DETERMINATION OF POOR COMPLIANCE WITH OSH RULES OF CONSTRUCTION WORKERS USING ORDINAL REGRESSION MODEL

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Abstract

Occupational accidents in the construction industry constitute one of the major problems in Turkey. The industry alone is responsible for 32.0% of all fatal industrial accidents from 1992–2015. Beyond precautionary efforts, workers need to participate and cooperate in the construction process to reduce the high number of accidents. The objective of this study is to provide an in-depth understanding of the underlying causes and motivations that affect the compliance of workers in following occupational safety and health (OSH) rules. A total of 482 workers were surveyed in 2016–2017. Cronbach's alpha was used to measure the reliability of the dataset. Ordinal logistic regression was conducted to determine the parameters that affect the compliance of workers in following OSH rules. Results show that most construction workers do not believe in the following findings: companies should provide OSH training before starting work; focusing on OSH would increase work efficiency and quality; OSH training is effective in preventing occupational accidents; OSH training is effective in reducing the frequency of occupational accidents; and OSH training is important for the safe use of equipment. Thus, the safety culture should be developed first in order for workers to gain awareness, adaptation and their sustainability.

Keywords: Ordinal logistic regression, Construction industry, Construction worker, Safety compliance.

İNŞAAT İŞÇİLERİNİN İSG KURALLARINA OLAN ZAYIF UYUMUNUN SIRALI REGRESYON ANALİZİYLE BELİRLENMESİ

Özet

Türk inşaat sektörünün en önemli sorunlarından biri iş kazalarıdır. İnşaat sektörü 1992-2015 yılları arasında meydana gelen tüm ölümcül kazaların %32,0'sinden sorumludur. İhtiyati çabaların ötesinde iş kazası sıklığını azaltmak için iş görenlerin sürece katılmaları ve iş birliği yapmaları gerekir. Bu çalışmanın amacı, iş sağlığı ve güvenliği (İSG) kurallarına uyma konusunda çalışanların uyumunu etkileyen sebeplerin ve motivasyonların derinlemesine anlaşılmasını sağlamaktır. 2016-2017 yılları arasında toplam 482 iş görene anket yapılmıştır. Veri setinin güvenilirliğini ölçmede Cronbach alfa kullanılmıştır. İşçilerin İSG kurallarına uyumunu etkileyen parametreleri belirlemek için sıralı lojistik regresyon uygulanmıştır. Sonuçlar, çoğu inşaat işçisinin aşağıdaki bulgulara inanmadığını göstermektedir: şirketler çalışmaya başlamadan önce İSG eğitimi vermelidir; İSG'ye odaklanmak iş verimliliğini ve kalitesini artıracaktır; İSG eğitimi iş kazalarını önlemede etkilidir, İSG eğitimi iş kazalarının sıklığını azaltmada etkilidir ve ekipmanın güvenli kullanımı için İSG eğitimi önemlidir. Bu nedenle, çalışanların farkındalık, uyum ve sürdürülebilirlik kazanmaları için öncelikle güvenlik kültürü geliştirilmelidir.

Anahtar Kelimeler: Sıralı lojistik regresyon, İnşaat sektörü, İnşaat işçisi, İş Güvenliği uyumu.

1. Introduction

Turkey ranks 17th among the 25 largest countries in the world in terms of construction output [1]. The construction industry employs many workers given that it is a labor-intensive sector. In fact, the contribution of the sector to GDP is over 6%, with more than 1.5 million people currently employed in the sector. When the direct and indirect impacts of other sectors are considered, the share of the construction industry in the Turkish economy reaches 30% and its share in employment rate reaches 10% [2]. However, OSH assurance remains a major challenge in the construction industry; the diverse and complex nature of this industry causes frequent fatal and non-fatal occupational injuries worldwide [3-19]. Moreover, the

construction industry ranks higher in fatal occupational injuries than other sectors [20-27].

The construction industry alone is responsible for 30% of all fatal industrial accidents across the European Union despite the fact that it employs only about 10% of the working population [28-29]. According to the National Safety Council of the United States, an estimated 2,200 deaths and 220,000 disablement injuries each year are related to the construction industry [30]. In the United States, the United Kingdom, Italy, and Ireland, the construction industry accounts for 22%, 25%, 25%, and 50% of all fatal accidents, respectively [28,31]. According to the statistics of Japan Industrial Safety and Health Association, an annual average of 94 serious construction accident cases that resulted in three or more deaths/injuries were reported in Japan for the last 20 years [32]. Construction accidents also account for 30%–40% of overall industrial accidents in Japan [28,34]. In Korea, the construction industry is also responsible for the highest number of fatalities among all industries [35]. Each year, up to 120 people are killed in construction sites in the United Kingdom, and approximately 3000 workers suffer from a major injury in construction-related accidents [36]. In China, an estimated 3,000 construction industry fatalities occurred in 2003 alone [37]. According to occupational accident statistics in 2014, 184 fatality cases in Malaysia were inspected by the Department of Occupational Safety and Health. Among all industries, the highest number of recorded fatalities belonged to the construction industry at 72, which is equivalent to approximately 40% of total cases [38]. Work-related accidents and deaths lead to major problems in Turkey similar to that in many other countries [39]. According to the Social Security Institution, 37.78% of industrial fatalities in Turkey occurred in the construction industry in 2015 [40].

To solve this problem, numerous valuable studies that investigated the root causes of occupational accidents in the construction industry have been published. Each study approached the issue from different perspectives and developed precautions to prevent accidents. Some researchers investigated safety management systems, occupational hazard and risk assessments, safety inspections, organizational complexity, and strategies for improving safety performance in the construction industry [41-49]. Others discussed factors that contribute to accident frequency and severity using statistical analysis techniques and case reports [7,8,39,50-51]. However, their results failed to provide an in-depth understanding of the underlying causes and motivations that affect the compliance of workers in OSH rules or requirements.

In addition, the attitude of construction workers toward OSH has not been sufficiently discussed [31,52-53]. The behavior of workers that contradicts instructions, their lack of consciousness about occupational safety, and their disregard for the importance of the issue can cause occupational accidents. Thus, unsafe human behaviors

were considered the cause of 80% of accidents [54]. Wilson (1989) indicated that site managers and 93% of owners agreed that most accidents were caused by human factors rather than working conditions [55]. Thompson et al. (1998) also assumed that unsafe behavior is intrinsically linked to workplace accidents [56]. Therefore, safety management is necessary to focus on the reduction and elimination of unsafe behaviors of construction workers. This study aims to determine the group of workers who do not have the required compliance in OSH practices and presents the opinions of these workers about general OSH practices. In this study, the lack of OSH compliance refers to behaviors that deviate from safety rules and regulations, thereby potentially causing injury to oneself and others and damaging property. Within the scope of the questionnaire, general information about workers and questions related with OSH training were directed because awareness about subject gained by OSH training also affects the compliance to OSH rules. A total of 482 construction workers participated in the study by accomplishing a questionnaire. Ordinal logistic regression was used to evaluate the database created in this study.

2. Materials and Methods

2.1. Questionnaire structure and population

The qualitative approach was used to enable the researchers to understand the range of perspectives of construction workers toward safety management practices [57]. The face-to-face survey is a qualitative data collection method widely adopted in various research fields, such as construction safety [58-62]. A qualitative methodology with face-to-face survey was employed in this study to obtain an in-depth understanding of the underlying causes and motivations affecting the compliance of workers in OSH rules or requirements in data collection process.

The questionnaire was developed based on safety intervention practices and safety behavior criteria from the literature review on recent and related publications [63-71]. The survey questions were designed to develop a comprehensive framework that can provide an improved understanding of the compliance of construction workers in Turkey in following OSH practices and their opinions about general OSH practices.

The study sample consisted of general construction workers from five different cities in Turkey, namely, Izmir, Istanbul, Ankara, Manisa, and Denizli. The face-to-face survey may result in socially desirable responses and lower accuracy than computer-administered questionnaires or paper-and-pencil questionnaires [72].

A face-to-face survey was conducted among 482 construction workers in 2016–2017. The survey was conducted in accordance with the descriptive research model to ensure that hypotheses about the approaches of participants toward OSH could be tested.

The questionnaire is composed of two sections. The first section is designed to collect general information about workers, such as age, gender, marital status, educational background, number of companies previously employed in, accident history, and end use of project worker worked. The second part consists of items rated using a five-point Likert scale and yes or no questions, which examined the compliance of workers in OSH rules and their opinions about general OSH practices by asking questions related with OSH training. The purpose of directed question related with OSH training is that workforce with inadequate training has a considerable impact on the high percentage work accidents and tends to unsafe behaviors. In addition, awareness about subject gained by OSH training also affects the compliance to OSH rules. The questionnaire that was ultimately presented to respondents comprised 17 questions. All data collected from the survey were analyzed using the Statistical Package for Social Sciences, version 10.0. Cronbach's alpha test was then used to measure the reliability of the collected questionnaires.

2.2. Ordinal logistic regression

Regression can be defined as a measure of the relation between the mean value of one variable (Y) and the corresponding values of other variables (X). If the measurement levels of X and Y are continuous, then the simplest relationship between Y and X is a straight line given by the simple linear regression model, wherein Y can take any numeric value between minus infinity and plus infinity [73].

The usual assumption of homogeneous variance is violated if Y is not continuous but binary. The key to validly describing the relationship between Y and X is to model the probability of an event $\rho = P(Y=1)$ instead of Y itself, where Y has only two possible values (1, 0) and ρ can take any numeric value between 0 and 1. The odds $\rho/(1-\rho)$ can take any positive value and the logarithm of the odds $\ln[\rho/(1-p)]$ (i.e., logit) range from minus infinity to plus infinity [74]. Therefore, a linear relationship can be assumed between the logit and X (Equation 1):

$$logit\ (p) = ln\left(\frac{\rho}{1-\rho}\right) = ln(\alpha + \beta X) \quad (1)$$

which is mathematically equivalent to the expression;

$$\rho = \frac{e^{(\alpha+\beta X)}}{1+e^{(\alpha+\beta X)}} \quad (2)$$

The term on the right-hand side of Equation 2 is called a logistic function. Thus, this model is called a logistic regression model [75]. In general, however, when the number of categories exceeds two, the binary logistic model ceases to correspond to a log-linear structure [76].

Ordinal logistic regression is used when the dependent variable is measured by a sequential scale. A parallel assumption exists in the ordinal logistic regression.

According to this assumption, parameter β does not change for different categories and different cut-off points. The parallelism between the models is tested.

Like other logistic models, the ordinal logit model that contains odds ratios is called the cumulative odds model, which contains J ordinal categories. A reference category is selected from the categories of the dependent variable, which is the highest-ranking group. J-1 cut-off point estimations can then be made through this model, which provide information about the cumulative probability for each of the consecutive categories. The probability of the last category is always equal to 1 because it is cumulative [77]. The general display of the Ordinal Logistic Regression model can be expressed as follows [78-79]:

$$ln(Y_j) = ln(\frac{P(Y \le J/X_1, X_2, ..., X_i)}{1-P(Y \le J/X_1, X_2, ..., X_i)}) = \alpha_j - (\beta_1 X_1 + \cdots + \beta_i X_i) \quad (3)$$

Assessing goodness of fit plays, a central role in the model-building procedure and should be conducted before any hypotheses are tested [74]. Pearson chi-square statistics, likelihood ratio statistics, and different R^2 values (Cox and Snell, Nagelkerke, McFadden) can be used to assess goodness of fit [80].

As a final step, the significance of the model parameters should be evaluated after these statistical controls. In ordinal logit models, coefficient interpretation is more complex than other logistic regression models. In ordinal logistic regression analysis, probability value (p) must be less than 0.05 before an independent variable may be deemed statistically related to the dependent variable. For variables that provide this condition, e^β values need to be calculated to interpret differences between categories of statistically significant variables. Finally, the last variable serves as the reference category.

3. Results

The reliability analysis of responses was performed using the Cronbach's alpha test before the data set used in the study was statistically analyzed. According to the results, the Cronbach's alpha of the data set is 0.747, which means that the internal consistency of the data set is acceptable [81].

3.1. Descriptive statistics

The dependent (D-Do you have the required compliance to OSH rules?) and independent variables should be statistically examined before modeling to understand data distribution and individual relationships (Tables 1 and 2).

Table 1 shows the following results:

• All female employees (100.0%) followed the required compliance in OSH rules even if they were fewer in number than males. Less than half of the men (44.2%) possessed the same compliance.

• In terms of marital status, almost half of married (47.8%) and single (42.1%) workers declared that they followed the required compliance in OSH rules.

• Workers older than 55 was the age range with the highest percentage (72.2%) of respondents who declared that they followed the required compliance in OSH rules, followed by the 45–49 age range (56.0%). The group of workers partially sensitive about the subject belonged to the 45-49 age range (44.4%).

• The level of importance that the employees gave to OSH increased as the level of education of employees increased. The group with the lowest OSH compliance was the illiterate group (21.4%), whereas that with the highest comprised workers with secondary education (48.6%).

• Employees often change firms because the construction industry is a project-based and dynamic environment. This situation seems to affect the compliance of employees in following OSH rules. Although more than half of respondents who worked in 1–3 companies (52.3%) declared that they followed the required compliance in OSH rules, this total compliance became partial when the number of companies increased.

•Surprisingly, workers who encountered an occupational accident in the past show less compliance (39.6%) in following OSH rules than those who did not (47.4%).

• The effect of end use of the project on worker compliance was also investigated. Results show that most respondents who reported following the required compliance in OSH rules worked at institutional and commercial building sites (51.4%) followed by those who worked at infrastructure/heavy construction projects (46.6%).

Table 2 shows the following results:

• Workers were directed to the question of whether or not companies should provide OSH training before employees start work. Workers who indicated that companies had to provide OSH training before employees started work also followed the required compliance in OSH rules (45.0%). Surprisingly, 62.5% of employees who indicated otherwise claimed that they also followed the required compliance in OSH rules.

• Almost half of the workers (51.7%) who believed that observing OSH rules increases work efficiency and quality declared following the required compliance in occupational health and safety rules. By contrast, 52.2% and 50.0% of workers who answered "no idea" and "no" to the same item, respectively, declared that they partially obey the rules.

• One striking result was that 49.7% of workers who were satisfied with the OSH training they received reported that they follow the required compliance in OSH rules, whereas 42.2% of those who were dissatisfied reported that they do not obey OSH rules.

• Approximately 61.1% of workers who strongly agreed that OSH training was useful to them as employees of the construction industry and for the industry itself mostly obeyed OSH rules. By contrast, more than half of the workers who disagreed or strongly disagreed with

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this idea (53.2%) did not obey the rules. As the idea that OSH training is useful for workers and the sector became established among respondents, the compliance to compliance with OSH rules also increased.

• Approximately 65.5% and 64.0% of workers who strongly agreed that OSH training is effective in preventing occupational diseases and accidents had the required compliance to OSH rules, respectively. Workers who did not agree with these views did not comply with the rules.

• Similarly, 62.6% of workers who agreed that OSH training reduces the frequency of occupational accidents and diseases mostly obey OSH rules.

• Finally, 62.5% of workers who regarded OSH training as important for the correct and safe use of equipment and materials had the required compliance in OSH rules.

3.2. Ordinal logistic regression model

The ordinal logistic regression model was used in determining the parameters that affect the compliance of workers in OSH rules and practices. Assumption of parallelism was tested as a first condition that the model should ensure.

Table 3 shows that the parallelism hypothesis was tested using the chi-square test. The probability of p value is 0.07. H0 cannot be rejected given that p> 0.05. Therefore, the hypothesis of parallelism provides that the dependent variable categories are parallel to each other, which means that the parameters are equal in each category. Goodness-of-fit can be tested after this assumption.

Table 3. Test of parallel lines.

Model	-2 Log Likelihood	Chi-Square	df	Sig. (p)
Null Hypothesis	618.465			
General	585.066	33.399	16	0.07

Pearson and deviance values are checked when examining the goodness of fit. The probabilities for these test statistics were greater than 0.05 (table 4). This finding shows that the model is in harmony with the data, which is an indication of goodness-of-fit.

Table 4. Goodness-of-fit.

	Chi-Square	df	Sig. (p)
Pearson	457.430	432	0.192
Deviance	458.978	432	0.178

Table 5. Pseudo R-square.

Cox and Snell	0.320
Nagelkerke	0.365
McFadden	0.184

The goodness-of-fit of the model was also investigated using R^2 values. However, R^2 values are low in these analyses because they are not a good criterion for logistic regression. Cox and snell r2 value was 0.320, whereas the nagelkerke R^2 value, which is used to remove the limitation of cox and snell R^2 value, was relatively high (0.365). Mc fadden R^2 value was 0.184 (Table 5).

The final step evaluates the significance of model parameters. Five independent variables were statistically associated with the dependent variable. The e^β values should be calculated to interpret the differences between categories of statistically significant variables. Within the scope of the study, this calculation was made only for statistically significant categories of variables. In addition, the last category of each variable was chosen as reference category. The reference category of dependent variable is "no," which means that workers do not follow the required compliance in OSH rules.

Table 1. Distribution of the OSH compliance of workers according to the demographics of participants (%)

Variables	Categories	D-Do you have the required compliance to OSH rules?		
		Yes	Partially	No
W1-Gender	Female	100	-	-
	Male	44.2	35.2	20.6
W2-Marital status	Married	47.8	32.5	19.7
	Single	42.1	36.9	21.0
W3-Age	19-24	41.5	36.6	22.0
	25-29	40.4	36.4	23.2
	30-34	53.1	30.9	16.0
	35-39	44.1	32.2	23.7
	40-44	42.0	38.0	20.0
	45-49	56.0	32.0	12.0
	50-54	33.3	44.4	22.2
	>55	72.2	16.7	11.1
W4-Educational Background	Illiterate	21.4	42.9	35.7
	Literate	36.7	40.0	23.3
	Primary education	45.9	35.8	18.2
	Secondary education	48.6	29.7	21.6
	High school	44.4	36.3	19.4
	Trade school	47.3	32.7	20.0
W5-Number of companies worked	1_3	52.3	29.7	18.0
	4_6	42.5	38.8	18.7
	7_10	40.7	40.7	18.6
	8_11	50.0	30.0	20.0
	>12	21.3	40.4	38.3
W6-Have you ever had an occupational accident?	Yes	39.6	41.6	18.8
	No	47.4	31.5	21.0

W7-What is the end use of project you worked?	Residential	40.9	35.4	23.6
	Institutional and Commercial	51.4	31.4	17.1
	Infrastructure/Heavy Construction	46.6	36.2	17.2
	Industrial	44.7	38.3	17.0

Table 2. Distributions of OSH compliance of workers according to variables (%).

		D-Do you have the required compliance to OSH rules?		
Variables	Categories	Yes	Partially	No
F1-Do companies have to provide OSH training before starting work?	Yes	45.0	34.4	20.6
	No idea	39.1	43.5	17.4
	No	62.5	25.0	12.5
F2-Does paying attention to OSH increase work efficiency and quality?	Yes	51.7	29.5	18.8
	No idea	23.4	53.2	23.4
	No	18.8	50.0	31.3
F3- Are you satisfied with the OSH trainings you attended?	Yes	49.7	34.2	16.1
	No idea	37.1	41.4	21.4
	No	28.1	29.7	42.2
F4-Do you believe that OSH training is useful for you and the sector as an employee of the construction industry?	Strongly disagree	22.8	24.1	53.2
	Disagree	15.1	37.7	47.2
	No idea	33.3	44.4	22.2
	Agree	54.5	40.4	5.1
	Strongly agree	61.1	30.2	8.7
F5-Do you agree that OSH training is effective in preventing occupational diseases?	Strongly disagree	25.3	22.7	52.0
	Disagree	13.0	32.6	54.3
	No idea	17.7	48.4	33.9
	Agree	58.5	38.7	2.8
	Strongly agree	65.5	26.4	8.0
F6-Do you agree that OSH training is effective in preventing occupational accidents?	Strongly disagree	27.0	21.6	51.4
	Disagree	10.9	34.8	54.3
	No idea	23.3	44.7	34.0
	Agree	53.7	42.1	4.2
	Strongly agree	64.0	27.2	8.8
F7-Do you agree that OSH training is effective in reducing the frequency of occupational accidents and diseases?	Strongly disagree	28.2	18.3	53.5
	Disagree	8.7	41.3	50.0
	No idea	22.0	42.4	35.6
	Agree	56.5	39.8	3.7
	Strongly agree	62.6	29.6	7.8

F8-Do you think OSH training is important for the correct and safe use of equipment and materials?	Strongly disagree	19.4	21.0	59.7
	Disagree	17.9	35.7	46.4
	No idea	25.0	52.3	22.7
	Agree	53.0	41.7	5.4
	Strongly agree	62.5	34.6	10.5

According to table 6;

[W2]: the reference category of variable "marital status" is single. According to the results, the required compliance in OSH rules among married workers is 1.45 times lesser than single workers.

[W6]: the reference category of variable is "no," which means that the worker has never encountered an occupational accident. Results show that the required compliance in OSH rules of workers who encountered an occupational accident is 1.51 times less than those who have not.

[F2]: the reference category of variable is "no," which means that the worker believes that paying attention to OSH does not increase work efficiency and quality. Surprisingly, the number of workers who hold this opinion and have the required compliance in OSH rules is 2.72 times lesser than that of the reference category.

[F6]: the reference category of variable is "strongly agree," which means that the worker agrees that OSH training prevents occupational accidents. The number of workers who strongly disagree with this idea and follow the required compliance in OSH rules is 3.677 times lesser than that of the reference category. Workers who disagreed or who were indecisive with this idea also did not obey OSH rules 5.80 and 4.87 times more than that of the reference category, respectively.

[F8]: the reference category of variable is "strongly agree," which means that the worker believes that OSH training is important for the correct and safe use of equipment and materials. The number of workers who have the required compliance in OSH rules and who strongly disagree or disagree with this idea is 5.50 and 2.44 times less than that of the reference category, respectively.

4. Discussion

The fatality rate in construction sites is unacceptably high in Turkey, where the number of work-related accidents and deaths also remain a controversial topic. In the last few years, the legal framework on occupational health and safety in Turkey has often been subject to minor and fundamental amendments. However, no noticeable decrease in the number of such accidents has been observed despite the fact that progressive and essential legislation aiming to prevent work accidents have been introduced in Turkey [82-84]. Researchers also investigated country-level studies and focused on the possible factors influencing such rates in Turkey [85-89]. However, the investigation of injuries and fatalities, statistical analysis, determination of preventive measures, improvement of regulations, and controlling subcontractors as contact strategies are not sufficient in achieving zero accidents when fatality rates in the construction industry are considered [63,64]. Employees should participate and cooperate in the process to reduce the number of accidents. To demonstrate how the issue is addressed in terms of employees, 482 construction workers were studied to identify elements of the poor compliance of construction workers in OSH rules and practices.

Table 6. Significance of model parameters.

	Variables	β	Wald	e^{β}	p
Do you have the required compliance to OSH rules?	[D=Yes]	-1.09	3.74		0.04
	[D=Partially]	**1.10**	**3.79**		**0.04**
Marital status	[W2=Married]	-0.37	0.19	1.45	0.04
	[W2=Single]	**0**	.		.
Have you ever had an occupational accident?	[W6=Yes]	0.41	4.01	1.51	0.05
	[W6=No]	**0**	.		.
Does paying attention to OSH increase work efficiency and quality?	[F2=Yes]	-1.00	7.13	2.72	0.01
	[F2=No idea]	**-0.21**	**0.24**		**0.62**
	[F2=No]	0	.		.
Do you agree that OSH training is effective in preventing occupational accidents?	**[F6= Strongly disagree]**	**1.30**	**8.81**	**3.68**	**0.00**
	[F6= Disagree]	1.76	14.08	5.80	0.00
	[F6= No idea]	**1.58**	**17.61**	**4.87**	**0.00**
	[F6= Agree]	-0.02	0.00		0.96
	[F6= Strongly agree]	**0**	.		.
Do you think OSH training is important for the correct and safe use of equipment and materials?	[F8= Strongly disagree]	1.70	16.02	5.50	0.00
	[F8= Disagree]	0.89	4.87	2.44	**0.03**
	[F8= No idea]	0.14	0.13		0.72
	[F8= Agree]	0.10	0.16		0.69
	[F8= Strongly agree]	0	.		.

The first thing that needs to be emphasized is the fact that construction workers usually have lower education levels than workers in other sectors, which is especially true in less developed or developing countries where minimal skill and/or certification is required to become a construction worker. Turkey can be cited as an example as it possesses the highest fatality rate at construction sites and the least schooling years among construction workers [90]. According to the Center for Construction Research and Training, in 2007, workers in the construction industry had a lower level of educational attainment than those employed in other industries [91].

Besides worker education level, OSH training is also very important. Sawacha et al. (1999) stated that lack of safety training is one of the causes of accidents [42]. Wilkins (2011) stated that poor training and poor retention of relevant knowledge among construction workers are the two factors responsible for such high incidences of injury [52]. Thus, safety training is crucial in improving construction safety. In addition, choosing the right training method is important to ensure the effectiveness of the training. As a matter of fact, approximately 74.7% of workers who responded to the questionnaire preferred applied education.

Unsafe behavior is the most significant factor that causes site accidents in the construction industry [92-94]. Safety behaviors cannot be expected from workers who indicate that they do not have the required compliance in OSH rules. The results of this study show that developing a safety culture is necessary to allow workers to gain this awareness and show necessary compliance.

5. Conclusion

This study aims to determine the group of Turkish construction workers who do not have the required compliance in OSH practices and presents the opinions of these workers about general OSH practices. The results are expected to contribute to literature by providing statistical insight and giving a clear understanding of the safety culture of workers who did not have the required compliance in OSH rules. In addition, views on the OSH practices of workers, the safety culture of construction workers, and the causal conditions were identified. Lastly, a grounded model based on newly created data was developed to explain the approach of construction workers to OSH practices.

An interesting outcome of this study is that workers who encountered occupational accidents in the past are less precise in following OSH rules, which is exactly the opposite of what was expected. Workers who experienced work accidents are expected to have decreased their level of belief in OSH practices and have lost their compliance in complying with the rules. This finding was not reported in other literature, which indicates that this finding is a unique condition in Turkey.

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