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Evaluation of Workers Unsafe Behaviors using Safety Sampling Method in an Industrial Company

Maryam Abbasi[1], Reza Gholamnia[2], Seyed Shamseddin Alizadeh[2] and Yahya Rasoulzadeh[1*]

[1]Department of Occupational Health Engineering, Tabriz University of Medical Sciences, Tabriz, Iran; m_abbasii@yahoo.com, ss.alizadeh2013@gmail.com.
[2]Department of Health Sciences, School of Health, Safety and Environment, Shahid beheshti University of Medical sciences, Tehran, Iran; holamnia@sbmu.ac.ir

Abstract

Background: In order to control occupational accidents, it is essential to find out unsafe behaviors and their rate among workers. This study was aimed to determine unsafe behaviors rate and offer some control measures. **Methods and Materials:** In this descriptive-analytical study, safety sampling technique, interview and document review methods were adopted. In a pilot study, the number of observations and samples were determined 3145 and 185, respectively. Finally, in order to analyze the data, Chi-squared test and regression were used. **Findings**: The results showed that 25.08% of the workers behaviors were unsafe. It was found that there is a significant correlation between unsafe actions and education level ($P>0.05$) while the correlation between unsafe action and age, work experience, married status, job and time of observations was not significant ($P<0.05$). Furthermore, the highest unsafe actions were observed in testing man and workers above 51 years old and above 21 years of work experience. **Application/ Improvements:** Although the rate of unsafe behaviors in study group was relatively low compared with unsafe acts, the improper use of personal protection equipment was the most dominant problem. In order to reduce these behaviors, training programs, daily surveillance and safety culture improvement among workers and authorities are strongly suggested.

Keywords: Accidents, Occupational Safety, Safety Sampling, Unsafe Acts, Workplace

1. Introduction

Human resource is one of the most valuable assets in any country and is the foundation for sustainable development. The World Health Organization estimates that approximately 45% of world population and 58% of people over 10 years are workforce[1]. According to Census 1997 it was estimated that the workers number in Iran is estimated 14 million. Therefore, they are prone to a variety of work-related illnesses and accidents[2]. Work-related injuries are one of the most important problems in public health. Also these injuries are one of the most important factors that caused loss work-time and are the most important health, social and economic factors in industrial and developing communities[3]. It has been reported that around the world each year more than 300 thousand workers have lost their lives to this cause and many more are disabled[4,5]. According to the ILO, almost a third of deaths occur due to occupational accidents[6]. Accident is an unplanned event that disrupts the conduct or continuation of an activity and always occurs by unsafe acts, unsafe conditions or a combination of them. Occupational accidents due to their severe economic, social and political potential consequences are a threat for industries[7,8]. Heinrich believes that the cause of 88% of accidents is unsafe acts, the cause of 10% of accidents is unsafe conditions and the cause of 2% of accidents is unforeseen factors[9]. Sal mine and Tall berg stressed that 91% of job losses that have occurred in Australia in 1982-1984 was related to behavioral factors[10]. Lutness states that over 95% of all reported incidents caused by human error[11]. Some researchers suggest that 80 to 90% of

* *Author for correspondence*

accidents are caused by human error[12]. In Iran, according to statistics released by the Social Security Corporation, major cause of accidents in all years studied is unsafe act[13]. Duty of man in modern industry is controlling a large number of different and critical operations. Usually it is assumed that the error is one of the main factors that create risk of catastrophic disasters in these operations[14]. In this context and with clarifying the role of unsafe acts as a major factor in the accidents, since the second half of the twentieth century, in developed countries the control of accidents has focused on unsafe acts[15]. More than 60 percent of the world workforce is in developing countries, but only 5-15%of this population has access to occupational health services. Thus, the rate of work-related accidents in developing countries is more than in developed countries[16,17].

In addition to the damage inflicted injuries on manpower, it imposes large economically costs[14,6]. One aspect of studies in many industrialized countries in order to reduce or prevent of occupational accidents is improving education, job conditions, quality of work and tools and surveying the results of occupational accidents[4]. On the other hand, a wide range of personal and occupational factors such as age, sex, educational level, occupational or lifestyle factors are known as factors associated with the risk of fatal occupational accidents[16,15]. Obviously, to control unsafe behaviors, knowledge of them percentage among employees and determine the factors influencing them is required. The aim of this study is to determine the proportion of unsafe acts and their relationship with the demographic characteristics of workers such as age, employment experience, marital status, education level, occupation, previous accident history.

2. Materials and Methods

This study is a descriptive - analytical and cross-sectional study that was performed using sampling technique of safety behaviors, observation, interviews and review of documents[11]. In this study, unsafe acts are operations outside the scope of standard and defined limits in the system and can affect the safety system[17]. Therefore, the list used in this study was designed based on unsafe acts that has been provided by the American National Safety Council[18]. This checklist includes all kinds of unsafe acts that a worker can do in job. In this context, interviews with workers also helped to identify the types of their unsafe behaviors. Overall, this study was conducted in several stages as follows:

- **Step 1:** First, a preliminary assessment was conducted to identify factory existing processes and workers and also to determine the types of unsafe acts and a list of workers unsafe behaviors was provided.
- **Step 2:** Twelve specific occupational groups were identified for pilot study and from each group a job was selected for studying. According to previous studies, sample size for the pilot study was determined 200 cases[19,11]. Therefore, in this study 17 observations were conducted for every 12 students (204 observations).
- **Step 3:** After considering the results of the pilot study, the accuracy of 5% and confidence interval of 95% the total number of observations was determined using the following way. First unsafe behavior ratio was calculated using Formula (1).

Formula 1 $$P = N_2/N_1$$

Where:
N1: The total number of observations
N2: Observations which unsafe acts are observed in them
P: Unsafe behavior ratio

According to previous studies, sample size for the pilot study was determined 200 cases[11,19]. Therefore, in this study 17 observations were conducted for every 12 students (204 observations). Sixty-six observations of these 204 observations were unsafe. Thus P is equal to:
P = 69/204=0.338

The total sample size for the study was calculated from the Formula (2)

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

Where:
N: Sample size
S: Required accuracy
K: Value provided from standard normal table for confidence interval
P: Unsafe behavior ratio

In this study, according to other studies that have been done in this area, K is considered equal to 2[12]. As a result, we have:

$$N = \frac{2^2(1- 0.338)}{0.05^2[?I?](0.338)} = 3133$$

Table 1. Demographic information of the studied cases

children	marital status	work experience	age	Personnel code	children	marital status	work experience	age	Personnel code
1	1	7	36	2574	1	1	17	43	2100
2	1	10	53	2989	0	1	9	34	2512
1	1	4	31	2960	1	1	10	34	2542
2	1	16	43	2164	2	1	9	30	9429
0	1	11	33	2465	0	1	10	31	2869
0	0	10	32	2844	2	1	23	46	1520
1	1	9	28	2811	2	1	9	35	2894
1	1	10	32	2664	2	1	17	39	2125
3	1	13	40	2933	0	1	5	45	2679
0	1	10	32	2765	1	1	10	34	2424
1	1	17	41	2118	2	1	10	36	2711
0	0	10	33	2507	0	1	9	32	2509
1	1	10	34	2549	2	1	17	41	2128
0	1	10	33	2686	1	1	10	38	2766
2	1	18	41	2029	1	1	10	36	2827
1	1	11	34	2608	1	1	10	34	2461
2	1	18	45	2008	0	1	11	33	2501
0	1	10	31	2414	1	1	10	34	2541
2	1	10	36	2690	1	1	12	33	2351
0	1	9	37	2519	1	1	10	34	2829
1	1	11	32	2495	0	1	10	31	2789
0	0	4	26	2963	0	0	8	33	2843
1	1	9	33	2809	0	1	2	31	2972
0	1	10	31	2694	0	1	9	33	2842
children	**marital status**	**work experience**	**age**	**Personnel code**	**children**	**marital status***	**work experience**	**age**	**Personnel code**
1	1	10	29	2474	2	1	18	40	2031
1	1	10	35	2879	0	0	9	33	2494
1	1	10	32	2632	1	1	12	33	2337
1	1	10	38	2911	1	1	10	34	2772
0	1	8	32	2804	1	1	10	31	2831
2	1	10	39	2478	0	0	4	30	2850
1	1	17	43	2098	0	1	4	30	2821
2	1	17	40	2074	1	1	10	31	2768
0	1	10	37	2595	2	1	11	38	2562
0	1	10	34	2499	1	1	11	31	2635
0	1	10	32	2601	3	1	18	39	2037
1	1	9	34	2606	0	0	93	27	2961
2	1	17	46	2102	0	1	10	32	2576
0	1	10	31	2558	1	1	10	31	2476
1	1	10	33	2462	2	1	18	40	2172
1	1	9	33	2809	1	1	12	36	2318
1	1	8	34	2808	2	1	10	41	2906
0	1	3	31	2970	1	1	2	30	2968
1	1	10	34	2791	2	1	18	41	2055
1	1	18	37	2036	0	0	10	30	2730
1	1	11	36	2389	2	1	17	40	2097
0	1	9	34	2790	2	1	17	41	2121
0	0	10	31	2848	1	1	9	34	2756
4	1	10	47	2923	1	1	10	33	2429

*: 1 is an indication of married workers and 0 is the indication of being single

This means that the minimum number of observations is 3133. Finally, the total number of workers and the number of observations in 12 occupational groups were determined 185 and 3145 respectively.

- **Step 4:** Workers demographic characteristics such as age, experience, education, history of previous trauma, marital status were collected from medical records in the safety and health unit.
- **Step 5:** All observations during 29 days in the morning from 7:30 am to 2 pm were conducted quite intangible because, if the worker knows the observer objective, he/she may make changes in his/her behavior. Researchers tried to conduct each observation as much as possible short so that the observer be able to see the activity and determine whether it is safe or unsafe.
- **Step 6:** Collected data were entered in SPSS 17 software and analyzed using chi-square and correlation statistics tests.

3. Results

In this study 3145 observations were conducted in 29 working days in the morning shift. Of the total number of observation, 790 (25.1%) were unsafe.

The distribution of the different variables, the most and least abundant in the age groups respectively. The maximum and minimum frequencies of observations of different variables were as follows respectively:

In age groups 31-35 years old (52.17%) and more than 51 years old (3.26%), experience 6-10 years (60.87%) and experience more than 21 years (4.9%), marital status (married 89.67% and single 10.33%), job type (operator 26.08% and forklifts 3.8%), education level (diploma 51.63% and undergraduate 9.78%), observed hour (8-9 am 22.19% and 13-14 pm 8.85%).

The maximum and minimum frequencies of unsafe observations of different variables were as follows respectively:

In age groups more than 51 years old (26.47%) and 26-30 years old (23.84%), experience more than 21 years (27.45%) and 1-5 years (21.57%), marital status (married 25.56% and single 21.05%), job type (tester 31.1% and press operator 19.12%), education level (under-diploma 28.5% and undergraduate 21.57%), observed hour (13-14 pm 26.71% and 12-13 pm 22.66%).

Among the observed unsafe acts, non-use or misuse of personal protective equipment (8.37%), removing the machinery guards (6.46%), improper body position while

Table 2. Distribution of unsafe acts based on the type of job

No.	Unsafe acts (%)	Unsafe acts	Observations*	Subject number	Type of job
1	21.63	74	342	20	Turner
2	22.22	38	171	10	Storekeeper
3	25	77	308	18	Milling
4	26.12	58	222	14	The washing up worker
5	21.66	26	120	7	Forklift driver
6	27.92	43	154	9	Assembly worker
7	30.83	37	120	7	Tester
8	25.97	213	820	48	Operator
9	22.80	39	171	10	Grinding operator
10	19.02	39	205	12	Press operator
11	26.68	91	341	20	Drilling operator
12	29.24	50	171	10	Controller
Total	**25.08**	**789**	**3145**	**185**	

* The number of observations for each worker was 17.

Table 3. Distribution of unsafe acts based on the subjects work experience

No.	Unsafe acts (%)	Unsafe acts	Observations	Subject number	Work experience (Year)
1	21.36	66	309	18	1-5
2	25.26	382	1908	112	6-10
3	26.36	87	343	20	11-15
4	25.16	112	428	25	16-20
5	27.75	42	157	10	More than 21
Total	**25.08**	**789**	**3145**	**185**	

doing work (4.02%) and improper lifting and manual handling (1.6%) were the most frequent.

Among the subjects, only 10.87% were with no history of previous accident and 89.13% of them had suffered an accident during their working years.

Table 2 shows the distribution of unsafe acts based on the type of job. Total observations were 3145. The maximum and minimum observations were conducted in operators group (820 observations) and testers and forklift driver groups (120 observations) respectively. 789 (25.08%) observations were unsafe. The highest and lowest percentage of unsafe acts observed within the testers group (30.83%) and press operators group (19.02%) respectively.

Table 3 shows the distribution of unsafe acts based on the subjects work experience. According to this table, the maximum and minimum number of subjects have 6-10 years experience (112 subjects) and more than 21 years experience (10 subjects) respectively.

Chi-square test showed the significant correlation between the level of education and unsafe acts ($p<0.05$). In this study was no significant correlation between the unsafe acts with age, work experience, marital status, occupation, education level, and observed hours ($p>0.05$).

4. Discussion

Researchers believe that the main cause of accidents is unsafe behavior[6], and these factors were surveyed in this study. According of the results of the present study, 25.8% of employees acts were unsafe. In a study in Kermanshah Oil Refinery and in another study in Iran Gas Company, it was reported that 24.5% and 26.7% of employees acts were unsafe respectively[12,13]. In another similar study at a foundry industry, the unsafe acts has been reported as 59.2%[18].

Statistical analysis showed that there was a significant inverse relationship between unsafe behaviors and level of education. Namely, with increasing levels of education, unsafe acts are reduced. These results have been obtained in other studies too[7,12,18]. High rates of unsafe acts among people with low literacy can be the following reasons: Low levels of knowledge and awareness of unsafe acts among them and delegating to them difficult and dangerous tasks. The lowest percentage of unsafe acts observed in the undergraduate group was with 21.57%. This findings have been obtained in another study[12].

Highest and lowest unsafe acts based on marital status were observed in married single individuals with 25.56% and 21.5% respectively. These results were obtained in another study[12]. However, there was no significant relationship between unsafe acts and marital status. One of the reasons for high levels of unsafe acts among married people can be intellectual conflicts.

Among unsafe acts, use or misuse of personal protective equipment was the highest percentage of them (8.37%). This finding is consistent with the findings of other researchers[7,12,18-21]. The second most abundant unsafe act was the removing protection devices during the activity. The consequences of this behavior are caught the hands or clothing between the devices, throw the particles or oil.

According to Table 2, with increasing experience the unsafe acts increased. Because of the fact that with increasing experience, the proficiency of staff is increased, therefore the reducing accidents expected at this stage. The findings of this study are contrary to this expectation and further studies are needed in this area.

Assessment of unsafe acts helps to design the control measures. Based on the findings of this study it training course and regularly monitoring are recommended to reduce the unsafe acts. Also providing and implementing an effective safety program will help to improve safety culture and climate and an effective safety culture can help to reduce unsafe acts in the workplaces.

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