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Original

Risk Factors Affecting Occupational Accidents and Related Causes: Case Study

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Abstract

Background: Electricity is considered as the fifth cause of occupational deaths. Occupational accidents caused by electricity do not form a high percentage of total occupational accidents, but are considered due to the severity of injuries which often result in death. The present study aimed to investigate the factors affecting occupational accidents among employees of a power distribution company in Khuzestan province. **Methods:** The present study was a descriptive-analytical study which conducted as cross-sectional on the files related to the accidents of the personnel of a company in 2017. Inclusion criteria were a history of accidents during the last 5 years from 2013 to 2017. Thus, all the personnel files of the employees of the company were reviewed and a number of 92 files of the personnel who were injured during the above-mentioned years were extracted. The required information such as demographic information (age, marital status, education level), organizational information of the injured person (employment status, job title), type of injury and place of injury on the body, rate of accidents in different seasons, days, and hours were recorded on a specific worksheet in the files. SPSS software version 22 was used for analyzing the factors affecting occupational accidents using descriptive tests and chi-square test. Significance level was considered as 0.05. **Results:** The maximum number of accidents occurred in summer during 8 to 10 am and the age group of 25 to 29 years reported the highest number of fatalities. In addition, most accidents occurred in the occupational group having a job experience of 1 to 5 years. **Conclusion:** Human errors and non- use of personal protective equipment, deficit of equipment and supervision, as well as the failure in implementing technical and safety instructions were the most critical causes of accidents and the actions such as technical and safety training before starting the work were evaluated as effective measures in controlling accidents.

Keywords: Accidents; safety; electricity

Introduction

Accident is defined as an unplanned event that causes or stops the work or its progress.[1] With the access of human to new types of energy and the development of new technologies, the necessary context for more well-being of human being has been provided. Along with it, adverse complications such as the increased diversity and severity of occupational accidents and occupational diseases, have increased significantly.[2] Todays, occupational accidents are known as one of the

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major problems of developing countries, so that occupational accidents have involved thousands of workers in the world, especially in developing countries, every year resulting in the death or disability of many workers.[2-4]

Occupational accidents are known as the third major cause of death in the world and the second major cause of death in Iran after car accidents and are also recognized as one of the most critical risk factors of health and economic development.[5] Occupational accidents and work-related diseases have been regarded for a long time and many studies in various occupations and communities were conducted by the World Health Organization in the United Kingdom, Vietnam, and other parts of the world like in Iran in different jobs. The rate and causes of occupational accidents vary in different industries and occupations as well as different geographical areas.[6-8] Based on the current statistics, the accidents caused by electricity are among the deadliest accidents which can cause irreparable damages to society. Statistics indicate that about 4400 accidents occur in the United States and about 400 people die due to electric shock every year.[9]

The electric power industry has been significantly developed during the recent years due to the growing population and the need for electricity. Since power distribution networks have been expanded significantly at low and medium voltage voltages in the cities and villages of Iran in recent years. In other words, the above-mentioned networks are the main point of contact for customers, consumers, and most people of society with power distribution facilities. Thus, a large percentage of electricity accidents which result in financial loss and casualties occur within the range of power distribution networks or are somehow related to the network.[6, 10-13] Investigating the consequences of accidents in the distribution sector of the electric power industry indicates that one of the challenges facing the management of distribution companies is the reduction of casualties and financial loss due to accidents.

The operational part of power distribution companies makes workers face a variety of risks due to the variety of activities and high volume of executive operations because of the nature of work and extent of relevant networks and equipment and consequently the high involvement of workforce and exposure to the accident. Given the growth of distribution networks and privatization processes, a close look at electricity events is of great significance. In order to inform the employees about the risk factors and the effective causes of accidents in their work environment and make them more sensitive about taking preventive strategies more seriously, the present study aimed at investigating the risk factors affecting the occurrence of accidents among employees of a distribution company in Khuzestan province.

Methods

This study was a descriptive-analytical study of cross-sectional type which was conducted retrospectively in March 2017. In order to conduct this study, first all personnel files of the employees working in the company were reviewed. In general, 92 personnel files of the cases who were injured during 2013-2017 were extracted. The information on the accidents which occurred during 2013-2017 being recorded in the company's safety unit accident registration and analysis forms was used. The required information like demographic information (age, marital status, education level), organizational characteristics of the injured person (employment status, job title), type of injury and place of injury on the body, rate of occurrence during different seasons, days, and hours were recorded in a worksheet which was prepared for this purpose. The risk factors affecting the cause of accidents were identified using the available reports and documentation in the personnel file as well as in-person interviews with the injured employees and use of the opinions of safety experts. In order to analyze the factors affecting the

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occurrence of accidents, the information extracted from personnel files was entered into SPSS software version 22 and then analyzed using descriptive tests and statistical test of Chi-square and P <0.05 was considered as the significance level. Finally, a list of causes and control strategies was provided for finding the causes of accidents and presenting control strategies by studying library texts and interviewing safety personnel and company supervisors.

Results

The research findings indicated that the highest number of accidents occurred at the age group of 25-29 years with 27.17% while the lowest incidence rate was at the age group of less than 20 years with 2.1%. In addition, the highest incidence of occupational accidents was 30.43% among the employees with 1-5 years of work experience.

The research findings indicated that the highest number of occupational accidents occurred 8-10 am with a frequency of 16.30% in terms of occurrence time while the hours 16-18 and 14-16 with 14.04 and 13.04%were the highest time range of the occurrence of accidents.

The findings revealed that the highest occurrence of accidents by season was respectively in summer, winter, fall, and spring. The research findings showed that the highest type of occupational accident among the employees of power distribution company was respectively electric shock, falling from height, and the maximum type of burn, trauma, injury, and death. Furthermore, comparing the type of treatment showed that admission at home or in the hospital was the most frequent case (the details of each variables are given in Tables 4, 5, 6).

The research findings showed that electric shock is the most common occupational accident among the employees of the power distribution company and the most significant causes for the occurrence of electric shock among the employees of this company are the lack of personal protective equipment and non-compliance with network privacy.

Table 1. The number of injured employees and their frequency percentage by age group

cumulative frequency percentage	Frequency of injured employees (%)	Age group
2.10	(2.10)2	20<
7.53	(5.43)5	20-24
34.70	(27.17)25	25-29
50.00	(16.30)15	30-34
66.21	(15.21)14	35-39
75.99	(9.78)9	40-44
82.51	(6.52)6	45-49
85.77	(3.26)3	50≤
100	(14.13)13	Non-reported age
-	(100)92	Total

Table 2. The number and frequency percentage of the injured employees by work experience

cumulative percentage	Frequency (percentage)	Work experience
16.30	(16.30)15	Less than a year
46.73	(30.43)28	1-5
65.24	(18.47)17	6-10
77.15	(11.95)11	11-15
85.84	(8.69)8	16-20
91.27	(5.43)5	≤25
100	(8.69)8	Non-recorded
-	(100)92	total

Table 3. The number and frequency of the injured employees by accident time

cumulative percentage	Frequency (percentage)	Occurrence time (hour)
4.34	(4.34)4	0-2
5.42	(1.08)1	2-4
6.50	(1.08)1	4-6
10.84	(4.34)4	6-8
27.14	(16.30)15	8-10
32.57	(5.43)5	10-12
41.26	(8.69)8	12-14
54.30	(13.04)12	14-16
68.34	(14.04)13	16-18
73.77	(5.43)5	18-20
80.29	(6.52)6	20-22
84.63	(4.34)4	20-24
100	(15.21)14	Non-recorded
-	(100)92	total

Table 4. The frequency of accidents by accident type

cumulative percentage	Frequency (percentage)	Accident type
55.43	(55.43)51	Electric shock
80.43	(25.00)23	Fall from height
85.86	(5.43)5	Exposure to bad weather
89.12	(3.26)3	Wild animal attack
91.29	(2.17)2	Accident
100	(8.69)8	Other items
-	(100)92	total

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Finally, the relationship between all studied variables and their relationship with the severity and probability of accident were analyzed using the statistical test of Chi-square. In all cases, the significance level was determined at 5% as the decision criterion. A significant relationship was observed between age and work experience and the probability of accidents (P = 0.02), while no significant relationship was observed between age and work experience (P> 0.05). No significant relationship was found between the probability of accidents with education (P> 0.05). There was a significant relationship between the probability of accidents at different hours (P = 0.01), while there was no significant relationship between the severity of accident and the time of the occurrence accident (P> 0.05). In studying other variables, no significant relationship was observed.

Discussion

This study aimed at investigating the risk factors affecting occupational accidents among the employees of a power distribution company. In this study, a significant relationship was observed between age and work experience and the probability of accidents (P = 0.02), while no significant relationship was observed between age and work experience (P> 0.05). The results of the study indicated that most accidents occurred at the age group of 25-29 years having a work experience of 1 -5 years and also most deaths occurred at this age group. On the other hand, the least number of accidents was related to the age of below 20 and over 50. The reason for the low number of accidents in this group was the lower number of employees as well as inexperience as a main reason for the high rate of accidents and deaths in this group.

Table 5. Comparison of accident type

Nature of injury	Frequency (percentage)	cumulative percentage
Electric burn	(28.26)26	28.26
Death	(8.69)8	36.95
Cut and injury	(23.91)22	60.86
Trauma, dents	(16.30)15	77.16
Eye injury	(2.17)2	79.33
Non-recorded	(17.39)16	96.72
spinal cord injury	(3.26)3	100
Total	(100)92 -	-

Table 6. Comparison of the treatment type

Treatment type	Frequency (percentage)	cumulative percentage
Outpatient	(31.52)29	31.52
Hospitalization	(38.04)35	69.56
Death	(6.52)6	76.08
Non-recorded	(23.91)22	100
total	(100)92	-

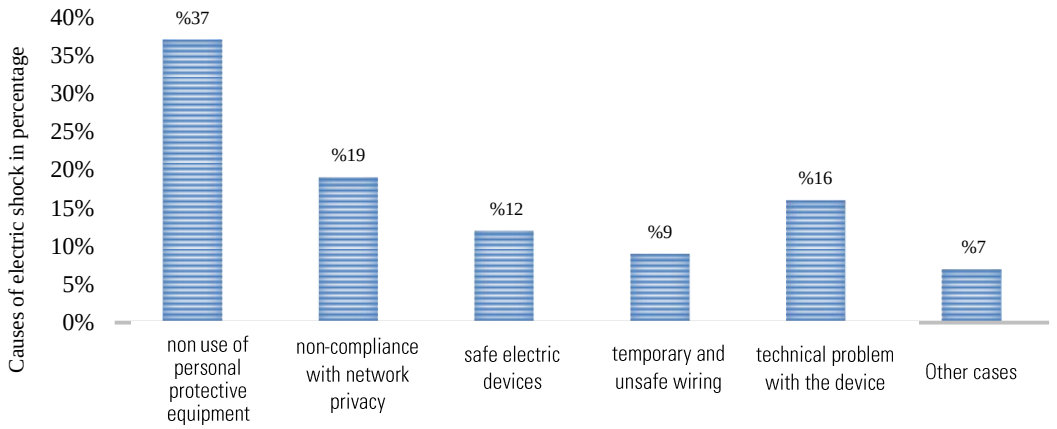

Figure 1. Comparison of the causes of electric shock

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Therefore, such employees should be protected. A study by Halvani et al. in Yazd province reported that the frequency of accidents was more among young people. In addition, the results of a study by Jafari et al. and Alizadeh et al. indicated that the highest rate of accidents was among young people and this result is in line with the results of the present study.[7, 9, 14, 15] The occurrence of accidents in this age group can be reduced by continuously teaching young people about workplace safety tips and accompanying them with experienced people at this age group.[16] The results revealed that there was a significant relationship between the probability of accidents at different hours (P = 0.01) while there was no significant relationship (P> 0.05) between the severity of accidents and the time of accident. In summer, due to the high temperature of Khuzestan province and the increase in electricity consumption, the damage in electricity network is increased which result in the increases of the workload of personnel in the power distribution company increase of accidents in summer in comparison to other seasons.

The results of conducted studies on the role of climatic parameters in the occurrence of accidents indicated that working in hot weather leads to an increase in mental fatigue and reduction of employees' productivity. The result may be distraction and reduction of concentration on work and non-compliance with safe tips (such as the non-use of personal protective equipment in hot weather). Finally, it leads to the increase of the probability of human error and accident and the results of these studies are line with the present study.[17-19] Most of the accidents occurred at the early hours of work which can be considered because of the high volume of work during such hours. In addition, a large part of the development, construction, and optimization is performed at the early hours of the day due to the reduction of the power outage at the peak hours of night. However, the statistics of accidents recorded in the afternoon or at night because of the lack of appropriate monitoring of such accidents always allocates a lower ratio which should be regarded.[7, 20] In most studies conducted in different societies, the highest occurrence of accidents was in the morning shift while the least occurrence of accidents was in the evening shift.

The results of this study are in line with other studies. [21, 22]The mean age of accident in contractors was significantly less than that official workers and a significant difference was observed between the mean age of accidents in two groups of contractors and official workers. Due to the expansion of contracting forces in the electric power industry, this ratio will also increase because the number of official forces is decreasing. On the one hand, most of the remaining official forces do the usual work less and the contractor group does such works.[6]The results revealed that electric shock and fall from height were the two most common accidents among the employees of the power distribution company and the most frequent body organs in these accidents were hands and legs.

This finding was in line with the studies by Mambini et al., Bakhtiari et al., Mehrparvar et al.[23-25] Due to the nature of work, the consequence of most accidents was burns and fractures most of which happened due to electric shock because of working at height and the fall from height due to the non-use of lift and personal protective equipment such as seat belts. The non-use of personal protective equipment is one of the most significant causes of personnel electric shock in the present study. The study by Matlabi et al. it was found that the most insecure behavior among workers was because of the non-use of personal protective equipment being consistent with the present study. In the study, [26] several studies were conducted to inform and improve the use of personal protective equipment among employees and reduce this unsafe behavior. The studies by Fallah et al. and Solhi et al. showed that the use of personal protective equipment (hearing aids) can be improved using BASNEF model.[27, 28]

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Conclusion

The results of this study indicated that the accidents which occurred in the above-mentioned power distribution company have a specific pattern which can be used for reducing the probability of accidents in power distribution companies by identifying the patterns and causes of the occurrence of accidents. It can be said that there the non- use of personal protective equipment, combination of incomplete monitoring and supervision, lack of no electricity test before working, lack of technical skills and expertise of operating team drivers, inappropriate equipment, lack of lifts and technical problem of lifts, and the absence of supervisors of operations on site are among the most significant causes of accidents. The results of studying the causes of accidents indicated the need for acculturation for observing safety rules and regulations and the use of personal protective equipment and other safety items.

For this purpose, the strategies to prevent accidents such as developing laws and regulations regarding the contractors employment such as pre-employment technical and safety training, using stricter safety rules, holding safety and health training courses, technical training requirements for operating team drivers, monitoring the network equipment, holding technical and safety committees meetings in hazardous regions, periodic lift service, the increase of advertising for safe work such as banners, monthly security slogans, etc. and ultimately, periodic examinations for conforming the ability of performing the related work are recommended as solutions to control the probability and severity of accidents.

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Conflict of interest

No conflict of interest was reported by the authors.

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