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Investigating the Characteristics of Fatal Construction Injuries in İzmir, Turkey using Descriptive Statistics

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***Abstract*— In Turkey, the construction sector is responsible for the largest number of work-related fatalities among all industries. Study aimed to form newly created database by focusing on the safety problems of a specific industry and determine the characteristics of the fatality. The analysis was based on data from 94 deaths. Descriptive analysis techniques were performed on the data set using SPSS software. Among the 6223 work-related injury victims who died between 2007-2011 overall in Turkey, 344 (5.5%) were from Izmir and among 6223 victims who died overall in Turkey 1857 (29.8%) and 344 victims who died in İzmir 94 (27.3%) were construction workers. The evaluation of the type of injuries in construction sector has revealed that in 63 of cases (67.7%) fell down from elevation, in 6 cases (6.5%) struck by falling object and road accidents were the cause of death. Findings of the cross tabulation study showed that fall from elevation is the leading cause of fatality, and plasters/painters, form workers, and roofers are more susceptible to falls.**

***Keywords*— Characteristics of accidents, Construction accidents, Cross Tabulation analysis, Fatal injuries, Univariate analysis**

I. INTRODUCTION

The building and construction industry (hereafter referred to as 'construction') is a dynamic industry that drives the economy of developing countries, but at the same time it presents hazardous work sites, where fatal occupational injuries frequently occur. Many studies reported that a high percentage of work-related injuries is attributed to the construction work (Cameron et al., 2008; Colak et al., 2004; Roudsari and Ghodsi, 2005; Tricco et al., 2006). In Canada, in 2008, those working in construction had the highest rate of injury at 24.5 cases per 1,000 employees (ESDC, 2015). The work-related injuries 2005-06: Construction Industry report shows that self-employed workers in Australia recorded a similar rate of injury to employees (SWA, 2009). In different researches, it has been demonstrated that work-related accidents in construction occurred with the uppermost rate of mortality (Ore and Stout, 1996; Pollack, Griffin, Ringen and Weeks, 1996; CDC, 2001). According to OSHA statistics out of 3,929 worker fatalities in private industry in calendar year 2013, 796 or 20.3% were in construction—that is, one in five worker deaths in 2012 were in construction (OSHA, 2015). The reason of this grim picture is mostly due to factors unique to construction, such as the temporary and transitory nature of construction workplaces, the construction workforce being diverse and complex nature of work tasks, trades, and environment (e.g., Ringen et al., 1995a; Ringen, Seegal and Englund, 1995b).

The factors addressed above make it inherently challenging to implement appropriate safety practices for the construction (Nietzel, Seixas and Ren, 2001). However, plenty of efforts are being made to improve safety on construction sites. These efforts involve practical interventions based on scientific research. Investigation of accident factors is particularly essential in safety science to prevent fatal occupational injuries from repeating. Factors causing work-related accidents can be determined by investigating characteristics associated with the incident. According to literature review, wide range of personal and occupational factors, such as age, gender, experience, educational level, task, occupational status or lifestyles, have been found to be related to the risk of suffering a fatal occupational injury (Bhattacherjee, Chau, Otero, Legras, Benamghar and Michaely, 2003; Chau, Benamghar, Siegfried, Dangelzer, Franc, 2004; Gauchard, Chau, Touron, Benamghar, Dehaene, Perrin, 2003; Mirabelli, Loomis and Richardson, 2003; Richardson, Loomis, Bena, Bailer, 2004). Factors related to the occurrence of a fatal occupational injury may act at several levels in addition to worker's individual conditions, such as the workplace (proximal environmental conditions), the work environment (work organization and conditions) or even the social and political levels (employment or economic policies) (Castejón and Crespán, 2005).

Turkey, which is still considered as a developing country, possesses one of the largest construction industries in the world. The importance of the construction has become more vital than ever for Turkey's economy with high rate-steady growth and employment creation needs. According to list of countries by the largest output in construction, Turkey ranks 17th among the twenty-five largest countries in the world by construction output (UNdata, 2014). The GDP of construction sector is over 6% and more than 1.5 million people are currently employed by this sector. When the direct and indirect impacts on other sectors are taken into account, the share of the construction in the Turkish economy reaches 30% and the employment rate reaches %10. This sector is one of the main driving forces in the economic uplift of the country (European Commission, 2015).

Nevertheless, the same development in occupational safety and health area cannot be achieved in Turkey. Work-related accidents increase with the raise of investments and construction growth. On 13 May 2014, an explosion at a coal mine in Soma, Manisa, Turkey, caused an underground mine fire, which killed 301 workers in what was the worst mine disaster in Turkey's history (BBC News, 2014; The Guardian, 2014). Construction is also responsible for the prevalent number of job-related fatalities among all industries in Turkey. According to data given by the Social Security Institution (SSI), 2.45% of occupational accidents occurred in Turkey ended with deaths and the construction was reported as accounting for 33.5% of work-related accidents with the highest rate of fatality (SSI, 2011). The latest disaster in construction was the deaths of ten workers at a construction site in Istanbul when an elevator carrying them suddenly plunged to the ground from the 32nd floor late on Sept. 6 (Hürriyet Daily News, 2014). After such disasters, protests were set off against what was perceived as official laxity and corruption and raised questions over the implementation of safety standards. Therefore, occupational safety has become a sensitive issue nationwide and accordingly, number of inspections on construction sites and mines increased while regulations are being updated. However, there is still not enough research on occupational safety to support these efforts. Moreover, the recordkeeping system in Turkey is not adequate, the accuracy of existing data is in question and it is not possible to obtain detailed (regional and industry specific) statistics from the existing database to encourage scientific research.

This study aimed to fulfill one of the gaps in occupational safety research in Turkey and focused on the construction safety problems of a specific region in the country. Izmir, which is the 3rd largest city in Turkey with a population of 3.606.326 million, was selected as the data source for this study. Based on the ever-increasing population growth rate (Wikipedia, 2015), Izmir is among the cities with the highest demand for housing and infrastructure thanks to its favorable climate and job opportunities. Thus, construction industry has been very active in İzmir to answer these demands, where plenty of fatal injuries occurred due to this rapid development. Statistics show that 1857 workers lost their lives in construction In Turkey between 2007 and 2011. Of the 1857 cases, 94 of them (5%) occurred in İzmir (Table 1). Among the 6223 work-related injury victims who died between 2007-2011 overall in Turkey, 344 (5.5%) were from Izmir and among 6223 victims who died overall in Turkey 1857 (29.8%) and 344 victims who died in İzmir 94 (27.3%) were construction workers (Table 1). The numbers depicted here were obtained from SSI web site (Social Security Institution, 2011); however, it is not possible to see how many of these fatalities occurred in construction. Further efforts were needed to obtain region and industry specific data.

Fatal occupational injuries in construction were investigated in detail by browsing the records of the Registry Services of Occupational Injuries and Diseases at the İzmir city Authority of Social Security Institute (SSI). The study involved examining work-related fatal injuries in 5 years period (2007-2011) in İzmir and was conducted to determine the characteristics of the accidents. Following the data acquisition and taxonomy processes, descriptive statistical analysis was performed by using univariate and cross tabulation analysis. Findings and results of this study are shared and discussed in the following sections of this paper.

TABLE 1- NUMBER OF OCCUPATIONAL ACCIDENTS

	Number of Occupational Accident s		Number of Fatal Occupational Accidents		Number of Fatal Occupational Accidents in Construction Industry	
Year	***Izmir***	***Turkey***	***Izmir***	***Turkey***	***Izmir***	***Turkey***
2007	9832	80602	33	1043	9	359
2008	10095	72963	52	865	17	297
2009	7461	64316	54	1171	16	156
2010	7942	62903	78	1444	22	475
2011	7852	69227	127	1700	30	570

II. MATERIALS AND METHODS

A. Data Acquisition

Finding accident database is a serious challenge in Turkey, specifically within the scope of one chosen district, as mentioned before. Therefore, database used in this study was obtained from SSI's archives in İzmir with work permit. Since, the SSI archives contained all work-related injury reports in a single room regardless of industry or injury categorization system, report forms related with fatal occupational injuries in construction were handpicked among 340 fatal injury cases reported in İzmir between 2007 and 2011. During this period there have been no important changes in compensation practices or in the way that accident data were collected. Also the classifications of occupations and accidents remained unchanged. The data only consist of accidents occurring in the working area; occupational diseases and accidents happening on the way to or from work have been omitted. Overall 94 cases that resulted in work related death were located in the database. Of those, four records were disqualified because of inadequate information and three cases included multiple deaths. As a result, a total of 93 fatality cases were selected after browsing

hundreds of accident records reported by the employers from all industries.

A new taxonomy was created to rearrange and prepare the collected fatality data for descriptive statistical analysis. A total of 17 research variables, which were grouped under four different categories according to their relevance to their characteristics, were chosen for this study. These categories are time, project, accident, and worker characteristics.

Time characteristics variables were organized according to the accident occurrence date and included hour of the day, days of the week (both workday and weekday) and months of the year.

Project characteristics variables provide information about the project (type and end use) where accident occurred. Construction sites are unique dynamic environments; they are different in shape and size. Therefore, these variables help to classify and understand the construction environment where accidents mostly occur.

Accident characteristics variables reveal plenty of information regarding the accident; in other words, they define the accident. Variables such as nature of injury, source of injury, types of injury, damaged body part, environmental and human factors was examined within the scope of the study.

Worker characteristics variables, as one can easily understand, addressing victim's personal information was listed under this group. Workers' age group, status, educational background, safety and health training, responsibility and duration of work experience are variables that described workers' profile.

B. Descriptive Statistics

In this study descriptive statistics techniques were used for detailed investigation of data set. Descriptive statistics is defined as the discipline of quantitatively describing the main features of a collection of information, or the quantitative description itself (Mann, 1995). Descriptive statistics provides simple summaries about the sample and about the observations that have been made. Univariate and bivariate analysis are two types of descriptive analysis. Univariate analysis involves describing the distribution of a single variable, including its central tendency (including the mean, median, and mode) and dispersion (including the range and quantiles of the data-set, and measures of spread such as the variance and standard deviation). Bivariate analysis include cross tabulations and contingency tables, graphical representation via scatterplots, quantitative measures of dependence and descriptions of conditional distributions (Babbie, 2009).

In vast majority of the construction safety literature the findings are based on univariate analysis and aimed at shedding light on problematic areas in this field, especially for accident causation (Hatipkarasulu 2010, Hinze et.al 1998, Hinze et. al 2005, etc). In this research, univariate analysis was adopted for frequency analysis in two parts. The first part is for data screening purposes; and the second part is to understand what we have and choose the right variables for bivariate data analysis. Similarly, data analyses for this study relied on univariate analysis for data overview and classification. Frequency tables were utilized for reporting findings of univariate analysis in this paper.

After conducting the univariate analysis, cross tabulation, a bivariate analysis technique, was carried out to investigate whether a significant relationship between pairs of variables existed. Cross tabulation analysis produces a contingency table displaying the relationship, in the form of joint frequencies, of two or more variables, with the rows indicating one variable and the columns indicating the other. The joint frequency distribution can be analyzed by the Pearson chi-square statistic to determine whether the relationship variables are statistically independent. The null hypothesis of independence is rejected if the p value is greater than a level of significance, alpha (commonly taken as 0.05). Phi (Φ) and other metrics are used to evaluate the strength of association between the variables. Phi values from 0 to 0.1 show a weak relationship; from 0.1 to 0.3 indicate a moderate relationship; and values between 0.3 and 1.0 suggest a strong relationship (Healey, 2011). Due to symmetry, negative values of Φ are viewed to be the same as positive values. Results of cross tabulation analysis were presented using tables. Statistical Package for Social Sciences (SPSS) software was used for both univariate and bivariate statistical analyses.

III. RESULTS

The results of univariate and bivariate analyses are summarized in this section. Univariate analysis results are presented in accordance with the four variable categories (time, project, accident and worker characteristics), while bivariate analysis results include findings from cross tabulation analysis.

Results of time characteristics (work hour, day and month), which are demonstrated in Table 2, showed that a larger proportion (39%) of the construction workers' incidents occurred in the afternoon hours, between 12:01 pm and 16:00 pm. When days of the week are examined, it was observed that Mondays and Thursdays were the days with most fatal injuries, even though fatality numbers for other days were not so different. The results also show that construction and associated work deaths continue during the weekends in Turkey (15% on Saturdays and 3% on Sundays). It was also observed that majority (14%) of fatal injuries occurred in the month of May. There were also plenty (10.8%) of fatalities in April, July and September. On the other hand, there were less fatal injuries reported in colder months like December and January. This finding could be associated with faster work progress in temperate months, which could lead to more accidents in construction sites.

TABLE 2- TIME CHARACTERISTICS OF FATAL INJURY

Hour of injury	No. of deaths	% of deaths	Month of injury	No. of deaths	% of deaths
12.01-16.00	36	39	May	13	14
08.00-12.00	31	33	April	10	10,8
16.01-20.00	17	18	July	10	10,8
20.01-24.00	2	2	September	10	10,8
Unknown	7	8	August	8	8,6
TOTAL	93	100	February	8	8,6
Day of injury	**No. of deaths**	**% of deaths**	March	7	7,5
Monday	18	20	November	7	7,5
Thursday	18	19	June	6	6,5
Friday	15	16	October	6	6,5
Saturday	14	15	January	6	6,5
Tuesday	13	14	December	2	2,2
Wednesday	12	13	TOTAL	93	100
Sunday	3	3			
TOTAL	93	100			

According to project related data, the majority (64%) of the fatally injured workers were employed for new project or new addition for existing structures. Based on the project end use, most (51%) fatal injuries occurred in residential construction sites as displayed in Table 3-Project Characteristics of Fatal Injury. This result is expected, since the majority of construction work involves new projects and the demand for residential buildings is extremely high in the last decade in Turkey.

TABLE 3- PROJECT CHARACTERISTICS OF FATAL INJURY

Project Type	No. of deaths	% of deaths	Project end use	No. of deaths	% of deaths
New project or new addition	60	64	Residential	47	51
Maintenance or repair	24	26	Institutional/ Commercial	24	26
Manufacturing	7	8	Infrastructure/ heavy construction	13	14
Other	2	2	Construction material	7	7
TOTAL	93	100	Industrial	2	2
			TOTAL	93	100

The results of univariate analysis on accident characteristics, which describe the occurrence of the accident, are presented in Table 4. The evaluation of type of injuries in construction has revealed that in nearly two out of three fatal cases (67.7%) workers fell to their deaths from elevated heights. The leading causes of death have been found to be concussion/internal bleeding (72%) and 70 cases (75.3%) resulted with whole body damage. In addition, insufficient/ lack/ engineering controls have caused 15 workers (16.1%) to lose their lives. It was also revealed that three of the major sources of injury were building/structure (26.9%), working surface (20.4%), and scaffolding (18.3%). Factors contributing to accidents were also investigated among the accident characteristics and it was found out that lack of Personal Protective Equipment (PPE) usage as a human factor and work surface / facility /layout condition as an environmental factor were the most dominant variables with (44.1%) and (47.3%) respectively. (Table 4-Accidents Characteristics of Fatal Injury)

TABLE 4- ACCIDENT CHARACTERISTICS OF FATAL INJURY

Types of injury	**No. of deaths**	**% of deaths**	**Environmental factors**	**No. of deaths**	**% of deaths**
Fall (From Elevation)	63	67,7	Work-Surface/ Facility/Layout Condition	44	47,3
Struck by falling object	6	6,5	Materials Hand. Equip./Method	21	22,6
Road accidents	6	6,5	Flying Object Action	15	16,1
Electrocution	5	5,4	Overpressure/Under pressure	4	4,3
Cave-in	4	4,3	Other	4	4,3
Fire/ explosion	3	3,2	Weather, Earthquake, Etc.	3	3,2
Collapse of structure	2	2,2	Illumination	2	2,2
Caught In Or Between	1	1,1	TOTAL	93	100
Fall (Same Level)	1	1,1	**Human factors**	**No. of deaths**	**% of deaths**
Bite/Sting/Scratch	1	1,1	No PPE Used	41	44,1
Other	1	1,1	Insufficient /Lack Engineering Controls	15	16,1
TOTAL	93	100	Insufficient/Lack Administrative Controls	8	8,6
Source of injury	**No. of deaths**	**% of deaths**	Insufficient/Lack Housekeeping Program	6	6,5
Building/construction	25	26,9	Defective/Inappropriate Equipment In Use	4	4,3
Working surface	19	20,4	Perception Malfunction, Task-Environment	4	4,3
Scaffold	17	18,3	Malfunction In Securing/Warning Op	3	3,2
Heavy equipment	11	11,8	Misjudgment in Hazardous Situation	3	3,2
Crane	6	6,5	Other	3	3,2
Electric Apparat/Wiring	6	6,5	Safety Devices Removed/ Inappropriate	2	2,2
Ladder	1	1,1	Insufficient/Lack Written Work Program	2	2,2
Pressure (air, boiler, press vessel)	3	3,2	Position Inappropriate For Task	2	2,2
Other	3	3,2	TOTAL	93	100
Pipeline, Boxes/ Barrels, Etc.	2	2,2	**Damaged body part**	**No. of deaths**	**% of deaths**
TOTAL	93	100	Whole body	70	75,3
Nature of injury	**No. of deaths**	**% of deaths**	Head	18	19
Concussion/internal bleeding	67	72	Innards	2	2,2
Cut/Laceration	17	18,3	Neck	1	1,1
Electric Shock	5	5,4	Multi-injury	1	1,1
Fracture	2	2,2	unknown	1	1,1
Suffocate	1	1,1	TOTAL	93	100
Other	1	1,1			
TOTAL	93	100			

Investigation of worker characteristics revealed interesting and disturbing facts in Turkey associated with proper recordkeeping as shown in Table 5 - Worker Characteristics of Fatal Injury. For example, the age of deceased worker was reported as "unknown" in nearly half of the cases (41.9%). Moreover, it was found that 3 workers under 18 years old lost their lives, even though it was forbidden by law in Turkey to employ workers younger than 18 in construction sites at that time39). The results also revealed that, the majority of victims (55%) were employed as "worker" based on their employment status and in (66%) of cases the worker had elementary education as an educational background. It was also observed that 70 workers (75%) who died due to occupational injuries did not receive safety and health training, which stresses out the benefit of training. The most surprising finding was that 23 workers (%24.7) have died on the first day at their jobs. This distressing result is presumably due to the harsh reality in Turkey that it is possible for employers to insure their workers whenever they want (including after accident occurrence). It was also observed that (21.5%) of workers having fatal occupational injures had been working there for less than one month. The study also included investigating the distribution of causes of injuries in various occupations in the construction industry. The data showed that plasters/painters had a significant risk (26.9%) at construction. In addition, unskilled workers were the second highest risk group with 16.1% proportion of deaths (Table 5-Worker Characteristics of Fatal Injury).

TABLE 5- WORKER CHARACTERISTICS OF FATAL INJURY

Age groups	**No. of deaths**	**% of deaths**	**Responsibility**	**No. of deaths**	**% of deaths**
Unknown	39	41,9	Plaster/Paint	25	26,9
30-34	9	9,7	Unskilled worker	15	16,1
45-49	9	9,7	Formwork	12	12,9
25-29	7	7,5	Roof	10	10,8
40-44	7	7,5	Assembling	7	7,5
35-39	6	6,5	Other	6	6,5
55-59	4	4,3	Concrete	4	4,3
18-24	4	4,3	Installation	3	3,2
50-54	3	3,2	Reinforcement	3	3,2
16-18	3	3,2	Infrastructure	2	2,2
60-64	2	2,2	Operator	2	2,2
TOTAL	93	100	Foreman	2	2,2
Status	**No. of deaths**	**% of deaths**	Marble	1	1,1
Worker	51	55	Welder	1	1,1
Craftsman	32	34	TOTAL	93	100
Other	7	8	**Duration of work experience**	**No. of deaths**	**% of deaths**
Operator	3	3	Beginning at same day	23	24,7
TOTAL	93	100	1-30.d	20	21,5
Educational Background	**No. of deaths**	**% of deaths**	31.d-3 months	7	7,5
Elementary education	61	66	3-6 months	13	14
Post primary education	3	3	6-12 months	4	4,3
Higher education	1	1	12-24 months	1	1,1
Professional training	2	2	>24 months	5	5,4
Unknown	26	28	unknown	20	21,5
TOTAL	93	100	TOTAL	93	100
S&H Training	**No. of deaths**	**% of deaths**			
Undocumented	70	75			
Documented	14	15			
Unknown	9	10			
TOTAL	93	100			

The second part of the descriptive analysis included using cross tabulation to investigate the relationship between types of injury and other nominal variables. Only four of the 17 variables (Worker's responsibility, Source of injury, Human factor, and Environmental factor) were found statistically significant as shown in Table 6. According to results (Cramer's v) one can say types of injury was strongly impacted by responsibility of worker, source of injury, human factor and environmental factor. The second stage of cross tabulation analysis involved analyzing type of injury categories versus each statistically

significant variable category. Thus, major factors and categories affecting the occurrence of accident were determined. The results of this stage are summarized below. The numbers that are shown in parenthesis below (Table 6) mean that a certain percentage of workers lost their lives due to a specific type of injury category. Such as, when roof workers fatal cases were examined, it was found that 90 percent of fatal injuries were fall from elevation.

TABLE 6- CONTINGENCY TABLE – TYPES OF INJURY VS. NOMINAL VARIABLES

Variables	Pearson's X2(df), p		Phi&Cramer's V	
Worker's Responsibility	$X^2(110)= 261.979$	p=0.000	crv(110)=0.531	p=0.000
Source of Injury	$X^2(90) = 333.813$	p=0.000	crv(90) =0.632	p=0.000
Human Factor	$X^2(110)= 185.411$	p=0.000	crv(110)=0.447	p=0.000
Environmental Factor	$X^2(60) = 187.128$	p=0.000	crv(60)=0,579	p=0.000

The cross tabulation analysis between workers' responsibility and type of injury showed that, falling from elevation was a significant factor for formwork (100%), reinforcement (100%), roof (90%), plaster/paint (96%) and assembling (87.5%) workers while cave-in was a significant risk for infrastructure workers (100%).

According to the cross tabulation analysis between source of injury and type of injury, all building/construction sourced accidents ended with collapse of structure. In addition, heavy equipment was the source of injury for every case that ended with falls on same level, bite/sting/scratch, caught in between and road accident.

Cross tabulation analysis between types of injury and human factor showed that 92.7% of cases with lack of Personal Protective Equipment (PPE) usage ended with fall from elevation. While for all cases with defective/inappropriate equipment in use and inappropriate position for task ended with fall from elevation.

Type of injury versus environmental factor was performed as a final cross tabulation analysis. Results showed that when fall from elevation accident type was examined from the environmental factors point of view, it was seen that 90.9% of work surface /facility-layout condition and 76.2% of materials handle/equipment method cases affected the result. At the same time, as an environmental factor, overpressure/under pressure was the major contribution factor (75% of cases) for fire/explosion accidents.

DISCUSSION

Collecting detailed and accurate occupational accident data for research is a challenging task in countries like Turkey, where this kind of information is still perceived as confidential or too discomforting to share. Even though, the Turkish Labor Law states that employers are obliged to notify Social Security Institution (SSI)'s regional office within 3 days of the occurrence of an accident, some companies still refrain from reporting accidents and some are even able to run uninsured workers by abusing the deficiencies in the recordkeeping system. In addition, SSI reports only summary data to the public. Therefore statistics available to the public may not necessarily reflect real situation of work-related accidents and lack detailed data. The inadequacy of safety data led many researchers to conduct their studies by using surveys, but it is well-known that using real cases within the scope of studies is more inductive and realistic. Therefore, in this study instead of data collection by field survey, a new database for construction in İzmir was created by browsing the archives of Turkey's Social Security Institution. Using the new regional database, it was possible to perform descriptive analysis techniques like univariate analysis and cross tabulation.

Univariate analysis results showed that the duration of employment, in other words, work experience was the most prominent factor in fatal construction injuries in İzmir. It was observed that workers with less work experience, particularly within the first month of employment, are more prone to fatal injuries. This finding could also be supported with past research on similar topic. Colak et. al., (2004) found that majority of workers die in the first three months, indicating that workers are also employed in dangerous positions without concerning their work experience. Castejón et. al. (2009) also implies that temporary workers usually have less experience and training, and are exposed to worse working conditions. High number of repeated short-term contracts, which are characteristics of the employment structure of the construction industry, could be one of the reasons why almost 50% of injuries happened within a month after employment. Turkey's lax recordkeeping system for construction could be the other reason for the accumulation of data in the first month. According to the labor laws in Turkey, employer is obliged to notify Social Security Bureau just before an employee has started to work. But in construction sector, a worker can be employed even before "the paper work" has been completed (Social Insurance and Universal Health Insurance Law, 2006). Contractors misuse this legal gap, and may initiate legal insurance procedure on the day of the accident. The findings of univariate analysis revealed other malpractices by contractors in Turkey, such as using underage workers as addressed in "Results" section.

Fall from elevated heights has been reported as the leading cause of accidents in construction industry (range from 22 to 33%) by many researchers (Ore and Stout, 1996; Hinze, Pedersen and Fredley, 1998; Jackson and Loomis, 2002; Hinze, Pedersen and

Fredley, 1998; Fabrega and Stakey, 2001). In this study, it is found that the reason of deaths in 67.7% of cases was caused by the falls, which is higher than what was declared in similar research studies. It was particularly observed that almost all of the cases involving plasters/painters, form workers, reinforcement workers and roofers ended with fatal injury caused by fall from elevation.

Causes of fatalities due to fall from elevation was investigated further using cross tabulation analysis. Results showed that 92.7% of cases with lack of Personal Protective Equipment usage ended with fall from elevation. It was also observed that all of the cases with defective/inappropriate equipment in use and inappropriate position for task ended with fall from elevation. This shows that fall prevention and protection is the most critical issue to be addressed in construction.

Road accident and struck by falling object were found to be the other two major causes of fatal construction injuries. This result also complies with the findings of Arndt et al., who also found that one of the common causes of fatal injuries in the construction industry is struck by falling objects (Arndt et al. 1997).

A particularly interesting result from the analysis is the expected increased risk related to a specific job or workplace. Plaster/paint, formwork and roof workers were found to be the three risky groups that accidents mostly (50.6 %) ended with fatality. In addition, unskilled workers were found as second risky group that fatal injuries frequently occurred. Occupational health and safety services should take into account these increased risk situations and higher risk jobs in their planning of preventive actions and training in companies (Villanueva and Garcia, 2011).

If accidents are studied by occupational status, differences in concentrations of minor and major accidents can be found. In general, accidents mostly seem to occur in the lower job positions: the risk of accidents among non-skilled workers is almost the same as the rest of the other job positions. Earlier studies that investigate the effect of occupational status also state that non-skilled workers on construction sites are over-represented in fatal injury statistics (Saloniemi and Oksanen 1998).

It is expected that findings of this study could ultimately reduce the severity of potential accidents and prevent workers from the fatal consequences. Using the results of this research, safety managers can specify workers training programs (e.g. more focus on fall protection topic for plasters/painters, form workers, and roofers), issue appropriate personal protective equipment for workers working at elevated heights, and coordinate project safety plans by adding safety orientation for newly employed workers. In future studies researchers may work with a similar database, but collected from different districts or different year range. One of the results of the study is that contrary to general belief, univariate analysis may be insufficient alone while interrupting distribution of data set. It has been possible to obtain more detailed results with the cross tabulation and secondary analysis as used in the study.

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