

Analysis of electrical accidents and the related causes involving citizens who are served by the Western of Tehran

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Abstract

Background: Electrical burns account for a significant percentage of fatal accidents. Each year, a number of consumers in Iran suffer from electrical injuries due to technical problems, equipment failures, and the unauthorized use of electricity. The aim of this study was to examine the root causes of accidents that involved electricity in the district served by the Western Tehran Province Electricity Distribution Company.

Methods: This was a descriptive study in which incidents involving electricity-related injuries were investigated among customers served by the Western Tehran Province Electricity Distribution Company. Therefore, we collected and analyzed incident reports filed by citizens from 2005 through the first half of 2009 in the Distribution Company's coverage area, including Savejbolagh, Shahriyar, eastern Karaj, Qods City, southern Karaj, western Karaj, Malard, and Mehrshahr. The reported events were analyzed using SPSS software.

Results: Exposure of electricity lines and unauthorized construction of residential houses in areas where there were medium- and low-voltage lines were responsible for 37% of the injuries. The findings showed that the highest rate of accidents occurred in 2008 and the first half of 2009. The highest rate of accidents occurred among people with a mean age of 35.

Conclusion: The results from investigating the causes of electrical accidents emphasized the necessity of developing a culture of safety in communities, especially among employees who are engaged in occupations related to electricity, construction workers, and school children to reduce the rate of such accidents.

Keywords: occupational accidents, electricity, injuries, Iran

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1. Introduction

In many countries, occupational accidents have impaired the health and safety of workers in various professions. In 1998, France reported 1.35 million occupational accidents among 14.5 million workers, which was a 3% increase in the number of accidents reported in 1997. Of these accidents, 52% caused injuries (1, 2), and they also cause social and economic problems, disability, and loss of work time, increased healthcare costs, and other adverse consequences (3-7). According to the International Labor Organization (ILO), there are more than 15 million work-related accidents annually on a worldwide basis, and about one million people die each year due to occupational accidents (8). The mean rate of fatal occupational accidents in the world is 14 such accidents per 100,000 workers, with Europe reporting 5.89 fatal accidents per 100,000 workers (9), and the U.S. reporting 3.2 fatal accidents per 100,000 workers (10). However, according to the Bureau of Labor Statistics in Iran, 43% of accidents are accompanied with injuries (11). According to statistics released by the Social Security Organization in Iran in 2003, 268 people died in 14,114 accidents that occurred at the workshops (12). Accordingly, a study in Semnan between 2002 and 2006, the rate of occurrence of fatal accidents or other injuries at work was reported to be 3.8 per 100,000 workers (13).

Electrical burns account for a significant portion of accidents that lead to death. It has been reported that 42% of events that led to death were due to work-related electrocutions and contact with electrical lines between 1992 and 2002 (14). Iran is not exempt from this trend, and each year, many citizens incur electrical injuries due to equipment failures and unauthorized use of power sources. Thus, incidents involving injuries due to electrical shocks during the five-year period from 2005 through 2009 were analyzed to study the main causes of such incidents among the citizens served by the Western Tehran Province Electricity Distribution Company. The purpose of the study was to determine how to prevent such incidents and their consequences, which range from minor injuries to death. So, in addition to providing detailed information concerning the magnitude of this problem, the results of this study can be a pioneering effort in regional planning to keep citizens safe. The overall aim of the study was to investigate accidents involving electrical shocks and related factors for the citizens served by the Western Tehran Province Electricity Distribution Company during the specified time period.

2. Material and Methods

This study was conducted using a descriptive-analytical approach in 2010. In this study, accidents involving electrical shocks to citizens in the specified area were investigated in detail. The study population consisted of all citizens at risk of exposure to electrical shocks in Western Tehran Province. The statistical samples were selected from reports of citizens' accidents that were filed in the service areas, which included Savejbolagh, Shahriyar, eastern Karaj, Qods City, southern Karaj, western Karaj, Malard, and Mehrshahr from 2005 to 2009. Data collection was performed using information recorded by the Western Tehran Province Electricity Distribution Company. The variables that were studied included the year of occurrence, comparison of the numbers of accidents in the nine areas covered, the causes of the accidents, the consequences of the accidents, the gender of the people involved, and the times that the accidents occurred.

The data recorded by the Electricity Distribution Companies in West of Tehran were used in this study. After obtaining the necessary permits to get information from the offices that register accidents that involve electricity distribution companies, the required data were extracted for each region. After the data were collected, they were analyzed using SPSS (Statistical Package for Social Sciences), version 16.

3. Results

The results showed that highest accident rates occurred in 2005 and in the first half of 2009. Also, the data indicated that the maximum rate of accidents occurred in the last 10 days of the months (Table 1). The data indicated that there were 11 cases of fatal electric shock, with the three deaths in the Qods City area in 2009 being the largest number recorded in any of the nine specific areas (Table 1). Our investigation indicated that about 36.7% of accidents were caused by exposures to electricity transmission networks during in buildings (10%) and during unauthorized construction operations of residential houses in the areas of Medium Voltage (MV) and Lowest Voltage (LV) lines (26.7%). Most of the accident victims were men (27 out of 30 or 90%). The results of the analysis of the eight regions over about five-year period indicated that most of the accidents occurred in the Malard area (14 out of the 30 incidents) and the next highest number (six accidents) was in the Qods City region. Our study showed that most of the accidents, i.e., 46%, occurred in the summer. The mean age of the accident victims was determined to be 35, with accidents occurring among people in the age range of 20 to 70.

Table 1. Frequency of accidents in different areas of citizenship (by year, month and outcome)

	Year, Month, Outcome	Frequency (%)
By year	2005	1 (3.3)
	2006	7 (23.3)
	2007	2 (6.6)
	2008	10 (33.3)
	2009 (First half)	10 (33.3)
	Total	30 (100)
By month decade	First decade	9 (30)
	Second decade	9 (30)
	Third decade	12 (40)
	Total	30 (100)
By Outcome of the accident	Bruising and shock.	1 (3.3)
	Eclipse power	1 (3.3)
	Burn	10 (33.3)
	Injuries, burns and fractures member	1 (3.3)
	Burns and amputations	1 (3.3)
	The fracture	1 (3.3)
	Vehicle Fire	2 (6.7)
	Death	11 (36.7)
	Missing	2 (6.7)
	Total	30 (100)

The analysis of the data based on level of education indicated that most of the accidents (24 of 30, 80%) involved people at the lower education levels (diploma and lower).. However, there were only five accidents involving people with an associate degree, and there was only one accident that involved a person with a B.S. degree. The data indicated that 36.7% of the accidents (26.7+10) occurred during the construction of illegal houses in private areas where there were medium-voltage (between 1 to 33 KV) power lines. There were 11 deaths as a result of these accidents.

4. Discussion

The results showed that there was an increasing trend of such accidents over the period of the study. However, due to the lack of national statistics concerning accidents involving electrical shocks, it was not possible to reach any conclusions concerning the occurrence of such accidents nationwide. However, some studies have reported an upward trend in accidents at near of power plants (14). Rahmani et al. (YEAR) conducted a study of the electricity distribution company in Alborz Province to assess the rate of occupational accidents, and they noted that there was an increasing trend four such accidents over an eight-year period (15). Thus, considering the results of Rahmani et al.'s study and the results of our study, both of which indicated increasing trends in electrical accidents, effective management is in order to improve the safety of the electricity distribution company in west of Tehran province is required. Mahmudi suggested that merely having knowledge and awareness does not lead to good performance; he stated that attitudes also must change, and he said that the structure of people's beliefs must be based on deep scientific principles to function properly (16).

The highest accident rate occurred in 2008 and 2009, and the main causes of these accidents performing construction operations in the power network area and the exposure of buildings in the area to lowest-voltage (lower than 1 KV) lines. Also, the control chart that was plotted based on unsafe behavior measurements (16) showed that unsafe behavior and unsafe conditions lead to more frequent electrical accidents involving civilians. The results of our study indicated that 36.7% of accidents resulted in death and that the victims were burned in 33.3% of the

accidents. The results of our study were in good agreement with the results of Naqvi Knjyn and Rahbar's study, which reported that the citizens' mortality rate was 38% (14). In Tirasci et al.'s study, electrocution was reported as the second highest cause of death in the construction industry in the United States and Turkey (17). Rahmani et al.'s study on occupational accidents in the Electricity Distribution Company in west of Tehran indicated that 75% of such accidents occurred due to the negligence of workers and that most of the incidents resulted in workers being burned (15). Rahmani et al.'s study and the findings of this study both indicated that there was a very high burn rate in the accidents that have occurred in the west of Tehran. Lack of standardization of power transmission lines in this company could be one explanation for the high rate of burns among citizens. Therefore, it is recommended the relevant authorities take proper actions by providing solutions to reduce the accidents and the associated burns that occur in the company.

The results showed that most accident victims were male (90%), and this finding was consistent with the results of Sheikhezadi et al.'s study conducted in Tehran in 2009 (18) and Naqvi Knjyn and Rahbar's study (14). The high rate of electrocution accidents in men is likely due to their dominance in power-related workplaces. Thus, it is important for managers and supervisors to emphasize relevant training to make employees and citizens more aware dangers associated with power lines. Such measures could reduce the incidents of electrocution, given that 50% of the accidents in the southern region in 2008 and 50% of the accidents in the western region in 2009 were related to the placement of buildings in the regions where there were medium voltage power lines. The results of this study were consistent with Rahbar and Naqvi Knjyn's study in which they reported 50% of accidents involving the electrocution of citizens were related to the placement of buildings in the areas where there were medium voltage power lines. Therefore, it is recommended that the relevant officials and authorities of the electricity distribution companies in west of Tehran take effective measures to improve the transmission lines and make the electrical networks safer and more secure.

Our study indicated that the greatest number of accidents occurred in the summer. Naqvi Knjyn and Rahbar also reported that most of the accidents in Tehran occurred in the summer (14). The results of Rahmani et al.'s study and Sadeghian et al.'s study regarding accidents in the Electricity Distribution Company in western Tehran, Alborz Province showed that most of the incidents occurred in the summer (15, 19). The results of our study led to the same conclusion. Because of the importance of protecting people lives, it is recommended that protective-preventive instructions be developed and that competent centers conduct follow-up assessments of their use and effectiveness to reduce the number of electrocution accidents in the summer. Our study indicated that the highest rate of accidents was among young people. Their relative inexperience could be one explanation. Another explanation could be the prevalence of young people in the stealing electrical equipment and instruments in Tehran. In studies conducted by Darveniza et al. (20), the highest rates of accidents in different occupations occur among young people. The results of Rahmani et al.'s study also showed that the highest rate of occupational accidents in the electricity distribution company in Tehran occurred among young adults (mean age of 36) (15), while, in the U.S., the greatest rate of occupational accidents has been reported to occur among people with a mean age of 45 (21), which was not consistent with the results of our study. The difference in the various results may be due to differences in the systems that govern the communities and to differences in cultural and social conditions of the communities that were studied.

In this study, the highest rate of accidents occurred among people with education levels of diploma and lower. Rahmani et al.'s results also showed that 53% of occupational accidents in the electricity distribution company in Tehran occurred among those with education levels below high school. Rahmani et al. mentioned low education level as a reason for the high incidence of accidents. Apparently, they concluded that the low level of education leads to a lack of understanding and full awareness regarding the dangers associated with electrical equipment, and our findings were in complete agreement with their findings (15).

Human error and expansion of electricity network frontage, the lack of safety training, failure to use personal protective equipment, supervisory and equipment efficiency, and the lack of availability of technical and safety instructions were the most significant reasons for accidents. Thus, some actions were evaluated for their effectiveness in reducing the occurrence of such accidents, and the actions included technical and safety training before starting work, the time spent working in a given day, increasing the frequency of safety inspections, recording and reporting of minimum events, and keeping the network up to date and in good condition (14).

5. Conclusion

Our investigation of the causes of electrical accidents and the frequency of their occurrence clearly indicated that there is a need for emphasizing the development of a culture of safety in different areas of various communities, especially among employees engaged in occupations related to electricity and construction and education to school children to reduce the accident rate. Thus, the following recommendations should be implemented: 1) Facilitation and expedition for the process of people transition from space of distribution network to other areas, 2) Identification of high-risk areas as the responsibility of all personnel, especially authorities who have responsibility for regions' safety, 3) Implementation of immediate measures for emergency cases in which modifications are required, 4) Increasing public awareness about the dangers associated with power lines and electricity networks by providing educational pamphlets and safety messages via radio broadcasts.

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Conflict of Interest:

There is no conflict of interest to be declared.

Authors' contributions:

All of authors contributed to this project and article equally. All authors read and approved the final manuscript.

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