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Epidemiology of Fatal and Non-Fatal Industrial Accidents in Khorasan Razavi Province, Iran

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Abstract: One of the most important causes of severe injuries in workplaces is industrial accidents. This descriptive and analytical study aimed at describing the rate of accidents that occured from 2013 to 2015 at selected industrial sites in Khorasan Razavi province. All data were collected from the Department of Labor and Social Affairs of Khorasan Razavi province. Analytical tests including Chi-square and Logistic Regression tests were used to analyze data. The mean and standard deviation of workers' age in non-fatal and fatal accidents were 30.28+13 and 32+11.21 years, respectively. A significant relationship has been resulted between insurance status and fatal accidents (p = 0.001). The rate of fatal accidents in 201 4 was 8.4 times higher than those in 2013 (p = 0.006 and OR = 4.8). Accident prevention programs and training plans should be improved in order to decrease accident rates at industrial sites. The rate of fatal accidents can be minimized by developing and maintaining industrial emergency plans.

Key words: Epidemiology, occupational workers, fatal, non-fatal, accidents

INTRODUCTION

Occupational events in modern societies and developing countries may impose a great cost on society. European Agency for Safety and Health at Work estimated that each year, 4.6 million occupational events occur in Europe. These events may cause 146 million of hours lost in workplaces (Rikhardsson and Impgaard, 2004). Occupational events are an intergral part of the most important industrial issues (Barkhordari *et al.*, 2011). In 2008, 1 000 deaths and 2000 accidents due to occupational accidents were reported (Melia *et al.*, 2008). In addition to accidents, some industrial workers at the mines, agriculture, electronic and construction industries are exposed to occupational agents such as asbestos, silica, heavy metal fume, noise and other hazardous agents under unfavorable work conditions (Arndt *et al.*, 2005). Some of these industries contribute to accidents involving citizens (Kalte *et al.*, 2014a, b). Sadeghain *et al.* (2013) 's study in 2013 showed that most of the injuries were due to electricity distribution. The accidents mostly occurred in the summer (33%) and among workers (16.7%) aged 25 to 29 and 40 to 44; there were no accidents reported for workers who were <20. Approximately 48% of them were hospitalized. Moreover, 35% of them had their treatments in out-patient clinics and 7.4% of them died. According to Unal *et al.* (2008)'s study in 2007, accident and mortality rates were 12.7 and 15.6 per 100,000 workers respectively in Agriculture. Moreover, men constituted 96.1% of the injured people. A high percentage of events affected workers within the age range of 25-29 years old (24.3%). In addition, the number of workers injured due to accidents with work experience was <1. Metal manufacturing processes had recorded the most dangerous occurrence of events (32.5%). The most frequently reported were falling events (1 6%). Worker's behavior and safety policies in workplaces had a positive relationship (Mohamed *et al.*, 2009; Khandan *et al.*, 2013).

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Improvidence and inappropriate safe guards accounted for the high rate of accidents (Colak *et al.,* 2004). Majority of deaths and disabilities were from construction industries; However, occupational events were seen in metal manufacturing, construction, textile industries, coal mining and vehicle manufacturing industries (Unsar and Sut, 2009). In California, the rate of some deadly workplace accidents in unintentional trauma was reported in mining (3.3 RR), agricultural services (3.8 RR 1), construction (3.5 RR) and agriculture (4.4 RR) (Loomis *et al.,1997).*

Khorasan Razavi province has several industries such as mining, oil industries, metal melting factories and construction. Some epidemiological studies have been conducted in order to evaluate the event rates in these industries. The aims of this study were to describe the occurrence of accidents and determine the fatal and non-fatal accident rates in some industrial sites of Khorasan Razavi province.

In Iran, construction is one of the high-risk sectors of work. Previous studies have shown that the accident rate of this industy is high and most injuries occurred through falling. Most deaths occured after victims sustained injuries at the head. Fracture was the most frequent injury in non- fatal accidents (Malakouti *et al.,* 2013; Bahrampour *et al.,* 2009). Invetsigations conducted by Camino Lopez *et al.* maintain that from 1990-2000, 27.7% of events occurred within the age range of 30-39 years old from the domain of workers in the Construction industry. The highest rate of events was reported in workers who had work experience of three months to two years (46.3%). Exertion (20.9%) was the cause of high percentage of events, followed by tools breaking (20.5%), downfall (10.7%) and low percentage of events were due to radiations, heat exposure, fire and explosion (5.5%). Most events occurred between 10:00 and 11 A.M (Lopez *et al.,* 2008).

Unsafe actions were contributing factors to mining accidents. Most frequent types of non- fatal injuries were related to bone bruises and sprain. In a study conducted in Iran's mining industries, the percentage fatal accident was 2.8% (Malek and Aghilmej ad, 2013).

Agricultural accidents sometimes were very serious. Rate of fatal accidents in the Republic of Korea in agriculture were 90 per 100,000 that were three times higher than the average fatal accident rates (Takala (1999).

MATERIALS AND METHODS

This descriptive and analytical study has investigated all events that happened from 2013- 2015 in the Industrial sites of Khorasan Razavi province. All pieces of information regarding accidents were obtained from the Department of Labor and Social Affairs of Khorasan Razavi province. Data collection was done using a questionnaire involving 370 workers from the study population. Details in the questionnaire included information involving accident history, age and occupation of the affected workers, work experience, educational level, insurance status, marital status, outcome of accident and the type of shift-working systems. Data collected were analyzed using SPSS 16 Software, Chi-square and Logistic Regress ion.

RESULTS AND DISCUSSION

Testing the population normality was done sung Kolmogorov' Smirnov test. However, it is important to use non-parametric tests for non-normal populations. About 370 workers in total were affected by accidents from 2013-2015 in Khorasan Razavi province. The mean and standard deviation of workers' age in non-fatal and fatal accidents were 30.28+13.1 and 32+11.21 years old, respectively. The effects of gender (p = 0.82), workers' experience (p = 0.63) and marital status (p = 0.88) on fatal and non-fatal accidents were not significant. According to the results of this study, 39.2% of the accidents affected non-skilled workers. The lowest death rate for headmasters was 11.3% whilst the death rates due to accidents were the highest for non-skilled workers (43%). Effect of educational levels on fatal accidents was not significant (p = 0.91). Strong and significant relationships existed between insurance status of workers (insured vs. not insured) and fatal accidents (p = 0.001). Accident victims who died insured were 8.1%, whilst 25.3% of them were not insured. In the present study, there was no significant relationship between industrial site (construction, mining industries, rubber industries and agriculture) and fatal accidents (p = 0.14). The results indicated that there were no significant differences between the fatal accidents and the year in which the accidents occurred. No significant relationship was seen between the type of the shift work systems and fatal accidents (p = 0.75), even though most fatal accidents occurred during the day shift. The distribution of fatal and non-fatal accidents based on industrial sites and characteristics of workers is shown in Table 1.

In order to investigate the algebraic effect of jobs, insurance status, industrial sites and the year in which fatal accidents occurred, Logistic Regression test was used. According to the results, all the four variables had a significant effect on the dependent variable. From 201 4 to 2015, rate of fatal accidents increased significantly, as compared to the 2013 to 201 4 period. The rate of fatal accidents for 201 4 was 7.2 times higher than the rate in 2013 (p = 0.007, OR = 3.9) and for 2015 was three times higher than that of 2013 (p = 0.041, OR = 3.145). Rate of

Table 1: The distribution of fatal and non-fatal accidents

	Non-fatal accident		a fatal accident				
Variables	Frequency	Percent	Frequency	Percent	Frequency	Total percent	p-value
Gender							
Men	303	87.4	223	12.2	307	97.3	0.82
Female	67	12.6	147	12.7	63	2.7	(fisher exact test)
Total	370	100	370	100	370	100	
Experience							
<1 year	120	90	10	80	93	11.6	0.63
<1 year	250	10	360	20	277	88.4	(fisher's exacttest)
Total	370	100	370	100	370	100	
Kind of job							
Welding	84	76.7	50	19.6	55	16.8	0.717
Non-skilled workers	128	8.9	140	21.3	140	45.2	
Headmasters	79	7.7	40	17.8	35	10.3	(fisher's exacttest)
Workers in							
service sectors	24	1.2	60	23.	35	10.2	
Other	55	5.5	80	17.	105	17.5	
Total	370	100	370	100	370	100	
Marital status							
Married	170	12.5	250	29.2	253	63.6	0.88
Unmarried	200	87.5	120	70.8	117	36.4	(Chi-square)
Total	370	100	370	100	370	100	
Educational level							
Unlettered	100	8.2	100	34.	127	32.2	
High school	180	6.	160	33.	143	37.7	0.91
University	90	85.	110	31.6	100	30.1	(Chi-square)
Total	370	100	370	100	370	100	
Insurance status							
Insured	210	92.4	280	39.4	253	64.6	0.001
Not insured	160	7.6	90	60.6	117	35.4	(Chi- square)
Total	370	100	370	100	370	100	
Kind of industry							
Construction	190	13.1	50	39.5	169	47.1	
Mining and rubber industry	50	10.6	65	33.5	50	14.4	0.14
Agriculture	40	6.1	165	10.5	39	9.4	(Chi-square)
Other	90	70.2	90	16.5	112	29.1	
Total	370	100	370	100	370	100	
Year							
2013	135	90.4	40	61.6	111	28.6	
2014	121	3.4	160	17.8	127	30.8	0.1
2015	114	6.2	170	20.6	132	40.6	(Chi-square)
Total	370	100	370	100	370	100	
Month							
Spring	72	8.5	120	35	93	26.6	
Summer	74	16.6	110	40.4	92	24	0.64
Fall	86	12.6	80	9.2	93	26.6	
Winter	138	62.3	60	15.4	92	22.8	(Chi-square)
Total	370	100	370	100	370	100	
Shift work							
Day shift	150	14.3	200	20.6	236	73.35	
Afternoon shift	140	5.4	110	40.8	75	23.83	0.7
Night shift	80	80.3	60	38.6	59	2.82	(Chi-square)
Total	370	100	370	100	370	100	

p-value = 0.05 was considered significant

fatal accidents in the service sector workers was higher than that of welding workers (p = 0.005, OR = 7.963). Probability of the rate of fatal accidents in workers without insurance was 4.6 higher than that of insured workers (p = 0.0001, OR = 3.9). Results of the logistic regression analysis and effects of independent variables on fatal accidents are presented in Table 2.

There were higher accident rates in construction and mining industries as compared to the other sites. A study conducted in Turkey showed that high figures of general incidence and fatal accident rates had occurred in construction industries (Ceylan, 2012). Rate of Agricultural accident was 9.4%. Browning *et al.* (1998) have reported that crude accident rate of injured fanners per 100 fanners was 9.03. This result strongly agrees with that of the present study. Indications from the results are that nearly 73.33% of events happened during the day-shift and this finding is consistent with

Table 2: The results of the logistic regression analysis

Year	Variables	p-value	OR
Years			
2013	Reference		
2014		0.005	4.805
2015		0.041	3.145
Kind of job			
Welding	Reference		
non-skilled			
workers		0.229	2.018
Headmasters		0.967	1.04
Workers in service sectors		0.005	87.963
Other		0.009	7.793
Kind of industry			
Construction	Reference		
Mining and rubber industry	0.317	0.545	
Agriculture		0.115	0.305
Other		0.003	0.171
Insurance	Insured	Reference	
Not insured		0.0002	3.9

p = 0.05 a significantly

Mbaye *et al.* (2001) study. Comparing the results of this study with previous ones, it is clear that younger men are more susceptible to accidents caused by industrial events (Melia *et al.,* 2008; Lopez *et al.,* 2008). Deadly accident rates in mining and agriculture industries were significantly lower than those in construction industries. Women had a comparatively lower rate of accidents than men. One of the underlying reasons for this trend is the low number of women in these industries. Even though, the majority of accidents affected workers with insurance, fatal accidents affected workers with no insurance cover. Judging from the results, improving the insurance coverage for industrial employees will lessen the number of fatal incidences especially in mining and construction industries (Ceylan, 2012). The value of welfare and medical services after accidents can be increased when the health insurance system is improved. Despite of the fact that the burden of accidents cost attributable to industrial accidents was high, allocated budget for accident prevention is low (Leigh *et al.,* 1997). More accidents were recorded for non-skilled workers than their skilled counterparts. Lack of particular skills training, job experience and job knowledge, these workers have more fatal and non- fatal accidents in comparison with other workers.

It is recoomended that more traming programs be organized in order to increase the safety and health knowledge of workers. Occupational safety and health program are capable of promoting the performance of workers and reducing the number of industrial accidents and project costs (Cox and Cox, 1991; Kartam and Bouz, 1998). Level of education of workers shows no significant relationship with fatal and non- fatal accidents. Accident rates among workers who have attained the level of university education were lower than others. Workers with High School education had high fatal and non- fatal accident rates.

Prevention of accidents seriously needs industrial emergency plans. Therefore the provision of first aid traming program may help prevent more accidents in industrial sites. Improvement of emergency medical services in workplaces can help the workers during the early moments of incidence. Also, adequate and proper safety equipments for the workers should be provided by their employers. Such equipments may reduce the frequency and severity of accidents. Root causes of accidents and the definition of risk control measures can be defined by the use of risk assessment methods (Sohrabi *et al.,* 2016). Improper documentation about safety and health tramg programs have made data gathering, a difficult task. Majority of accidents in developing country are undocumented. Shift-work schedule was suggested for future studies (Rahmai *et al.,* 2013) in order to enhance the reduction of accident.

CONCLUSION

The highest accidence rates were recorded for construction industries. Numerous accidents took place during the day-shift. Also, younger men were more vulnerable to accident caused by industrial events. Health programs and occupational safety are capable of promoting the performance of workers. Additionally, in order to lessen the frequency of fatal accidents, insurance coverage of industrial employees should be improved.

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