

## Occupational Health Hazards among Workers of Aluminum Industry

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### Abstract

**Background:** Aluminum manufacturing had a variety of chemical, physical, biological, psychosocial, and ergonomic hazards, are characterized in the context of both occupational and community health. **The aim of the study:** Was to assess the occupational health hazards among workers of Aluminum Industry. **Research design:** A descriptive research design was utilized to conduct this study. **Setting:** This study was carried out at Tiba Industry for Aluminum, Horus and El Qasas Industry in Benha-Mit Ghamr Road. **Sampling:** Convenience sample of workers who worked in the previously mentioned setting included 230 workers. **Tools:** Two tools were used for data collection. **Tool I:** An interviewing questionnaire to assess worker's socio demographic characteristics, Health problems of the studied workers during the last six months and worker's knowledge regarding occupational health hazards. **Tool II)** An observational checklist to observe workers' practices for using personal protective equipment and observe the environment safety and sanitation. **Results:** 29.6% of studied workers suffered from stress and exhaustion, while 37%, 45.2% and 44.3% respectively had no blood, kidney and ear problems. 50.9% of studied workers had average knowledge, 25.2% had poor knowledge regarding occupational health hazards. 59.1% of the studied workers had unsatisfactory total practices regarding precaution in aluminum industry. **Conclusion:** More than half of the studied workers had average total knowledge about occupational health hazards. and had unsatisfactory practices regarding their total practices level in aluminum industry. There were highly statistical significance differences between the studied workers' total knowledge and their socio demographic characteristics regarding age and education. There were highly statistical significance differences between the studied workers' total knowledge and their practices regarding aluminum exposure hazards. **Recommendation:** Training program should be provided for workers at aluminum industries to improve their knowledge and practices regarding occupational health hazards.

**Keywords:** Aluminum Industry, Occupational Health Hazards, Workers.

### Introduction

Occupational health deals with all aspects of health and safety in the workplace and has a strong focus on primary prevention of hazards. Occupational health is a multidisciplinary field of healthcare concerned with enabling an individual to undertake the occupation in the way that causes least harm to health. OH aligns with the promotion of health and safety at work,

which is concerned with preventing harm from hazards in the workplace (Reese, 2018).

Occupational health hazards are the risks to the health of workers which refer to the process or situation that cause accidents or disease at workplace. Occupational health hazards are brought by unsafe work conditions and unsafe work behaviors. Workplace hazards or injuries are preventable with the use of appropriate occupational

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safety and health services (**Degavi et al., 2021**).

Workers at aluminum industries are exposed to various occupational hazardous factors such as fumes, gases, mineral dusts, coal tar pitch volatiles, electromagnetic fields and others. Aluminum factory workers have been shown to suffer from respiratory symptoms either chronic or work related ones as cough, phlegm, dyspnea, wheezing and chest tightness (**Georgakopoulou et al., 2021**).

Occupational Health Nurses (OHNs) should make a major contribution to the sustainable development, improved competitiveness, job security and increased profitability in enterprises and communities by addressing those factors which are related to the health of the workers. By helping to reduce ill health occupational health nurses can contribute to the increased profitability and performance of organizations and reduce health care costs. OHNs should help to reduce the externalization of costs onto the taxpayer by preventing disability, social exclusion and by improving rehabilitation services at work (**Sadhra et al., 2022**).

Occupational Health Nurses should provide the aluminum industry workers with essential education. This may be within existing training program that are developed specifically by OHNs to inform, educate and train aluminum industry workers in how to protect workers from occupational hazards, non-occupational but workplace preventable diseases or to raise awareness of the importance of good environmental health management practices (**Abdelrahim et al., 2021**).

### **Significance of the study**

According to the globe estimation about 2.9 billion workers across the globe are exposed

to hazardous risks at the work place. Workers exposed to the occupational risk factors lost about 22 million years of healthy life. By far the main cause of years of healthy life loss (measured in Disability-Adjusted Life Years (DALYS)), within in occupational diseases, was international injuries with 48% of the burden. This was followed by hearing loss due to occupational noise (19%) and chronic obstructive pulmonary disease due to occupational agent (17%) (**World Health Organization (WHO), 2018**).

### **Aim of the study**

This study aimed to assess the occupational health hazards among workers at Aluminum industry.

### **Research Questions**

1. What is the workers' knowledge about occupational health hazards related to aluminum exposure?
2. What are workers' practices related to safety measures of prevention occupational health hazards related aluminum exposure?
3. Is there a relation between workers' knowledge and their practices related to aluminum exposure hazards?

### **Subject and methods**

#### **Research design:**

A descriptive research design was utilized to conduct this study.

#### **Setting:**

This study was conducted at Tiba Industry for Aluminum, Horus Industry and El qasas Industry at Benha-Mit Ghamr Road.

#### **Sampling:**

A convenient sample of workers who worked in the previously mentioned setting was chosen. The total number of workers was 230 in year 2022.

#### **Tools of data collection:**

**Data were collected by using two tools:**

**The first tool: Structured interview questionnaire:** It was designed by the

researchers based on reviewing related literatures and it was written in simple clear Arabic language and consisted of three parts to assess the following:-

**The first Part:-** It was concerned with socio demographic characteristics of workers which included six closed ended questions about age, level of education, residence, marital status, number of family and family monthly income

**Part II: It was designed to assess** health problems among aluminum industry workers during the last 6 months resulting from occupational hazards which included nine closed ended questions about cardiac problems, blood problems, kidney problems, respiratory system problem, gastrointestinal problems, eye problems, ear problems, musculoskeletal and nervous system problems and skin problems.

**Part III:** It was concerned with the studied workers knowledge about occupational health hazards which included nineteen closed ended questions (meaning of occupational hazards, causes, physical hazards, mechanical hazards, chemical hazards, psychological hazards, accidents that may be exposed in working, types sources of aluminum poisoning, types signs of aluminum poisoning, types first aid in case of suffocation or shortness of breath , first aid in case of burns, first aid in case of injury/bleeding, first aid in case of falling with fractures, first aid in case of fainting, first aid in case of shock, first aid in case of an eye injury, measures to prevent occupational hazards).

#### **Scoring system**

The scoring system for the workers' knowledge about occupational health hazards was calculated as following: (2) score for a correct and complete answer, (1) score for correct and incomplete answer and (0) for don't know. For each area of knowledge, the score of items was summed-up and the total

divided by the number of the items, giving a mean score for the part. Those scores were converted into a present score. The total scores of knowledge = 19 points. The total score was considered good when score  $\geq 75\%$  ( $\geq 28$  points), while considered it equals  $50\% > 75\%$  ( $19 > 28$  points) and considered poor when the total score was  $> 50\%$  ( $> 19$  points).

**The second tool:** It was concerned with an observational checklist which included two parts: **Part I: A)** It was concerned with practices of the studied workers regarding occupational health hazards which divided five questions about (1) Personal protective equipment, (2) Practices in the cutting section, (3) Practices in the aluminum furnaces section, (4) Practices in the aluminum lathe and forming department, and (5) Practices in aluminum extrusion and rolling section.

**B)** An observational checklist was used: To observe environmental safety and sanitation conditions.

#### **Scoring system**

The total practices score = 36 points

The total practices score were considered satisfactory if the score  $\geq 60\%$  ( $\geq 27$  points) and considered unsatisfactory if it is  $< 60\%$  ( $< 27$  points).

**The scoring system for work environment was scored as follows:** (1) Score for present and (0) score for not present

#### **Content validity of the tools:**

The tools validity was done by three experts of Faculty Staff Nursing from Community Health Nursing specialists who reviewed the tools for clarity, relevance, comprehensiveness, understanding, applicability and reliability modifications were done accordingly based on their responses.

**Reliability of the tools:**

The reliability of the tools was done by Cornbrash's Alpha coefficient test which revealed that each of the two tools consisted of relatively homogeneous items as indicated by the moderate to high reliability of each tool. The internal consistency of knowledge was 0.770 and practice was 0.855.

**Ethical considerations:**

All ethical issues were assured; oral consent has been obtained from each worker before conducting the interview and given them a brief orientation to the purpose of the study. They were also reassured that all information gathered would be kept confidentiality and used only for the purpose of the study. Workers had right to withdraw from the study at any time without giving any reasons.

**Pilot study:**

The pilot study was carried out on 23 workers who represented 10% of the total sample size 230. The pilot study was aimed to assess the tool clarity, applicability and time needed to fill each tool, completing the tool consumed about 20-40 minutes. No modifications were done, so the pilot study sample was included in the total sample.

**Field of work:**

The data was collected from workers who attended in the previously selected industry through the interview with them. The study was conducted at a period of five months which started from the beginning of December 2021 to the end of April 2022. The researchers visited Tiba industry, Horus industry, El qasas industry respectively on Sunday, Monday, and Wednesday respectively. Each industry was visited by the researchers one day per week from 10am to 2pm to collect data and increased knowledge of workers regarding occupational health hazards, the average number of interviewing workers was between 3-4 workers/ day depending on their responses to the

interviewers, each interviewed workers takes about 20- 40 minutes to fill the tools depending upon their understanding and responses as well as distribute the questionnaire.

**Statistical analysis:**

Computerized data entry and statistical analysis were done by using Statistical Package for Social Science (SPSS Version 22). All data collected were organized, tabled and analyzed by using the Statistical Package for Social Science which was used frequencies and percentages for qualitative descriptive data and chi-square coefficient  $\chi^2$  was used for relation tests and mean and standard deviation were used for quantitative data, Pearson correlation coefficient was used for correlation analysis and degree of significance was identified.

**Statistically significance was considered as follows:**

- Highly significant result when p-value <0.001.
- Significant result when p-value <0.05.
- Not-significant result when p-value >0.05

**Results:**

**Table (1):** Shows that; 50% of the studied workers are aged 30<40 years with Mean  $\pm$ SD 39.35 $\pm$ 5.16 and 50% had secondary education respectively, 77% of them were married. Also the family member of 51.7% of them were >5 members and 86.1% had no enough income and 68.7 of them were living in rural area.

**Table (2):** Shows that; 29.6% suffering from stress and exhaustion, while 37%, 45.2% and 44.3% of the studied workers hadn't blood, kidney and ear problems respectively. On the other hand; 27.4%, 40.9%, 30.9%, 27.3% and 47.4% respectively of them had irritation of the nasal membranes, anorexia, eye irritation, knee roughness, dermatitis respectively. And

100 % of the studied workers didn't make Periodic medical checkup.

**Figure (1):** Clears that; 50.9% of the studied workers had average total knowledge, While; 25.2% of them had poor knowledge and 23.9% had good knowledge about occupational health hazards.

**Figure (2):** Reveals that; 59.1% of the studied workers had unsatisfactory total practices level regarding precaution in aluminum

industries and 40.9% of them had satisfactory total practices level.

**Figure (3):** Clears that; 66.7% of the studied industries had safe environmental sanitation, While 33.3% of them had unsafe environmental sanitation.

**Table (3):** Shows that, there was a highly statistically significant relation between total knowledge level and total practices level regarding aluminum exposure hazards.

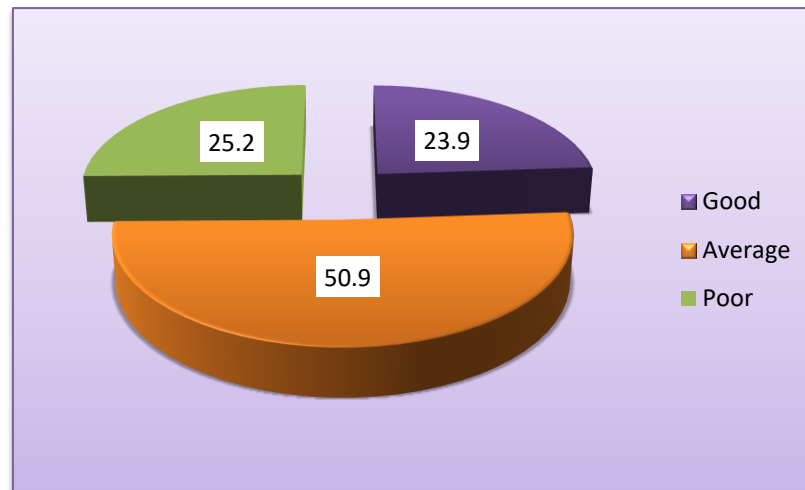
**Table (1): Frequency distribution of the studied workers regarding their socio-demographic characteristics (n=230).**

Socio-demographic characteristics	No.	%
<b>Age/Years</b>		
< 20	19	8.3
20 <30	65	28.3
30 <40	115	50.0
≥ 40	31	
Mean ±SD		39.35±5.16
<b>Education</b>		
don't read or write	16	7.0
Primary	35	15.2
Secondary	115	50.0
High	64	27.8
<b>Marital status</b>		
Single	53	23.0
Married	177	77.0
<b>Family member number</b>		
2 - 3	19	8.3
4 – 5	92	40.0
>5	119	51.7
<b>Monthly income</b>		
Enough	32	13.9
Not enough	198	86.1
<b>Residence</b>		
Rural	158	68.7
Urban	72	31.3

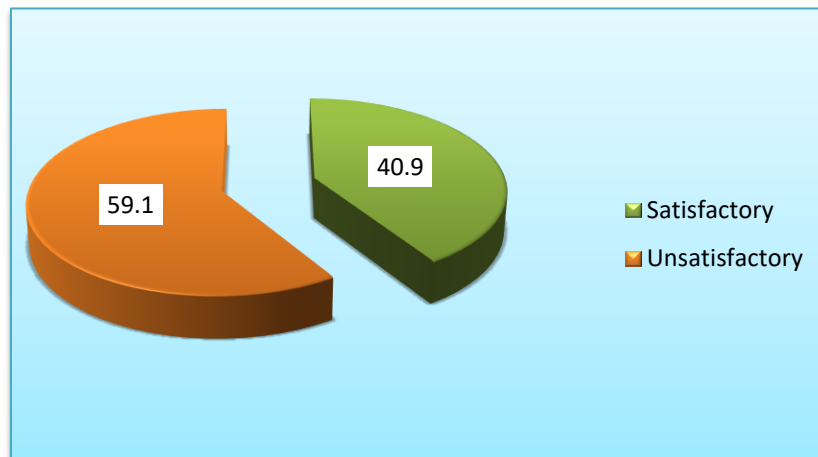
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**Table (2): Frequency distribution of the studied workers regarding their past health problems (n=230).**

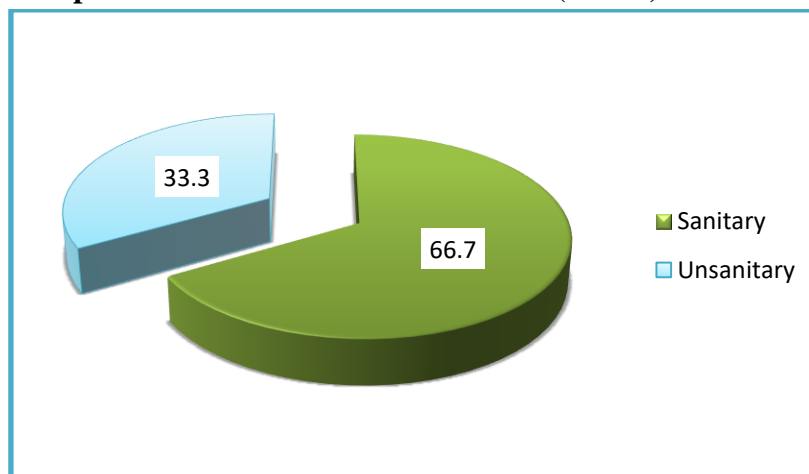
Health problems	No.	%
<b>Blood problems</b>		
Nothing	85	<b>37.0</b>
Anemia	60	26.0
Iron deficiency	54	23.5
Diabetes mellitus	31	13.5
<b>Kidney problems</b>		
No problem	104	<b>45.2</b>
Kidney stones	52	22.6
Urinary tract infection	74	32.2
<b>Respiratory problems</b>		
No problem	32	13.9
Irritation of the nasal membranes	63	<b>27.4</b>
Dry cough without sputum	26	11.3
Cough accompanied by sputum	29	12.6
Shortness of breath, wheezing and chest tightness	54	23.5
Bronchitis	46	20.0
<b>Digestive problems</b>		
No problem	58	25.2
Anorexia	94	<b>40.9</b>
Colon disorders	31	13.5
Heart burn	32	13.9
Stomach colic	15	6.5
<b>Eye problems</b>		
No problem	53	23.0
Eye infections	64	27.8
Excessive tearing	66	28.7
Visual impairment	48	21.0
Myopia	16	7.0
Eye irritation	71	<b>30.9</b>
Keratitis	35	15.2
<b>Ear problems</b>		
No problem	102	<b>44.3</b>
Itchy ears	32	14.0
Otitis media	42	18.3
Ear infections	24	10.4
Ear weakness	57	24.8
<b>Skeleton problems</b>		
Nerve weakness	35	15.1
Pain in the body	49	21.3
Arthritis	32	13.8
Slipped disc	52	22.5
Knee roughness	63	<b>27.3</b>
<b>Skin problems</b>		
No problem	26	11.3
Eczema	51	25.2
Psoriasis	46	20.0
Skin burns	67	29.1
Dermatitis	109	<b>47.4</b>
<b>Periodic medical checkup:</b>		
Yes	0	0.0
No	230	<b>100.0</b>



**Figure (1): Percentage distribution of the studied workers' total knowledge level regarding occupational health hazards (n=230).**



**Figure (2): Percentage distribution of the studied workers' total practices level regarding precaution in aluminum industries (n=230).**



**Figure (3): Percentage distribution of the studied industries regarding safety environmental sanitation (n=3).**

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**Table (3): Statistically relation between knowledge and practices level of the studied workers regarding occupational health hazards (n=230).**

Total Knowledge	Total practices level				X <sup>2</sup>	P-value
	Satisfactory (n=94)		Unsatisfactory (n=136)			
	No	%	No	%		
Poor (n=58)	4	4.3	54	39.7	56.37	.000**
Average (n=117)	48	51.1	69	50.7		
Good (n=55)	42	44.7	13	9.6		

### Discussion

Aluminum production is accompanied by emissions of dust and gases, which are potentially harmful to the workers and the local environment. Occupational health and safety in every work environment entails the promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations. Employers should comply with the measures to be taken regarding hazards or risks to safety and health from the production of aluminum, they should provide and maintain workplaces, equipment, tools and machinery, and should organize work so as to eliminate or, control hazards and risks in the production of aluminum (**Murzin et al., 2021**).

Regarding the studied workers' socio-demographic characteristics in aluminum industries; the current study illustrated that half of the studied workers ranged in age between 30 to less than 40 years old with Mean  $\pm$ SD 39.35 $\pm$ 5.16 years. This result might be due to this age group is the most group that can work in the aluminum factory in accordance with work regulations and laws. This result was supported by **Rahmadani & Syafri (2022)** who conducted a study on "Survey of knowledge and practice related health risks of mercury exposure among gold craft workers" in Rappocini area, Makassar City in Saudi Arabia. On sample 52 and stated

that 55.8% of the study subjects were 26-35 years old.

In the present study, half of the study workers had secondary education. This result agreed with **Torbor (2019)** who carried out a study in Ghana to assess "urine fluoride concentration among Potroom workers of Volta Aluminum Company" and mentioned that 93.9% had attained secondary/vocational level of education. This could be related to the sample selection, work criteria of recruitment competencies and/or similar socio-economic characteristics of both countries.

Concerning past health problems of the studied workers, the current study showed that nearly half of them had dermatitis and so anorexia but nearly one third of them had eye irritation, while more than one quarter of them had stress and exhaustion, irritation of the nasal membranes, or knee roughness . These results are different with **Martell & Guidotti, (2022)** who carried out a study in Canada entitled " Trading One Risk for Another: Consequences of the Unauthenticated Treatment and Prevention of Silicosis in Ontario Miners in the McIntyre Powder Aluminum Inhalation Program". On sample 547 and reported that 32% of the respondents had respiratory problems. It might be due to extreme heat in the industry, effect of volatile dust and standing for a long time.



Furthermore, this study reported that more than half of the studied workers had average total knowledge about occupational health hazard. This result supported by **Wekoye et al., (2019)** who carried out a study to assess "Knowledge and Attitudes on Practices of Occupational Safety and Health in the Informal Non-food Manufacturing Sector" in Kampala City, Uganda. On sample 424. They reported that about 40% of respondents had fair knowledge about occupational health hazards .

However, the finding was in contrast to that of another study conducted by **Pandit et al., (2019)** in USA, entitled "Impact of safety climate on hazard recognition and safety risk perception" on sample 280. Which revealed that 61.5% of the respondents had a poor knowledge on occupation-related hazard? From the researcher's point of view, this might be due to the educational level of the studied workers and lack of training courses about occupational health and safety.

Regarding the total practices level of the studied workers regarding precaution in aluminum industries, the current study illustrated that more than half of the studied workers had unsatisfactory practices regarding their total practices level in aluminum industry and the rest of them had satisfactory total practices level regarding precaution in aluminum industry. This result was in the same line with **Setyawan et al., (2019)** who carried out a study in Indonesia entitled "Determinant of Personal Protective Equipment Practices on Construction Welders" on sample 245 and reported that 48.8% of the respondents had good practice of safety measures against hazards associated with foundry work, whereas 51.2% of them had poor practice of safety measures. This might be due to lack of training courses about occupational health and safety or lack of

awareness and health information about the effects of occupational health hazards.

The current study represented that about two thirds of the studied industries had safe environmental sanitation, while the rest of them had unsafe environmental sanitation. This result in accordance with **Arnold et al., (2019)**, who conducted a study in Sri Lanka to assess "Occupational hazards in medium and large scale industrial sectors in Sri Lanka: experience of a developing country" on sample 200 and reported that the application of measures taken to maintain safe environmental sanitation were found unsatisfactory in 64.8% of the studied work settings. This might be attributed by increasing the risk of morbidity and mortality among workers. This might be due to lack of health awareness among workers. Due to lack of medical care was recommended to raise awareness of workers and protect them at the workplace.

The current study illustrated that there was highly statistical significance relation between the studied workers total knowledge and their practices regarding aluminum exposure hazards. This result was in accordance with **Amsalu, (2021)** who reported that level of knowledge was significantly associated with safety practices of the studied workers.

### **Conclusion**

More than half of the studied workers had average total knowledge about occupational health hazards. More than half of the studied workers had unsatisfactory practices regarding their total practices level in aluminum industry. There were highly statistical significance differences between the studied workers' total knowledge and their practices regarding aluminum exposure hazards.

### **Recommendations**

- Training programs should be provided for workers at aluminum industries to improve

their knowledge and practices regarding occupational health hazards.

- Regular periodic checkup for all workers for early detection of any health problems and health needs.
- Orientation program for the new workers before beginning work should focus on work nature and the requirement of the job.

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## المخاطر الصحية المهنية بين العاملين في صناعة الألومنيوم

أفنان شكرى محمد - أحلام الأحمدى سرحان - أمينة عبد الرازق محمود

تعتبر صناعة الألومنيوم من الصناعات التي لديها كثير من المخاطر الصحية التي تؤثر على صحة العاملين فيها وتشمل مخاطر فيزيائية ونفسية وكيميائية وبيولوجية والتي تعتبر سبب مهم للأمراض بين العمال. لذلك هدفت هذه الدراسة الي تقييم مخاطر الصحة المهنية بين العاملين في صناعة الألومنيوم . وقد أجريت الدراسة في مصنع طيبه و حورس و القصاص لصناعة الألومنيوم بطريق بنها - ميت غمر. حيث كشفت النتائج عن أكثر من نصف العاملين داخل عينه البحث لديهم متوسط اجمالى المعرفة حول مخاطر الصحة المهنية وأكثر من نصف العاملين لديهم ممارسات غير مرضيه فيما يتعلق بمستوى ممارساتهم فى صناعة الالومنيوم. كما أوصت الدراسة انه يجب توفير برنامج تدريبي للعاملين فى صناعات الالومنيوم لتحسين معارفهم وممارساتهم فيما يتعلق بمخاطر الصحة المهنية.