

### Assessment of the prevalence of occupational accidents and their influential factors in an electricity distribution company during a five-year period

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#### Abstract:

**Background:** Occupational accidents have been considered as one of the most important crippling factors contributing to disabilities and life-threatening situations in many countries. This study was conducted to survey the prevalence of occupational accidents and the factors of that lead to injuries in an Electricity Distribution Company during a five-year period.

**Methods:** In this descriptive study, the accident report form included items asking about the season of the year when the accident occurred, the ages and the average age of those injured, the type of employment, work experience, nature of the injuries that occurred, parts of the body affected, treatments that were applied, average number of days lost per accident, the levels of education of those involved, and their marital status. Data was analyzed using SPSS.

**Results:** A total of 66 Electricity Distribution Company workers were determined to be suffering from injuries due to accidents. The accidents mostly occurred in the summer (33%). Most of the injured workers (16.7%) belonged to the age groups of 25 to 29 and 40 to 44; there were no accidents reported for workers who were less than 20. About 48% of the accident victims had to be hospitalized. Furthermore, 35% of the accident victims were treated in outpatient clinics, and 7.4% of the accident victims died. We demonstrated that there were significant relationships between: 1) marital status and accidental injuries ( $P < 0.001$ ); 2) the average age of those injured among both permanent and temporary workers ( $P < 0.001$ ), 3) the level of education and the consequences of the accidents ( $P < 0.001$ ), and 4) the average of days lost per accident in both the permanent and temporary workers ( $P < 0.001$ ). In this study, no significant relationships were found between the accident occurrence and age ( $P > 0.05$ ) or work experience and the distribution of the accidents ( $P > 0.05$ ).

**Conclusion:** This study indicated that most of the injuries in these accidents were related to the nature of employment, marital status, and level of education. The results showed the necessity for providing appropriate safety training for the workers.

**Keywords:** Occupational accidents, Injuries, Iran

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## 1. Introduction

An occupational accident is an unanticipated and unplanned occurrence in the workplace that results in one or more workers incurring personal injury, illness, or death. Occupational accidents include accidents and injuries that occur when workers or traveling as a requirement of their occupation. Occupational accidents that result in death, disease, or personal injuries include accidents that occur when employees are taking their usual routes to and from the workplace and accidents that occur during work-related training (1).

Occupational accidents have been considered in many countries as one of the most serious threats to workers lives, health, and well-being (2). Some countries do not provide information related to occupational accidents, but, based on the available information, the mean rate of fatal occupational accidents worldwide was 14.0 per 100,000 employees in YEAR (3). The rates are very different from the mean for individual countries and areas. The European Union's rate was 5.89 per 100,000 workers, whereas the maximum rate of 23.1 fatalities per 100,000 workers occurred in Asia. The rapidly industrializing countries, such as the countries of East Asia (including Thailand and the Republic of Korea) have stated high rates of fatal accidents (3). The annual fatality rate in the United States was 3.2 per 100,000 workers from 1989 to 1992 (4). A study revealed that, worldwide, about 120 million occupational accidents occurred in 1993, leading to 210,000 deaths (500 deaths per day). Studies in the following years also indicated that this number increased in 1994 and afterwards. In 1997, 17 million working days were lost in England due to accidents (5, 6). According on Iranian Ministry of Labor, the annual incidence of injuries in Iran is 43% generally.

Occupational injuries are mainly caused by work conditions as well as some personal characteristics (7), significant amounts of money are spent annually to compensate workers for work-related injuries, diseases, and disabilities. This imposes many damages to the active manpower of our society (8). Occupational injuries are caused mainly by unsafe work conditions (9), but some individual characteristics also increase the risk of accidents (10, 11). Thus, it is important to recognize risk factors in order to plan, develop, implement, and evaluate safety regulations and requirements that promote awareness and reduce the occurrence of injuries (12, 13).

Several studies have been conducted with the specific goal of determining the causes of occupational injuries. As a result, the following causative factors have been identified: 1. The situation at (14), Age groups (15), Level of educational and safety training (16), Work experience (17), The effects of smoking (18), The consumption of alcohol (19), Psychosocial factors (20), Shift work (21), Working too fast (22), and Chemicals (23). Some surveys (24, 25) have emphasized the role of job security in causing injuries and damage. These studies have shown that permanent workers are less susceptible to occupational injuries than temporary workers. Since only a few such studies have been conducted, some workers have already indicated that more research is needed to assess the relationship between temporary employment and increased occupational injuries (25). This study was conducted in an Electricity Distribution Company during a five-year period to survey the factors that contributed to occupational injuries. Clearly, estimating the distribution of accidents and determining their causes are effective factors that can be used for preventing accidents in the future.

## 2. Material and Methods

This was an occupational injury inspection study that included the workers of West Tehran Province Power Distribution Company (WTPPDC). All accidents that occurred and were recorded in the central buildings and the central warehouses during a five-year period (2005-2009) were made available for use in this study. Also, statistics of safety committee meetings, which were related to the most severe accidents, were studied to determine the main causes of the accidents. Thus, data concerning the season the accident, age, and the average age of those who were injured, type of employment (permanent or temporary workers), work experience, the nature of the injuries that occurred (type of injury), the affected parts of the body, treatments (outpatient or inpatient), the average days lost per accident, the level of education, marital status (single or married), and others were collected using an accident report form that was designed specifically for this purpose.

Accident records and payrolls were examined for the five-year study period to collect data in relation to number of workers involved in specific activities, the nature of their employment, the nature of their work responsibilities, and the number of accidents that occurred. Data for injuries for which no time was lost on the job (where the affected person resumed work within 24 h of the injury and no leave was taken) as well as data for time-loss injuries (where the affected person did not resume work within 24 h of injury and leave was taken until the person is well enough to resume duty) were analyzed. The raw data were loaded on the SPSS (Statistical Package for Social Sciences) 16.0

packet program, and the frequency distribution, ANOVA, t-test, arithmetic mean, and chi-squared test were performed. The normality of data was confirmed using the Kolmogorov-Smirnov test.

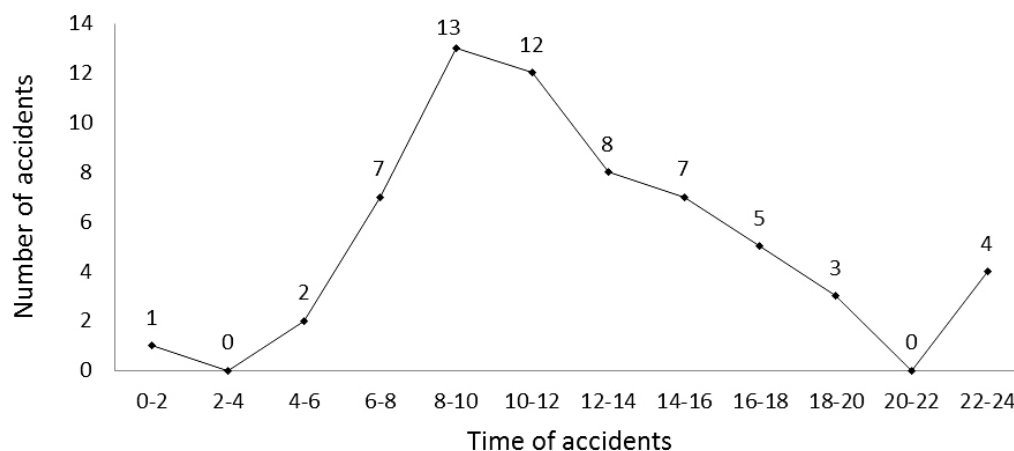
### 3. Results

The ages of the injured workers were between 21 and 58, and the mean age was almost 39 years. Most of workers were married (59.3%), and 46.3% of them had a high school education without a diploma, and 35.2% of them had a high school diploma. Only 3.7% of them had a college education. In addition, most of injured were permanent workers (51.9%). All of the 66 occupational accidents that occurred at the West Tehran Province Power Distribution Company were assessed during a five-year period (2005-2009). Most of the accidents occurred in the summer (33%). The accident rate was highest in the second half of the month (42.6%), especially on days 11-20 of the month.

The minimum and maximum rates of accidents were on Thursday (5.6%) and Wednesday (20.4%), respectively. Most of the accidents (16.7%) occurred between 8:00 AM and 12:00 PM (Figure1). Most of the injured workers (16.7%) were in the 25 to 29 and 40 to 44 age groups. The age group with the least injuries (0%) was workers who were less than 20 years old (Table 1). In this study, no significant relationship was found between the accidents that occurred and age ( $P>0.05$ ). There was a significant relationship between workers' marital status (single or married) and the accident rate ( $P<0.001$ ). The rate of accidents was higher among married workers (Table 1).

In the individual analysis of accidents that focused on the body parts involved in the accidents, it was found that almost 35% of the accidents had affected the workers' hands and arms. The feet were affected in 22.8% of the accidents, and the face was affected in 19.6% of the accidents. The results indicated that the average number of body parts damaged per accident was 1.3 (Table 1). The age distribution of those injured was normal. The average ages of the permanent and temporary workers who were injured were 44 and 29, respectively. The relationship between the average ages of both the permanent and temporary workers who were injured was statistically significant ( $P<0.001$ ). The temporary nature of employment was found to have a significantly higher risk of causing injuries than permanent employment (Table 2).

Most of the accidents that led to death, injury, fracture, and amputations occurred among the workers with working experience of one to five years. The fewest such accidents (7.4%) occurred among workers with less than one year of work experience. No significant relationship was found in this study between work experience and the distribution of the accidents ( $P>0.05$ ). The relationship between the level of education and consequences of the accidents was statistically significant ( $P<0.001$ ). The highest occurrence of accident in permanent and temporary workers were seen among those who had not finish their high school (68.8%) and those with high school diploma (57.6%) respectively (Table 3). As it is shown in Table 3, electrical burns and fractures accounted for the highest and second-highest number of injuries, respectively. Also, in this study, no correlation was found between the type of accident and the consequences of the accident for both permanent and temporary workers who had accidents ( $P>0.05$ ).



**Figure 1.** Trend of accidents during day and night work hours

**Table 1.** Distribution of accidents according to age group, marital status and body parts involved

parameter		n	%
Age group	<20	0	0
	20-24	6	11.1
	25-29	9	16.7
	30-34	4	7.4
	35-39	7	13
	40-44	9	16.7
	45-49	8	14.8
	≥50	7	13
	Age not reported	4	7.4
Body parts involved	Hand and arm	32	34.8
	Foot (the pelvic, thigh, leg and foot)	21	22.8
	Face	18	19.6
	Head and neck	13	14.1
	Trunk and back	6	6.5
	Internal organs	2	2.2
Marital status	Single	14	25.9
	Married	32	59.3
	Not recorded	8	14.8

**Table2.** Average age of those injured in both the permanent and temporary workers during a five-year period

Type of employment	Incidents	Age (Min/Max)	Average age	Standard deviation
Temporary workers	21	21/57	30	8.7
Permanent workers	28	28/58	43.85	6.9
Not recorded	5	.....	.....	.....

**Table 3.** Distribution of accidents according to level of education, type of injuries, and type of treatment among the permanent and temporary workers

Parameter		Permanent workers		Temporary workers	
		n	%	n	%
Level of education	High school	22	66.8	9	27.3
	Diploma	6	18.8	19	57.6
	Associate degree	1	3.1	1	3
	Bachelor's degree or Higher	0	0	1	3
	Not recorded	3	9.4	3	9.1
Type of injuries	Electrical burns	10	31.2	17	51.2
	Fracture	11	34.4	7	21.2
	Death	0	0	4	12.1
	Cuts and wounds	3	9.4	3	9.1
	kink	4	12.4	0	0
	Spinal injury	1	3.1	1	3.1
	Amputation	0	0	2	6.1
	Eye damage	1	3.1	0	0
	Not recorded	2	6.2	2	6.1
Type of treatment	Hospitalization	15	46.9	15	45.5
	Outpatient treatment	12	37.5	12	36.4
	Death	0	0	4	12.1
	Not recorded	5	15.6	2	6.1

The average number of workdays lost per accident was 53.4 for the permanent workers and 31625 for the temporary employees (26). The t-test showed a significant relationship between the average number of days lost per accident in both the permanent and temporary workers ( $P < 0.001$ ). Table 3 demonstrates that about 48% of the accident victims were hospitalized. Furthermore, 35.2% and 7.4% of accident victims had outpatient treatment or died, respectively. The distribution of accidents in different parts of the Company was as follows: 50% in the low-voltage electrical networks, 36% in the 20-kV electrical networks, 2% in the administrative staff, 5% in the measurement groups, and 5% in the other occupational groups.

#### 4. Discussion

At the global level, there are very few well-documented studies to determine the prevalence rate and pattern of accidents in electricity distribution companies. There are no studies that have determined prevalence rates and patterns of accidents in the Electricity Distribution Company in Iran. However, there are some accident-related studies in other factories. The aim of this study was to survey the occupational accidents to find the causes for the accidents and the resulting injuries. This study indicated that accidents have occurred at the Electricity Distribution Company at a disturbingly high rate. The high rate of accidents in summer was due to the fact that the seasonal workers, including high school and university students, lacked the required professional skills and experience for the work they were assigned. This is consistent with Halvani et al.'s findings in their study that was conducted concerning construction accidents (6).

The highest rate of accident consequences ( $n = 20$ ) was electrical burns, which was followed closely by fractures ( $n=17$ ). This shows that the most severe and intense injuries resulted from electrical accidents, which was inconsistent with Colak's findings that the highest consequence rates of accidents were injuries and fractures (27). The difference in the results of the studies may be due to differences in the populations that were studied. The results of the study showed that the highest rate of accidents was among workers (24.1%) with one to five years of work experience. Also, the lowest rate of accidents (7.4%) belonged to workers with six to 10 years of work experience. This is not consistent with Halvani et al.'s findings (28), which indicated that the highest rate of accidents was for workers (34.8%) with less than one year of job experience. Also, the lowest rate of accidents (12.5 %) was for workers with more than 20 years of job experience. The difference in the results of the studies may be due to differences in the populations that were studied.

In this study, no correlation was found between the accidents that occurred and age. Most of the injured workers belonged to the age groups of 25 to 29 and 40 to 44, but other studies have shown that accidents are more common among the younger age groups (23, 29, and 30). The difference in the results of the studies may be due to differences in the populations that were studied. The results of the study showed that accident rates were higher among married workers. The study highlights the fact that married workers have more difficulties and that these difficulties may cause increased accident rates. Married workers with domestic problems should be identified early to decrease the influence of these difficulties in the short- and long-term. This will reduce the burden of injuries among the workers and may prevent future accidents and injuries.

The type of employment was found to have considerable effect on the causes of injuries. Permanent workers were at less risk than temporary workers. The safety training provided by the Company was relatively weak. The only method for acquiring knowledge about safety was job experience. Thus, because the permanent workers had more work experience, they may have been in a superior situation compared to the temporary workers. This finding of higher risk of accidents among the temporary workers was similar to the findings of earlier reports issued by Sampaio et al. and Morris, in which they dealt with accidents of temporary workers (24, 25). The cause of this increased risk may be attributed to the temporary status of the working group, but it also may be attributable to some other parameter, e.g., the lack of job security might have played an important role in such workers having accidents. The permanent workers would certainly have more extensive experience and thus would have accumulated more safety knowledge than the temporary workers (23). In this study, it should be noted that the risk of having an accident increased as the educational level decreased. Most of the accidents that produced injuries occurred among the permanent workers who had a high school level of education and among the temporary workers who had a high school diploma. But, as has been observed by other authors who have conducted surveys of safety training, such training cannot reduce accidents when the level of hazards is high and when the use of reliable techniques and safe work practices is limited (31). This finding suggests that further research should be conducted to evaluate and determine the appropriateness of safety training programs.

Prevention of occupational accidents is an important task of human resource management. Intervention to decrease occupational accidents should be multi-faceted to be effective. Activities on various levels, workplace visits, risk assessment activities, and attitude surveys among the general public must be combined in order to reduce occupational accidents and, as a result, reduce the incidence of claims due to accidents. A comprehensive, overall survey of the specific tasks and risk exposures identified together with a systematic collection of risk scenarios from exposed workers through critical incident and other techniques, should be the next steps of intervention (1). Task-related, appropriate engineering and design solutions should be developed for the different problems highlighted above. The choice of such applied development activities should be made with a priority towards decreasing injuries and their severity. Changes in work organization and improved safety standards could result in the remarkable lowering of fatal and non-fatal injuries (1). Knowledge of the predictors of work-related injuries and general training for existing and new employees may contribute to strategies for preventing accidents and injuries, especially among newly-employed or temporary workers (32). The development of a standardized database to monitor occupational injuries across companies is feasible (33). Personal protective equipment can decrease the incidence and severity of injuries significantly, thereby reducing the number of days lost to medical leave (34, 35).

### **5. Conclusion**

The results of this study show that the highest rate of accidents occurred in the summer. The highest rate of accidents was among workers with minimum working experience. Also, the results of the study showed that accident rates were higher among married workers. It seems that various factors, such as teaching safety principles to workers and asking them to use some protective instruments, can decrease the occurrence of accidents significantly. In addition, several studies have highlighted the importance of safety measures to prevent accidents in different jobs. Studies should be conducted to determine the prevalence rate and pattern of accidents in electricity distribution companies around the country. Those studies should survey occupational accidents to identify the parameters that are responsible for causing accidents and injuries.

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### **Conflict of Interest:**

There is no conflict of interest to be declared.

**References**

1. Govanović G, Arandelović M, Govanović, M. Multidisciplinary aspects of occupational accidents and injuries. Working and Living Environmental Protection Series. 2004; 2 (4):325-33.
2. Majori S, Bonizzato G, Signorelli D, Lacquaniti S, Andreetta L, Baldo V. Epidemiology and prevention of domestic injuries among children in the Verona area (north-east Italy). *Ann Ig.* 2002; 14(6):495 – 502.
3. Takala J. Global Estimates of Fatal Occupational Accidents, *Epidemiol.* 1999; 10: 640- 6.
4. Feyer AM, Williamson AM, Stout N, Driscoll T, Usher H, Langley JD. Comparison of work related fatal injuries in the United States, Australia, and New Zealand: method and overall findings. *Inj Prev.* 2001; 7(1): 22-8.
5. Dong W, Vaughan P, Sullivan K, Fletcher T. Mortality study of construction workers in the UK. *Int J Epidemiol.* 1995 Aug; 24(4):750-7. Pubmed PMID: 8550272
6. Halvani GH, Jafarinodoushan R, Mirmohammadi SJ, Mehrparvar AH. A survey on occupational accidents among construction industry workers in Yazd city: Applying Time Series 2006-2011. *JOHE.* 2012; 1 (1).
7. Mohammadfam I, Moghimbeigi A. Evaluation of Injuries among a Manufacturing Industry Staff in Iran, *Journal of Res Health Sci* 2009; 9(1): 7-12.
8. Choobineh AR Amirzadeh F. General occupational health. 6th ed. Shiraz: Publishers of Shiraz University of Medical Sciences; 2003. [Persian].
9. Azadeh A, Nouri J, Mohammad Fam I. The impacts of total system design factors on human performance in power plants. *Am J Appl sci.* 2005; 2:1301-4.
10. Engel, HO. Accident proneness and illness proneness: a review. *J R Soc Med.* 1991; 84(3): 163-4.
11. Dembe AE. The social consequences of occupational injuries and illnesses. *Am J Ind Med.* 2001; 40:403–17.
12. O'Connor TG, Davies L, Dunn J, Golding J. Distribution of accidents, injuries, and illnesses by family type. ALSPAC Study Team. Avon Longitudinal Study of Pregnancy and Childhood. *Pediatrics.* 2000 Nov;106(5):E68. Pubmed PMID: 11061805
13. Grossman, DC. The history of injury control and the epidemiology of child and adolescent injuries. *Future Child.* 2000 Spring-Summer;10(1):23-52. Pubmed PMID: 10911687.
14. Melamed S, Yekutieli D, Froom P, Kristal-Boneh E, Ribak J. Adverse work and environmental conditions predict occupational injuries. The Israeli cardiovascular occupational risk factors determination in Israel (CORDIS) study. *Am J Epidemiol.* 1999; 150, 18–26.
15. Cloutier E. The effect of age on safety and work practices among domestic trash collectors in Quebec. *Saf Sci.* 1994; 17, 291–308.
16. Wong TW. Occupational injuries among construction workers in Hong Kong. *Occup Med (Oxf).* 1994; 44, 247–52.
17. Salminen ST. Epidemiological analysis of serious occupational accidents in southern Finland. *Scand J Soc Med.* 1994; 22, 225–7.
18. Ryan J, Zwerling C, John E. Occupational risks associated with cigarette smoking: A prospective study. *Am J Publ Health.* 1992; 82, 29–32.
19. Wells S, Macdonald S. The relationship between alcohol consumption patterns and car, work, sports and home accidents for different age groups. *Accid Anal Prev.* 1999; 31, 663–5.
20. Niedhammer I, Bugel I, Goldberg M, Leclerc A, Gueguen A. Psychosocial factors at work and sickness absence in the Gazel cohort: a prospective study. *Occup Environ Med.* 1998; 55, 735–41.
21. Smith L, Folkard S, Poole CJ. Increased injuries on night shift. *Lancet.* 1994; 344, 1099–100.
22. Harrell WA. Perceived risk of occupational injury: control over pace of work and blue-collar versus white-collar work. *Percept Mot Skills.* 1990; 70, 1351–9.
23. Saha A, Kumar S, Vasudevan DM. Factors of occupational injury: A survey in a chemical company. *Ind Health.* 2008; 46:152–7.
24. Sampaio RF, Martin M, Artazcoz L, Moncada S. Occupational accidents in Barcelona (Spain), from 199 to 1993. *Rev Saude Publica.* 1998; 32, 345–51.
25. Morris JA. Injury experience of temporary workers in a manufacturing setting: Factors that increase vulnerability. *AAOHN J.* 1999; 47, 470–8.
26. Khosravi J, Hashemi Nazari S S, Dehghani Fard S, Jabbari K. Evaluation of occupational accidents leading to death in workers of emarat service contractors and urban green spaces of Tehran in 2004 and 2005. *Journal of Forensic Medicine,*2007; 13(2),68-77.
27. Colak B, Etiler N, Bicer U. Fatal occupational injuries in the construction sector in Kocaeli, Turkey, 1990-2001. *Ind Health.* 2004; 42(4):424-30.

28. Halvani Gh, Aminipour MR. Survey of work events in factories of social securing organization in Yazd City. *Toloe Behdasht Magazine*. 2004; 2:9-17.
29. Colao AM, Pisciotano V, Giampaletti C, Cenci G. Occupational accidents among immigrant workers in the Fabriano areas. *Med Lav*. 2006; 97: 787-98.
30. Candela S, Duca P, Bedogni L. The cases of accident in the ceramic tile industry in relation to the age and job seniority of the workers. *Med Lav*. 1993; 84:217-25.
31. Bhattacharjee A, Maiti J. New look into the Quantitative analysis of mine safety studies. *Transactions of the Society of Mining, Metallurgy, exploration, Ins (USA)*. 2000; 308:1-8.
32. Barreto SM, Swerdlow AJ, Schoemaker MJ, Smith PG. Predictors of first nonfatal occupational injury following employment in a Brazilian steelworks. *Scand J Work Environ Health*. 2000; 26(6): 523-8.
33. Yager JW, Kelsh MA, Zhao K, Mrad R. Development of an occupational illness and injury surveillance database for the electric energy sector. *Appl Occup Environ Hyg*. 2001; 16(2): 291-4.
34. Sorock GS, Lombardi DA, Hauser RB, Eisen EA, Herrick RF, Mittleman MA. A case-crossover study of occupational traumatic hand injury: methods and initial findings. *Am J Ind Med*. 2001; 39(2): 171-9.
35. Prezant DJ, Freeman K, Kelly KJ et al. Impact of a design modification in modern firefighting uniforms of burn prevention outcomes in New York City firefighters. *J Occup Environ Med*. 2000; 42(8): 827-34.