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Comparing Accidents Caused by Unsafe Performance of Workers Affiliated to Main Contractors and Subcontractors (Case Study: Seimare Dam of Ilam, Iran)

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Abstract

Introduction: *Work-related accidents are major problems in the world, imposing a great deal of suffering for human communities. This article aimed to compare the accidents caused by unsafe performance of workers affiliated to main contractors and subcontractors of Seimare Dam of Ilam, Iran.* ***Methodology****: This is a descriptive study on 119 files of workers suffered from accidents. They were working for 7 contractors (3 main and 4 subcontractors) in Seimare Dam of Ilam, Iran. The data were analyzed using SPSS.* ***Findings:*** *The results showed that, out of 119 injured workers, 53.8% was related to the main contractors and 46.2% to subcontractors. Given the number of working days and the number of workers compared to the number of accidents, subcontractors accounted for greater percentage of accidents.* ***Conclusion:*** *Subcontractors accounted for greater percentage of work-related accidents. Therefore, safety and strengthened HSE management is required in this regard.*

Keywords*: Main Contractors, Subcontractors, HSE Management, Work-related Accidents.*

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INTRODUCTION

270 million work-related accidents happen annually worldwide. Almost two million 200 thousand workers lose their lives. Nearly 160 million suffer from work-related diseases, and 260 million accidents cause three days of work absence (Mansouri and Azimi Husseini, 2015). The share of Third World countries including developing or undeveloped countries is 3-4 times as many as that of developed countries. Estimated financial loss was reported over 1.251 trillion dollars in 2006, equivalent to 4% of global GDP (Marsh and Mclennan, 1988). In addition to the effect on economic indicators, accidents and particularly work-related ones are associated with human losses (Mohammad Fam, 2008). Human is one of the critical elements associated with HSE management system. Contractors are the group facing an ever-increasing importance on a daily basis. They employ workforce for certain tasks. Therefore, they play a key role in promoting health, safety, and environment. The status quo indicates that sufficient and constant sensitivity is not taken into account by contractors in terms of HSE plans especially management systems related to health, safety, and environment (Idak Zadeh and Khosroshahi, 2013). HSE performance evaluation of contractors can enhance the awareness of HSE performance changes. As a result, it prepares the ground for motivation and opportunity in order to promote the quality of performance. It can also stimulate the curiosity, questions and challenges about the way things work. In other words, HSE performance measurement and evaluation of contractors cause motivation for optimal behaviors and, accordingly, promotion of HSE indicators (Mohammad Fam et al, 2011). As stated, HSE performance measurement of contractors is a key stage in management process and forms the bases of continuous improvement. If measurement is not well done, it adversely affects the effectiveness of safety management systems and would not provide reliable information on safety risk control for the management (Kathryn, 2009). Today, contracting companies are required to observe all HSR rules and regulations to prevent work-related accidents. However, various contractors sometimes do not follow HSE rules, which cause accidents in working environment. Protecting employees, workers, and valuable resources is possibly by correct HSE management and implementation of procedures by contractors and employers. Therefore, the reliability of lack of risk is of great importance especially by contractors and managers (Abbas Pour et al., 2007).

Since employers are required to ensure the competency of contractor for safe work implementation based on HSE risks, criteria are required to be imposed for selecting contractors. HSE management plan is one of these criteria. HSE management plan is mostly developed based on contractor's HSE Management System for every project in order to correctly manage the risks in line with activities (Saeedi et al., 2009). Therefore, observation of safety measures and prevention of work-related accidents and diseases must be in the agenda of all industrial communities especially Iran. Iran is on the path of development. Therefore, healthy human-centered slogan must be the basis of sustainable development. As a result, protecting HR and financial resources and provision of new workers,

entrepreneurs, and employers are of great importance to develop HR and prevent financial resources. In this research, we investigate the causes of lack of safety measure in contracting companies in order to provide appropriate solutions. This can play a key role in securing the work environment of contracting companies and reducing risks for the workers working in contracting companies. The model of hiring contractors has faced numerous changes in recent years so that a large volume of executive activities are performed by subcontractors. In other words, employers mainly play the role of policy making and monitoring. In recent years, the use of contracted workforce has significantly increased. Therefore, risk and responsibility have transferred to the workers in contracting companies. Lack of attention to HSE management by contractors can lead to painful work-related accidents along with financial and human losses (Jafari and Mapar, 2011). Given that a large part of HSE issues are associated with contractors in various industries, dam industry in the one with a wide range of contractors due to the workload. A number of workers are involved in this field. Therefore, HSE management system needs to be focused in order to provide a healthy and safe environment for the workers affiliated to contractors.

This article aimed to determine the extent of accidents associated with unsafe performance of workers in Seimare Dam of Ilam, Iran affiliated to main contractors and subcontractors. Seimare Dam of Ilam lies 106 km southeast of Ilam on Seimare River between Ilam and Lorestan provinces of Iran. It is located in 12' 47° E longitude and 17' 33° N latitude. Power plant is being constructed across from the Talkhab village, 1.5 km far from the dam. This is an applied study with descriptive-analytical method.

METHODOLOGY

Arrangements were made by visiting the HSE Management Unit of Seimare Dam of Ilam in order to get the submitted information. Work-related accidents were collected from the files based on type, cause, and the harm that caused amputation or disability and illness or death. Then, the files of injured, still working for main and subcontractors were classified. We compared the accidents which happened for workers affiliated to main and subcontractors. The statistical population consisted of all workers supervised by main and subcontractors in Seimare Dam of Ilam, Iran. They all experienced an accident, which caused amputation, disability, or death. The data were collected in Excel and analyzed in SPSS using Chi-square.

RESULTS

This article aimed to compare the accidents caused by unsafe performance of workers supervised by main contractors and subcontractors of Seimare Dam of Ilam, Iran. First, demographic information was collected: Marital status, education, age, work experience, and type of contractor. Then, the frequency percentage and distribution diagrams were drawn.

Table 1: Frequency Distribution of Injured Workers of Main Contractors and Subcontractors

Contractor		Main Contractor		Subcontractors	
		Number	%	Number	%
Marital Status	Single	9	7.6	17	14.3
	Married	55	46.2	38	31.9
Age	20-30	23	19.3	29	24.4
	31-40	27	22.7	17	14.3
	41-50	10	8.4	7	5.9
	>50	4	3.4	2	1.6
Education	Incomplete Secondary Certificate	32	26.9	11	9.2
	Secondary Certificate	19	15.9	36	30.2
	Associate Degree	5	4.3	6	5.1
	Bachelor	7	5.9	2	1.7
	Master Degree	1	0.8	0	0
Injured Organ	Hand	16	13.4	13.4	24.3
	Leg	20	16.8	14	11.9
	Trunk	19	16	6	5
	Head	9	7.6	6	5
Consequence of Accident	Fracture	28	23.5	28	23.5
	Contusion	24	20.2	22	18.5
	Rupture	2	1.7	2	1.7
	Twisting	3	2.5	2	1.7
	Crack	3	2.5	0	0
	Amputation	2	1.7	1	0.8
	Death	2	1.7	0	0
Number of Lost Days	<50 Days	30	25	27	23
	50-100 Days	28	23.5	28	23.5
	>100 Days	6	5	0	0
Work Experience	<10 Months	9	7.5	15	12.5
	10-20 Months	27	22	23	20.5
	21-30 Months	16	13.7	13	11
	31-40 Months	8	6.5	4	3
	41-50 Months	1	0.8	0	0
	>50 Months	3	2.5	0	0
Time of Accident	Day	55	46	36	30
	Night	9	8	19	16

Out of 119 workers in this study, 93 (78.2%) were married and 26 (21.8%) single. The following diagram shows the distribution of frequency according to marital status. Out of 119 workers in this study, 55 (46.2%) had secondary certificate, 43 (36.1%) lower than secondary certificate, 11 (9.2%) associate degree, 9 (7.6%) bachelor, and 1 (0.8%) master's degree. The following diagram shows the distribution of frequency according to education. Out of 119 workers in this study, 50 (42%) had 10-20 months of working experience, 29 (24.4%) 21-30 months, 24 (20.2%) less than 10 months, 12 (10.1%) 31-40 months, 3 (2.5%) over 50 months, and 1 (0.8%) 41-50 months. The following diagram shows the distribution of frequency according to education. Out of 119 workers in this study, 52 (43.7%) were aged 20-30 years, 44 (37%) 31-40, 17 (14.3%) 41-50 years, and (5%) older than 50.

Table 2: Relationship among Variables using Chi-Square test

Variable	Chi-Square	Freedom Degree	P-Value
Injured Organ	11.560	3	0.009
Consequence of Accident	4.968	6	0.548
Lost Days	5.590	2	0.064
Age	3.500	3	0.321
Time of Accident	6.897	1	0.009
Work Experience	6.822	5	0.234
Marital Status	4.917	1	0.027
Education	18.806	4	0.001

Chi-Square was employed to find the significant relationship between class and discrete variables.

First Hypothesis: Type of Contractor had a significant relationship with Injured Organ.
The results of Chi-Square test showed that Type of Contractor had a significant relationship with Injured Organ. Leg, trunk, and head were the most affected organs among workers of main contractors; however, arm was among the workers of subcontractors. Therefore, as findings showed, the likelihood of main organ injury by work-related accidents was greater in workers of main contractors than subcontractors. In line with similar results, Kia Kajouri (2009) studied "factors affecting work-related accidents in small and medium-sized workshops of Mazandaran Province, Iran". He found out that hand was the most injured organ.

Second Hypothesis: Type of Contractor had a significant relationship with Consequence of Accident.
The results of Chi-Square test showed that Type of Contractor had no significant relationship with the Consequence of Accident. The study by Khosravi (2007) on contracting companies of Tehran municipal utilities and green spaces showed that 9 work-related deaths were reported in 2004 and 6 in 2005. Total number of workers was nearly 21000, meaning that 43 death per 100 workers occurred in 2004 and 26 in 2005. In this study, the number of workers of main contractors was 690. Two deaths were reported. In other words, one death happened for every 345 workers. Findings showed that no death was reported among the workers of subcontractors. As the first hypothesis showed, the likelihood of main organ injury by work-related accidents was greater in workers of main contractors than subcontractors.

Third Hypothesis: Type of Contractor had a significant relationship with the Number of Lost Days.
The results of Chi-Square test showed that Type of Contractor had no significant relationship with the number of lost days and they are independent. However, there were 6 cases of more than100 lost days for main contractors. In line with our study, the study by Azad et al. (2012) on Comparison of Performance between Contractors and Workers of East Alborz Coal Company in terms of Safety showed that the consequence was lost working days, accounting for 6296 days for workers and 4048 days for contractors.

Fourth Hypothesis: Type of Contractor had a significant relationship with Age of Injured Workers.
The results of Chi-Square test showed that Type of Contractor had no significant relationship with the Age of Injured Workers and they are independent. In line with our study, the study by Mohammad Fam et al. (2011) on "A Method for Hiring Safe Contractors using Fuzzy Efficiency Profile Homogenization of Every Input and Hierarchy" showed that the mean difference was found between the variables and unsafe behaviors: Age had a significant relationship with unsafe behaviors.

Fifth Hypothesis: Type of Contractor had a significant relationship with Time of Accident.
The results of Chi-Square test showed that Type of Contractor had no significant relationship with the Time of Accident. No study in line with ours was found in this regard. According to the findings, subcontractors are required to take safety measures at nights.

Sixth Hypothesis: Type of Contractor had a significant relationship with Work Experience of Injured Workers.
The results of Chi-Square test showed that Type of Contractor had no significant relationship with Work Experience of Injured Workers and they are independent. In line with our study, the study by Mohammad Fam et al. (2011) on "A Method for Hiring Safe Contractors using Fuzzy Efficiency Profile Homogenization of Every Input and Hierarchy" showed that the mean difference was found between the variables and unsafe behaviors: Inexperienced workers accounted for more work-related accidents.

Seventh Hypothesis: Type of Contractor had a significant relationship with Marital Status of Injured Workers.
The results of Chi-Square test showed that Type of Contractor had a significant relationship with Marital Status of Injured Workers. Most injured workers of main contractors were married; however, single workers of subcontractors experienced work-related accidents. In line with our study, the study by Kia Kajouri (2009) on "factors affecting work-related accidents in small and medium-sized workshops of Mazandaran Province, Iran" showed that married workers were the most vulnerable group in terms of work-related accidents.

Eighth Hypothesis: Type of Contractor had a significant relationship with Education of Injured Workers.
The results of Chi-Square test showed that Type of Contractor had a significant relationship with Education of Injured Workers. Most injured workers of main contractors had lower-than-secondary certificate and undergraduates. Among subcontractors, secondary certificate holders were the most affected group. In line with our study, the study by Kia Kajouri (2009) on "factors affecting work-related accidents in small and medium-sized workshops of Mazandaran Province, Iran" showed that lower than secondary certificate holders were the most vulnerable group in terms of work-related injuries.
According to Table 2, since significance level is 0.009 (<0.05), H_0 hypothesis is not verified. Therefore, at 95% confidence level, Type of Contractor had a significant relationship with Injured Organ.

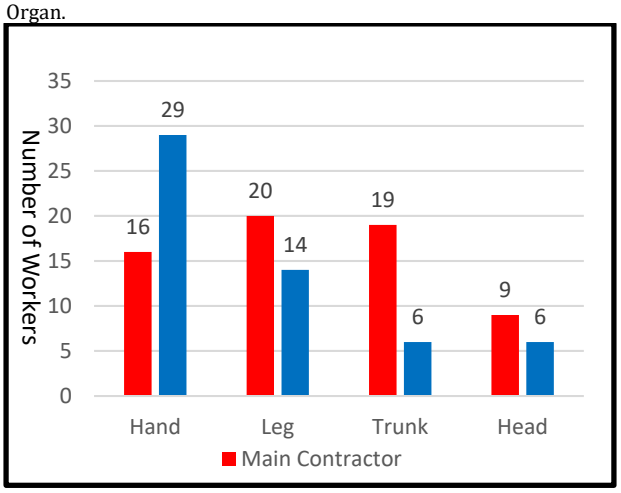

Fig 1: Comparing Injured Organs and Type of Contractor

According to Fig. 1, legs, trunk, and head were the most affected organs among workers of main contractors; however, arm was among the workers of subcontractors. Field investigations showed that subcontractors perform more difficult activities and are engaged with tools. Therefore, they are more likely to have hand injuries. According to Table 2, since the significance level is 0.548 (>0.05), H_0 hypothesis is verified. Therefore, at 95% confidence level, Type of Contractor had no significant relationship with Consequence of Accident.

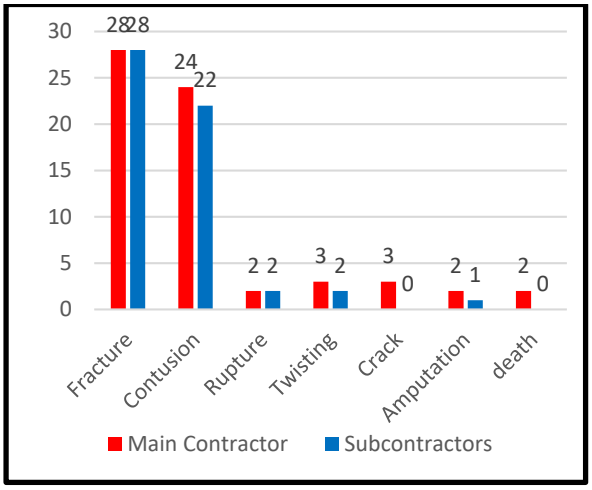

Fig 2: Comparing Consequence of Accidents and Type of Contractor

According to Table 2, no significant relationship was found between type of contractor and consequence of accident. Note that, according to Fig. 2, two deaths were reported among the workers of main contractors due to road accidents. Since only two road accidents, which caused death, were reported, they can be ignored.
According to Table 2, since the significance level is 0.064 (>0.05), H_0 hypothesis is not verified. Therefore, at 95% confidence level, Type of Contractor had no significant relationship with Lost Days.

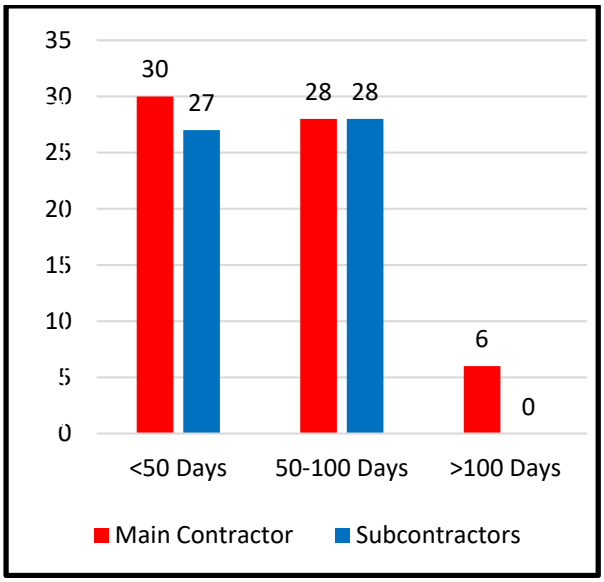

Fig 3: Comparing the Number of Lost Days and Type of Contractor

According to Table 2, since the significance level is 0.321 (>0.05), H_0 hypothesis is not verified. Therefore, at 95% confidence level, Type of Contractor had no significant relationship with Age of Injured Workers.

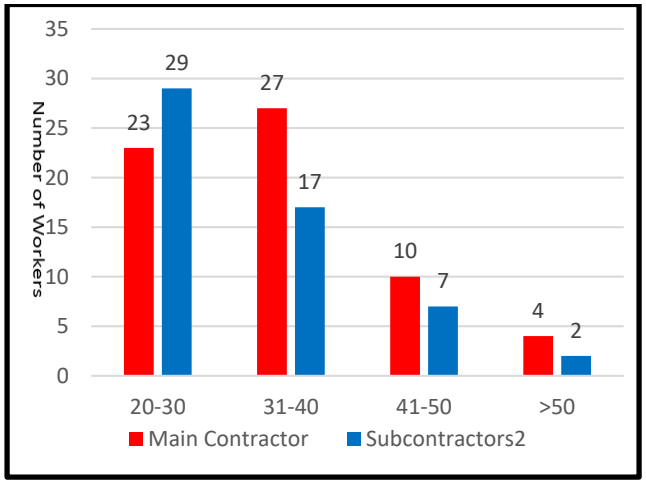

Fig 4: Comparing Age of Injured Workers and Type of Contractor

According to Table 2, since the significance level is 0.009 (<0.05), H_0 hypothesis is not verified. Therefore, at 95% confidence level, Type of Contractor had significant relationship with Time of Accidents.

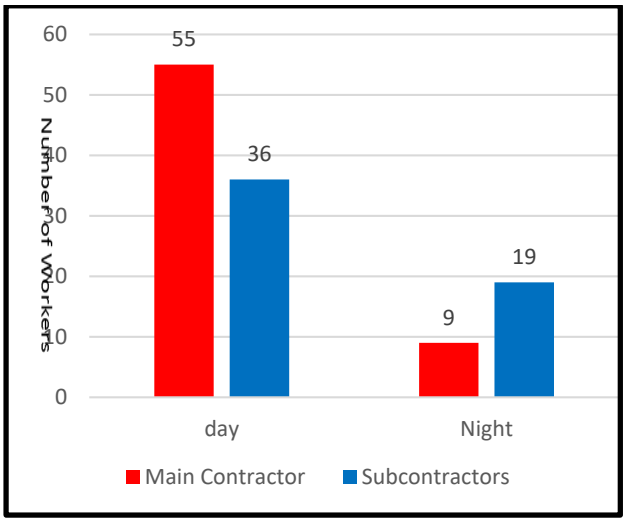

Fig 5: Comparing Time of Accidents and Type of Contractor

According to Table 5, most work-related accidents of workers of main contractors happened during days, while night accidents were reported for the workers of subcontractors. Therefore, the likelihood of night accidents is greater. According to the findings, subcontractors are required to take safety measures at nights.
According to Table 2, since the significance level is 0.234 (>0.05), H_0 hypothesis is not verified. Therefore, at 95% confidence level, Type of Contractor had no significant relationship with Work Experience.

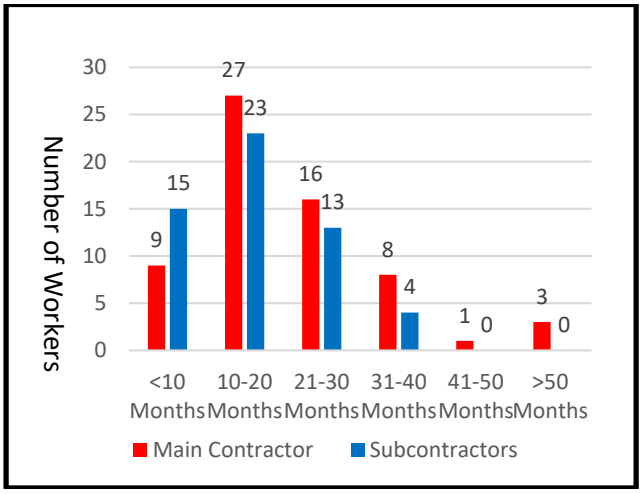

Fig 6: Comparing Work Experience of Injured Workers and Type of Contractor

According to Table 2, since the significance level is 0.027 (<0.05), H_0 hypothesis is not verified. Therefore, at 95% confidence level, Type of Contractor had a significant relationship with Work Experience. According to Fig. 7, most injured workers of main contractors were married; however, single workers of subcontractors experienced work-related accidents.

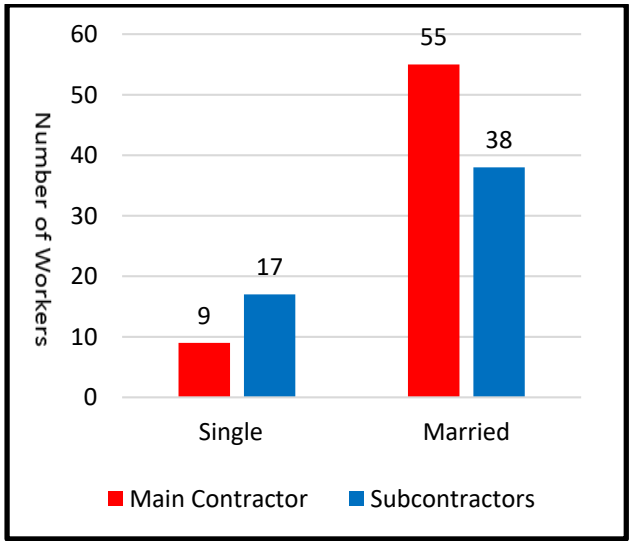

Fig 7: Comparing Marital Status of Injured Workers and Type of Contractor

According to Table 2, since the significance level is 0.001 (<0.05), H_0 hypothesis is not verified. Therefore, at 95% confidence level, Type of Contractor had a significant relationship with Education of Injured Workers.

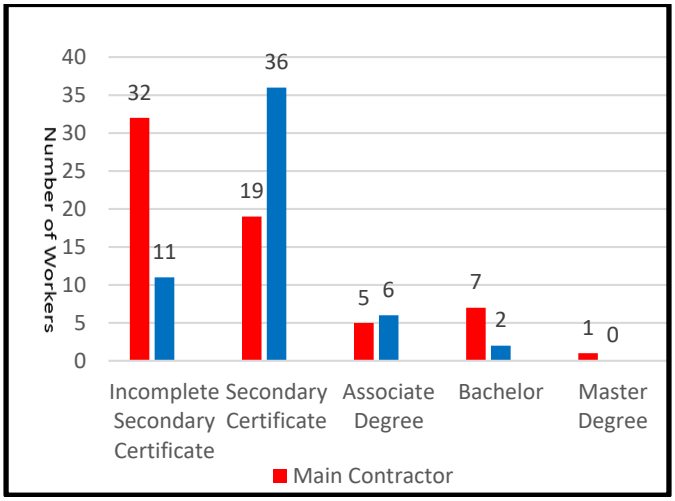

Fig 8: Comparing Education of Injured Workers and Type of Contractor

Most injured workers of main contractors had lower-than-secondary certificate and undergraduates. Among subcontractors, secondary certificate holders were the most affected group. This is mainly because most simple workers are engaged with risk factors.

Table 3 shows total number of accidents to working days of individuals. As it can be seen, 1.4 accidents were reported for every 100 working days of main contractors and 2.7 for subcontractors.

Table 3: Working Days-to-Accident Ratio

	Main Contractors	Subcontractors
Working Days	4440	1980
Number of Accidents	64	55
Average Number of Accidents /100 Days	4.1	7.2

Table 4 shows the percentage of injured workers to the total number of workers of main and subcontractors. As it can be seen, the rate of injuries was 9.27% for main contractors and 23.4% for subcontractors (Over 2.5 times).

Table 4: Number of Workers-to-Number of Accidents

	Main Contractors	Subcontractors
Number of Workers	690	335
Number of Accidents	64	55
Percentage of Injury	27.9	41.16

DISCUSSION

The results of Chi-Square test showed that Type of Contractor had a significant relationship with Injured Organ. Leg, trunk, and head were the most affected organs among workers of main contractors; however, arm was among the workers of subcontractors. The likelihood of main organ injury by work-related accidents was greater in workers of main contractors than subcontractors.

The results of Chi-Square test showed that Type of Contractor had no significant relationship with the Consequence of

Accident. In this study, the number of workers of main contractors was 690. Two deaths were reported. In other words, one death happened for every 345 workers. As stated, the likelihood of main organ injury by work-related accidents was greater in workers of main contractors than subcontractors. The results of Chi-Square test showed that Type of Contractor had no significant relationship with the number of lost days and they are independent. The results of Chi-Square test showed that Type of Contractor had no significant relationship with the Age of Injured Workers and they are independent. The results of Chi-Square test showed that Type of Contractor had no significant relationship with the Time of Accident. Most work-related accidents of workers of main contractors happened during days, while night accidents were reported for the workers of subcontractors. This has something to do with the fact that contracting workers mainly work at nights. Therefore, the likelihood of night accidents is greater. According to the findings, subcontractors are required to take safety measures at nights. The results of Chi-Square test showed that Type of Contractor had no significant relationship with Work Experience of Injured Workers and they are independent. The results of Chi-Square test showed that Type of Contractor had a significant relationship with Marital Status of Injured Workers. Most injured workers of main contractors were married; however, single workers of subcontractors experienced work-related accidents. The results of Chi-Square test showed that Type of Contractor had a significant relationship with Education of Injured Workers. Most injured workers of main contractors had lower-than-secondary certificate and undergraduates. Among subcontractors, secondary certificate holders were the most affected group.

CONCLUSION

According to the results, main contractors are advised:

1. Not to impose married workers to unsafe affairs since they are under the pressure if life responsibility and vulnerable to work-related accidents.
2. Simplify the safety principles for workers holding certificate lower than secondary degree and monitor them.

According to the results, subcontractors are advised:

1. Consider the safety rules for simple workers since they are working with equipment and machinery.
2. Hire workers capable of working at nights since night accidents are reported among the workers of subcontractors. Such workers must not have physical or eye sight problems. Safety rules must be taken into account for night-shift workers.
3. Monitor inexperienced and single workers and hold training classes on potential hazards.
4. Clearly consider HSE and safety rules for the workers of subcontractors since the results showed that work-related accidents were twice as many in subcontractors than in main ones. Stricter follow-up is also required on HSE rules and regulation. All HSE staff must be hired by HSE employer and contractors must not be involved.

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