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**Original article**

**Analysis of Iranian construction sector occupational accidents (2007-2011)**

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ABSTRACT

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The purpose of present study is to investigate the characteristic factors responsible for occupational accident occurrence in construction sector. The current study analyzes 4074 construction occupational accidents recorded by the Ministry of labour and social affair offices in Iran, from the years 2007-2011. First using descriptive statistics methods, we obtained general understanding of accidents. Afterwards, utilizing the Chi-square test we analyzed the association between factors influencing accidents. The most victims were less than 35 years old (64.4%), with elementary and secondary education level (64.58%), and married (68.31%). Additionally most accidents occurred on summer (29.16%), during 8-12 hours of day (46.1%) and among less than 1 year experience workers (35.74%). Marital status and time of day were not significantly related to accident occurrence. However, season which accidents occurred, victim's education, age of victim and victim's experience was significantly related to accident occurrence. The accident control programs, especially related accidents, identifying groups at risk and factors' affecting the accidents is very important. Using further studies, improving safety culture, training, and encourage workers to participate in safety programs and the use of personal protective equipment we can reduce accidents.

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## 1. Introduction

According to the International Labor Organization, approximately two million people die while at work every year. In the construction industry alone, at least 60,000 people die on construction sites and many hundreds of thousands sustain serious injuries or contract occupational diseases (Cheng, Leu et al. 2012). Hamalainen et al. (Hämäläinen, Takala et al. 2006) estimated that there were approximately 350,000 fatal occupational accidents and 264 million nonfatal work-related accidents around the world in 1998 (Macedo and Silva 2005). Occupational accidents have a major impact upon human integrity, but they also bring about high costs for a country's social security system and cause large levels of absenteeism and low productivity (Macedo and Silva 2005). Because of occupational accidents, permanent disabilities and deaths occur and economic and workday losses emerge. In particular, the death of workers or their permanent disability leads to negative economic loss and social problems for employers, employees and their families. Occupational accidents can be reduced by attaching importance to this issue and by taking effective preventative measures (Unsar and Sut 2009).

The construction industry is dynamic and hazardous due to the diverse and complex nature of work tasks, trades, and environment, as well as the temporary and transitory nature of construction workplaces and workforces (Kines, 2002). Therefore, the risk of occupational accidents in the construction industry is far greater than in a manufacturing based industry. In the construction industry, the tremendous losses of human and economic resources caused by occupational accidents have become a serious problem (Liao and Perng 2008). Many reasons have been proffered in answer to the question of why the construction industry has such high accident rates. These include: (1) the inherently hazardous nature of construction projects; (2) personnel factors; (3) environmental and equipment factors; (4) project factors; and (5) management factors (Cheng, Leu et al. 2012). More specifically, in order to stay economically competitive and sustainable and to earn maximum profits, many contractors only execute basic safety measures and eliminate many important hazard prevention training programs during construction project implementation (Cheng, Leu et al. 2010). Chi and Wu analyzed 1230 occupational injury incidents in Taiwan and found that most accidents occurred in the construction industry (662, 50.6%) (Chi, 1997). Many recent studies have also indicated the gravity of occupational injuries in construction industry (Cheng, Leu et al. 2012). The occupational safety and health issues of this industry are thus worthy of further discussion. Among the greatest concerns of occupational safety researchers, in general, and particularly in the construction sector has been and still is to understand the causes that produce accidents. Thus, studies have been conducted into such aspects as training, overtime, the age of the worker, to determine their impact on safety (Liao and Perng 2008, Camino López, Fontaneda et al. 2011). Accident analysis is used to identify factors contributing to occupational injuries and to develop strategies for injury prevention. The analysis of aggregated accident data rather than single case analysis is considered as the only way of discovering any unifying and common factors in accident events (Liao & Perng, 2008). The purpose of an accident analysis is to obtain accurate, objective information about the causes of accidents in order to prevent the incident from recurring (Byung Yong, 1997).

In Iran, the Ministry of labour and social affair is responsible for writing occupational and industrial safety regulations and supervising on their implementation. According to regulations, all employers require to report occupational accidents during 72 hours after accident occurrence. Ministry of labour and social affair analysis this accidents and plan for prevent their recurring. This study covers the analysis of occupational accidents that occurred in construction sector between 2007 and 2011. Consequently, some recommendations have been presented to reduce and prevent occupational accidents.

## 2. Materials and methods

### 2.1. Data collection

As noted above, collecting and analyzing of occupational accidents is Ministry of labour and social affair responsibility. The current study analyzes 4074 construction sector occupational accidents recorded by the

Ministry of labour and social affair offices in Iran, from the years 2007-2011. Occupational accidents reports have various information such as: victim age, gender, experience, accident result, time of accident, ect. For each accident report, age, work experience, and other relevant factors were classified into several useful categories for further analysis (C.-F. Chi, et al., 2009).

## 2.2. Data classification

We extracted six factors from occupational accident reports. Age was classified into five categories. Work experience was classified into five different levels and victim's education was classified into five different levels. Marital status was classified into two categories of single and married. Time of accident occurrence in day was categorized into six levels and the season of accident occurrence was classified into four categories. Table 1 is shown these factor's categories and occupational accidents' distribution.

## 2.3. Statistical analysis

First using descriptive statistics methods, we obtained general understanding of accidents. Afterwards, the researchers used the Chi-square test to analyze the association between factors influencing occupational accident occurrence (Cheng, et al., 2012; Kuan, 2006). We used Excel software and SPSS version 16.0. Research on water quality is made by prospective epidemiological and analytical method. Is performed within months from May to June '12. The sampling plan was designed to expand the analysis of drinking water in all residences, respectively from two samples for each watershed. Sampling was conducted for 21 days, taking an average of 3.1 samples per day. Three teams are engaged in sampling. Samples were transferred within 4 to 6 hours, depending on the terrain, to laboratories for microbiological and physicochemical analysis. To facilitate research, the region of Dragash have divided into five areas; Opoja, Brezne, Dragas, Brod and Restelicë. In this way including villages that lie mainly in these areas and have closer communication. Sampling was carried out according to the WHO manual on plastic bottles prepared in advance.

## 3. Results

### 3.1. Frequency distribution of variables

Tables 1 show a summary of the major findings of the analysis in terms of age group, work experience and so on. The frequency analysis on each coded variable indicated that the majority of victims were less than 35 years old (2624, 64.4%), had less than 1 year of working experience (1456, 35.74%), had less than high school education (2631, 64.58%) and married (2783, 68.31%). Additionally, the most accidents were occurred in summer (1188, 29.16%) and during 8-12 (1878, 46.10%) (See table 1).

Associations among factors were revealed by the Chi-square. Marital status and time of day were not significantly related to accident occurrence. But victim's education, age of victim, season of accident occurrence and victim's experience ( $p < 0.001$ ) were significantly related to accident occurrence.

## 4. Discussion

The risk of occupational accidents in the construction industry is far greater than in a manufacturing based industry (Liao and Perng, 2008). Construction sector is one of the most dangerous sectors in the United States. In 2004, construction workers were 7.7% of the US workforce, but suffered 22.2% reported work-related deaths (Waehrer, 2007). This research developed a classification scheme mostly based on existing literature to categorize 4074 occupational accidents in terms of influencing factors. The result from the present study indicated that the workers involved in the most occupational accidents were the workers with the age 34 years old and below (36.4%). This result is consistent with the findings of other studies (Chi 2003, Chi, Yang et al. 2009). Younger workers, aged below 35, were represented disproportionately in the all of accidents, and it is suggested that this was caused by their inexperience and carelessness. The occupational accident rate of the group of 45 years old and above was very low (17.21%) and this result was in consistent with the findings of other studies (Unsar and Sut 2009). The reason for this may be that they are more experience, responsible and careful. Moreover, the reason for this high occupational accident rate in the group of 34 years old and below may be due to the high employment

rate in this age group (Unsar and Sut 2009). Working experience increases with age and risky behavior in general is influenced by age. This is reflected in the rate of accidents at work (Unsar and Sut, 2009). The frequency distribution of experience seems to confirm that young workers (< 35 years old) suffer occupational accidents due to their lack of experience (Chi et al. 2009).

**Table 1**

Distribution of accidents according to factors influencing them.

Factor	Frequency	%	p
<b>Age group</b>			0.000***
< 25	1139	27.95	
25-34	1485	36.45	
35-44	749	18.39	
45-54	461	11.31	
≥55	240	5.90	
<b>Work experience</b>			0.000***
< 1 year	1456	35.74	
1-5 years	878	21.55	
5-10 years	647	15.88	
10-15 years	408	10.01	
> 15 years	685	16.82	
<b>Victims education</b>			0.000***
Elementary	1470	36.08	
Secondary	1161	28.50	
High school	443	10.87	
Diploma	864	21.21	
Academic education	136	3.34	
<b>Marital status</b>			0.001
Single	1291	31.69	
Married	2783	68.31	
<b>Season of accident occurrence</b>			0.000***
Spring	990	24.30	
Summer	1188	29.16	
Fall	1022	25.09	
Winter	874	21.45	
<b>Time of day</b>			0.017
24-4	61	1.50	
4-8	76	1.86	
8-12	1878	46.10	
12-16	1205	29.57	
16-20	793	19.47	
20-24	61	1.50	

\*\*\*p&lt;0.001

Most accidents occurred among workers with primary and secondary education (66.58%). One of the reasons is the employment of these workers in industries and occupations that require a lot of exercise, and physically hard. Another reason could be the their low understanding of risks due to the low level of education, lack of adequate and effective training, and lack of supervision.

Married people account for the largest number of accidents have (68.31). The reason of most accidents among married people can be because of their employment in many firms, hazardous tasks and hard work. In summer, construction activities increase and this can increase accident occurrence. Considering the occupational accidents by hour period, can state that 8-12 h period (46.1%) was that when more accidents occurred. This finding is consistent with Macedo study that showed more accidents occurred during 8-12 h and 12-16 h periods (Macedo and Silva 2005). A study on fatal falls in the US construction industry found that 76% occurred between 06:00 and 17:00 h (Cattledge 1996 a). A study of non-fatal falls in the State of Virginia found that 85% of all injuries due to falls took place between 08:00 and 16:00 h (Cattledge 1996 b). The time of an accident has also been studied in others countries, thus in Portugal, the highest accident rates occur between 8:00 and 12:00 h (Macedo and Silva 2005). It has also been shown that more injuries occur in the morning in Australia than in the afternoon on every working day of the week (Wiggleworth 2006). One reason for increasing accidents during these periods is the fact during 8-16 h most enterprises are working full and similarly throughout time. Several studies have suggested that new and inexperienced workers have the greatest risk of occupational accidents (Jeong 1998, Chi 2005, Lin et al. 2008). In this study, the finding that most of the occupational accidents occurred during the first year of employment (35.74%) was consistent with previous findings (Lin et al. 2008). Byung study also indicated that 51.30% of all injuries occurred during the first year of employment (Byung Yong 1997).

## 5. Conclusion

Successful strategies for accident prevention will depend on effective analysis and commitment on the part of employers and co-operation by employees working together towards the elimination of actual and potential risk. That is, the analysis of accident data can influence accident prevention programs (Byung Yong, 1997). Successful accident prevention relies largely on knowledge about the causes of accidents. In any accident control activity, particularly in occupational accidents, correctly identifying high-risk groups and factors influencing accidents is the key to success interventions (Lin, 2008). Although many factors affect the occupational accidents, this study analyzed some factors such as age groups, working experience, education and so on. To reduce the overall occurring rate of occupational accidents in the construction sector, it is important to implement required safety practices and training effectively to insure that all workers acknowledge and follow these requirements regulations when working. The results of this study provide a framework for improving the safety practices and training programs that are essential for protecting workers. Prevention measures, including safe work practices, guarding, and PPE are proposed for accident prevention and employers must implement daily inspections of tools, equipments and workplaces (Chi, 2009). The findings identified in this study can be used to decide on the accident prevention programs. In order to prevent or reduce the number of occupational accidents, the components causing occupational accidents should be identified via analysis, assessments, necessary measures should be taken, and audits should be used to see if the measures are implemented effectively or not. What is important here is the continuous implementation of measures and auditing. The success of preventing occupational accidents depends on this process. Accidents may be decreased if a safety culture is constituted and shared with employees.

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