ISSN 2786-0183
Helwan International Journal for Nursing Research and Pratctice
Vol. 3, Issue 8, Month: December 2024, Available at: https://hijnrp.journals.ekb.eg/

Citizens' Awareness Regarding Sinai Manganese Factory Hazards at Abu Zenima City at South Sinai Governorate

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Abstract

Background: Manganese is a versatile and essential chemical element plays a crucial role in various industrial applications, including steel production, where it acts as a vital alloying agent to enhance the strength and durability of steel. Awareness between citizens should be informed about encouraged to engage with local health authorities for regular monitoring and preventive measures **Aim**: This study aimed to assess citizens' awareness regarding Sinai manganese factory hazards at Abu Zenima city at South Sinai governorate. **Research design:** A descriptive design was used in this study. **Setting**: Home visit in at Abu Zenima City in South Sinai Governorate-Egypt. **Sample:** A convenience sample composed of 375 citizens. **Tool of data collection:** Two tools, **1st tool** included four parts, **1st part:** Demographic characteristic, **2nd part:** Medical history, **3rd part:** Citizens' knowledge about manganese and its risks, and **4th part:** Citizens' reported practices regarding manganese factory hazards, **2nd tool:** Observational checklist for healthy home precautions regarding protection from manganese factory hazards. **Results:** 45.1 % of the studied citizens had poor knowledge, while 14.6 % of them had good knowledge. 75.6 % of studied citizens had unsatisfactory reported practice regarding manganese factories hazards and 41.7 % of them had satisfactory home healthy precautions about manganese risk prevention. **Conclusion:** There is statistically significant relation between citizens' demographic characteristics, their knowledge, reported practices regarding manganese and its risks. Also, there were highly statistically significant positive correlation between the studied citizen's total knowledge, total reported practices and home healthy precautions. **Recommendations:** Provide health education program for citizens about manganese and its risks.

Keywords: *Abu Zenima City, Citizens' Awareness, Manganese Factory Hazards, and South Sinai Governorate.*

Introduction:

Manganese (Mn) is a naturally occurring element that, while essential in trace amounts for various biological functions, poses significant hazards when present in elevated levels. Exposure to high concentrations of manganese can occur through inhalation of dust or fumes in industrial settings, as mining, welding, or battery manufacturing, as well as through contaminated water or soil. Chronic exposure to manganese is known to affect the nervous system, leading to neurological disorders similar to Parkinson's disease, a condition known as manganism. Symptoms may include tremors, muscle stiffness, and impaired cognitive function ***(Nam-Speers et al., 2023).***

Hazards refer to potential sources of harm or adverse health effects that can arise from various conditions or activities. Hazards can be physical, chemical, biological, or psychosocial in nature, each posing different risks depending on their context and exposure. Due to rapid urbanization and the globalization of economic and industrial activity, a tremendous amount of hazardous waste materials has been released into various environmental media at escalating levels ***(Prasad & Suresh, 2023).*** This surge in hazardous waste, which includes toxic chemicals, heavy metals, and other dangerous substances, has significantly impacted air, water, and soil quality. The increased industrial and economic activities often outpace the development of effective waste management and environmental protection measures, leading to widespread contamination and posing severe risks to both ecosystems and human health ***(Dewi et al., 2023).***

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Air pollution was the cause of 100,509 premature deaths in Egypt in 2022. It is a major threat to global health and prosperity. Air pollution, in all forms, is responsible for more than 6.5 million deaths each year globally, a number that has increased over the past two decades. These pollutants can exacerbate chronic respiratory diseases, such as asthma and Chronic Obstructive Pulmonary Disease (COPD), increasing the risk of severe respiratory distress and death. Linked to cardiovascular problems, including heart attacks and strokes, by inducing inflammation and oxidative stress that affect heart function. Long-term exposure to air pollution is associated with a heightened risk of lung cancer ***(Abubakar et al., 2024).***

Respiratory problems can arise from inhaling manganese dust or fumes, potentially leading to conditions as bronchitis or reduced lung function. Additionally, excessive manganese exposure may disrupt metabolic processes and impact reproductive and developmental health. Effective control measures and regular monitoring are essential to prevent these adverse effects and protect both workers and the general population from the risks associated with high levels of manganese exposure ***(Song & Zhang, 2022).***

Raising citizens' awareness about the harmful effects of manganese is crucial for safeguarding public health and promoting environmental stewardship. Many citizens may not be aware of the risks associated with elevated manganese levels, which can result from industrial activities, contaminated water sources, or polluted soil. Increased awareness can empower individuals to recognize symptoms of manganese toxicity, such as neurological disorders or respiratory issues, and take preventive measures ***(Taylor et al., 2021).*** Educational campaigns and community outreach programs can inform citizens about the importance of monitoring and reducing manganese exposure, understanding potential sources of contamination, and advocating for stringent environmental regulations. By fostering a well-informed public, we can encourage proactive behaviors and support policies aimed at minimizing manganese-related health risks, ultimately contributing to a healthier and safer environment for all ***(Cacciuttolo et al., 2023).***

Community Health Nurses (CHNs) play a vital role in addressing and mitigating the hazards associated with manganese factories. CHN are instrumental in monitoring and assessing the health impacts of manganese exposure within the community, particularly in areas where industrial activities are prevalent. CHNs educate residents about the risks of manganese exposure, including its potential effects on neurological and respiratory health, and provide guidance on preventive measures and symptom recognition ***(Saleh et al., 2024).***

Nurses collaborate with local health authorities and environmental agencies to ensure that proper safety standards and regulations are enforced, and nurses advocate for community-wide health screenings and interventions. Additionally, CHNs often serve as a liaison between affected individuals and healthcare services, ensuring that those impacted by manganese exposure receive appropriate medical care and support. By raising awareness, promoting preventive practices, and coordinating with various stakeholders, community health nurses play a crucial role in protecting public health from the hazards associated with manganese factories ***(Bai et al., 2023).***

Significance of the study

The Egyptian Ministry of Environment indicated that the causes of air pollution in Egypt include carbon dioxide, metal production and manganese. According to WHO estimates in Egypt, about 150 workers die every year related to working in manganese factory ***(Mustafa, 2021).*** The presence of the manganese factory near the residential areas may affect the safety of the air and the safety of the community members, which exposes them to many diseases as a result of exposure to manganese dust. The factory could be a source of pollution. It is necessary to identify the risks resulting from the presence of the factory near residential areas and the health problems spread in the area in order to reduce the pollution spread ***(Sovacool et al., 2022).***

World Health Organization (WHO) estimates that around 7 million citizens die every year from exposure to fine particles like manganese in polluted air that penetrate the lungs and cardiovascular system,

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causing diseases including stroke, heart disease, lung cancer, chronic obstructive pulmonary diseases and respiratory infections, including pneumonia. Ambient air pollution alone about some 4.2 million deaths. WHO estimates that in 2019, about 37% of outdoor air pollution-related premature deaths were due to ischemic heart disease and stroke, 18% and 23% of deaths were due to chronic obstructive pulmonary disease and acute lower respiratory infections respectively, and 11% of deaths were due to cancer within the respiratory tract ***(WHO, 2021).*** Therefore, this study was conducted to assess citizens' awareness regarding to Sinai manganese factory hazards at Abu Zenima city at South Sinai Governorate.

Aim of the study

This study aimed to assess citizens' awareness regarding Sinai manganese factory hazards at Abu Zenima city at South Sinai governorate through:

1- Assessing citizens' knowledge regarding manganese and factory hazards
2- Appraising citizens' reported practices regarding manganese factory hazards.
3- Determining citizens' healthy home precautions regarding protection from manganese factory hazards.

Research Questions:

To fulfill the aim of the study, the following research questions were formulated:

1- What are citizens' knowledge regarding manganese and factory hazards?
2- What are citizens' reported practices regarding manganese factory hazards?
3-What are citizens' healthy home precautions regarding protection from manganese factory hazards?
4- Is there relation between citizens' knowledge, reported practices and their demographic characteristics?

SUBJECTS AND METHODS

Research design:

A descriptive research design was applied to achieve the aim of the study.

Study Setting:

This study was conducted at Abu Zenima City in South Sinai Governorate through home visits. This region had consisted of nearly 5000 citizens home, select the homes by using systematic random sample (every third home) chosen. Abu Zenima City away from the capital Tur Sinai City 120 kilometers and the factory is less than two a kilometer away from residential areas.

Type Sample: A convenience sample was used in this study.

Sample Size:

Sample size was 357 citizens was be calculated by the following equation:

$$\mathbf{n = N / (1 + Ne^2)}$$ **(Adam, 2020).**

While;
n = Sample size.
N= Target population (total).
e= Coefficient factor = 0.05.
The actual sample size was 357 from total 5000 citizens through year 2023-2024.

Tools for data collection:

Data was collected using the following two tools:

Tool: A structured interviewing sheet**:** was used in the study, it's developed by investigator after reviewing the national and international related literature and contains four parts:

Part (I): Demographic characteristics of citizens consisted of 7 items such as age, educational level, marital status.

Part (II): Medical history of citizens consisted of 9 items such as suffers from chronic diseases, if the answer is yes, mention it, smoking, if yes.

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Part (III): Citizens' knowledge about manganese and its risks consisted of 14 closed ended questions as: Meaning of manganese, forms of the element of manganese, respiratory symptoms that occur when inhaling manganese vapor.

Scoring system:

Each statement was assigned score according to citizen's response were: complete correct answer was scored 2 grades; incomplete correct answer was scored 1 grade and don't know was scored 0. Total score were 28 grades from 14 questions. The total scores each item summed up and then converted into percent score **as the following:**

- **Good knowledge** (≥ 75%) = ≥ 21 grades, was considered high score.
- **Average knowledge** (50 - < 75%) = 14 - < 21 grades, was considered moderate score.
- **Poor knowledge** (< 50 %) = < 14 grades, was considered poor.

Part (IV): Citizens' reported practices regarding manganese factories hazards consisted of 4 sub items as:

A- Citizens' reported practices about general practices regarding manganese factories hazards consisted of 13 closed ended questions as: Wash hands frequently with soap and water, wash fruits and vegetables with running water, put fruits and vegetables in vinegar water for a quarter of an hour before washing, wear a mask sometimes.

B- Citizens' reported practices about first aid in the event of suffocation or shortness of breath regarding manganese factories hazards consisted of 6 closed ended questions as: Eliminate choking causes, move the injured person to a well-ventilated place, remove tight clothing.

C- Citizens' reported practices about first aid in case of eye injury regarding manganese factories hazards consisted of 3 closed ended questions as: Wash the eyes with plenty of running water, remove contact lenses.

D- Citizens' reported practices about first aid in case of skin injuries regarding manganese factories hazards consisted of 3 closed ended questions as: Wash the affected skin with plenty of running water, apply moisturizing creams.

Scoring system:

Each statement was assigned score according to citizens' response were, done 1 and not done 0, respectively. Total score were 25 grades for 25 items. The scores of items summed up and then converted into percentage score **as the following:**

- (> 60) **was considered unsatisfactory** = > 15 grades.
- (≤ 60) **was considered satisfactory** = ≤ 15 grades.

Tool (II): Observational checklist for healthy home precautions regarding protection from manganese factory hazards consisted of 6 sub items as:

A- Citizens' healthy home precautions about ventilation regarding protection from manganese factory hazards consisted of 6 closed ended questions as: The house is well ventilated, an appropriate number of windows in each room.

B- Citizens' healthy home precautions about water sources regarding protection from manganese factory hazards consisted of 3 closed ended questions as: A drinking water purifier, a good water source for bathing and washing hands.

C- Citizens' healthy home precautions about lighting regarding protection from manganese factory hazards consisted of 3 closed ended questions as: A continuous source of electricity, an electricity control panel.

D- Citizens' healthy home precautions about detergents regarding protection from manganese factory hazards consisted of 3 closed ended questions as**:** Adequate quantities of chlorine and soap available, detergents stored in designated places.

E- Citizens' healthy home precautions about household wastes regarding protection from manganese factory hazards consisted of 3 closed ended questions as: Waste is collected inside the house; waste is separated into different bags (food leftovers - normal waste).

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F- Citizens' healthy home precautions about first aid and personal protective measures regarding protection from manganese factory hazards consisted of 4 closed ended questions as**:** A first aid bag is available; the house is close to the hospital or specialized clinics.

Content validity:

Validity was ascertained by a panel of three experts in branch of Community Health Nursing, who was review the tools for the format, layout, consistency, accuracy, and relevance.

Tool Reliability:

Reliability was tested statistically using the appropriate statistical tests to assure that the tools are reliable before data collection. Answers from the repeated testing were compared Test- re- test reliability was 0.86 for knowledge, Cronbach's Alpha reliability was 0.856 for reported practices and 0.878 for healthy home precaution.

Ethical Considerations:

The research approval was obtained from the Scientific Research Ethical Committee in the Faculty of Nursing, Helwan University before starting the study. The investigator was clarified the objective and aim of the study to citizens included in the study, The investigator assured anonymity and confidentiality of subjects' data. Citizens informed that they are allowed to choose to participate or not in the study and that they have the right to withdraw from the study at any time.

Scoring system:

Each statement was assigned score according to present 1, and not present 0, respectively. Total score were 22 grades for 22 items. The scores of items summed up and then converted into percentage score **as the following:**

- (> 60) **was considered unsatisfactory** = > 13 grades.
- (≤ 60) **was considered satisfactory** = ≤ 13 grades.

I. Operational Item:

It was included preparatory phase, content validity and reliability, pilot study and field work.

A. Preparatory phase:

Prepare the study tools based on related literature review and develop the study tool and test its content validity and reliability.

Pilot study:

A pilot study conducted on (10 %) equal 36 citizens under study to assess the feasibility, practicability, clarity and objectivity of the tools. Based on the results, no modification was done. Citizens in the pilot study were included in the main study sample because no modifications were done.

Field work:

- An official letter issued from the dean of Faculty of Nursing Helwan University to the chairman of Abu zenima city after explain the purposes of the study. Interviewing citizens will be done through home visit including the aim of the study to obtain permission after establishing a trustful relationship, each subject interviewed individually by the investigator to explain the study purpose.
- Data collected within 3 months from first of October until end of December 2023 two days /week (Sunday and Tuesday), from 9am - 2pm, till the needed sample completed, interview of citizens, informed consent obtained from citizens after the investigator introduce himself for each citizen, then explain the purpose of the study to assess knowledge, and reported practice of citizens' awareness regarding Sinai manganese factory hazards at Abu Zenima city at South Sinai governorate. Study collected through structure face to face

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interview and the entire tool filled by the investigator.

- The investigator utilizes two tools, was need 20 -25 minutes and meeting the citizens two days per week (Sunday and Tuesday) from 9am - 2pm.
- The investigator taken 119 citizens per month, total number of citizens = 357 citizens.

III- Administrative Item:

An official Permission was obtained from Dean of Faculty of Nursing Helwan University and official Permission from citizens, at Abu Zenima City in South Sinai Governorate in which the study was conducted. This letter included a permission to collect the necessary data and explain the purpose and nature of the study.

IV- Statistical Item

The collected data from the studied sample was revised, coded and entered using personal computer (PC). Computerized data entry and statistically analyzed using SPSS program (Statistical Package for Social Science) version 24. Data were presented using descriptive statistics in the form of frequencies and relative percentages. Chi square test (X^2) was used to calculate difference between qualitative variables; however, a correlation is used when you have two quantitative variables and a chi-square test of independence is used when you have two categorical variables through this equation:

$$\chi^2 = \sum \frac{(O-E)^2}{E}$$

Where:

Σ=sum O= observed value E= expected P=.0001

Degrees of Significance of the results were:

- Non-Significant (NS) if $p > 0.05$.
-Significant (S) if $p < 0.05$.
-High Significant (HS) if $p < 0.01$.

Result:

Table (1): Shows that, 32.2% of the studied citizens aged ≥ 40 years old with a mean ± SD was **41.78 ± 1.06.** 34.5% of them had secondary education, 79% of them were married, 51.5% of them had enough monthly income and 36.4% of them had 2-4 family members. The crowding rate is 1.6 person for each room.

Table (2): Indicates that, 81.2 %, 31.0 % & 29.7 % of the studied citizens suffered from chronic diseases as high blood pressure and heart disease respectively, furthermore 88.2 % & 73.0 % of the studied citizens were smoking since from 1- < 5 years respectively.

Figure (1): Illustrates that; 45.1% of the studied citizens had poor total knowledge level regarding manganese and its risks, 40.3% of them had average total knowledge level regarding manganese and its risks, while 14.6% of them had good total knowledge level regarding manganese and its risks.

Figure (2): Illustrates that**;** 75.6% of the studied citizens had unsatisfactory total reported practices level, while 24.4% of them had satisfactory total reported practices level.

Figure (3): Shows that; 58.3% of the studied citizen had unsatisfactory home healthy precautions about manganese risk prevention, while 41.7% of them had satisfactory home healthy precautions about manganese risk prevention.

Table (3): Shows that**;** there were statistically significant relation between the studied citizens' total knowledge level and their age and educational level and monthly income ($p<0.05$). While there was no statistically significant relation between the studied citizens 'total knowledge level and other demographic characteristics regarding marital status, and number of family members**.**

Table (4): Shows that; there were highly statistically significant relation between the studied citizens' total home healthy precautions level and their age, educational level and monthly income ($p<0.005$). While there was no statistically significant relation between the studied citizens' total home healthy precautions level and other demographic characteristics regarding marital status and number of family members.

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Table (5): Reveals that; there were highly statistically significant positive correlation between the studied citizens' total knowledge, total reported practices and total home healthy precautions regarding manganese and its risks.

Table (1): Frequency Distribution of the Studied Citizens regarding their demographic Characteristics (n=357).

Demographic characteristics	No.	%
Age/years		
< 20 years	56	15.7
20 < 30 years	79	22.1
30 < 40 years	107	30.0
≥ 40 years	115	**32.2**
Mean ±SD	**41.78 ± 1.06**	
Educational level		
Cannot read and write	0	0.0
Read and write	7	2.0
Basic education	29	8.1
Preparatory education	107	30.0
Secondary education	123	**34.5**
University education or more	91	25.5
Marital status		
Single	49	13.7
Married	282	**79.0**
Divorced	11	3.1
Widowed	15	4.2
Monthly income		
Not enough	124	34.7
Enough	184	**51.5**
Enough and save	49	13.7
Number of family members		
Two members	37	10.4
2-4 members	130	**36.4**
5-7 members	127	35.6
More than 7 members	63	17.6
Number of rooms in the house		
Only one room	30	8.4
2 rooms	38	10.6
3 rooms	86	24.1
More than 3 rooms	203	**56.9**
Crowded index		
Crowding rate	2 person/room	

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Table (2): Frequency Distribution of the Studied Citizens regarding their Past and Current Medical History (n=357).

Past and current medical history	No.	%
Suffers from chronic diseases		
Yes	290	**81.2**
No	67	18.8
***If the answer is yes, mention it? (n=290)**		
High blood pressure	90	**31.0**
Low blood pressure	10	3.4
Diabetic mellitus	54	18.6
Varicose veins	28	9.7
Heart disease	86	**29.7**
Kidney diseases	22	7.6
Others mentioned	0	0.0
Smoking		
Yes	315	**88.2**
No	42	11.8
If yes, since when? (n=315)		
Less than one year	50	15.9
From 1- < 5 years	230	**73.0**
From 5 - < 15 years	26	8.3
≥ 15 years	9	2.9

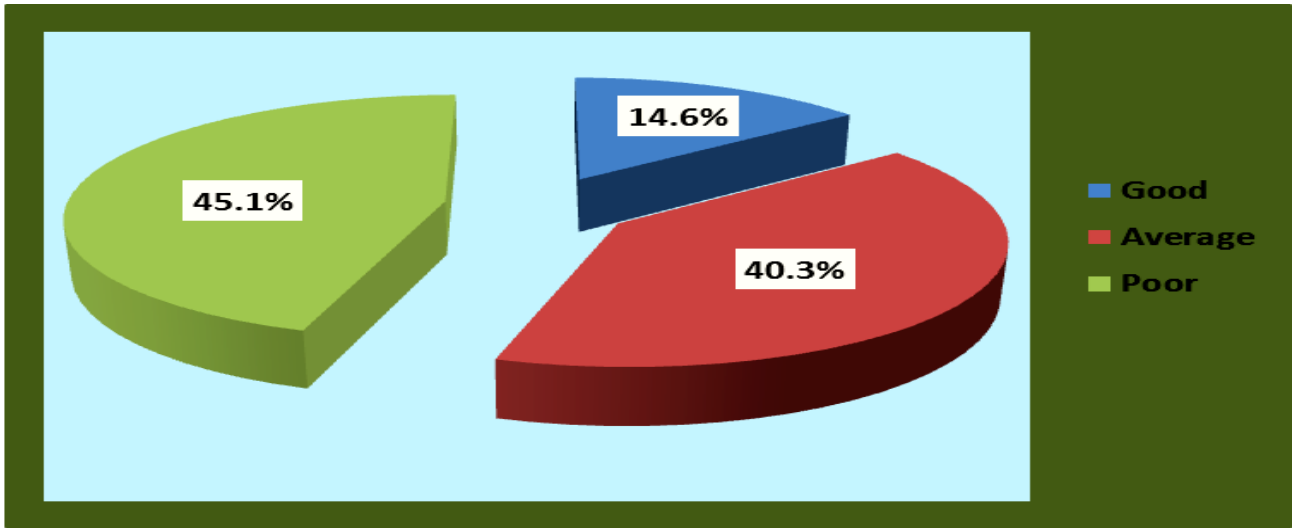

Figure (1): Percentage Distribution of the Studied Citizens' Total Knowledge Level regarding Manganese and Its Risks (n=357).

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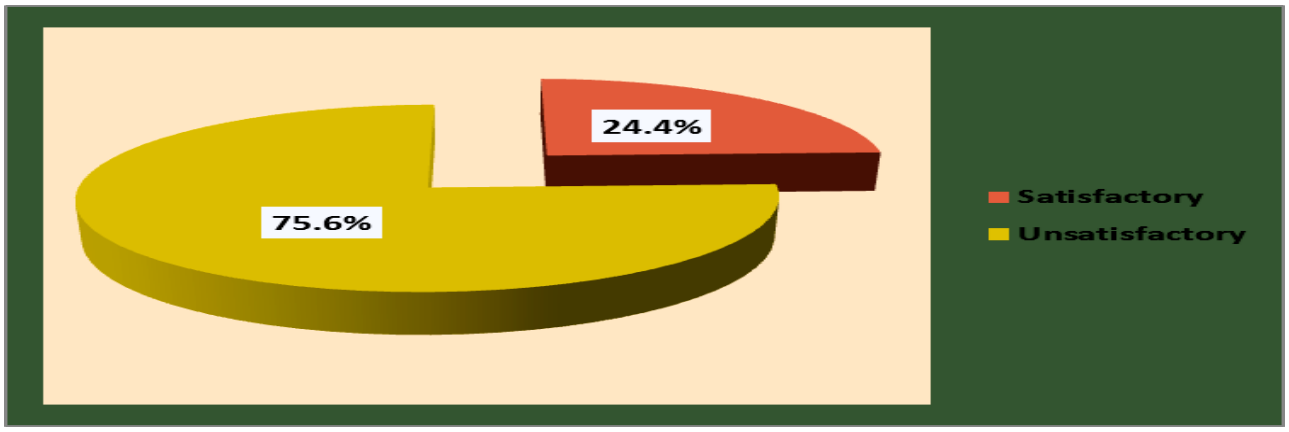

Figure (2): Percentage Distribution of the Studied Citizens regarding Total Reported Practices Level about Manganese Factories Hazards (n=357).

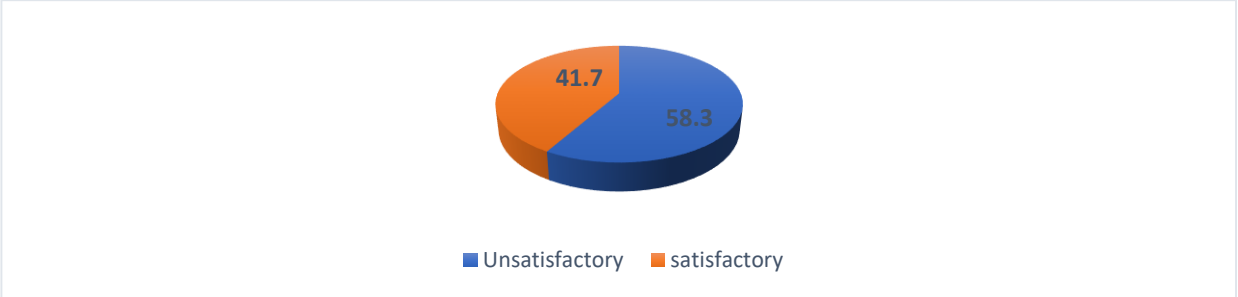

Figure (3): Percentage Distribution of the Studied Citizens regarding Total Home Healthy Precautions about Manganese Risk Prevention (n=357).

Table (3): Relation between demographic Characteristics of the Citizens and their Total Knowledge Level (n=357).

Demographic characteristics	Total knowledge level						X^2	p-value
	Poor (n=161)		Average (n=144)		Good (n=52)			
	No.	%	No.	%	No.	%		
Age/years								
< 20 years	33	20.5	17	11.8	6	11.5	5.382	.043*
20 < 30 years	35	21.7	35	24.3	9	17.3		
30 < 40 years	67	41.6	32	22.2	8	15.4		
≥ 40 years	26	16.1	60	41.7	29	55.8		
Educational level								
Cannot read and write	0	0.0	0	0.0	0	0.0	8.83	.032*
Read and write	٣	1.9	3	2.1	1	1.9		
Basic education	13	8.1	13	9.0	3	5.8		
Preparatory education	47	29.2	45	31.3	15	28.8		
High school education	55	34.2	50	34.7	18	34.6		
University education or more	43	26.7	33	22.9	15	28.8		
Marital status								
Single	22	13.7	21	14.6	6	11.5	2.251	.895
Married	128	79.5	110	76.4	44	84.6		

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Divorced	5	3.1	5	3.5	1	1.9		
Widowed	6	3.7	8	5.6	1	1.9		
Monthly income								
Not enough	57	35.4	51	35.4	16	30.8	.511	.002*
Enough	83	51.6	73	50.7	28	53.8		
Enough and save	21	13.0	20	13.9	8	15.4		
Number of family members								
Two members	17	10.6	14	9.7	6	11.5	.868	.990
2-4 members	57	35.4	55	38.2	18	34.6		
5-7 members	60	37.3	48	33.3	19	36.5		
More than 7 members	27	16.8	27	78.8	9	17.3		

***Statistically significant p < 0.05** ****High statistically significant p < 0.001**

Table (4): Statistically Relation between demographic Characteristics of the Studied Citizens and their Total Home Healthy Precautions (n=357).

Demographic characteristics	Total reported practices				X2	p-value
	Unsatisfactory (n=270)		Satisfactory (n=87)			
	No.	%	No.	%		
Age/years						
< 20 years	42	15.6	14	16.1	6.734	.017*
20 < 30 years	59	21.9	20	23.0		
30 < 40 years	82	30.3	25	28.7		
≥ 40 years	87	32.2	28	32.2		
Educational level						
Cannot read and write	0	0.0	0	0.0	8.69	.003*
Read and write	5	1.9	2	2.3		
Basic education	21	7.8	8	9.2		
Preparatory education	83	30.7	24	27.6		
High school education	93	34.4	30	34.5		
University education or more	68	25.2	23	26.4		
Marital status						
Single	37	13.7	12	13.8	.104	.991
Married	214	79.3	68	78.2		
Divorced	8	3.0	3	3.4		
Widowed	11	4.1	4	4.6		
Monthly income						
Not enough	93	34.4	31	35.6	5.629	.026*
Enough	139	51.5	45	51.7		
Enough and save	38	14.1	11	12.6		
Number of family members						
Two members	29	10.7	8	9.2	.550	.908
2-4 members	100	37.0	30	34.5		
5-7 members	95	35.2	32	36.8		
More than 7 members	46	17.0	17	19.5		

*Statistically significant p < 0.05 **High statistically significant p < 0.001

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Table (5): Correlation between Total Level of Knowledge, Total Level of Reported Practices and Total Home Healthy Precautions among Studied Citizens (n=357).

Variables	Total knowledge	
	r	p-value
Total reported practices	0.8290	0.000**
Total home healthy precautions	0.781	0.000**

**High statistically significant p < 0.001

Discussion

Manganese factories pose several significant hazards due to the nature of the metal and its compounds used in industrial processes. Manganese is an essential element in steel production and various other industrial applications, but exposure to its dust and fumes can lead to severe health risks. Prolonged inhalation of manganese particles can result in manganese, exposure can affect the respiratory system, causing chronic bronchitis and other lung conditions ***(Nylund, 2024).***

Citizens' awareness regarding the hazards associated with manganese factories is crucial for public health and environmental protection. Manganese, a heavy metal used in various industrial processes, can pose significant health risks if not managed properly. Exposure to high levels of manganese is linked to neurological and respiratory issues. Therefore, informed citizens are better equipped to advocate for stricter regulations and safety measures, ensuring that factories implement proper controls to minimize emissions and protect both workers and the surrounding community ***(Ilić et al., 2024).***

Regarding to demographic characteristics of the studied citizens. The present study findings related that mean age of citizens was 41.78 ± 1.06 years. This result is similar to a study conducted by **Adi et al., (2024)** who conducted a study in Indonesia n= 230 about "Trend of critical minerals utilization for Indonesia's Sustainable Energy Transition". They found that, the mean age of studied sample was 42.12 ± 1.20 years.

Concerning the level of education of studied citizens, the current study result revealed that, more than one third of the studied citizens had secondary education. This result in the same line with **Sasongko et al., (2024)** who carried out a study conducted in Indonesia n= 120 about " Trend of critical minerals utilization for Indonesia's Sustainable Energy Transition ", they found that 36.3 % of studied sample had secondary education. From the investigator point of view, secondary education among citizens in Sinai can be attributed to a combination of historical, economic, and social factors. One major factor is the region's challenging geographic and socio-political conditions. Sinai has faced long-standing issues such as limited infrastructure, including inadequate schools and educational facilities, which impedes access to quality education.

Regarding the studied citizens' marital status, the current study revealed that, the more than three quarter of studied citizens were married. This finding was in accordance with **Nguyen et al., (2023)** who conducted a study in Viet Nam n= 200 about " A critical review on the bio-mediated green synthesis and multiple applications of magnesium oxide nanoparticles " they found that, the 76.4 % of studied samples were married. From the investigator point of view, many citizens seek companionship and emotional support as they age. Marriage can provide a stable and enduring relationship that fulfills these needs.

Concerning monthly income of studied citizens, the current study result revealed that, more than half of studied citizens' monthly income were enough. This result in the same line with **Ramadan et al., (2023)** who carried out a study conducted in Egypt n= 130 about " Assessment of health status among workers of textile

ISSN 2786-0183
Helwan International Journal for Nursing Research and Pratctice
Vol. 3, Issue 8, Month: December 2024, Available at: https://hijnrp.journals.ekb.eg/

dyeing industry in the middle region of the Nile Delta Egypt ", they found that 52.5 % of studied sample monthly income were enough. From the investigator point of view, due to a combination of factors related to local economic conditions and cost of living. In many regions, including those with lower costs of living, the income levels might align well with the local prices for goods and services, making it easier for residents to meet their basic needs and maintain a modest standard of living.

Regarding the studied citizens' number of family members, the present study indicated that more than one third of studied citizens had from 2 - 4 members in family. These results agree with **Abdelzaher et al., (2023)** who conducted a study in Egypt n= 100 studied about " A comprehensive study on the fire resistance properties of ultra-fine ceramic waste-filled high alkaline white cement paste composites for progressing towards sustainability ", they found that, 35.6 % of the studied sample had from 2 to 4 members in family. From the investigator point of view, the economic conditions in Sinai can influence family size. Limited economic opportunities and resources might make smaller families more manageable and sustainable. In regions where financial constraints are prevalent, families may choose to have fewer children to ensure that they can provide better care and education for each child, or to align with the economic realities of the region.

Concerning smoking the result of present study revealed that majority of studied citizens were suffer from chronic diseases and less one third of them suffer from high blood pressure. This result in the same line with **Wu et al., (2023)** who carried out a study conducted in China n=150 about " Blood manganese and non-alcoholic fatty liver disease in a high manganese exposure area in China", they found that, 84.7 % of studied sample had suffer from chronic diseases and 30.9 % of them suffer from high blood pressure. From the investigator point of view, manganese is a component of the enzyme superoxide dismutase (SOD), which helps manage oxidative stress in the body. If manganese levels become imbalanced, it could potentially disrupt this balance, leading to increased oxidative stress. Oxidative stress has been linked to the development of hypertension and other cardiovascular diseases.

Concerning to skin problems that the result of current study showed less than half of studied citizens had itching and irritation of the skin. This result in the same line with **Elkadeem et al., (2024)** who carried out a study conducted in Egypt n=150 about "Techno-enviro-socio-economic design and finite set model predictive current control of a grid-connected large-scale hybrid solar/wind energy system: A case study of Sokhna Industrial Zone, Egypt", they found that, 46.2 % of studied sample had itching and irritation of the skin. From the investigator point of view, magnesium deficiency can lead to various skin issues, including itching and irritation. Magnesium plays a role in maintaining skin health by supporting cellular repair and reducing inflammation. A lack of magnesium may result in dry, itchy skin or exacerbate conditions like eczema and dermatitis.

Regarding to digestive system problems the result of present study revealed that more than two fifth of studied citizens had stomach ache. This result in the same line with **Algethami et al., (2024)** who carried out a study conducted in Saudi Arabia n=110 about " Magnetic sporopollenin supported magnesium nanoparticles for removal of tetracycline as an emerging contaminant from water ", they found that, 38.2 % of studied sample had stomach ache. From the investigator point of view, insufficient magnesium levels can lead to gastrointestinal symptoms as stomach cramps, nausea, and diarrhea. Magnesium plays a crucial role in muscle function, including the muscles in the digestive tract. A deficiency might disrupt normal digestive processes, leading to discomfort and pain.

Regarding studied citizens' total knowledge, the current study revealed that, less than half of them had poor knowledge about manganese and its risks, and less than quarter of them had good knowledge, this result agrees with **Liu et al., (2024)** who conducted a study in India about "Systematic review of occurrence and distribution of manganese in drinking water in India and implications for population health.", they found

ISSN 2786-0183
Helwan International Journal for Nursing Research and Pratctice
Vol. 3, Issue 8, Month: December 2024, Available at: https://hijnrp.journals.ekb.eg/

that,16.5 % of the studied sample had good total knowledge and 42.0 % of them had poor knowledge. From the investigator point of view, this may be due to Lack of citizens awareness about manganese and its. Also, most citizens don't attend workshops about manganese

Regarding studied citizens' total reported practices, the current study revealed that, more than three quarter of them had unsatisfactory level in total reported practices about manganese factories hazards, while less than one quarter of them had satisfactory total reported practice, this result agrees with **Ugwu et al., (2024)** who conducted a study in Nigeria about "Evaluating the human health risks of heavy metal contamination in copper and steel factory effluents in Nnewi, Anambra State, Nigeria", they found that, 23.9 % of the studied sample had satisfactory level in total reported practices, and 76.1 % of them had unsatisfactory total reported practices. From the investigator point of view, manganese exposure, particularly in high concentrations, can lead to serious health issues such as neurological disorders, respiratory problems, and other chronic conditions. Knowing these risks helps citizens take appropriate preventive measures to protect their health.

Regarding studied citizens' total home healthy precautions about manganese risk prevention, the current study revealed that, more than half of them had unsatisfactory level in total reported practices about home healthy precautions about manganese risk prevention, while more than two fifth of them had satisfactory total reported practice, this result agrees with **Rachkowski, (2024)** who conducted a study in Canada about "Strengthening environmental protection for a healthier Canada Act: the right to a healthy environment & accountability in chemicals management", they found that, 43.9 % of the studied sample had satisfactory level in total reported practices about home healthy precautions about manganese risk prevention, and 46.1 % of them had unsatisfactory total reported practices. From the investigator point of view, manganese particles can become airborne and be inhaled. Using air purifiers with appropriate filters and ensuring proper ventilation can help control indoor air quality and reduce the risk of inhaling harmful manganese dust.

Regarding to relation between studied citizens' demographic characteristics and their total knowledge, the current study revealed there were statistically significant relation between the studied citizens' total knowledge level and their age and educational level and monthly income. This result agrees with the study done by **Landrigan et al., (2022)** who conducted a study in British about "Principles for prevention of the toxic effects of metals. In Handbook on the toxicology of metals", they found that, there were statistically significant relation between the studied citizens' total knowledge level and their age and educational level and monthly income. From the investigator point of view, recognizing that knowledge levels may vary with age, education, and income helps in designing more effective educational programs and outreach efforts. Tailoring content to different demographic groups ensures that information is relevant and accessible, improving overall public understanding.

Concerning to highly statistically significant positive correlation between the studied citizens' total knowledge, total reported practices and total home healthy precautions regarding manganese and its risks. This result agrees with the study done by **Markiv et al., (2023)** who conducted a study in Spain about "Environmental exposure to manganese and health risk assessment from personal sampling near an industrial source of airborne manganese", they found that, highly statistically significant positive correlation between the studied samples' total knowledge, total reported practices and total home healthy precautions regarding manganese and its risks. From the investigator point of view, understanding that knowledge correlates with better practices emphasizes the importance of educational efforts. Providing accurate and comprehensive information about manganese helps individuals make informed decisions about their actions and behaviors, leading to safer practices.

ISSN 2786-0183
Helwan International Journal for Nursing Research and Pratctice
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Conclusion

Based on the results of the present study and research question the following conclusion includes:

Less than half of the studied citizens had poor total knowledge about manganese and its risks, more two thirds of them had unsatisfactory total reported practices regarding manganese factories hazards and less than half of them had satisfactory home healthy precautions about manganese risk prevention. Also, there were statistically, significant relation between citizens' sociodemographic data, their knowledge, reported practices and total home healthy precautions regarding manganese and its risks. In addition, there were highly statistically Significant positive correlation between studied citizens total knowledge, total reported practices and home healthy precaution regarding manganese its risks.

Recommendations

In the light of the result of this study, the following recommendations were suggested:

- Provide health education program for citizens about manganese factory hazards.
- Design booklets about manganese factory hazards and home healthy precautions about manganese risk prevention for citizens.
- Design posters and put in home of manganese factory hazards that would help citizens to improve' knowledge, reported practices and home healthy precautions about manganese risk prevention.
- Encourage citizens to make group discussion regarding manganese factory hazards to exchange knowledge, and practice about healthy precautions about manganese risk prevention used under supervision from community health nurse.
- Apply further research on large sample and other setting for generalization.

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