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Characteristics of Occupational Injuries in a Pharmaceutical Company in Iran

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ABSTRACT

Objective: To prioritize occupational hazards in a Pharmaceutical Company in Iran using the analytical hierarchy process (AHP).
Methods: This was a cross-sectional study conducted in a Pharmaceutical Company in Iran in 2017. All employees working in the administrative, production, installations and facilities, and laboratory units were studied using the consensus method (N=n=130 employees). A data collection form was designed for identifying the hazards using the Nominal Group Technique (NGT) method, as well as a pair-wise questionnaire was used for collecting required data in the quantitative phase. The collected data were analyzed using Expert Choice 10.0 and SPSS 23.0.
Results: The results showed that among hazards detected in the studied units, the highest and lowest weights and priorities were, respectively, related to "inhalation of toxic gases" (W=0.253) and "being exposed to radiation" (W=0.022) in the laboratory unit, "skin injuries" (W=0.205) and "bending and straightening for a long time" (W= 0.032) in the production unit, "falling down" (W=0.271) and "standing and sitting for a long time " (W=0.037) in the installations and facilities unit, and "hand joint failure" (W=0.295) and "working in a low-light environment" (W=0.092) in the administrative unit.
Conclusion: The results of the present study showed that there were hazards in all of the studied units. These results indicated a high level of hazards in the pharmaceutical company's units. Due to the increased medication diversification and increased workload for these companies, paying attention to the preventive and corrective measures in order to reduce the risk of emerging hazards is essential.

Keywords: Occupational hazards; Safety; Pharmaceutical company; Analytical hierarchy process (AHP); Iran.

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Introduction

Many people in the world (58%) spend one third of their adult lives in the workplaces and in this way, the economy of society is formed. On the other hand, about 100 million occupational hazards occur every year around the world. These occupational hazards create and impose high social and economic costs [1]. A hazard is an unplanned and damaging event that disrupts or interrupts an activity and is always the result of unsafe actions, unsafe conditions, or a combination of these two [2]. Occurring errors and making mistakes in the human actions are inevitable and part of the human reality [3]. In all workplaces, there are harmful factors that endanger the employees' health. These factors can be classified into five major groups including physical, chemical, mechanical (ergonomic), biological and psychological factors [4].

According to the statistics of International Labor Organization (ILO), two million people are killed annually in the world due to work-related hazards and illnesses, i.e. one person every 15 seconds. Currently, the human casualties due to work are three times the number of people killed each year in wars. According to the ILO, occupational hazards cause the greatest human suffering and economic compensation. The ILO has also announced that the average cost of work-related hazards and illnesses accounts for 4% of the countries' gross domestic product [5]. In recent decades, Iran has grown and developed increasingly, which one of its adverse effects is the dramatic increases in the number and variety of occupational hazards. According to statistics issued by the Legal Medicine Organization, despite the fact that the number of casualties caused by occupational hazards in 2012 was more than that in the past ten years, this trend continued to grow at 19.1% in 2012 [6]. Therefore, occupational hazards can be considered as a growing problem of public health in Iran and in the world [7].

The results of a study conducted in the UK have shown that these hazards have caused damage to about 850,000 people and a loss of £ 1-2 billion to the healthcare system per year [8]. In the United States also they have caused deaths of 44,000 to 88,000 people and a loss of $ 37 billion per year, and are considered as the fifth cause of deaths [9]. Although in developed countries, one person of every 10 people is injured due to the occupational hazards, there is not sufficient evidence of the consequences of insecure care in developing countries [10]. Some consequences of occupational hazards are permanent disabilities, deaths, loss of working days and economic losses. In particular, the death of workers or their permanent disability results in economic losses and social problems for employers, workers and their families. Because these hazards can be reduced by preventive measures [11], identifying the causes of occupational hazards and factors affecting their occurrence is a major issue in preventing them. One of the important tools for preventing industrial hazards is the descriptive-analytical analyses and prioritization of factors affecting the occurrence of occupational hazards [12, 13].

The rate of work-related hazards and accidents has been decreased in different countries through using guidelines and taking safety measures. Although the rate of such hazards and accidents is decreasing, it is still rising in some high-risk industries [14] Low skill and lack of professional training play a major role in occurring occupational hazards and injuries. Among the African, the Eastern Mediterranean and South Asian countries, the occurrence of occupational hazards and injuries is more common in South Asia [15]. According to a study conducted in Germany, 2.8% of the working population has been injured by work-related hazards at least once. The most important factors that cause such hazards and risks have been carrying heavy loads, unpleasant situations, environmental stresses, and stressed work. Also, the lack of physical activity may increase the rate of work-related hazards and accidents [16].

Given that many adverse events and hazards occur in the industries, taking preventive and interventional measures is, in many cases, costly and requires the changes in the internal processes, which reduces the possibility of implementing safety promotion programs. On the other hand, these adverse events and hazards are different in various units and, therefore, taking specific actions are required in each unit. Thus, the identification and prioritization of these hazards in each industry can ensure the prevention of hazards. In this regard, the present study aimed to prioritize occupational hazards in a Pharmaceutical Company in Iran using the analytical hierarchy process (AHP).

Materials and Methods

Study Population

This was a cross-sectional study conducted in a Pharmaceutical Company in Iran in 2017. All employees working in the administrative, production, installations and facilities, and laboratory units were studied using the consensus method (N=n=130). This pharmaceutical company was registered in 1948. The Pharmaceutical Company, which aims to maintain the community health through producing human medicines based on the world knowledge and standards, is a subset of the Red Crescent Society of Iran. The major medicines produced by the company include cardiovascular medicines, antihistamines, analgesics, antibiotics, hormonal and diabetic medicines, and medicines related to the fever and inflammation, digestion, and nervous system. The high ability to export manufactured products and collaborate with major global companies for joint medicine production and achieve the humanitarian goals of the Red Crescent Society are some of the

strengths of this company. The products of this company are in various forms of pills, hard capsules, syrups and suspensions which are manufactured in accordance with Good Manufacturing Practice(GMP) rules and the latest standards of the World Health Organization.

This study was carried out in two phases.

This study was approved by the North Tehran Branch, Islamic Azad University. Also, the following fundamental principles were taken into account as the ethical considerations: doing the required coordination with the company's heads and units' administrators through an introducing letter, providing the required explanations of the project and its objectives for the studied employees and obtaining written informed consent from them, giving enough time for completing the pair-wise comparison questionnaire to the studied employees, voluntary participation in the project, anonymous responses to the questionnaire items, and confidential data analysis.

Phase 1: The qualitative phase

In order to identify hazards in the studied Pharmaceutical Company, a team was formed which was consisted of an expert in the Occupational Safety and Health, an expert in the Industrial Safety, an expert in the Industrial Management, the units' administrators, and the employees working in the units. In the present study, in addition to reviewing the related documents, including safety regulations and instructions, the past events reports and statistics available in the pharmaceutical company were also studied. The team's comments were used to identify the hazards. The expert team first identified all hazard sources and described each activity, and then the hazards associated with each activity were identified. Comprehensive information about current activities and device components was obtained through recording the observations and conducting interviews with the process owners. Then, among the hazards identified by the nominal group technique (NGT), the most important hazards of each unit were identified.

Phase 2: The quantitative phase

In the quantitative phase, the AHP was used in order to prioritize hazards. At first, a researcher-made pair-wise comparison questionnaire was designed. The questionnaire used for prioritizing the hazards and consisted of two parts. The first part of the questionnaire included items related to the demographic characteristics of participants such as age, sex, education, work experience, and service unit. The second part of the questionnaire included four sections prioritizing hazards of the laboratory unit (9 hazards), production unit (9 hazards), installations and facilities unit (10 hazards), and administrative unit (6 hazards). The participants were asked to compare each studied hazard with other ones and determine its relative importance. The pairwise comparisons were made by the nominal scale divided into nine hierarchies from "1=equal importance" to "9=absolute importance". In order to score the studied hazards' severity and probability of occurrence, the numbers 1 to 10 were assigned, in such a way that 10 was assigned to the worst situation and 1 to the best one. The collected data were analyzed using Expert Choice 10. 0 and SPSS 23.0.

Results

The results showed that majority of the studied employees participating in this study were male (83.1%), in the 31-40 age group (60%), were working in the production unit (28.5%), and had between 1 to 10 years work experience (79.2%), and a diploma degree (50%) (Table 1).

Table 1. The demographic characteristics of the studied employees.

Variables		Frequency (%)
Sex	**Male**	108 (83.1)
	Female	22 (16.9)
Age (year)	**≤30**	15 (11.5)
	31-40	78 (60)
	>40	37 (28.5)
Education	**Under Diploma**	31 (23.8)
	Diploma	65 (50)
	Associate Degree	6 (4.6)
	Bachelor's Degrees	28 (21.5)
Service Unit	**Laboratory**	14 (10.8)
	Production	37 (28.5)
	Physical Protection	31 (23.8)
	Technical and Engineering	16 (12.3)
	Finance	7 (5.4)
	Human Resources and Support	25 (19.2)
Work Experience	**1-10**	103 (79.2)
	11-20	25 (19.2)
	21-30	2 (1.5)

In the laboratory unit, a total of 44 activities were investigated and their hazards were identified. After integrating and removing repetitive hazards, a total of 9 hazards were selected and prioritized as follows:

Spills of acids and caustic substances, being exposed to radiation, noise, inhalation of dust, standing and sitting for a long time, strained joints, inhalation of toxic gases, skin absorption of toxic and chemical substances, and burns and mutilation with heat.

In the administrative unit, out of 11 activities reviewed, there were 6 hazards, including: hand joint failure, sitting and staring at the monitor for a long time, computer electromechanical radiation, inhalation of toxic substances, working in a low-light environment, and skin absorption.

In the production unit, out of 55 activities studied, 9 hazards were identified and selected, including: skin injuries, inhalation of suspended particles, noise, heat and pressure, bending and straightening for a long time, falling down the objects and device components, skin absorption, inappropriate carrying of objects, and working with antibiotics and certain medications.

In the installations and facilities unit, 10 hazards out of 28 activities were detected, including inhalation of toxic vapors and gases, creating electric arcs and eye injuries, noise, heat, skin absorption, inappropriate carrying of objects, microbial contamination (performing wastewater treatment tests), standing and sitting for a long time, falling down, and electricity burns.

Initially, in order to prioritize the hazards, two indicators of severity and occurrence were weighted in the installations and facilities unit. Then, each of the hazards was weighted in terms of the indicators and, ultimately, the hazards were prioritized.

The results showed that among hazards detected in the studied units, the highest weights and priorities were related to "inhalation of toxic gases" (W=0.253) in the laboratory unit, "skin injuries" (W=0.205) in the production unit, "falling down" (W=0.271) in the installations and facilities unit, and "hand joint failure" (W=0.295) in the administrative unit (Table 2).

Discussion

There are many hazards in the industries and in practice their prevention is time-consuming and costly. Various studies have been conducted in different industries to prioritize adverse events and hazards using the AHP [17-19]. However, the researchers in their searches didn't find any study on the prioritization of hazards in the pharmaceutical industries, where there are a lot of adverse events and hazards. Identifying such hazards can change the medical staff's attitudes to and perceptions of them and ultimately it will provide patients with better services and ensure their safety [20]. According to the results of a study and among five geographical regions, Asia (65%), Africa (11.8%), Europe (11.7%), America (10.9%), and Oceania (0.6%) have respectively had the highest global work-related mortalities in 2015 [21].

In the present study, the hazards of the laboratory, production, administrative and installations and facilities units, as the hazardous units, were studied. 44 hazardous activities in the laboratory unit, 11 hazardous activities in the administrative unit, 55 hazardous activities in the production unit, and 28 hazardous activities in the installations and facilities unit were identified. Faye *et al*., [22] in their study identified 56 potential errors in seven pharmaceutical management processes. Also, Gokhman *et al*., [23] in their study found 296 errors, among which 196 were related to the inappropriate disinfection technique and the remaining 100 errors were due to the errors in the medication administration, preparation, and handling and execution techniques.

Among the nine hazards identified in the production unit, "skin injury" (W=0.205) and "bending and straightening for a long time" (W=0.032) had, respectively, the highest and lowest weights and priorities, which have been confirmed by the results of other studies. For example, the results of a study conducted in Spain showed that 95% of occupational exposure was related to the skin exposure and 4% was related to the mucosal exposure [24]. Also, the results of a study conducted in India indicated that the skin exposure during the year before the study was 63% and during the study period was 43% [25]. Although there are differences among the rates and percentages of skin exposure and injuries reported in the different studies, this hazard has been one of the most important hazards. However, the differences observed in the findings of different studies can be due to the differences in the research environments, the degree of industries' adherence to the principles of occupational health, and the demographic characteristics of studied employees.

Among the hazards identified in the installations and facilities unit, "falling down" (W=0.271) and "standing and sitting for a long time" (W=0.037) had the highest and lowest weights and priorities, respectively. Kines in a study (2002) on the workers who were injured in the building construction, found that 19 out of 20 adverse events which had led to deaths was related to the falling down [26]. The results of other studies [27-29] also confirm the results of the present study. In order to avoid repeating such adverse events and resulting injuries, some suggestions can be offered, including the use of appropriate and standard guardrails, observing the safety principles of working with scaffolds, providing work safety training for workers working at high altitudes, and the use of appropriate personal protective equipment.

Among the hazards of the administrative unit, the highest and lowest weights and priorities were, respectively, related to the "hand joint failure" (W=0.295) and "working in a low-light environment"

Table 2. The weights and priorities of hazards detected in the studied units.

Units	Hazards	Weights (W)	Priorities (P)	Inconsistency Ratio	Units	Hazards	Weights (W)	Priorities (P)	Inconsistency Ratio
Laboratory	Spills of acids and caustic substances	0.222	3	0.99	Production	Skin injuries	0.205	1	0.1
	Being exposed to radiation	0.022	9			Inhalation of suspended particles	0.144	3	
	Noise	0.047	6			Noise	0.070	7	
	Inhalation of dust	0.108	4			Bending and straightening for a long time	0.032	9	
	Strained joints	0.028	8			Falling down the objects and device components	0.199	2	
	Standing and sitting for a long time	0.036	7			Skin absorption	0.095	6	
	Inhalation of toxic gases	0.253	1			Inappropriate carrying of objects	0.104	5	
	Skin absorption of toxic and chemical substances	0.059	5			Working with antibiotics and certain medications	0.113	4	
	Burns and mutilation with heat	0.225	2			Heat and pressure	0.039	8	
Installations and facilities	Inhalation of toxic vapors and gases	0.131	3	0.08	Administrative	Hand joint failure	0.295	1	0.09
	Creating electric arcs and eye injuries	0.072	5			Sitting and staring at the monitor for a long time	0.093	5	
	Noise	0.078	4			Computer electromechanical radiation	0.133	3	
	Heat	0.062	7			Inhalation of toxic substances	0.287	2	
	Skin absorption	0.070	6			Working in a low-light environment	0.092	6	
	Inappropriate carrying of objects	0.044	9			Skin absorption	0.099	4	
	Microbial contamination (performing wastewater treatment tests)	0.049	8						
	Standing and sitting for a long time	0.037	10						
	Falling down	0.271	1						
	Electricity burns	0.185	2						

(W=0.092), which are similar to the results of Smith *et al*., [30] and Dadarkhah *et al*., [31] studies. Aminian *et al*., [32] in their study concluded that 74% of the studied sample complained of skeletal-muscular disorders in at least one of the nine body areas. Mesbah *et al*., [33] in their study found that expressed discomfort among office workers was mainly related to the neck and shoulder areas, and attributed the high rates of disorders in these areas to the static and repetitive work. It is recommended that providing required training for the employees working in the studied Pharmaceutical Company should be followed closely in order to prevent these disorders.

Among the nine hazards identified in the laboratory unit, the highest weights and priorities were related to the "inhalation of toxic gases" (W=0.253), "burns and mutilation with heat" (W=0.225) and "spills of acids and caustic substances" (W=0.222), respectively. In the Wang et al.'s study (2014) also the most important hazards were related to the respiratory and musculoskeletal disorders [17]. Therefore, considerable attention should be paid to the use of special masks and warning labels on chemicals. Personal protective equipment should also provide adequate protection against the hazards of the chemicals in the laboratory to which the employees are exposed.

The present study had some limitations, including the extensive and widespread occupational hazards in the studied Pharmaceuticals Company, the overlap of certain hazards in different units, and the lack of scientific knowledge of some employees about occupational hazards. Moreover, although different techniques are available for prioritizing occupational hazards, the AHP technique was used in this study using classical numbers which are less accurate than fuzzy ones.

The results of the present study showed that there were hazards in all of the studied units. These results indicated a high level of hazards in the pharmaceutical companies' units. Due to the increased medication diversification and increased workload for these companies, paying attention to the preventive and corrective measures in order to reduce the risk of emerging hazards is essential. For priority hazards, it is suggested that the employees should use filtered masks and anti-acid and special gloves based on their work and activities. In order to reduce the risk of falling down in the installations and facilities unit, it is suggested that the workers should wear safety belts and helmets, and their work environment should become safe before starting work and activities using special safety guardrails.

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