the occurrence of accidents for truck drivers. In Iran, the share of human factors against other causes of traffic accidents is not well known, even though they are the most important causes [12-13].

A topic that has received much attention in the transportation industry is the association between accident risk and poor condition, seat status, immobility, WMSD, and long-distance driver fatigue [14]. In addition, in various studies, the accidents of truck drivers on the roads have received less attention in terms of occupational diseases. Given that such accidents occur on the roads of Iran daily, unfortunately, no logical solution has been found. Therefore, this study aimed to investigate the impact of WMSDs on the occurrence of road accidents in professional truck drivers.

Materials and Methods

This descriptive cross-sectional study was conducted from May to January 2017 amongst professional truck drivers working in the Iranian transportation system with medical records in occupational medicine centers. A two-stage cluster sampling was performed. Out of 15 occupational medicine centers located in the north, south, east, west, and center of Tehran, 5 were randomly selected. According to the following formula [20], with a driving accident prevalence of 0.27 (P = 0.27) based on a similar study (22) and an error rate of 0.06 (d = 0.06), the sample size was determined to be 211 drivers. However, to ensure the presence of drivers and possible drops, the number of samples was increased to 225, of which 25 were excluded from the review process based on the exclusion criteria, such as cancellation or non-submission of information. Finally, 200 eligible drivers were included in the study as the main samples.

Formula 1.

$$n = \frac{Z^2 pq}{d^2}$$

Where p is the prevalence based on a similar study, and d is the error rate (precision).

The selection of samples from each center was performed through systematic sampling. This method is a probability sampling method in which sample members from a larger population are selected according to a random starting point but with a fixed periodic interval. This interval, the sampling interval, is calculated by dividing the population size by the desired sample size. In this way, from 100 drivers referred to the centers daily, based on the existing list, the samples were selected with a coefficient of 5 from the first person. In other words, the first choice was person number 5 based on the list.

Similarly, numbers 10 and 20 were chosen until the end. Forty-five samples from each center were selected on average. Those willing to cooperate were chosen among the selected samples, and others were eliminated from the study.

Prior to sampling, all drivers were informed about the cooperation and implementation of the plan, as well as the confidentiality of information. Inclusion criteria were: male drivers with more than 2 years of driving experience. Exclusion criteria included an incomplete answer to the questionnaire, drivers with congenital problems in the musculoskeletal system or a history of serious damage to the system, and a history of surgery in this system. In the end, the research assistant checked each of the questionnaires to verify that all the questions had been answered.

A standard ergonomics and driver safety questionnaire was used to collect and record information. This questionnaire is designed based on specialized information and previous studies (1.22). To determine the validity of the questionnaire, before starting the study, 15 participants were selected to complete the questionnaire. After two weeks, the same questionnaire was filled out by the same participants, and their answers were compared. Then, the correlation test was performed based on the test-retest method. The correlation coefficient (reliability) was set at 0.75 (75%). The validity of the questionnaire was also confirmed by 5 experts after the necessary corrections.

This questionnaire had three parts: In the first part, information on demographics, including age, height, weight, average daily driving time, day and night rest, exercise time per week, and smoking status were recorded. In the second part, drivers were asked to answer a number of questions according to the mental scale, such as workload, job stress, and job satisfaction on a scale of 1 to 10, observing safety tips while driving, and the number of accidents and quasi-accidents. After extraction of the data, parameters such as job stress and satisfaction were divided into three groups: no job stress and satisfaction (0), moderate job stress and satisfaction (1-5), and severe (6-10) job stress and satisfaction. The third section included questions about WMSDs, the Body Part Discomfort Map, feeling pain, discomfort /numbness in nine areas of the body (Fig. 1) over the past 12 months, and pain intensity on a scale of 0-10 (painless to severe pain). This rating is derived from the Borg index [15].

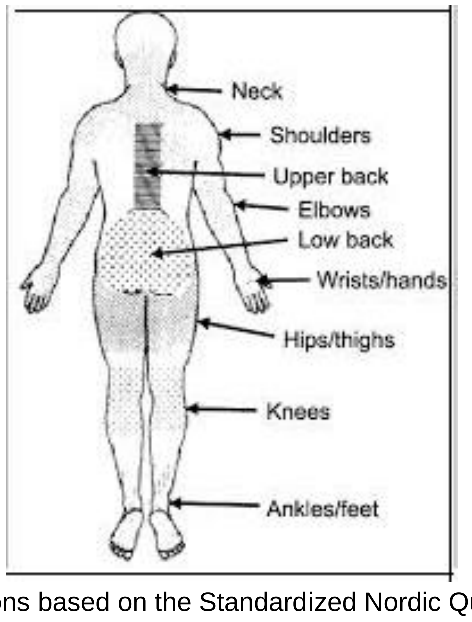

Fig. 1. The map of musculoskeletal regions based on the Standardized Nordic Questionnaire [16]

Due to the non-normality of the data based on the Kolmogorov-Smirnov test, non-parametric Chi-square and Kruskal-Wallis tests and Spearman correlation coefficient were used to compare and test the hypotheses at a significance level of less than 0.05 and a 95% confidence level. SPSS 24 statistical software was used to data analysis and descriptive indicators (mean, standard deviation, minimum, maximum). This research was registered with the code of ethics IR.TUMS.MEDICINE.REC.1397.491.

Results

Personal characteristics (demographics and health-related factors) and occupational factors of the participants are presented in Table 1. 200 (87%) drivers participated in this study, who were all men with a mean age of 47.5 ± 9 years and an average BMI of 27.9 ± 9.05 kg / m2. Participants were divided into the two groups of experienced (n=148, 74% as group 1) and non-experienced accidents (n=52, 26% as group 2). . The drivers in the group1 had 142 (95.9%) collisions with cars, 7

(4.7%) collisions with pedestrians,17 (11.4%) collisions with obstacles, and 6(4%) overturns. The average driving and rest time per day were 10.6±2.5 and 8.7±1.12 hours, respectively.

Table 1. Demographic characteristics of drivers (n = 200)

Variables	Mean	SD	Min	Max	Kolmogorov-Smirnov
Age (years)	5.47	9	30	70	.001
Body mass index (kg / m2)	27.9	2.9	21.8	40.7	.000
Driving time per day (hours)	10.6	2.5	5	16	.000
Continuous driving time (hours)	2.3	.46	2	3	.000
Rest time per day (hours)	8.7	1.1	6	12	.000
Exercise time per week (hours)	.92	1.04	0	5	.000

BMI is a measurement of people's leanness or corpulence based on their height and weight intended to quantify tissue mass (Below 18.5= Underweight), (18.5= Healthy 24.9), (25.0-29.9= Overweight), (30.0 and above = Obese) (Health Ministry of IRAN). In this study, 68.9% of group 1 and 61.5% of group 2 had overweight; further, 18.9% and 19.2% of groups 1 and 2 were obese, respectively. Drivers (90.5%) exercised less than 3 hours during the week. The mean of demographic variables between drivers with and without road accidents was assessed using the Spearman test. The results showed that the mean age of group 1 was higher than group 2, and the difference between them was also significant (P = 0.048) (Table 2). Group1 had between 1-10 accidents; the average number of accidents was 1.4 (±1.1). In terms of age, the average number of accidents in the age group of 60-75 years was 4.4, being higher than the other two age groups. However, since the number of drivers in the age groups was not the same, by comparing the ratios, 0.68 accidents per person in the age group of 30-45 years, 0.78 accidents in the age group of 45-60 years, and 0.76 in the age group of 60-75 years occurred; these differences were statistically significant (P=0.001). Stress and job satisfaction in drivers were the variables evaluated based on a quality scale (0-10). The average level of stress in the first age group (30-45 years) was higher than other groups, and the level of job satisfaction in the age group of 60-75 years was higher than other age groups. The average job satisfaction of drivers with a crash experience was 4.3 and without a crash was 5.1. The results showed that the average rest time per day and the exercise duration per week in group 1 were less than in group 2 (Table 2). The association between the exercise duration per week was significant with the occurrence of accidents (P <0.05) but not with their number.

Table 2. Mean and standard deviation of individual parameters of drivers (with and without accidents)

			Age (years)	BMI	Driving per day	Daily rest (Hour)	Exercise per week (Hours)	Job stress	Job Satisfaction	Number of accidents
Accident history	With accident	Mean	48.2	27.8	10.5	8.7	0.8	3.3	4.3	1.4
		(SD)	(9.1)	(3.01)	(2.5)	(1.1)	(1.04)	(2.07)	(2.1)	(1.1)
	Without accident	Mean	45.3	28.02	11.07	8.75	1.1	3.7	5.1	–
		(SD)	(8.6)	(2.9)	(2.5)	(1.05)	(1.03)	(2.8)	(1.9)	
		*Sig (p-value)	0.051	0.7	0.2	0.9	0.033	0.3	0.027	-
Age groups (year)	30-45	Mean		28.4	12.1	8.5	1.1	5.09	4.1	0.75
		(SD)	–	(2.8)	(2.5)	(0.91)	(1.2)	(2.8)	(2.3)	(0.57)
	45-60	Mean		27.8	9.9	8.8	0.74	2.3	4.7	0.9
		(SD)	–	(3.08)	(1.7)	(1.1)	(0.8)	(2.05)	(0.8)	(0.9)
	60-75	Mean		25.2	7.07	8.6	0.8	1.2	4.9	4.4
		(SD)	–	(1.4)	(1.5)	(1.6)	(0.9)	(1.6)	(2.01)	(1.05)

*Examination of data normality was performed with the Kruskal-Wallis test (p<0.05).

From the 9 parts of the body, among the two groups of drivers, the average pain intensity from highest to lowest was reported in the knees, low back, shoulders, neck, and legs as 7.12, 7.06, 3.7, 2.9, 2.12, and 1.43 in group 1 and 6.75, 6.73, 3.3, 3.15, 2.2, 1.4 in group 2, respectively (Table 3).

The Kruskal-Wallis test results also showed no significant difference between pain in different body parts in the drivers of groups1and 2 (Table3). As mentioned above, drivers responded to pain intensity in different body parts on a 0-10 basis. Then, according to previous studies [1], Pain intensity was divided into three groups: 0 painless, 1-5 mild pain, and 6-10 severe pain. In both groups of drivers, pain in the lower back and knee was the most common, so that the results showed the intensity of pain in the lower back and neck were 62.1 (n=92) and 61.4 (n=91) percent in group1 and 51.9 (n=27) and 53.8 (n=28) percent in group 2, respectively. The highest prevalence of pain in both groups was in the lower back, knee, and neck, respectively. In the elbow, hand, and hip areas, the pain intensity was the lowest (Table 3).

Table 3. Mean severity of musculoskeletal pain among drivers with and without road accidents

		Neck	Shoulder	Upper back	Low back	Waist	Wrists and hands	Hip	Knee	Feet and ankles
With accident	Mean	2.9	3.7	1.4	0.7	7.06	0.9	1.08	7.12	2.12
	SD	2.5	1.9	1.2	0.9	2.04	1.04	1.2	2.3	1.4
	Sever pain percent(n)	10.1(15)	8.1(12)	0(0)	62.1(92)	0(0)	0(0)	0(0)	61.4(91)	.6(1)
	Sig.	.516	.063	.995	.061	.212	.343	.172	.378	.695
Without accident	Mean	3.1	3.3	1.4	0.9	6.75	1	0.7	6.73	2.2
	SD	2.4	1.9	1.3	1.2	2.4	0.9	0.9	2.5	1.5
	Sever pain percent(n)	11.5(6)	5.7(3)	0(0)	51.9(27)	0(0)	0(0)	0(0)	53.8(28)	0(0)

*Examination of data normality was performed with the Kruskal-Wallis test (p<0.05).

In this study, low back pain was less common among drivers with daily rest, and this difference was significant (p=0.02). A significant association between neck, shoulder, and low back pain with weight was also found in drivers (p <0.05) (Table4).

Table 4. Correlation between musculoskeletal pain and weight among truck drivers

		Neck	Shoulder	Upper leg	Elbow	Low back	Wrist	Hips	Knee	Foot
Weight	Correlation Coefficient	.288**	.239**	.118	.126	.159*	-.002	.126	.120	.020
	Sig. (2-tailed)	.000	.001	.095	.076	.024	.983	.075	.090	.782
Rest during the day	Correlation Coefficient	-.018	-.035	-.061	-.073	-.159*	.129	-.071	-.144*	.036
	Sig. (2-tailed)	.799	.621	.392	.304	.025	.069	.320	.042	.612

** Correlation is significant at the 0.01 level.

* Correlation is significant at the 0.05 level.

Discussion

This study investigated the prevalence of WMSDs and their impact on the occurrence of road accidents in professional truck drivers. Parameters such as stress, BMI, exercise, and driving time were also examined. The effect of these factors on the incidence of skeletal disorders was also mentioned. The mean age of group 1 was higher, but the hours of exercise per week, rest, and job satisfaction were lower compared to group 2. In total, group 1 had 172 accidents with other vehicles, pedestrians, obstacles, and overturns. Drivers in group 1 with an average age of 45-60 years had the highest number of accidents compared to the age group 75-60 years; this was negatively related to the study of Sergio et al. [17] and Etemadinejad et al. [18]. The reasons for the lower number of accidents in this age group can be attributed to the experience and more safety tips by this group in driving. In group 1, the mean BMI was lower than in group 2; however, more than half of the drivers in both groups (with and without accidents) were overweight, which was consistent with the study of Abedi et al. [19]. Truck and bus drivers were slightly more than 25 kg / m2; thus, it could be a warning for obesity in the future. Based on these results, the reasons for overweight drivers included prolonged sitting and having snacks while driving. Most drivers answered yes to the question of having snacks while driving. The type of diet in restaurants along the way could also be another factor in weight gain.

In Iran, high job stress levels are among the most important causes of anger in driving [10]. Studies have shown a significant association between job stress and work-related injuries [21], and professional drivers are exposed to various types of job stress; the association between stress and the occurrence of accidents is also significant ($P < 0.05$) [22]. In this study, the average stress level in the first age group (30-45 years) was higher than in other groups. The reason could be attributed to factors such as less driving experience and fear of road accidents than other groups. Also, the association between the number of road accidents and stress in drivers with accident experience was negatively significant, indicating that the number of accidents decreases with increasing stress ($P < 0.05$). According to the present study, younger drivers had more stress and fewer accidents than the second age group (45-60 years), and drivers with accident experience had less stress and more road accidents. Thus, stress can be a deterrent to accidents and have a positive effect on drivers' awareness. However, Peter Finn et al. have demonstrated that young drivers are more likely (than others) to be involved in accidents and fatalities since they are more risk-averse, do not understand dangerous situations, or both [23]. The effect of job satisfaction on improving the quality of work and maintaining the health of drivers is evident. Job satisfaction in group 1 was lower than in group 2; this was consistent with Abedi et al., showing that 62.6% of bus drivers and 61% of truck drivers were dissatisfied with their jobs [19].

A study by Tucker P. (2010) among professional drivers showed that hard work played a more important role in increasing the risk of back disorders than other factors [23]. Mozaffari et al. (2015) reported low back pain at 24.3% and neck pain at 27.2% in truck drivers [25]. Also, Yasobant et al. (2015) reported a higher prevalence of neck, back, shoulder, and wrist pain in bus drivers than in other limbs [2]. According to the present study, the highest prevalence of pain (mild and severe) was in the lower back, knees, shoulders, neck, legs, and upper back, respectively. The results showed a significant but inverse association between elbow pain and rest, exercise and hands/wrists pain, and back and knee pain and rest ($p < 0.05$), In other words, with increased rest and exercise, the pain in these areas decreased. The association between back and wrist pain and direct stress was significant ($p < 0.05$). The study showed the highest rate of WMSD in the back, knee, and shoulder areas of truck drivers in the last 12 months [19], confirming the present study results. In both studies, the most common cause of discomfort for truck drivers was in the lower back, knees, and shoulders. Thus, it can be concluded that most 9 limbs suffer from pain and discomfort (only severe pain). The reason for this is the driving history, type and age of the vehicle, road conditions, seats, and various other factors, including long sitting with much pressure on the back and knees, the large diameter of the truck steering wheel, and relatively long distance. Also, due to the control of the truck steering movement, the shoulders are under much pressure, being a local source of pain in the long run. Low rest leads to more fatigue in drivers; thus, by affecting musculoskeletal health, it can play an important role in the occurrence of accidents. Guglielmi O et al. found that 51.1% of the drivers were at risk of obstructive sleep apnea (OSA), 17.3% had bad sleep quality, and 8.9% had excessive daytime sleepiness (EDS) [26].

According to the present study, the average daily rest period in the accident group was lower than in the non-accident group, as the study of Saccomanno F.F. et al. showed a significant association between driving more than 9.5 hours with the occurrence of road accidents due to continuous driving and fatigue [27]. Zaranka et al. also showed that increasing working hours reduced the sleep and rest of truck drivers [28]. However, there is no conclusive evidence for an optimal rest period (other than strenuous physical work) or to support the claim that increasing the rest period offsets the negative effect of extended work shifts [24]. However, statistically, no significant association was observed between skeletal pain and accidents in any of the nine areas in drivers with accident experience except the foot; still, all drivers suffered from skeletal pains in different limbs. In contrast, Jahangiri et al. showed a positive and meaningful association between WMSDs, especially neck, upper back, and knee pain, with road accidents [22].

This research had several limitations. First, the information collected was based on the drivers' mental information; thus, there was a possibility of error in the actual number of accidents. Further, due to the lack of centers related to the transportation industry in accurately registering drivers' diseases, the cases announced by drivers needed to be carefully investigated. Finally, it was difficult to coordinate and receive information from truck drivers due to their type of job.

Conclusion

Although there was no statistically significant association between musculoskeletal disorders and road accidents in group 1, according to the analysis, the incidence of pain in different body areas in this group was higher than in group 2.

Therefore, it can be concluded that skeletal pains affect the occurrence of accidents. The reason may be attributed to the abnormality of the data and the small number of samples and, on the other hand, the lack of accurate information by drivers due to forgetfulness caused by the time interval between the data collection and accident occurrence. Hence, the development and implementation of a national plan for the occupational health of drivers can be effective in collecting accurate information, increasing road safety, reducing fatal accidents, and improving the health of drivers.

Acknowledgement

The authors would like to thank all the drivers and staff of the health centers who sincerely cooperated in conducting this research.

Conflict of interest: None declared.

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