

Modeling Causes and Extent of Negligence of Occupational Accidents Assessed by Labor Office Inspectors and Official Experts of the Judiciary

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Abstract

Aim: The purpose of this study was to model the causes and negligence of occupational accidents assessed by labor inspectors and justice official experts of Isfahan province from the perspective of health, safety, and environment management. **Materials and Methods:** This is a descriptive-analytical cross-sectional study that was conducted cross-sectionally to determine the causes of occupational accidents in some industries and workshops in Isfahan province. Data collection was by census, which after reviewing all cases, finally 367 cases completed by inspectors of the labor and justice official experts of Isfahan province have been reviewed. **Results:** The results showed that regarding the injured person's negligence percent, the least agreement was related to the opinion of the inspector and the opinion of the 7-member panel (intra-class correlation coefficient = 31.5%) and then the lowest agreement was related to the opinion of the inspector with the opinions of 3- and 5-member panels. There is a high level of agreement among all groups to determine the percentage of negligence for the contractor (>60%). There was no statistically significant difference between the 3-member and 5-member staff in any of the potential causes of the accident ($P > 0.05$). This disagreement is seen in 40% of cases. The results showed that the disagreement between the 3-member and the 5-member panels is 27%. The rate of disagreement between the 5-member and 7-member panels is 10%. **Conclusion:** Based on the results, people who have more work experience receive less negligence percentage. However, if the injured person has a higher work experience in the current job, the accident occurred with a higher percentage of negligence.

Keywords: Causes, modeling, negligence, occupational accidents

INTRODUCTION

Thousands of occupational accidents occur around the world every day. Improper personal protective equipment, improper work environment and workers' mistakes are the main causes of accidents. By using the information collected in the accident investigation, similar or more dangerous accidents in the future can be prevented. Some accidents cause serious bodily, social, and industrial harm and damages, which will have a significant effect on productivity and production by reducing work efficiency, and most importantly, adverse social effects and, consequently, psychological effects. The first step in preventing occupational accidents is to investigate the causes of its occurrence and to evaluate the performance of related organizations and institutions.^[1] Numerous factors are involved in the occurrence of occupational

accidents, including personal, occupational, environmental, organizational, and family issues. Many of them are hidden factors that model show they affect the occurrence of unwanted events is difficult. One of the life-threatening factors is occupational accidents. From a safety perspective, an accident system is an unintended event resulting from one or more unsuccessful events that adversely affect the system,

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product, equipment, or personnel.^[2] Analysis and modeling of the causes of occupational accidents play an important role in prevention programs. A study aimed at investigating the causes of occupational accidents in Iran's chemical industry showed that out of 30 important accidental factors, 21 had the most role in occupational accidents. The study of accident statistics in most countries shows that the distribution of accidents in people at risk is not uniform, therefore the human factor can be considered as the most important and main factor in the occurrence of occupational accidents.^[3] However, based on the results of other studies, many individual factors, lifestyle, and work environment conditions have been identified as effective factors in the risk of occupational accidents, including age, smoking, alcohol and physical stress, and complexity of work pointed out.^[4] The development of industry, the increasing use of tools and machines, sometimes not observing the correct principles in construction, and not being familiar with the proper use of these tools, lead to the occurrence of accidents. Choosing the right force reduces human accidents and errors and consequently reduces costs and increases production and improves product quality. Occupational accidents threaten the lives of many people in developing as well as developed countries every year. The results of a study showed that occupational accidents are the third leading cause of death in the world and the second leading cause of death in Iran after traffic accidents.^[5] Millions of occupational accidents occur around the world every year. Some of these accidents lead to death and others lead to temporary or permanent disability.^[6] A study showed that occupational accidents are considered as one of the important causes of labor loss and loss of working hours.^[7] According to an International Labour Organization (ILO) report in 2006, there were approximately 270 million occupational accidents in which nearly 2.2 million workers lost their lives. ILO statistics also show that about 250 million occupational accidents occur worldwide each year, and the death rate from occupational accidents is 14/100,000.^[8] The incidence of fatal occupational accidents in developing countries is 3–4 times that of industrialized countries. In the European Union, nearly 4000 people die each year as a result of occupational accidents and nearly 4 million are injured.^[9] Identifying the causes and factors affecting the occurrence of accidents is an important and fundamental issue in preventing their recurrence, so that the implementation of management and engineering measures requires recognizing the most important and most effective causes in the occurrence of accidents.^[10] In our country, as in other countries of the world, there is a similar situation regarding the incidence of occupational accidents. According to the report of the Ministry of Labor, Cooperation and Social Welfare, by the end of October 2015, 297 deaths due to occupational accidents have been referred to forensic medicine centers in Tehran province. This is while in the same period of last year, 282 deaths due to occupational accidents were reported, which shows a growth of 5.3% in 1394.^[11] Without identifying the various causes of the accident, and its consequences, managers will not be able to make appropriate decisions to manage accidents. In order to

find the causes of accidents and eliminate or control them, it is necessary to use a model or methods that, while identifying and analyzing the primary and root causes of accidents, can be a fundamental step to control the causes of occurrence, codify improvement plans and corrective actions before the occurrence of the harvest event.^[12] Inspection, investigation, and determination of causes and factors of accidents and determining the extent of negligence of each factor involved in accidents in both human dimensions and work environment and equipment requires a special legal and technical process that has in the legal system of the country.^[13] Researches and articles have been done to investigate the causes of occupational and nonoccupational accidents in different sectors of industry, mining, services, and even agriculture, but so far, the causes of an accident and the negligence factors for it have not been compared with each other from different legal, judicial and technical perspectives by the authority or legal authorities. Therefore, in order to compare the opinions of two important and influential groups in determining the extent of individual negligence and related causes, the analysis of Documentary and acceptable information and research in this area should be conducted. Given the importance of the subject, the purpose of this study was modeling causes and negligence of occupational accidents assessed by labor inspectors and justice official experts from the perspective of health, safety, and environment management.

MATERIALS AND METHODS

This research is a descriptive-analytical study that was conducted to determine the causes and extent of negligence or causes of occupational accidents in some industries and workshops in Isfahan province. In this study, 367 cases were reviewed by the inspectors of the labor and the experts of the association of justice official experts of Isfahan province. The required data were examined through the information contained in 367 occupational accidents investigation files referred to the inspectors of the labor and the association of justice official experts of Isfahan province, and a form was designed to standardize the data. The total number of votes and opinions of both inspectors of Isfahan Province Labor and experts of Isfahan Association of Official Experts (367 cases) with one-person expert and experts of 3,5,7,9 and 11-member were extracted, and analysed using SPSS statistical software. Kappa agreement statistics and McNemar–Bowker test were used to assess the compliance of experts and labor inspectors with the diagnosed causes of the accident. The degree of agreement between experts and labor inspectors on the percentage of negligence detected for individuals in the accident was assessed using within-class agreement limits and the result of the Wilcoxon test. The relationship between the reported percentage of negligence for individuals in the accident (worker, employer, etc.) and demographic characteristics, job-related variables, and causes of the accident was evaluated with a multivariate regression model.

RESULTS

Agreement between different groups of case evaluators

Table 1 shows the degree of agreement on the percentage of default determined by the case assessment teams. The degree of agreement is explained using the intra-class correlation coefficient (ICC). A higher ICC value indicates higher agreement. Values below 0.4 indicate weak agreement, 0.4–0.6 indicate moderate agreement, 0.6–0.8 indicate good agreement, and above 0.8 indicate excellent agreement. Since the sample size was lower for 9-member panel, it was not included in the analysis. Regarding the percentage of negligence in the accident, the lowest agreement is related to the inspector and the 7-member panel (ICC = 31.5%). After that, the minimum agreements related to the inspector’s opinion are with 3- and 5-member delegations. The most agreement (excellent agreement) between a panel of 5 and 7 members is to determine the percentage of the employer’s negligence. There is high agreement among all groups to determine the percentage of negligence for the contractor (>60%) [Table 2].

According to the sample size, the agreement between the inspector, the 3-member panel, and the 5-member panel was evaluated. There is a statistically significant difference between the opinions of the inspector and the 3-member panel in terms of causes 1, 2, and 5 ($P < 0.05$) and a statistically significant difference between the views of the inspector in terms of causes 1, 2, and 8 ($P < 0.05$). There was no statistically significant difference between the 3-member and 5-member panels in any of the potential causes of the accident ($P > 0.05$). Higher values of kappa statistics indicate more agreement. Values below 0.4 indicate a weak agreement. Due to carelessness and

negligence, there is a weak agreement between the inspector and the 3-member and 7-member panels. This disagreement is seen in nearly 40% of cases. The rate of disagreement in this regard between the 3-member and 5-member panels is 27%, while the disagreement between the 5-member and 7-member panels is 10%.

Modeling the causes of the accident with the percentage of negligence determined by the inspector and the 3-member panel

According to the available sample size, the relationship between potential factors related to the percentage of accident negligence determined by the 3-member board was evaluated. In the raw univariate regression model, the relationship between each of the auxiliary variables and the percentage of negligence determined by the 3-member board was evaluated and the combined relationship of the variables was evaluated in a multivariate regression model ($R^2 = 0.28$). According to the multivariate regression model, people with more work experience receive less negligence percentage. However, if the injured person has a higher work experience in the current job, there is a higher percentage of negligence in the accident. The unrelated activity of the accident during the accident is associated with a percentage of negligence of about 10.61% more. The presence of carelessness and negligence increases the percentage of negligence received by 13.08%. Unsafe working conditions reduce accidents by 9.75%. Negligence to implement safety actions, lack of training, unsafe tools, and negligence to adopt appropriate methods while performing work reduce 14.07%, 8.65%, 8.19%, and 12.95% of the received negligence, respectively [Table 3].

Table 1: The level of agreement between the case review teams for the parties involved in the case

	Case investigators				
	Labor inspector	3 members	5 members	7 members	9 members
Injured person					
Labor inspector		45.9*	46.3	31.5	17.4
3 members			56.8	63.5	30.7
5 members				71.1	51.8
7 members					31.9
9 members					
Employer					
Labor inspector		55.9	53.5	50.7	84.6
3 members			63.1	61.5	81.8
5 members				84.6	88
7 members					78.4
9 members					
Contractor					
Labor inspector		68.3	68.5	67	58.9
3 members			74.2	76.6	81.4
5 members				87.5	95.7
7 members					97.9
9 members					

*ICC. ICC: Intra-class correlation coefficient

Table 2: Degree of agreement and disagreement in determining the causes of the accident

Cause of the accident	3-member panel			5-member panel			7-member panel		
	No	Yes	Kappa	No	Yes	Kappa	No	Yes	Kappa
Carelessness and negligence									
Labor inspector									
No	78 (21.3)	126 (34.3)	0.22	35 (23.5)	47 (31.5)	0.31	4 (13.3)	11 (36.7)	0.2
Yes	24 (6.5)	139 (37.9)		7 (4.7)	60 (40.3)		1 (3.3)	14 (46.7)	
3-member panel									
No				19 (12.8)	17 (11.4)	0.31	2 (6.7)	3 (10.0)	0.28
Yes				23 (15.4)	90 (60.4)		3 (10.0)	22 (73.3)	
5-member panel									
No							5 (16.7)	3 (10.0)	0.71
Yes							0 (0.0)	22 (73.3)	
Lack of adequate supervision									
Labor inspector									
No	128 (35.0)	100 (27.3)	0.237	35 (23.5)	50 (33.6)	0.123	11 (36.7)	8 (26.7)	0.2
Yes	42 (11.5)	96 (26.2)		18 (12.1)	46 (30.9)		4 (13.3)	7 (23.3)	
3-member panel									
No				33 (22.1)	29 (19.5)	0.309	8 (26.7)	2 (6.7)	0.4
Yes				20 (13.4)	67 (45.0)		7 (23.3)	13 (43.3)	
5-member panel									
No							7 (23.3)	5 (16.7)	0.133
Yes							8 (26.7)	10 (33.3)	
Unsafe working environment conditions									
Labor inspector									
No	298 (81.2)	27 (7.4)	0.464	120 (80.5)	12 (8.1)	0.398	26 (86.7)	2 (6.7)	0.348
Yes	17 (4.6)	25 (6.8)		8 (5.4)	9 (6.0)		1 (3.3)	1 (3.3)	
3-member panel									
No				33 (22.1)	29 (19.5)	0.309	8 (26.7)	2 (6.7)	0.4
Yes				20 (13.4)	67 (45.0)		7 (23.3)	13 (43.3)	
5-member panel									
No							7 (23.3)	5 (16.7)	0.133
Yes							8 (26.7)	10 (33.3)	

DISCUSSION

The advancement of technology and the emergence of new technologies in the present age, however, has increased the speed of work more and more and has created more comfort in the lives of human societies and has created many welfare facilities.^[14] But unfortunately, with the advent of these advances and technologies, the number, type, and severity of accidents have also increased. According to this definition, the place of work duty can be both at work and while going back and forth to work or along the way, as well as another selected place according to the employer's order. On the other hand, inspection, investigation, and determination of causes and factors of accidents and determining the degree of negligence of each factor involved in accidents in both human dimensions and work environment and equipment requires a special legal and technical process in the legal system. Every country has its own definition, and in administrative and judicial systems, inspectors and expert experts review, comment, and issue verdict in accordance with the usual instructions and procedures. So far, various researches and studies and articles have been conducted to investigate the causes of occupational and nonoccupational

accidents in different sectors and modeling in occupational accidents.^[15] In the present study, the findings showed that the most common causes of accidents are falls from heights, collisions with objects, and collisions with rotating objects, respectively, and most accidents occur in a group with 1–5 years of work experience. Another finding of the study showed that the highest number of accidents occurred in the early working hours, i.e., 11–12 in the afternoon, which can be attributed to the high volume of work during these hours. Regarding the percentage of negligence of the accident, the least agreement is related to the inspector and the 7-member panel, and after that, the lowest agreement is related to the inspector's opinion with the 3- and 5-member panels. The highest agreement between the 5 and 7 members is in determining the percentage of the employer's negligence. There is no statistically significant difference between 3 and 5 members in any of the potential causes of accidents. Due to carelessness and negligence, there is a weak agreement between the inspector and the 3-member and 7-member panels, and this disagreement is seen in nearly 40% of cases. This is while the rate of disagreement in this regard between the 3- and 5-member panels is 27%. The rate

Table 3: Predictive variables of the percentage of negligence determined for the injured person by the 3-member panel

	Raw model			$(R^2=0.28)$ Adjusted m=model		
	β	SE	P	β	SE	P
Age	0.38	0.1	<0.001	-	-	-
Time of incident	-0.38	0.32	0.231	-	-	-
Married status (single/married)	5.95	2.79	0.033	-	-	-
Number of academic years (<6/6-12/>12)	-0.77	1.54	0.615	-	-	-
Occupation (simple/skilled worker or office worker)	7.23	2.53	0.004	-	-	-
Wages (Tomans)	0.00014	0	0.023	-	-	-
Work experience in the workshop (months)	-0.0004	0.001	0.633	-0.002	0.001	0.021
Current work experience (days)	0.002	0.0004	<0.001	0.001	0.0004	<0.001
Citizenship (Iranian/non-Iranian)	-6.07	4.59	0.187	-	-	-
Accident activity during the accident (related/unrelated)	9.7	5.53	0.08	10.61	4.98	0.034
Carelessness and negligence	18.26	2.67	<0.001	13.08	2.53	<0.001
Insufficient supervision	2.19	2.53	0.388	-	-	-
Unsafe conditions	-4.6	3.61	0.203	-9.75	3.18	0.002
Negligence to take safety precautions	-11.35	2.46	<0.001	-14.07	2.36	<0.001
Lack of skills and training of executive agents	-8.58	3.65	0.019	-8.65	3.22	0.008
Unsafe tools	-3.95	2.96	0.183	-8.19	2.74	0.003
Unsafe use of equipment and tools	-2.57	5.09	0.614	-	-	-
Negligence to apply the proper way of doing work	-10.43	2.74	<0.001	-12.95	2.56	<0.001

of disagreement between the 5- and 7-member panels is 10%. According to the multivariate regression model, the presence of carelessness and negligence increases the negligence rate by 13.08%. Because the causes of an accident and how to determine the negligence from different legal and technical perspectives by legal authorities are not compared with each other or very limited to it, therefore, appropriate scientific results have not been provided in this regard and it is not possible to compare the analytical results of this study with other studies.

CONCLUSION

Based on the selected model, people with more work experience receive less negligence percentage. However, if the injured person has a higher work experience in the current job, there is a higher percentage of negligence in the accident. Given the important role of employers, it seems that informing employers about their legal obligations can play an important role in reducing occupational accidents. The results of the study showed that the highest frequency of accidents in this study is among workers of the construction industry, therefore, it can be expected that the highest cause of accidents among these workers is falling from a height. Another important point is that if workers are aware of safety regulations, they can avoid dangerous areas and help prevent accidents. It is suggested that in order to ensure the present findings, in future research, this study will be conducted with a larger sample size and the results will be compared with the present study. It is also suggested to predict the factors affecting the recurrence rate and severity of the accident with other modeling methods.

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Ethics code

The ethics code is IR.MUI.RESEARCH.REC.1398.795.

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Conflicts of interest

There are no conflicts of interest.

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