

## Identifying the Unsafe Behaviors among Construction Industry Workers and Determining the Effect of Kiken Yochi Training (KYT) Intervention on their reduction in Iran

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### ABSTRACT

Nowadays, occupational related diseases and accidents are considered one of the main causes for mortality worldwide. However, Kiken Yochi Training (KYT) is one of the interventions to reduce the incidence of unsafe behaviors at workplace, yet there are few evidence-based studies on its effectiveness. This study was aimed to identify the unsafe behaviors among workers in the construction industry in Iran and determine the influence of Kiken Yochi Training intervention on their reduction. In this study, the unsafe behaviors of workers in Atieh Sazan construction Company, Tehran, Iran, were investigated. For this purpose, 452 workers were randomly selected and 11733 observations regarding unsafe behaviors were reported. In the second phase, Kiken Yochi Training was applied over three months, then observations were recorded once again. Socio-demographic questionnaire and Tarrant's checklist were used. 25.69% of the recorded behaviors in the first phase and 18.57% after the intervention, were unsafe. Unsafe use of equipment and inappropriate ergonomic status were among the most common risky behaviors. The average percentages of unsafe behaviors before and after the intervention were reduced by about 36%. Kiken Yochi Training was effective in diminishing the unsafe behaviors among workers. There was a significant relationship between the number of unsafe behaviors, age, experience, type of occupation, educational status, and having a previous accident (P value <0.01). In the present study, it was concluded that the occurrence of unsafe behaviors among construction industry workers could be reduced by promoting awareness and raising knowledge. Moreover, it was recommended to have continuous monitoring, training sessions based on behavioral safety principles establishment, a safety culture in addition to reliance on academic experiences development.

**KEY WORDS:** *Unsafe Behaviors, Construction Industry, Kiken Yochi Training Intervention, Occupational Health, Iran*

### INTRODUCTION

The latest statistics showed that about 45% of the world's population is workforce labor which impacts positively on the economic status in any society [1-2]. Therefore, the health conditions and

occupational culture of the workforce are prerequisites for productivity in terms of sustainable social-economic development [3]. Many people spend more than one-third of their life in noisy environments

facing a variety of occupational hazards [1-4]. The local, national, regional, and international governments and policy-makers increasingly try to assure labor safety as one of the welfare requirements [5-6]. The incidence of occupational accidents is a common issue and consist of considerable percentages in the most countries [1-7]. According to the International Labor Organization and the World Health Organization (WHO) report in 2002, about 50 million occupational injuries and 350 thousand life-threatening accidents occurred annually worldwide [8]. Unfortunately, occupational deaths in the developing countries are 3 to 4 times higher compared to developed countries, so that occupational accidents are deemed as one of the most substantial problems in the developing countries [9-10]. The International Labor Organization (ILO) defined the occupational accident as an unplanned and unexpected work-related accident that results in death, illness, or injury to one or more workers [11]. These accidents will yield in absenteeism, disability, and even mortality which may decrease the productivity and aggravate the financial expenditures in various industries [12]. Unsafe behaviors are the leading causes of occupational accidents. The outcomes of different researches proved that risky behaviors are accounted for more than 70% of working place related accidents [2-7-13]. In order to minimize these negative effects, a behavioral approach emerged as a new method to prevent or reduce unsafe behaviors and certainly their adverse consequences [13-14].

The Kiken Yochi Training (KYT) is one of these training programs in which four distinct phases begin by identifying and discussing between groups and finish by designing and presenting risk reduction strategies. Having considered the aforementioned purposes, the influencing factors should be recognized to reduce unsafe behaviors among workforces [14]. Poosanthanasarn et al. found a significant lumbar activity difference among workers who performed KYT and did not [15]. Murai et al. investigated risky behaviors in pharmacy sector and revealed that more than 95% of students under the KYT training program had changed their assessment of risky behaviors. Similarly, they showed that the KYT risk reduction training program had effectively reduced human error through group discussions [16].

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Sato et al. also found that nurses in the KYT-training group had reported a higher score in reducing risk than those in the other group. The researchers showed that the implementation of KYT-training programs was associated with an increase in nurses' sensitivity towards reducing occupational risks [17].

Es-haghi et al. examined the effect of educational intervention in the incidence of unsafe behaviors and concluded that the educational intervention approach can significantly reduce unsafe behavior rates, raise awareness, and change workers' attitudes at the workplace [18].

KYT is a strategy aimed to increase awareness towards risky and unsafe conditions as well as improve the motivation of teamwork, promote information sharing about hazards of the workplace with others, and enhance problem-solving abilities by collective participation among workers.

Given the importance of KYT strategy, at the same time, limited evidence exists regarding its effectiveness, this study was designed and implemented in order to identify unsafe behaviors among workers in the field of the construction industry and determine the impact of KYT intervention.

## MATERIAL AND METHODS

The current study was a semi-experimental interventional study conducted at Atieh Sazan construction Company in Tehran over a six-month period. In this study, observation and safety sampling methods were used to analyze, detect, and reduce unsafe behaviors among the participants.

In the first phase, the construction industry was defined and the relevant job analysis was performed for work stations in each occupational group. In this phase, the workplaces in different departments were identified regarding tasks performed. Based on the safety measures and accidents recurrence, the available occupations were prioritized, ranked, and listed. Job analysis was determined by the division of tasks and subtasks. In the second phase of the study, a list of unsafe practices was identified using the related list compiled from the American National Safety Association. In this study, the list of unsafe practices in Tarant's study was also used [19].

In the next step, the results of pilot study were utilized with an error level of 5% and a confidence

interval 95%. The sample size was selected randomly among 452 persons from the personnel list. A total of 11733 observations, for all the participants, were performed (Equation 1).

Equation 1:

$$N = \frac{K^2(1 - P)}{S^2P}$$

Where:

**N** is the total number of observations needed (3778).

**K** is amount obtained from the standard normal table (2).

**S** is accuracy needed (0.05).

**P** is the ratio of observations of unsafe behaviors to total (0.12).

Unsafe behaviors were recorded using a checklist. Subsequently, the KYT intervention was implemented through its four phases: discussion, evaluation, planning, and implementation in which the anticipated threats and unsafe behaviors were identified through small groups and the control strategies for them were discussed and taught to the participating workers. Unsafe behaviors of workers was re-determined and reported once again during the 3-months of KYT intervention. At this stage, the frequency and type of detected unsafe behaviors were compared with those identified before the intervention.

### *Statistical Analysis:*

Socio-demographic data of the subjects were analyzed using Stata software version 12. Standard deviation, mean, and quartiles were used for data

description. Fisher exact test and Chi-square ( $\chi^2$ ) tests were applied for qualitative variables while paired T-test was useful in comparing the mean of quantitative variables before and after the intervention. Analysis of variance (ANOVA) was also used in cases of more than two groups-quantitative variables. In this study, the significance level (p) was considered to be less than 0.05 and all its values were two-sided.

## **RESULTS**

In the present study, 452 workers were randomly selected and their unsafe behaviors were observed for 6 months. The subjects' age mean was  $36.13 \pm 3.74$  years-old ranged from 24 to 45 and the average years of their work experience were  $14.94 \pm 2.03$  years with a range from 12 to 18 years. 413 (91.37%) were married and 76.11% had a history of occupational accidents. The educational level of participants included 24.51% under diploma, 28.93% diploma, 27.19% finished their upper secondary education, and 19.37% bachelor's degree and higher education.

In this study, 117 333 observations were recorded in total in which 5194 (44.26%) of them were unsafe, 25.69% in the first phase and 18.57% were post-intervention. The frequency of unsafe behaviors before intervention has been presented in Table 1.

The average number of unsafe behaviors before the KYT intervention was  $\approx 77$  whereas at the end of the intervention was  $\approx 41$ . The difference between the numbers before and after the intervention was statistically significant (P-value <0.05).

**Table 1.** Frequency of some of the most common unsafe behaviors before and after KYT intervention

Occupation	Type of Unsafe behavior	Before KYT		After KYT	
		Frequency	Percentage	Frequency	Percentage
<b>Welding</b>	Inappropriate ergonomics	57	1.89	41	1.88
	Unsafe use of equipment	61	2.02	38	1.74
	Spraying molten material during welding	81	2.69	49	2.25
	touching hot welding wire				
	Wearing loose clothes, long sleeves, ring and so on	27	0.9	19	0.87
	Inappropriate ergonomics	61	2.02	43	1.97
	Lifting or carrying heavy loads	55	1.82	43	1.97
<b>Masonry</b>	Piling materials in the corridors and workers' passageways	43	1.43	28	1.28
	Wearing loose clothes, long sleeves, ring and etc.	37	1.23	21	0.96
	Inappropriate ergonomics	71	2.35	55	2.52
<b>Reinforcement</b> (Armature worker)	Unsafe use of equipment	49	1.63	37	1.7
	Wearing loose clothes, long sleeves, ring and so on	39	1.29	32	1.47
	Use of unstable and temporary bases to hold	42	1.39	29	1.33
<b>Insulation</b>	Holding the piece by hands while drilling	33	1.09	24	1.1
	Hold the piece with hand when drilling	61	2.02	49	2.25
	Electrocution due to the contact with the machine due to wrong wiring	31	1.03	18	0.83
<b>Electrician</b>	Inappropriate ergonomics	46	1.53	30	1.38
	Use of unstable and temporary bases to hold	24	0.8	17	0.78
	Unsafe use of equipment	33	1.09	21	0.96
	Use hands instead of hand tools	43	1.43	31	1.42

The risky behaviors prior to KYT intervention were unsafe equipment use, wearing loose clothes with long sleeves and rings, inadequate ergonomic status, lifting or carrying heavy loads, holding the drill by hands while working, lifting loads with curved waist inappropriately, spraying molten materials, and touching the hot wire during welding.

The rate of unsafe behavior reduced after KYT intervention implementation. The most common unsafe behaviors in the construction industry sector included pouring tools on the floor, unsafe use of equipment, holding the piece by hands while drilling, carrying heavy loads, spraying molten material and touching the hot wire during welding, wearing loose clothes, long sleeves and ring.

The results showed that the number of unsafe behaviors was associated with work experience negatively and significantly ( $r = -0.765$ ,  $P$ -value  $<0.05$ ). Additionally, the relationship between the number of unsafe behaviors and age up to 45 years-old was negative and significant ( $r = -0.682$ ,  $P$ -value  $<0.05$ ) but it became positive and still significant after 45 years-old ( $r = 0.523$ ,  $P$ -value  $<0.05$ ). On the contrary, the relationship between marital status and the number of unsafe behaviors was statistically non-significant ( $P$ -value = 0.167).

The results of accident's history in this study also related to a high proportion of unsafe behaviors ( $\approx 147$ ) compared to the limited accident's history ( $\approx 75$ ), and the difference was statistically significant ( $P$ -value  $<0.05$ ) (refer to Figure1).

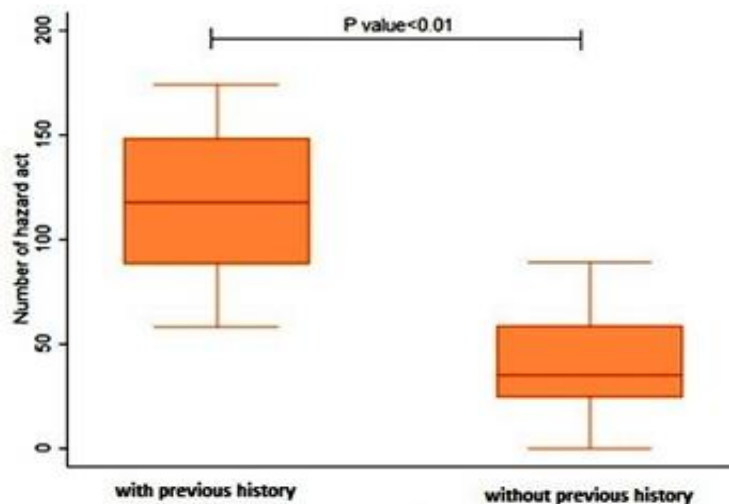


Figure 1 : Average number of unsafe behaviors in workers according to previous accident history

The findings also revealed that the average number of unsafe behaviors varies according to the educational levels of workers. The average number of unsafe behaviors among diploma workers was around 164 while it was about 98 among upper high school graduates workers. The higher mean value of unsafe behaviors was among those who had a bachelor's degree and higher, this was approximately 63. The differences were statistically significant ( $P$ -value  $<0.05$ ).

It can be concluded that the average number of unsafe behaviors in various jobs in the construction industry was significantly different ( $P$ -value  $<0.01$ ). Additionally, Post-Hoc tests also proved that there was a significant difference between the number of unsafe behaviors among simple workers groups and other groups.

## DISCUSSION

The incidence of occupational accidents globally is relatively high over time, especially in the construction industry. Based on the ILO annual report, around one third of the work-related deaths occur as a result of occupational preventable accidents [1-3-20]. In various studies, unsafe behaviors were recognized as a main reason to create occupational accidents. Therefore, in the present study, different types of unsafe behaviors involved in the incidence of adverse consequences were identified. Furthermore, the effectiveness of educational interventions such as (KYT) to reduce these behaviors was assessed. Based on the obtained results, the KYT intervention had a considerable impact on decreasing the incidence of unsafe behaviors and consequently their unpleasant side-effects.

In the present study, the average percentage of unsafe behaviors considerably reduced after the KYT intervention from 26% to 19% approximately, indicating that the workers were influenced by the educational intervention. The results were consistent with the previous studies of Poosanthanasarn and Yasuda in which KYT played a big role in raising awareness and improving safety procedures both workers and radiologists, respectively [14-15-19-20]. However, Gravand et al. evaluated a gas refinery company and detected that the ratio of unsafe behaviors was 32.20%. The reason for this inconsistency can be explained by the nature and basic differences of various industries, their safety systems, and current procedures [6].

In this study, the relationship between age and the incidence of unsafe behaviors in the workplace was negative and significant with ages less than 45 years old. The findings of Hasheminejad et al study were meaningful considering age. They found that the unsafe behavior chance happening was higher among workers under 25 years old as they lack the adequate knowledge and experience [21].

There was a positive significant relationship between unsafe behaviors and history of former accidents which was consistent with the inclination-talent theory assuming that the specification sets the person to commit more unsafe behaviors and as a result of preceding accidents. This also was in line

with the results of Hasheminejad et al. and Gravand et al. studies [6-21].

The results of study conducted by Es-haghi et al showed that the educational intervention reduced the incidence of unsafe behaviors significantly, and concluded that using educational and practical interventions in the workplace can decrease unsafe behaviors by increasing in awareness and changing workers' attitudes [18].

Work experience was also one of the factors influencing negatively the incidence of unsafe behaviors, so that by increasing the years of work expertise, the incidence of unsafe behaviors reduces which also was consistent with the previous studies in the literature [3-4-6-7-21]

In a meta-analysis study conducted by Tuncel et al, it was found that the behavior-based safety (BBS) was one of the interventional methods adopted to reduce the incidence of unsafe behaviors and occupational accidents, resulted in a significant decline of unsafe behaviors [22]. These results were consistent with the results of the current study.

There was a significant relationship between the level of education and the occurrence of unsafe behaviors which was in line with other studies in the literature. This could be due to the increase in awareness and training levels among highly-educated people. From another side, failure of less-educated workers to comply with the roles and regulations could be another justification. Additionally, in contrast to highly-educated people, workers of low education level are usually engaged in more risky jobs and then exposed to behave unsafely [4-23].

## CONCLUSION

Based on the results of the present study, commonly unsafe behaviors in the construction industry were inappropriate ergonomic working environment, unsafe use of equipment, and wearing inappropriate clothes. Accordingly, KYT as an educational intervention was effective and efficient in reducing the occurrence of unsafe behaviors among workers. Moreover, continuous monitoring, implementation of training courses based on the behavior of workers, and the creation of a safety culture were also recommended.

## CONFLICT OF INTERESTS

There was no conflict of interest in this study.

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