



Risk Factors of Work-Related Head and Neck Injuries: A National Survey

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Abstract

Background: Occupational accidents made injuries in different parts of the body; two important parts of them are head and neck. We aimed to identify the risk factors of work-related head and neck injuries with using of a nationwide occupational accident data.

Methods: This analytical cross-sectional study was conducted on the nationwide data that was gathered in 2013-2018. The target population was industrialized and non-industrialized adults, aged 18 yr or older. Dependent variable was the head and neck injuries. The independent variables were included, age, sex, education level, work experience, job, shift work, injury cause, referred center, season, accident day, accident time, and action after accident. Univariate logistic regression analyses and subsequently, a multivariate logistic regression model was used for analysis.

Results: Out of the 17066 injured workers, 4072 (23.86%) subjects had head and neck injuries. The results of multivariate logistic regressions model showed, age ranges 30-39 (OR = 1.218; 95% CI: 1.036,1.433; $P= 0.017$), 40-49 (OR = 1.313; 95% CI: 1.044,1.652; $P= 0.020$), and ≥ 60 (OR=1.620; 95%CI: 1.028,2.553; $P=0.038$) and having male sex (OR = 1.657; 95% CI: 1.075,2.555; $P= 0.022$) were final work-related risk factors of head and neck injuries in Iran. Also winter season (OR = 1.212; 95% CI: 1.00,1.469; $P= 0.050$) could increase the head and neck injuries odds.

Conclusion: Older workers in Iran are more vulnerable against the occupational head and neck injuries. Moreover, having male sex was other risk factor of the head and neck injuries.

Keywords: Head and neck injuries; Workers; Occupational; Iran

Introduction

Based on the ILO (International Labour Organization)(1), an occupational accident is an unexpected and unplanned occurrence, including acts of violence, arising out of or in connection with work which made a personal injury, disease or

death in one or more workers (2). Occupational accidents made injuries in different parts of the body; two important parts of them are head and neck. Injuries of these two parts can range from minor soft tissue lacerations to complex facial,



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skull and neck vertebrae fractures, and cranial nerve injury (3). These kinds of injuries especially complex or sever of them, are associated with profound disruption of workers' personal and family lives; and significant economic burdens such as medical care costs and lost wages (4, 5). Instead of a single injury event, head and neck injuries may be act as chronic trauma disorders, which can be accompanied with long-term or lifelong physical, cognitive, psychosocial and/or emotional impairments (6). Furthermore, even workers sustaining mild these kinds of injuries may experience long-term consequences, including challenges in daily activities and return to work (6, 7).

Because of the importance of this kind of injuries, some studies for identifying the different work-related brain traumatic injury risk factors have been conducted before. A review study conducted showed, having male sex, working in the industries like agriculture, forestry, mining or construction, and falling are the risk factors of work-related traumatic brain injury (6). Moreover, falls and falling objects were two main risk factors to occupational traumatic brain injuries requiring hospitalization (8). Despite recognition of some this issue risk factors, the prevalence of this kind of injuries raised in recent years (4). For example, in the Canadian province of Ontario, claims for traumatic brain injury have been increased steadily from 1,503 (1.7%) in 2004 to 2,125 (3.9%) in 2013 (6). In such circumstances, head and neck injuries have been became as one of the main occupational fatal accidents. One study that was carried out on the occupational traumatic brain injuries showed, 22% of fatal work injuries are related to these injuries (9).

In general, national research focusing on occupational head and neck injuries among workforce has been surprisingly sparse until now. Given the devastating impacts of occupational head and neck injuries on the workforce and the need to better identifying of the etiology for prevention purposes, the aim of this study was identifying the risk factors of work-related head and neck injuries using a nationwide occupational accident data.

Materials and Methods

Research design and participants

This analytical cross-sectional study was conducted on the worker's accident data gathered by Ministry of Health and Medical Education of Iran in 2013 to 2018. For gathering the data, all seventy-three medical universities and their health care units were involved. The target population was industrialized and non-industrialized adults, aged 18 yr or older, suffered by an accident in his/her workplaces. Finally, data related to the 17066 accidents were registered from all around the country.

The present study was approved by the ethics committee at National Institute for Medical Research Development (NIMAD) No. 971303.

Measures

The dependent variable was the head and neck injury. This variable was a dichotomous one, zero [0] for persons who had not head and neck injuries and one [1] for who had these kinds of injuries. Having any soft and/or hard tissues injuries in head and neck parts that stopped the working was considered as the injuries in this study. The independent variables were included, age, sex, education level, work experience in the current job, job, shift work, injury cause, referred center, season, accident day, accident time, and action after accident. Age was a quantitative variable but categorized into five groups including 18-29, 30-39, 40-49, 50-59, and ≥ 60 . Sex as a dichotomous variable had two subgroups, male and female. Code 0 was considered for females while males had code 1. In data set, education level had seven subgroups but for this study, these seven subgroups were categorized into three subgroups. Work experience was a quantitative variable too, for this study, five groups (0-4, 5-9, 10-14, 15-19, and ≥ 20) were made from this factor. Regarding injured workers job, there was 130 different jobs in the data set however for investigation the relationship between these factors and depend variable, thirteen different categories based on

the 2018 version of U.S. standard occupational classification manual were made 10. Shift variable had three categories, including morning, afternoon, and night. Morning, afternoon, and night shifts were considered for persons whose work periods were from 6 a.m. to 14 p.m., 14 p.m. to 22 p.m., and from 22 p.m. to 6 a.m. respectively. Injury cause as a nominal variable had nine subgroups in data set however in this study it was recoded into five subgroups (fall to lower or same level, stroke by, caught on, in or between, electrical shock, others). Others as the last subgroup were included abnormal temperatures, excessive forces, acute exposure with ionizing radiation, and acute exposure with chemical agents. For season variable, four subgroups were considered (spring, summer, autumn, and winter). Actually, this variable showed the accidents happening seasons. Accident day variable showed in which day in a month an accident was occurred. In this study, it recoded to three main subgroups (first 10 d, second 10 d, third 10 d). In data set, the accidents happening time as a quantitative variable, recoded into four groups (1-6, 7-12, 13-18, and 19-24). Finally, number of workers variable was

categorized into four subgroups including ≤ 500 , 501-1000, 1001-1500, ≥ 1501 .

Data Analysis

To recognize the most influential factors on the dependent variable, first, univariate logistic regression analyses were conducted between each of independent factors and head and neck injuries as a dependent factor. Subsequently, a multivariate logistic regression model was used. However, for preventing to lose important variables due to confounding effects, variables that had $P \leq 0.2$ in univariate analyses were entered to the model. Statistically significant was accepted at the $P < 0.05$. All statistical test was implemented with using of Stata 15.1 (Stata Corp. USA) software.

Results

Descriptive Statistic

Out of the 17066 injured workers, 4072 (23.86%) subjects had head and neck injuries. Age mean and standard deviation of all subjects were 29.97 ± 12.69 yr old. See more details in Table 1.

Table 1: Prevalence of all independent factors by dependent factor, Iran, 2013-2018

Factors	Head and neck injuries				All n=17066 (%)
	No		Yes		
	N	%	N	%	
Age (yr)					
18-29	6167	47.47	1877	46.06	8044 (47.13)
30-39	4385	33.5	1401	34.38	5786 (33.90)
40-49	1763	13.57	582	14.28	2345 (13.74)
50-59	491	3.78	165	4.05	656 (3.84)
≥ 60	185	1.42	50	1.23	235 (1.38)
Sex					
Male	830	6.39	213	5.23	1043 (6.11)
Female	12161	93.61	3862	94.77	16023 (93.89)
Education level					
Illiterate & Primary & Secondary	5283	40.67	1737	42.63	7020 (41.13)
High school & Diploma	5644	43.45	1783	43.75	7227 (43.52)
University & Higher	2064	15.89	555	13.62	2619 (15.35)
Work experience (yr)					
0-4	7956	61.24	2471	60.64	10427 (61.10)
5-9	2581	19.87	854	20.96	3435 (20.13)
10-14	1185	9.12	412	10.11	1597 (9.36)

15-19	751	5.78	230	5.64	981 (5.75)
>=20	518	3.99	108	2.65	626 (3.67)
Job					
Production occupations	7922	70.51	2339	70.07	10261 (70.41)
Transportation and material moving occupations	351	3.12	95	2.85	441 (3.06)
Management occupations	175	1.56	60	1.80	235 (1.61)
Installation maintenance and repair occupations	868	7.73	258	7.73	1126 (7.73)
Construction and extraction occupations	840	7.48	326	9.77	1166 (8.00)
Food preparation and serving related occupations	58	0.52	11	0.33	69 (0.47)
Farming fishing and forestry occupations	235	2.09	37	1.11	272 (1.87)
Office and administrative support occupations	108	0.96	51	1.53	159 (1.09)
Architecture and engineering occupations	56	0.50	14	0.42	70 (0.48)
Healthcare support occupations	109	0.97	23	0.69	132 (0.91)
Protective service occupations	192	1.71	38	1.14	230 (1.58)
Sales and related occupations	48	0.43	12	0.36	60 (0.41)
Building and grounds cleaning and maintenance occupations	273	2.43	74	2.22	347 (2.38)
Shift work					
Morning (6 am-14 pm)	6704	51.60	2171	53.28	8875 (52.00)
Afternoon (14 pm-22 pm)	3353	25.81	1125	27.61	4478 (26.24)
Night (22 pm-6 am)	2934	22.58	779	19.19	3713 (21.76)
Injury cause					
Fall to lower or same level	1611	12.78	484	12.10	2095 (12.62)
Struck by	5795	45.97	2043	51.08	7838 (47.20)
Caught on, in or between	1883	14.94	447	11.18	2330 (14.03)
Electrical shock	135	1.01	49	1.23	184 (1.11)
Others	3181	25.24	977	24.43	4158 (25.04)
Season					
Spring	4157	32.00	1190	29.21	5347 (31.33)
Summer	3615	27.82	1049	23.75	4664 (27.33)
Autumn	3291	25.33	1157	28.40	4448 (26.06)
Winter	1929	14.85	678	16.64	2607 (15.28)
Accident day					
First 10 d	5231	40.26	1667	40.92	6898 (40.42)
Second 10 d	3836	29.53	1181	28.99	5017 (29.40)
Third 10 d	3929	30.21	1226	30.09	5151 (30.18)
Accident time (h)					
1-6	2881	22.17	847	21.46	3755 (22.00)
7-12	4616	35.52	1466	36.00	6082 (35.64)
13-18	4661	35.87	1484	36.44	6145 (36.01)
19-24	836	6.43	248	6.09	1084 (6.35)
Number of workers					
<=500	11618	89.41	3748	92.04	15366 (90.04)
501-1000	477	3.67	135	3.32	612 (3.59)
1001-1500	670	5.16	131	3.22	801 (4.69)
>=1501	229	1.76	58	1.42	287 (1.68)

Univariate logistic regressions

The univariate logistic regression indicated that factors including age ($P<0.001$), sex ($P<0.001$), education level ($P<0.001$), job ($P=0.006$), shift work ($P<0.001$), injury cause ($P<0.001$), season ($P<0.001$), accident time ($P=0.007$), number of

workers ($P<0.001$) were significantly associated with the head and neck injuries. Other factors including work experience and accident day had no significant effect on the dependent factor (Table 2).

Table 2: Associated factors with work-related head and neck injuries according to the univariate logistic regression, Iran, 2013-2018

<i>Factors</i>	<i>Odds ratio</i>	<i>Std. Err.[†]</i>	<i>P-value</i>	<i>95% CI[‡]</i>
Age	1.04	0.009	<0.001*	1.03 , 1.06
Sex	1.21	0.40	<0.001*	1.14 , 1.30
Education level	0.92	0.01	<0.001*	0.91 , 0.94
Work experience	0.99	0.007	0.191	0.98 , 1.00
Job	0.99	0.002	0.006*	0.98 , 0.99
Shift work	0.95	0.008	<0.001*	0.94 , 0.97
Injury cause	0.97	0.005	<0.001*	0.96 , 0.98
Season	1.07	0.007	<0.001*	1.07 , 1.10
Accident day	0.98	0.008	0.092	0.97 , 1.00
Accident time	1.03	0.008	0.007*	1.00 , 1.03
Number of workers	0.87	0.02	<0.001*	0.84 , 0.89

† Standard Error, ‡ 95% Confidence Interval, * Significant *P*-values

Multivariate logistic regressions model

Because *P*-value less than 0.1 was chosen as the model entry condition, so in addition to the three significant variables (age, sex, and season) six other variables including education level, work

experience, job, injury cause and accident time were entered to the model. Factors including age ($P=0.002$), sex ($P=0.016$), and season ($P=0.016$) were final significant associated factors with the head and neck injuries (Table 3).

Table 3: Associated factors with work-related head and neck injuries according to the backward multivariate logistic regression, Iran, 2013-2018

<i>Factors</i>	<i>Odds ratio</i>	<i>Std. Err.[†]</i>	<i>P-value</i>	<i>95% CI[‡]</i>
Intercept	0.081	0.020	<0.001*	0.051 , 0.130
Age	1.114	0.039	0.002*	1.041 , 1.191
Sex	1.692	0.371	0.016*	1.102 , 2.599
Season	1.080	0.035	0.016*	1.015 , 1.149

† Standard Error, ‡ 95% Confidence Interval, * Significant *P*-values

Moreover, the results of multivariate logistic regression model conducted for investigation the effects of subgroups of the three significant factors, showed age ranges 30-39 ($P=0.017$), 40-49

($P=0.020$), and ≥ 60 ($P=0.038$) were significantly associated with the dependent variable.

In addition, the odds of head and neck injuries were higher for male workers in comparison to

the female workers ($P=0.022$). Marginal significant association observed for winter season from

season factor ($P= 0.050$) (Table4).

Table 4: Final risk factors of work-related head and neck injurie in Iran, 2013-2018

<i>Factors</i>	<i>Odds ratio</i>	<i>Std. Err.</i>	<i>P-value</i>	<i>95% CI</i>
Age				
18-29			Ref.	
30-39	1.218	0.101	0.017	1.036 , 1.433
40-49	1.313	0.154	0.020	1.044 , 1.652
50-59	1.376	0.235	0.062	0.985 , 1.922
>=60	1.620	0.376	0.038	1.028 , 2.553
Sex				
Female			Ref.	
Male	1.657	0.367	0.022	1.075 , 2.555
Season				
Spring			Ref.	
Summer	0.857	0.087	0.123	0.704 , 1.043
Autumn	0.919	0.095	0.405	0.751 , 1.123
Winter	1.212	0.119	0.050	1.00 , 1.469

Discussion

To our knowledge, this is the first study in Iran carried out to identify the risk factors of occupational head and neck injuries between injured workers using a nationwide data. Three factors including age, sex, and season were identified as the risk factors of head and neck injuries in Iran. Regarding the accidents distribution between age ranges, older workers had less accidents in comparison to the younger workers. This finding was seen in previous studies and four main reasons were suggested for lower accident proportion among older workers; i) better working conditions; ii) use of acquired skills (compensatory skills); iii) less involvement in particular professions or leave them; and iv) having more specified type of accidents (i.e., falls). Moreover, for higher accident proportion among younger workers, three probable affecting factors were suggested; i) a more demanding working conditions; ii) lack of relevant experience and training, and iii) low general awareness about the existing risks (10, 11). However, prevalence of the head and neck injuries within the older workers were

higher than the younger workers moreover, with increasing the age the odds of this kind of injury also was increased. This finding was similar to others. The higher fatality rate of the older workers in comparison to the younger workers have been reported by some previous studies (12). In such circumstances, the prevalence of severe consequences of occupational accidents was more for the older workers than the youngers were. Aging has an aggravating effect on occupational health and safety as well as the older workers are in higher risks of suffering from severe/fatal accidents (13). This phenomenon might be due to the poor physical conditions, which means that they do not have the same agility when necessary (14). Moreover, in a joint study, ability to perceive and avoid hazards and poorer outcome to sustained injury decrease, with increasing the age (15).

In general, aging is associated with decrease of physical, physiologic and cognitive functions, like bone density, pulmonary oxygen uptake, exercise capacity, visual acuity, resistance to heat and cold stress and others (13, 16). Therefore, by considering this facts, being sensitive against the occupa-

tional hazards and having the higher prevalence of severe injuries in older workers is not far from the mind. In this study, persons who ages fell within the ranges of 30-39, 40-49, and ≥ 60 yr old are significantly in more danger of head and neck injuries versus the workers who ages fell within the range of 18-29 yr old. However, this significant association when 95% confidence intervals were examined was not seen for age range of 50-59. The lack of homogeneity of the sample between the levels of age factor was the major reason for the finding.

With regard to the sex factor, head and neck injuries prevalence among male workers is higher than the female workers, also odds of these kind of injuries was higher for the male than the female workers. Male workers were at more risk of head and neck injuries in comparison to the female workers. This finding was aligned with the other studies, in a study was mentioned that men have considerably more occupational accident than the women (17). Moreover, rates of physical injury claims between the men workers were higher than the women (18). This difference might be explained by the different jobs women and men do (19). While women are more employed in less dangerous jobs, such as service occupations or teaching, more men workers are employed in high-risk jobs, such as in the construction or production sectors (17). Moreover, different societal roles, the expectations, and responsibilities, between men and women workers may be exposed them to the different risks at the workplaces (19). Therefore, these different risks made more fatal and non-fatal occupational accidents to the men in comparison to the women. Some studies showed different results compare to the present study in recent years and some specific kind of injuries being more prevalent between the women workers. The rate of injuries caused by violent acts at workplaces has decreased among men, compared to the women (20).

Third factor that had statistic association with head and neck injuries was season. While total number of accidents were highest for summer season ($n=1708$) but according to the data set,

highest prevalence of head and neck injuries was seen for winter season (19.63%). Odds of this kind of injuries in winter season were greater than the spring season. Therefore, working in the winter season was identified as a potential risk factor of head and neck injuries. Most known frequent of injuries causes in winter season were falling, caught between two things, and strike by something respectively. Strike by something and falling were most frequent head and neck injuries cause. In comparison to the other seasons, these two injury causes make more head and neck injuries in winter season. In agreement with this finding, the maximum number of occupational accidents was happened in the winter season(21). The meteorological conditions and existing of low temperature in the winter season is associated with the various hazards, including slippery surfaces, poor winter elements such as tools, etc. and one of the consequences of these hazards is head and neck injuries. There are controversial findings about the effect of season and meteorological conditions on the occupational accidents, while some studies revealed association between the cold weather conditions and occupational accidents and injuries; others found that the hot weather could increase the risk of unintentional occupational fatal and non-fatal injuries (22, 23). In overall, in addition to the changing the workplaces environment in effect of cold or hot weather conditions, changes in behavior, reduction in skill and power of workers, disposed individuals to accidents (23).

Not registering variables such as PPE usage, training hours, etc. which possibly are the risk factors of occupational head and neck injury, were the main limitation of our study.

Conclusion

Head and neck are two important parts of the body, having trauma in these parts might be accompanied by a permanent disability and even death. Therefore, protecting of these parts of the body from occupational related accidents seems to be necessary. Older workers in Iran are more

vulnerable against the occupational head and neck injuries compare to the younger workers. Moreover, having male sex was the other risk factors of occupational related head and neck injuries. Therefore, the results are useful for injury targeted prevention strategies.

Journalism Ethics considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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Conflict of interest

The authors declare that there is no conflict of interests.

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