

Occupational Health Hazards among Workers in Chemical Factories

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Abstract

Background: Occupational health hazards are risks associated with working in specific occupations. Types of occupational health hazards are chemical, biological, physical, and psychological hazards. **Aim:** Assessing occupational health hazards among workers in chemical factories. **Design:** A descriptive exploratory study design was used. **Setting:** The study was conducted at industry area at EL Sharqia governorate, Egypt. Five factories, where selected which contain the largest number of workers. **Sample:** All available workers in five factories were 200. **Tools:** two tools were used; first tool an interviewing questionnaire consisted of four parts to assess worker's demographic data, medical history, exposure to various types of occupational health hazards, and level of knowledge. Second tool observational checklist consists of three parts to assess worker's compliance related to safety measures and work environment. **Results:** The study finding revealed that, 73.5% of workers were male and mean of workers age was 36.42 ± 5.2 as regard, 53.0% of workers were married, and 57.0% of workers were secondary education, 62.0% of workers had a family members more than five individuals, 76.5% of workers have not sufficient income, the mean of worker's no of years of factory work was 7.06 ± 3.55 , 94.0% of workers worked at day shifts, 52.0% of workers worked from 6-8 hours. Additionally, there was a highly statistically significant relation between worker's knowledge and exposure to occupational hazard. **Conclusion:** The study concluded that 86.5% of workers expose to physical hazards, 95% of workers expose to chemical hazards, 4% of workers expose to biological hazards, and 82% of workers expose to psychological hazards, more than two thirds of studied workers had unsatisfactory level of knowledge regarding occupational safety and health hazards, and statistically significant correlated between exposure to occupational hazard and environment when p-value was $<0.001^*$. **Recommendations:** Provide educational program to workers about different type of occupational hazard and importance of safety measures.

Keywords: Occupational Health Hazards, Workers, Chemical factories.

Introduction:

Occupational Health and Safety (OHS), also known Occupational Safety and Health (OSH), refers to the generic practice of addressing and reducing potential safety and health risks to employees. This can cover anything from risk assessment, injury prevention, work-life balance, safety protocols, and workplace hazards, to compensation and benefits, and employee management (Safety, 2022).

The workplace is the place where adults spend most of their time. During that time, they may experience diverse, often high-level, exposures, with subsequent health effects, which could be avoided. A large fraction of the population is affected by health conditions at

their workplaces. The global proportion of the population (ages 15+) that was economically active in 2017 is estimated at 62%. It is important that individuals are being safe in the workplace and are aware of the potential risks that can occur, as well as ways to prevent it as much as possible (International Labour Organization, 2017).

Chemicals are used virtually in every man-made product and have been an indispensable part in human life, sustaining activities and development, preventing, and controlling diseases. Being the third largest industrial sector in the world, its workplace health and safety requires the combined effort of OHS specialists, occupational hygienists, and health practitioners (ASK.EHS, 2020).

The worldwide risk of chemical incidents is increasing with the global rise in the production and use of chemicals (e.g., in agriculture). This is particularly the case in developing countries and those with economies in transition, where chemical production, extraction, processing, and use are closely tied to economic development, and where production is projected to increase six-fold by 2050. (**International Labour Organization, 2018**).

Occupational health nurses (OHNs) are specialists who practice in industrial and community settings to help improve the health and safety of workers and other community groups. The role of an OHN can be extremely diverse and specific responsibilities will depend upon where an OHN is employed. Some of the most common roles and responsibilities of OHNs include Observation of workers doing their job tasks to assess health statuses, Development of innovative health and safety programs, Management of work-related diseases, Disaster and emergency planning, Environmental health planning, Assistance with rehabilitation, and coordination of employee treatments and referrals (**Best Master of Science in Nursing Degrees, 2018**).

Significance of the study:

According to the Central Agency for Public Mobilization and Statistics (CAPMAS), the total number of workplace injuries in Egypt decreased by 19.7% in 2020 to 11,510, down from 14,331 cases in 2019. Workplace injuries in 2020 by sector were as follows: the governmental sector had 1,634 cases, or 14.2%; the public sector had 4,911 cases, or 42.7%; the private sector had 4,287 cases, or 37.2%; and the investment sector had 687 cases, or 5.9%. The report added that 89.1%, or 10,255, of the workplace injury cases recorded in 2020 were among males, while only 10.9%, or 1,255, were among females. Cairo governorate tops the list of workplace injuries with 1,982 cases (-17.2%), followed by Giza with 1,482 (-12.9%) (**Ahram, 2021**).

Aim of the study

This study aimed to assess Occupational Health Hazard among the chemical factory Workers through:

- 1- Assessing Types of Occupational Hazard Faced by the Workers.

- 2- Assessing workers' knowledge about occupational hazard related to chemical industry.
- 3- Assessing workers' practice towards safety measures of protection from occupational health hazards related to chemical industry.
- 4- Assessing work environment in chemical factory.

Research Questions:

- 1- What are Types of Occupational Hazard Faced by Workers?
- 2- Is there relation between workers' knowledge and occupational health hazards related to chemical industry?
- 3- Is there relation between workers' practice and safety measures related to chemical industry?
- 4- Is there relation between workers exposure to occupational hazard and work environment?

Subjects and Methods

Research Design:

A descriptive study was used to meet the aim of the study.

Setting:

The study was conducted at industry area at EL Sharqia governorate which contains ten chemical factories. Fifty percent of them selected five factories, which contain the largest number of workers.

Subjects:

All available (200) workers in five chemical factories are called (Sama Star, MD Industry, Alpha Egypt, NASA Company for paints).

Tools of data collection:

Data for this study was collected through using two tools.

First Tool: interviewing questionnaire: that was developed by the investigator after reviewing the relevant recent literature and was written in a simple Arabic language and consisted of four parts to collect data as follows:

Part I: Demographical data: - to assess age, sex, social status, level of education,

Number of family members, Family income level, Number of years of factory work, Work System, working hours, and taken training courses. Q1-Q11

Part II: Medical history: to assess Previous and Current patient history of the worker and follow up. Q12-Q24

Part III: was used to assess worker's exposure to occupational hazard and composed of 4 items included: physical hazard Q25- Q27, chemical hazard 28Q-Q33, biological hazard Q34-38, and psychological hazard Q39-43

Exposure to occupational hazards	Items	Score
Physical hazards	3	3
Chemical hazards	6	6
Biological hazards	5	5
Psychological hazards	5	5
Total	19	19

Workers' exposure to occupational hazards scoring system:

For the exposure items, exposure (1 points), not expose (0 points). For each item of exposure, the scores of the items were summed up and the total divided by the number of items. These scores were converted into a percent score.

- Total Score 19 grades
- Exposure to hazard if the percent score was 60% or more. (12 grades)
- Not exposure if less than 60%. (12 grades)

Part IV: used to assess workers' level knowledge about occupational hazards and compliance with safety measures consists of 17Q multiple choices 3Q assess knowledge about occupational safety definition, tools, and reasons for non-compliance of workers with personal protective equipment) and 14Q assess knowledge about definition, cause, injuries resulting from exposure to physical, chemical, biological, and psychological hazards, and how to prevent exposure to occupational hazards. Q44-Q60

❖ Scoring system for workers' level knowledge:

For the knowledge items, a correct and complete answer was scored (2), correct and incomplete answer was scored (1) and the incorrect answer was scored (0). For each area of knowledge, the scores of the items were summed-up and the total divided by the number of the items, giving a mean score for the part. These scores were converted into a percent score.

- Total Score 34
- Satisfactory knowledge if the percent score was 60% or more
- Unsatisfactory knowledge if less than 60%

The second tool: Observational checklist: consists of three parts:

Part I: Personal Protective Equipment Observational Checklist. This part was adopted from (*Seton, 2015*) to assess workers practice regarding personal protective equipment consists of 10 questions with use or not use of overall apron, gloves, earmuffs, safety shoes, eye protection, respirator, mask, face shield, and helmet Q1-Q10

❖ Scoring system to assess workers practice regarding personal protective equipment:

For the practice items, it was scored (1) for use and (0) for not use, the scores of the items were summed-up and the total divided by the number of the items, giving a mean score for the part. These scores were converted into a percent score.

- Total score 10
- Satisfactory if score 60% or more
- Un satisfactory if score less than 60%

Part II: Personal Hygiene Observational Checklist. This part was adopted from (*Seton, 2015*) to assess workers practice regarding personal hygiene consists of 6 questions with done or not done about hand washing, face mask, change clothes at the beginning of shift, wash legs, change the rubber boots, and change clothes at the end of shift. Q1-Q6

❖ Scoring system to assess workers practice regarding personal hygiene:

For the practice items, it was scored (1) for done and (0) for not done, the scores of the items were summed-up and the total divided by the number of the items, giving a mean score for the part. These scores were converted into a percent score.

- Total Score 6
- Satisfactory if the percent score was 60% or more
- Un satisfactory if less than 60%

Part III: Environment Observational Checklist. This part was adopted from (*Seton, 2015*) to assess worker environment consists of (45) questions with yes for present and perfect and needs improvement for present and needs improvement.

Divided into:

- Chemicals storage Q1-Q6
- Waste disposal Q7-Q12
- Use of chemicals -knowledge of workers Q13-Q18
- Availability of personal protection equipment Q19-Q22
- Chemical gases Q23-Q26
- Availability of hand washing facilities Q27-Q29
- Safety signals Q30-Q35
- Electricity safety Q36-Q39
- Housekeeping Q40-Q45

Environment assessment	Items	Score
A- Chemical Storage	6	12
B- Waste Disposal	6	12
C- Use of chemicals	6	12
D- Availability of personal protection equipment	4	8
E- Chemical gases	4	8
F- Availability of hand washing facilities	3	6
G- Safety signals	6	2
H- Electricity safety	4	
I- Housekeeping	6	2
total	45	0

❖ Scoring system to assess worker Environment:

For the observation items, it was scored (2) for yes, (0) for no, and (1) for needs improvement. The scores of the items were summed-up and the total divided by the number of the items, giving a mean score for the part. These scores were converted into a percent score. (*Seton, 2015*)

- Total Score 90
- Environment safe if the percent score was 60% or more
- Environment not safe if less than 60%

Pilot study:

A pilot study for tools of data collection was carried out on 10% in order to test whether they are clear, understandable, and feasible and applicability. For this study, the researcher randomly selected 20 workers to participate in the pilot testing of the questionnaire sheet and checklist. Simple modification was done based on pilot results and the sample who shared in the pilot study excluded from the study sample.

Administrative design:

An official permission for data collection was obtained from managers of chemical factories (Sama Star, MD Industry, Alpha Egypt, NASA Company for paints) Meeting and discussion were held between the researcher and manager's personnel to make them aware about the aims and objectives of the research, as well as, to get cooperation during the phases of the research.

Ethical consideration:

The Research Ethics Committee (REC) at the Faculty of Nursing, Ain Shams University approved the study protocol. Workers oral informed consent for participation was acquired after full explanation of the aim of the study and its procedure. Workers were given the opportunity to refuse participation and were informed that they could withdraw at any time during data collection. They were also assured that any information obtained would be confidential and used for the research purpose only. The investigator assured maintaining anonymity and confidentiality of all collected data.

IV-Statistical analysis:

Statistical presentation and analysis of the present study was conducted, using the mean, standard Deviation, and chi-square tests by (*IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp.*).

Results:

Table (1): Showed that, 73.5% of workers were male and mean of workers age was 36.42 ± 5.2 As regard, 53.0% of workers were married, 57.0% of workers were secondary education, 62.0% of workers had a family member more than five individuals, 76.5% of workers have not sufficient income, the mean of worker's no of years of factory work was (7.06 ± 3.55) , 94.0% of workers worked at day shifts, 52.0% of workers worked from 6 – 8 hours, and 89.0% had not taken training courses in professional risk.

Table (2): Showed that, 90% of workers used liquid chemical substance, 70.0% of worker's

exposure to inhalation of vapors resulting from the use of chemicals, 63.8% had been infected with chest crisis (asthma), and 61.7 % of them had injury more than year.

Fig. (1): Showed that, total satisfactory workers knowledge regarding of occupational safety and health was 29.0% and 71.0% was the total unsatisfactory workers regarding of occupational safety and health.

Fig. (2): Showed that, 40.0% of workers use personal protective equipment, while 60.0% of workers do not use.

Fig. (3): Showed that, 36.0% of workers done personal hygiene measure, while 64.0% of workers do not do.

Table (3): showed statistically significant deference between Relation between exposure to Health Hazards and worker's knowledge when p-value was <0.05*.

Table (4): showed statistically significant correlated between hazard and environment when p-value was <0.05*.

Table (1): Distribution of workers according to their demographic characteristics (N =200).

Demographic characteristics	No.	%
Age (years):		
<30	116	58.0
30<40	20	10.0
40>50	52	26.0
<50	12	6.0
Mean±SD	36.42±5.21	
Gender:		
Female	53	26.5
Male	147	73.5
Social status:		
Single	66	33.0
Married	106	53.0
Divorced	16	8.0
Widowed	12	6.0
Level of education:		
Illiterate	8	4.0
Read and write	30	17.0
Secondary (Technical)	114	57.0
University	48	24.0
No. of family members:		
Two individuals	37	18.5
From 3 to 5 individuals	39	19.5
More than 5 individuals	124	62.0
Family income level:		
Sufficient	47	23.5
Not sufficient	153	76.5
No. of years of factory work:		
From 3 – 5	84	42.0
From 6 to 10	78	39.0
More than 10	38	19.0
Mean±SD	7.06±3.55	
Work System (Shifts):		
Night shift	12	6.0
Day shift only	188	94.0
Working hours:		
From 6-8 hours	104	52.0
More than 8 hours	96	48.0
Training courses in professional risk:		
Yes	22	11.0
No	178	89.0

Table (2): Distribution of the workers according to exposure to chemical hazard in work environment N= (200).

Exposure to chemical hazard	No.	%
Usage of chemicals:	190	95.0
Nature of chemicals substances:		
Liquid substances such as	144	76.0
Vapors such as	46	24.0
The most vulnerable to chemical hazards are:		
Inhalation of vapors resulting from the use of chemicals	112	70.0
Touching chemicals by hand	90	56.3
Others remember	2	1.3
Infection with chemicals during your work:	94	59.5
Types of infection with chemicals:		
Inflammation and swelling of the skin and rash (blisters and skin ulcers)	8	8.5
Chest crisis (asthma)	60	63.8
Bronchitis	32	34.0
Ulcers of the digestive system	12	12.8
Dry eye	2	2.1
Time of injury:		
More than year	58	61.7
Less than year	36	38.3

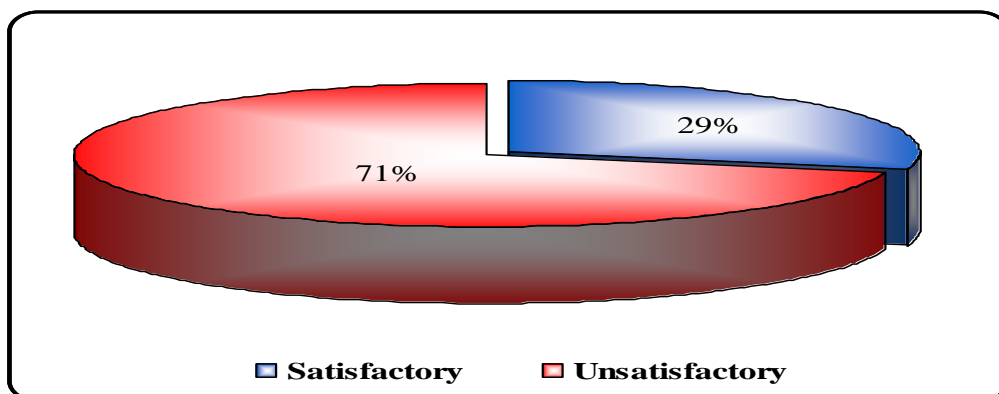


Fig. (1): Distribution of the workers according to their total knowledge N= (200)

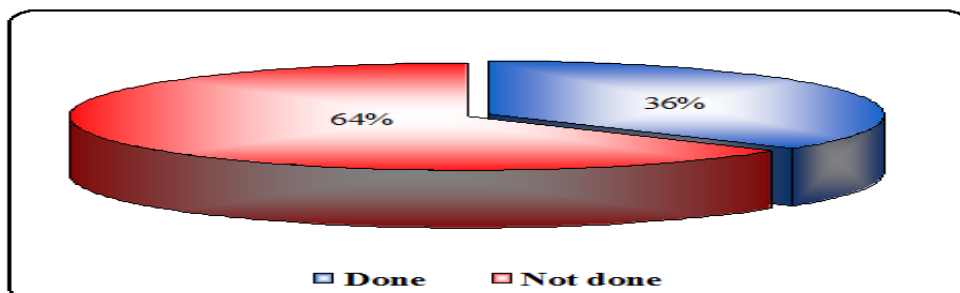


Fig. (2): Distribution of the workers according to their Practice regarding Personal Protective Equipment N= (200).

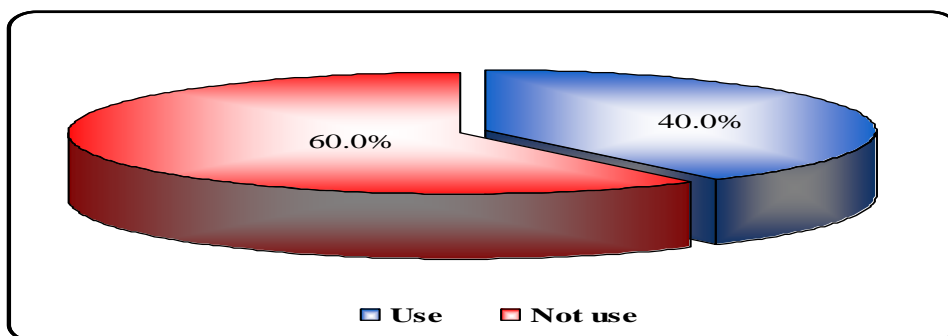


Fig. (3): Distribution of the workers according to their Performing personal hygiene measure; N= (200).

Table (3): Relation between exposure to Health Hazards and worker’s knowledge N= (200).

Exposure to Health Hazards	Total knowledge				Chi-square			
	Satisfactory		Unsatisfactory		X ²	P-value		
	N	%	N	%	N	%		
Does your work nature require exposure to such factors								
Load heavy objects	30	51.7	64	45.1	94	47.0	0.732 0.392	
Stand for long periods	44	75.9	116	81.7	160	80.0	0.874 0.350	
High temperature	2	3.4	6	4.2	8	4.0	0.065 0.799	
Low heat	1	1.7	5	3.5	6	3.0	0.457 0.499	
Push something	6	10.3	12	8.5	18	9.0	0.180 0.671	
Hearing high sounds of machines	11	19.0	51	35.9	62	31.0	5.531 0.019*	
Wrong bending	6	10.3	4	2.8	10	5.0	4.913 0.027*	
Climbing a ladder straight or spiral	3	5.2	9	6.3	12	6.0	0.099 0.753	
Pull something	2	3.4	14	9.9	16	8.0	2.300 0.129	
Using sharp machines	1	1.7	7	4.9	8	4.0	1.102 0.294	
Does the nature of your work require the use of chemicals	Yes	40	69.0	120	84.5	160	80.0	6.217 0.013*
	No	18	31.0	22	15.5	40	20.0	
Have you ever been infected with chemicals during your work	Yes	30	76.9	64	53.8	94	59.5	6.527 0.011*
	No	9	23.1	55	46.2	64	40.5	
Does the nature of your work require exposure to biological hazards	Yes	2	3.4	12	8.5	14	7.0	1.583 0.208
	No	56	96.6	130	91.5	186	93.0	
Have you ever been injured during work for any of these factors	Yes	3	75.0	6	42.9	9	50.0	1.286 0.257
	No	1	25.0	8	57.1	9	50.0	
Does the nature of your work put you under stress	Yes	27	46.6	137	96.5	164	82.0	69.546 <0.001*
	No	31	53.4	5	3.5	36	18.0	
Have you ever experienced any such pressure during work	Yes	36	80.0	116	97.5	152	92.7	14.710 0.844
	No	9	20.0	3	2.5	12	7.3	

Table (4): Correlation between hazard and environment.

Environment	Hazard	
	R	P-value
	-0.312	<0.001**

Discussion:

Concerning demographic characteristics of the studied workers, the present study revealed that, about three quarters of workers were male and mean of workers age was 36.42±5.2.

This study in same with *Ibrahim et al., (2017)* who mentioned that mean±SD of workers age was 39.07 ± 12.63. Contrariwise, this result in agreement with *Volberg et al., (2017)* who reported that about three quarters of studied workers were males.

The present study reported that, more than half of studied workers had a family members more than five individuals and more than three quarter of them had not sufficient income. This finding in agreement with *Ibrahim et al., (2017)* who found that two thirds of studied workers had not enough monthly income. Contrariwise, this result in disagreement with *Rajan, (2018)* who mentioned that more than half of studied workers strength of family member more than 4 members.

The current study revealed that, the mean of worker's no of years of factory work was (7.06±3.55) and most of them worked at day shifts. This result in agreement with *Lu et al., (2020)* who mentioned that more than half of studied workers their work schedule was day shift. Contrariwise, this study was disagreed with *Gelati et al., (2017)* who stated that the average length of time working in the profession was 15.35 years (SD ± 1.85).

The present study mentioned that, more than half of workers worked from 6 – 8 hours, and majority of them had not taken training courses in professional risk. This finding supported by *Aly & Mohammed, (2018)* who reported that range of working hours for studied workers was 8-12 hours with mean 8±0.3. Also, this study in agreement with *Zaky et al., (2018)* who stated that all of studied workers hadn't attended to any training programs.

Concerning exposure to chemical hazard in work environment, the current study stated that, most of workers used liquid chemical substance, more than two thirds of workers exposure to inhalation of vapors resulting from the use of chemicals, about two thirds had been infected with chest crisis (asthma), and more than half of them had injury more than year.

This result in same line with *Asgedom et al., (2019)* who proved that more than two thirds of studied workers suffered from accidental spilling of formaldehyde and respiratory problems related to inhalation of chemical evaporations and dust. Contrariwise, this study was disagreed with *Gelati et al., (2017)* who stated that more than one third of studied workers were exposed to chemical substances and had permanent complications.

Regarding workers' correct knowledge regarding occupational safety and health, the constant study mentioned that, more than half of

studied workers didn't know definition of occupational safety and health, gloves are occupational safety and health tools and reasons for non-compliance of workers with personal protective equipment because allergies and feeling bad. Also, majority of them answered correctly regarding causes of occupational accidents were non-compliance with personal protective equipment.

This study in agreement with *Hassan & Abad- Elzاهر, (2018)* who reported that majority of workers had incorrect answers regarding definition of occupational health, personal protective equipment for prevent occupational hazards. Also, this finding in same line with *Fouad et al., (2019)* who stated that more than two thirds of studied workers reported that noncompliance to personal protective equipment is the most cause for occurring occupational hazards.

In relation workers' practice regarding Personal Protective Equipment, the constant study reported that, all of studied workers were use over all apron and not use face shield and majority of them were not use earmuffs.

This study in same line with *Abdelwahab et al., (2019)* who stated that majority of studied workers were using overall personal protective equipment, and more than half of studied workers were not use face shield. Also, this result in agreement with *Balkhyour et al., (2019)* who mentioned that most of studied workers weren't use ear plugs/ muffs.

Concerning workers' total practice regarding personal protective equipment, the present study mentioned that, more than one third of studied workers use personal protective equipment while, more than half of studied workers do not use personal protective equipment. This finding support by *Baye et al., (2022)* who reported that about two thirds of studied workers do not use personal protective equipment. Contrariwise, this study in disagreement with *Kamble & Kurane, (2021)* who stated that more than three quarters of studied workers use personal protective equipment.

Regarding workers' performing personal hygiene measures, the constant study reported that more than one third of workers were change clothes at the beginning of shift, while majority of them were wash face. This study was disagreed with *Degavi et al., (2021)* who mentioned that more than

three quarters of studied workers were changed their work clothes after work and wash hands after work.

Concerning workers' total performing personal hygiene measure, the present study revealed that, about one thirds of workers follow personal hygiene measure, while about two thirds of them not follow. This result in agreement with *Ramadan et al., (2019)* who stated that most of studied workers had poor personal hygiene level.

Concerning relation between exposure to health hazards and worker's knowledge, the present study reported that, there was statistically significant difference between total knowledge with hearing high sounds of machines, does the nature of your work require the use of chemicals, have you ever been infected with chemicals during your work and does the nature of your work put you under stress. This study in same line with *Fouad et al., (2019)* who stated that, there was positive correlation between workers' total knowledge level and health hazards in tile factories.

Concerning correlation between hazard and environment, the present study revealed that, there was statistically significant correlation between hazard and environment. This result supported by *Brocal et al., (2018)* who mentioned there was positive correlation between level of safety of environment and occupational hazards.

Conclusion:

Based on the research questions, the study concluded that, the mean workers' age was 36.42 ± 5.2 , majority of them did not suffer from any diseases. More than two thirds of workers do not use personal protective measures and not do personal hygiene measure. There was a significant correlation between worker's exposure to occupational hazard and work environment.

Recommendations:

The following recommendations were inferred from the study:

- Provide educational program to workers about different types of occupational hazard and importance of safety measures.
- Provide educational program to workers in chemical factories about importance of safe work environment.
- Activating the role of visual, audio and read media in raising awareness about occupational hazard. Through health education messages about occupational hazard in mass media especially radio and television, this message can be delivered to large sector of the community.
- Researchers should conduct further studies to determine if increasing knowledge leads to changes in practices of workers regarding safety measures.

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