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Association of Non-Organizational Factors and Occupational Accidents: A Field Study based on Structural Equation Modeling

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Abstract

Background: Non-organizational or non-occupational factors are among the most important risk factors that significantly influence the emergence of occupational accidents. This study aimed to investigate the association between non-organizational factors and occupational accidents.

Materials and Methods: In this descriptive study the structural equation modeling was applied on the data that was collected using a self-developed questionnaire. The random selected sample (n=360) included damaged people referred to the emergency department in Tehran province for treatment during a five-year period (2019-2015). The data analysis was carried out using IBM SPSS AMOS v. 23.0. The goodness of fit indices, including $\chi 2/df$, RMSEA, GFI, CFI, NFI, and TLI, were evaluated.

Results: The mean age and work experience of the experts' panel was 37.52±2.73 and 9.90±3.18 years, respectively. The Cronbach's alpha coefficient of the non-organizational factors of occupational accidents was calculated as 0.86. Generally, 35.3% of accidents were due to slip and fall, as well as falling the heavy object with 24.1%. The non-organizational index was estimated at 2.95. The factor analysis findings showed a statistically significant association between the non-organizational factors and the occupational accidents ($p<0.05$).

Conclusion: The results showed a reverse and significant association between the index of non-organizational factors with the title and type of accidents, cause of accidents, type of outcome or damage caused by accidents, and time of accident occurrence. Additionally, this index indicated a direct significant association with the gender, age, work experience, education, marital status, and the type of shift work schedule of the affected people.

Keywords: Occupational Accidents, Analysis, Structural Equation Modeling

Introduction

Occupational accidents are unplanned and often destructive incidents that disrupt the performance, progress, or continuation of work. Occupational accidents are caused by unsafe acts, conditions, or a combination of these two. Additionally, these might be due to the weakness in the diagnosis or some failures in the risk management system in the workplace. In addition to physical harm and labor failure, the accidents could cause capital, equipment, and economic losses [1-3].

Several factors contribute to the incidence of occupational accidents, some of which are poor safety and work, size and magnitude of industry, lack of coordination, time pressure, financial and budgetary restraint, lack of data and standard

information, poor organizational and non-organizational communication, workers' poor participation in safety issues, workers' expertise, inadequate training, fatigue and exhaustion, improper equipment selection, improper use or inspection, poor safety management or awareness, and lack of protective equipment [4, 5].
People in different occupational groups live in three environments of work, society, and family. Society is practically out of people's control. The family and its problems are personal and cannot be entered. In the workplace, conditions can be provided in which the worker, despite non-organizational concerns and mental preoccupations, can be at peace, and it can serve as a psychological and a local shelter, being used to avoid the issues [6, 7].
Some studies have shown that the combination or interaction of occupational and individual factors, as well as those of non-organizational and non-occupational, can be very effective in the occurrence and exacerbation of occupational accidents. Non-organizational factors are among the most important risk factors that have been less studied. These factors include individual and family psychological characteristics, the individual interaction with the family and the community, and the psychological and social lifestyle [8, 9].
Taghipour and Raznahan (2017) showed three components, including employee unsafe acts, forgetfulness, and perceived work pressure, to have a greater portion in occupational accidents [10]. In another study, Mohmmadbeigi et al. (2012) stated that mental health was a decisive factor in increasing labor productivity. Furthermore, the absence of a suitable mechanism to create balance to deal with tension caused job dissatisfaction, thus reduced work quality and incidence of accidents [11]. Malakoutikhah et al. (2017), modeling the relationship between work-family conflict and occupational accidents in the steel industry, indicated that work-family conflict as a social parameter could affect workers' concentration and health [12]. Another investigation concluded that psychosocial factors could affect various aspects of workers' health [13]. Given that occupational accidents include a large portion of human casualties in the set of incidents and diseases, and their causes are mostly human errors, most previous studies have focused on the work setting and organizational issues. s. Certainly, everyone might experience mental conflict and focus loss on work in progress [14]. One of the central elements in occupational accidents is social, family, and non-organizational psychological factors. Thus, controlling these factors can lead to a decrement in the occurrence of occupational accidents. In this paper, the relationship between non-organizational factors with occupational accidents is investigated and evaluated based on factor analysis. Few studies have been concerned evaluating the relationship between non-organizational factors and occupational accidents using factor analysis, and the authors have not found any study in Iran.

Materials and Methods

This study was a descriptive analysis conducted in 2020. The study population and statistical sample included damaged people referred to the emergency department in Tehran province for treatment during a five-year period (2019-2015). The sample size was calculated 382 using Cochran's formula (0.04 error level). These samples were selected by the simple random sampling method. Finally, 360 persons participated in the study (participation rate = 94.2%).
Eighteen standard questionnaires were used to analyze the relationship between non-organizational factors and occupational accidents. These questionnaires included Maslach burnout, job satisfaction, job stress, job preference, job commitment, job security, job performance, organizational citizenship behavior, service quality, work quality, organizational needs assessment, job commitment, multi-factor leadership, job social laziness, job enthusiasm scale, besides family events and changes. In the study, the items that could be used and cited from the questionnaire to analyze the relationship between non-organizational factors and occupational accidents were extracted from these 19 questionnaires.
Step one: Data of five-year accidents (2015-2019) were collected by referring to the 115 emergency database. At this stage, data collection was performed using the 115 emergency checklists, and data of 392 occupational accidents were collected.
Step two: In this step, 19 questionnaires were studied and evaluated. Based on the criteria and objectives of the study, including the analysis of the relationship between non-organizational factors and occupational accidents, the items were extracted from the questionnaires. This activity was performed by the research team and consultants, including the emergency and psychological experts. Finally, a 62-item questionnaire was extracted.
Step three: This step involved conducting a Delphi study. In order to determine the panel of experts in the Delphi study, more emphasis was placed on the quality and mastery of the participants in the study than on the quantity of the samples [15]. In

other Delphi studies, the panel of experts had been selected based on purposeful and selective selection; based on this, 14 experts and specialists in the fields of health, safety, and environment (HSE), as well as psychology, were invited to study. After reviewing 19 questionnaires, 65 options were presented for the first round. It is noteworthy that the consensus level was considered equal to 70% (relative to the total number of respondents).

Step four: It included the study implementation phase. The confirmation questionnaire was given to 378 participants injured in the accidents.

Step five: Data analysis of this study was performed based on the study's objectives and using structural equation modeling.

IBM SPSS AMOS software version 23.0 was used to analyze the data. Statistical tests were two-way, and the significance level was less than 0.05. Structural equation modeling is a very general and robust multivariate analysis technique of the multivariate regression family that allows a set of regression equations to be tested simultaneously. It can reveal complex relationships between variables. It is advantageous to use SEM to understand the complex relationships between the various variables and factors directly or indirectly and covertly or explicitly involved in the occurrence of incidents. In addition, SEM is one of the strongest and most appropriate analysis methods in behavioral and social sciences research since the nature of such issues is multivariate and could not be solved in a two-variable way. Analysis of the covariance structures of the causal or structural equation models is one of the focal analysis methods of complex data structures. Therefore, since several independent variables exist that should be examined for their effect on dependent variables, structural equation modeling is necessary. Also, the goodness of fit of the models extracted and inferred from structural equation modeling using general indices, including $\chi 2/df$ (2-3) and RMSEA (0.05-0-08), and comparative indices, including GFI, CFI, NFI, and NNFI or TLI (0.95-1.0), is evaluated [16, 17].

Results

The expert panel in Delphi included 22 experts in the field of HSE and psychology. According to the individual and demographic data of the study population, the mean age and work experience of this expert panel were 37.52±2.73 and 9.90±3.18 years, respectively. Evaluation of the education level of the expert panel showed that approximately one-fifth of the people with equal proportions had bachelor's and doctoral degrees (18.2%) and about three-fifths had master's degrees (63.6%). After three rounds of Delphi study, a 56-item questionnaire was approved to analyze the non-organizational factors affecting occupational accidents. Cronbach's alpha coefficient for the questionnaire was calculated as 0.86.

Findings related to the evaluation of individual variables of injured persons in these incidents showed that the mean values of age and work experience were 40.22±10.12 and 9.23±7.72 years, respectively. Most of the participants had a diploma (32.0%), and the lowest had a master's degree or higher (7.8%). Furthermore, 62.0% of participants were single and 38.0% were married. 11.7% of the injured participants were women and 88.3% were male (Table 1).

Table 1. Demographical variables in studied individuals

Variables		Mean/Frequency (SD/%)
Age		40.22 (10.12)
Work experience		9.23 (7.72)
Education	High school	92 (25.5%)
	Diploma	115 (32.0%)
	Associate of science	75 (20.8%)
	Bachelor ≤	78 (21.7%)
Marital status	Married	137(38.0%)
	Unmarried	223 (62.0%)
Gender	Female	42 (11.7%)
	Male	318(88.3%)

The accident type analysis showed that more than half of the accidents (392 accidents) were related to falls from heights (52.4%). The lowest rates were associated with electric shocks (9.0%), crushing (10.8%), and burns (11.4%). The portion of collision with objects was 16.4%. The results concerning the type of trauma caused by accidents showed that 61.4% of the accidents led to blunt trauma and 38.6% to penetrating trauma. These results showed that the most types of consequence or injury were related to perforation (penetrating wounds) (21.6%), contusion and soft

tissue injury (15.5%), and scratching (13.6%). The lowest portion was associated with open limb fracture (3.3%), closed limb fracture (6.1%), and pelvic fracture (8.6%) (Table 2).

Table 2. Results of variables relevant to accidents in studied individuals

Variables		Frequency (%)
Accident	Fall	92 (52.4%)
	Electrocution	115 (9.0%)
	Dealing with objects	75 (16.4%)
	Crush	50 (10.8%)
	burn	28 (11.4%)
Trauma type	Blunt	221 (61.4%)
	Penetrating	139 (38.6%)
Consequence /Injury type	Open fracture	12 (3.3%)
	Closed fracture	22 (6.1%)
	Hip fracture	31 (8.6%)
	Dislocation	39 (10.8%)
	Soft tissue injuries	56 (15.5%)
	Laceration of vessels	33 (9.2%)
	Simple incision	40 (11.1%)
	Abrasion	49 (13.6%)
	Puncture wound	78 (21.6%)

The analysis of the work shift type of injured people showed that 21.4% of the accidents occurred for day workers, 40.1% for night workers, and 38.5% for shift workers. 26.2% of the accidents occurred in the morning shift, 29.4% in the afternoon, and 44.4% in the night shift. In addition, 29.6% of the accidents happened in the first two days of the working week, 20.6% in the middle, and 49.8% in the last two days (Figure 1).

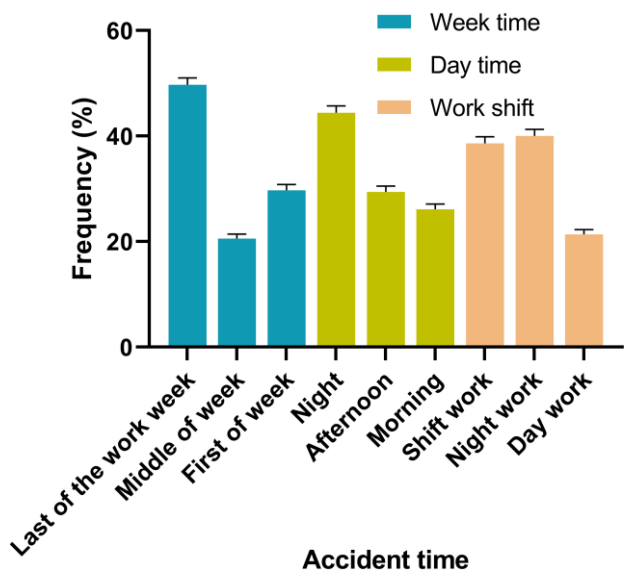

Figure 1. Results of variables related to accident time in studied individuals

According to the reports, the most common causes of accidents were slipping (35.3%), contact with sharp objects (28.3%), and falling heavy objects (24.1%), respectively. The lowest portion was related to the press (2.2 %), the furnace or element hot (2.5%), and breaking the saw blade or milling cutter (3.3%). The portion of other factors in these accidents was 4.2% (Table 3).

Table 3. Evaluation results of relevant causes to accidents in studied individuals

Variables		Frequency (%)
Cause of accident	slip	127 (35.3%)
	Heavy object fall	87 (24.1%)
	Contact with sharp objects	102 (28.3%)
	Breaking of saw blades	12 (3.3%)
	Furnace or hot element	9 (2.5%)
	Mangle	9 (2.2%)
	Other factors	15 (4.2%)

According to the analysis, the average index of non-organizational factors in the studied occupational accidents was 2.95 (from 5). Therefore, the role and portion of non-organizational factors in the occupational accidents was moderate. According to the structural equation modeling results, the non-organizational factors index and the 10 parameters related to occupational accidents had a significant relationship with each other (p<0.05). Furthermore, the index of non-organizational factors was inversely associated with the parameters, including the type of accidents, cause of accidents, type of traumas, type of consequences or damages caused by accidents, and incidence time of accidents (p<0.05). This factor analysis illustrated that the non-organizational factors index had a direct and significant relationship with the parameters of gender, age, and work experience, education level, marital status, and shift work schedule of injured participants (p <0.05) (Figure 2).

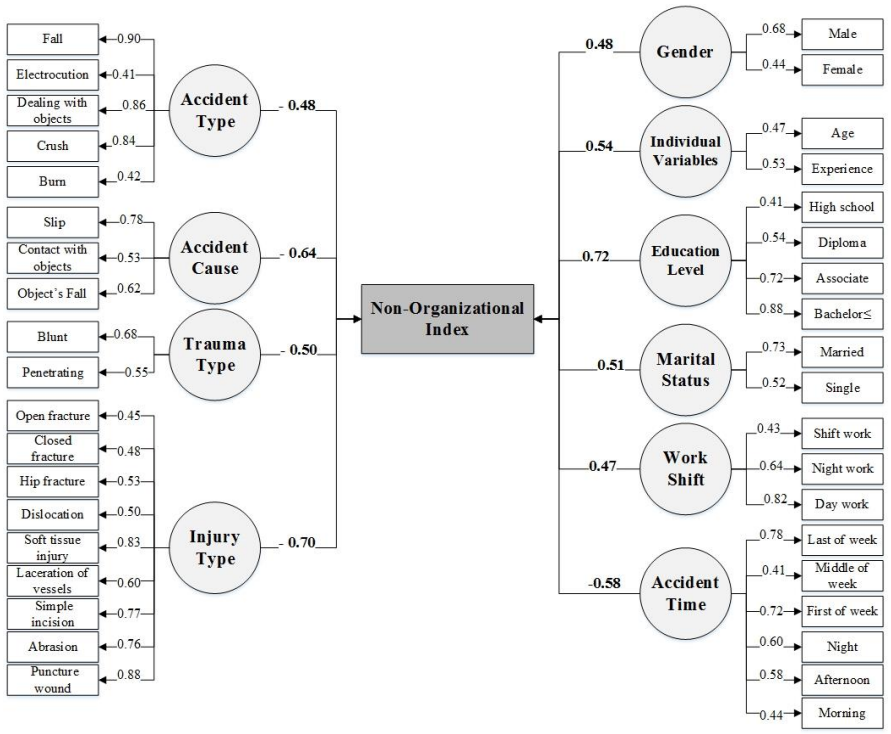

Fig. 2. Modelling results of the relationship between the Index of Non-Organizational Factors and occupational accidents parameters

According to the evaluation results of the modeling goodness-of-fit indices, the values of χ2/df, RMSEA, GFI, CFI, and NNFI (TLI) were 2.88, 0.062, 0.972, 0.965, and 0.973, respectively. Therefore, based on these results and their comparison with the desired criteria, this model was acceptable.

Discussion

According to the International Labor Organization, 2,340,000 people are injured in occupational accidents worldwide annually. In other words, 6,400 people die every day as a result of occupational accidents [18]. Also, according to the statistics of the Forensic Medicine Organization in Iran, 15,997 people have lost their lives due to occupational accidents in the last 10 years.

Primary and secondary consequences of occupational accidents include disabilities, medical expenses, insurance/crime costs, job closure by judicial authorities, decreased profits, payment of compensation to injured workers, payment of the salaries/benefits to injured workers in the period of recovery without working, replacement of another worker with the injured worker and payment of wages, return to work and placement in a position with a lighter workload and payment, psychological stress to workers and their family, mental injuries and neuropsychological conflicts due to disabilities, psychological stress in workers due to the need to other people in personal affairs, society's view of the individual disabilities and lack of welfare facilities, and damages to the community [19]. Therefore, given the mentioned consequences and the expenses related to the reduction and prevention of these accidents, the costs of prevention are much lower than those of control measures and compensation for these accidents [20, 21].

Various factors can contribute to occupational accidents. These factors are organizational and non-organizational that include lack of attention to the establishment of safety and health standard management systems, necessary safety budget allocation, periodic inspection and audit, safety

equipment, safety training, work process monitoring, standard physical condition, and proper ventilation, as well as uniform work, high-speed work, induction of employer stress on the worker, economic crisis, personal/social/family conflicts, diseases, welfare problems, shift and sleep disorders, psychological disorders, job incompatibility with ability, and also failure to perform pre-employment examinations, periodic examinations, job psychological aspects assessment [14, 22-25].

The results of some studies were consistent with those of the present work. The factor analysis revealed that non-organizational factors and parameters related to these occupational accidents had a significant relationship. The results showed that increasing or decreasing the desirability of the non-organizational index could be effective in reducing the incidence and aggravation of occupational accidents. According to some other studies, the type of trauma caused by accidents, which is an indicator of the injury severity, could change due to the decrease or increase in the level of the non-organizational factors. Also, the relationship between some variables such as the type of work shift and the non-organizational factors has been confirmed in other studies [8, 9, 26].

Therefore, studying the various causes and factors affecting the occurrence of occupational accidents and paying attention to the effective factors and causes in the occurrence of these accidents in any society can be specific to that work environment and occupational community. Consistent with various studies (27-29), this study revealed that although the index of non-organizational factors was estimated to be average, a significant relationship was observed between that and 10 parameters related to occupational accidents.

Also, this factor analysis indicated that this index was directly related to some parameters of accidents and inversely related to others. Further, the index had an inverse and significant relationship with the parameters of title and type of accidents, cause of accidents, type of traumas, type of consequences or damages caused by accidents, and time of accidents. In other words, by increasing the level of non-organizational factors index in the study population, the parameters related to the accidents might decline.

In addition, the modeling showed that the non-organizational factors index had a direct and significant relationship with the individual variables, including gender, age, work experience, education level, marital status, and shift schedule type of injured participants. This result showed that by increasing the level of parameters related to accidents, the index of non-organizational factors in the study population could have an upward trend. Furthermore, according to the results of the goodness-of-fit indices, the proposed model was acceptable, being cited as an important scientific finding [25].

Despite the proper design and accurate implementation of this research, one of its limitations was the lack of evaluation of various parameters related to accidents and non-organizational factors; examining the number of accidents with larger sample sizes and designing a prospective study might overcome the limitations.

Conclusion

The results indicated that various non-organizational factors, including personal, economic, social, family, and psychological, could affect occupational accidents. This study revealed that different non-organizational factors might adversely affect the parameters of the type of accidents, cause of accidents, type of traumas, type of consequences or damages caused by accidents, and time of accidents. Furthermore, these non-organizational factors could be affected by the individual variables, including gender, age, and work experience, type of education level, marital status, and shift schedule type of injured participants. The current study suggests designing and formulating a practical and appropriate program to train workers in order to familiarize them with non-organizational factors; it further provides a model for monitoring workers and evaluating non-organizational factors.

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