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Population's Knowledge Level, Attitude, and Preventive Practices Regarding Carbon Monoxide Poisoning: Sohag, Egypt

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Abstract

Background: Carbon monoxide poisoning is a severe health issue worldwide and it is one of poisonings that results in death in Egypt. So, it is crucial that the public is made aware of it**. Objectives:** The goal of this study was to evaluate knowledge level, attitude, and preventive practices toward carbon monoxide poisoning in a sample of populations in Sohag governorate, Egypt. **Methodology**: This cross-sectional study included 600 participants from Sohag governorate's populations. An Arabic-language interviewing survey was used. The questionnaire was consisted of three sections: knowledge, attitude, and preventive practices regarding carbon monoxide poisoning. **Results**: Evaluating the knowledge level of the participants toward carbon monoxide poisoning showed that 34.7%, 32.8%, and 32.5% of them have poor, moderate, and good knowledge levels respectively. The majority of participants (87.2%) exhibited a positive attitude, while 8.5% had a neutral attitude, and only 4.3% displayed a good attitude. Considering the prevention practices, among the participants, 43.7% shown good behaviors, while 30% exhibited poor practices, and 26.3% displayed moderate activities. **Conclusion**: Participants' knowledge about carbon monoxide poisoning was limited, but their positive attitude and prevention practices were encouraging. **Recommendations**: Public health education campaigns and increased awareness on social media and television are recommended.

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Key words CO poisoning, knowledge, attitude, practice

Introduction

The toxic gas carbon monoxide (CO) is colorless, odorless, tasteless, and non-irritating. Due to these physical characteristics, it has been referred to as the silent killer. Carbon monoxideis generally created when carbonaceous materials burn incompletely (Dorey et al., 2020 & Nalcı and Bayram, 2024).

Common sources of CO poisoning include malfunctioning gas heating systems, unattended running automobiles, generators, kitchen appliances, fire, and methylene chloride present in paint removers. The elevation in electricity prices, decreased fuel supply, increase the demand for home heating fuel in the winter will provoke many people to use wood and charcoal for warmth, as a consequence will rise the incidents of unintentional CO home poisoning (Lisbona and Hamnett, 2018 & Shehata et al., 2023).

Carbon monoxide has a 200-fold higher affinity for hemoglobin than oxygen. It combines with hemoglobin to generate carboxyhemoglobin leading to decrease the oxygen carrying capacity of hemoglobin. So, the primary pathophysiological mechanism of acute CO poisoning is hypoxia brought on by impaired oxygen delivery (Sekiya et al., 2019).

Carbon monoxide also binds to other haeme-containing proteins that include mitochondrial cytochrome c oxidase (COX; complex IV) and myoglobin in the skeletal muscle and heart. Carbon monoxide hinders mitochondrial oxidative phosphorylation, raises the levels of cytosolic haeme, and causes oxidative stress. Furthermore, it interfers with cellular respiration and causes reactive oxygen species (ROS) to be produced. Reactive oxygen species subsequently induce neuronal necrosis, apoptosis, and persistent inflammation resulting neurological damage (Rose et al., 2017 & Wang and Zhang, 2024).

Carbon monoxide poisoning is one of the leading causes of both deliberate and incidental morbidity and mortality worldwide (Liao et al., 2019). It is a serious health hazard in many developing countries. Carbon monoxide poisoning is a major cause of poisonings that result in death in Egypt (Abdel Aziz et al., 2021).

Acute symptoms of CO poisoning include general malaise, nausea, vomiting, dizziness, headache, and altered mental status (Weaver, 2020). Following an apparent recovery from early symptoms, patients with CO poisoning may develop neurological aftereffects, including Parkinsonism, psychosis, personality abnormalities, memory issues, and impaired attention (Lin et al., 2018).

Infants, elderly, patients with heart and lung diseases and anemia, pregnant women and their fetus, smokers, and people with elevated CO levels are some of the special categories in the population who are more susceptible to CO poisoning (Smollin and Oslon, 2010 & Sönmez, 2015).

The conventional treatment of CO poisoning is normobaric oxygen and hyperbaric oxygen (HBO). Hyperbaric oxygen is usually indicated in patients with

transient loss of consciousness or coma, hypotension, metabolic acidosis, evidence of myocardial injury, and COHb > 25% (Rose et al., 2017 & Wolf et al., 2017).

Unintentional CO poisoning has not gotten enough attention despite being a mostly preventable and avoidable cause of mortality. To encourage mortality reductions, it is necessary to educate the public about the causes and dangers of CO exposure (Moberg et al., 2023). The goal of this study was to evaluate the knowledge level, attitude, and preventive practices toward carbon monoxide poisoning in a sample of populations in Sohag governorate, Egypt.

Subjects and Methods

Study setting:

This cross-sectional study was carried out in Sohag governorate, Upper Egypt, from April to August 2024. It was applied to 600 male and female participants.

Study tools:

According to a prior study that had been published, the questionnaire was modified (AlMulhim et al., 2022). For this study, the questionnaire included twenty questions. It was prepared in Arabic form. The collection of data was done by interviewing the participants. Information regarding demographic data of participants, which includes age, gender, occupation, education level and place of residence, were requested. It was consisted of three sections: knowledge of CO poisoning (questions 8-13), attitude regarding CO poisoning (questions14-17), and preventive practices regarding CO poisoning (questions 18-20). Prior to the study commence, the questionnaire was pretested on ten participants to make sure they could understand every question

Inclusion and exclusion criteria:

The study included participants males and females (18 years and above) who were willing and available to participate and excluded all participants were not willing to participate in the study. Health care providers were excluded.

Sample size:

Based on a previous study by (AlMulhim et al. 2022) which found that the prevalence of people who had heard about CO poisoning was 52.1%. The sample size was calculated for the current study as 384 participants using the following formula (Charan and Biswas, 2013):

$$\text{Sample size} = \frac{(Z1-\alpha/2)\ 2\ P\ (1-P)}{d2}$$

Here:

Z1-α /2 = Is standard normal variate (at 5% type 1 error (P<0.05) it is 1.96)

p = Expected proportion of who heard of CO poisoning (52.1%).

d = Absolute error or precision (0.05)

The sample size was increased to 600 subjects to assume any drop out cases.

Ethical Considerations

The aim of the research was explained to the participants through an interview at the beginning of the questionnaire. Informed written consent was taken from participants after explanation of the method of participation in the questionnaire. Participation in the study was voluntary without providing any rewards and carried no risk for participants. Participants were informed about their right to withdraw at any time without any consequences. The questionnaire was anonymous, and no identifying information would be shared. This study got the approval of the Medical Research Ethics Committee of the Faculty of Medicine, Sohag University. The Institutional Review Board (IRB) registration number: Soh-Med- 24-03--10PD.

Data analysis

The gathered data were examined using IBM SPSS Statistics, Version 20. The results were calculated on a percentage basis and analyzed using the Chi-square test. The reliability of the questions was tested (Cronbach's Alpha = 70%), and their validity was assured.

Results

Socio-demographic data of the participants

A comprehensive total of 600 individuals fulfilled the inclusion criteria for participation in this study. Regarding the socio-demographic characteristics of the participants, approximately fifty-eight percent (58.2%) of them were females and forty-one percent (41.8%) were males. The distribution of age among the participants was 38.5% (18 to 30 years), 37.2% (31to 40 years), and 24.3% (41 to 60 years). In relation to the education level, 39.5% of the participants possessed a university degree, 24.2% secondary or below, 20% uneducated, and 16.3% postgraduate. Considering the employment Status, the most commonly reported ones were: 41.5% employee, 29.8% not working, 18.7% workers, and 10% students. Urban participants in this study were 46.3%, while rural ones were 33.3% (Table 1).

In terms of hearing about CO poisoning, a significant majority of 403 (67.2%) participants stated that they had heard about it (Figure 1). Regarding the sources of information about CO poisoning, the commonest source was social media (24%) followed by friends and family (21%) as illustrated in figure (2).

Knowledge of the Participants

Asking the participants if CO gas has a characteristic smell and a distinctive color, their responses were 35.8%, 31.5% (I don't know), 33.2%, 53.8% (No), and 31%, 14.7% (Yes) respectively. Participant's responses about if there is an increase in CO poisoning incidence in certain season of the year variation were: 58.8% (I don't know), 30.7% (yes), and 10.5% (No) respectively. Regarding participant's knowledge about the sources of Co exposure, the most common ones were heater/fireplace (44.5%), coal combustion (17.2%), car exhaust (12.3%), while (28.7%) of participants stated that they don't know. About thirty percent (30%) of the participants reported that they don't know any symptoms or signs of Co poisoning, while other responses were: loss of consciousness (26.2%), fatigue, headache and loss of concentration (22.7%), and nausea/vomiting (20.5%). When asked about the first action that will be taken in suspicion of CO poisoning, 47.7% of participants said that opening windows and doors to allow air circulation is the best action, while 23.7% of them said

that removal of the person from the place of poisoning is better. Mean score and standard deviation of participants' overall knowledge scores about CO poisoning was (3.30 ±1.85). In this study evaluating the knowledge level of the participants toward CO poisoning showed that 34.7%, 32.8%, and 32.5% of them have poor, moderate, and good knowledge levels respectively (Table 2).

About the comparison of knowledge level with socio-demographic characteristics of participants, a statistically significant relationship was noted with gender (<0.001), age (0.004), level of education (<0.001), and employment status (<0.001) as presented in table 3.

Attitude of the Participants

Regarding, smoking (cigarettes or shisha) indoor or in poorly ventilated places, most of the respondents 90.3% said no, while 9.7% of them said yes. The majority of the (90.2%) participants stated that they don't use the heater in enclosed or poorly ventilated spaces. In addition, 87% of the participants don't light fire/wood/ charcoal for heating or cooking in enclosed or poorly ventilated areas, while, 13% of them do. About 79% of the respondents are care about opening windows where the gas heater is located and during its use and on the other side 21% of them aren't care (Figure 3). The mean score for the total attitude was 3.47, with a standard deviation of 0.86. The majority of participants (87.2%) exhibited a positive attitude, while 8.5% had a neutral attitude, and only 4.3% displayed a good attitude (Table 4).

Prevention practices of the Participants

Considering the prevention practices, 77% of the participants acknowledged the effectiveness of using windows and air vents to diminish CO accumulation. in addition, 67.3% realized the necessary of annual maintenance of heaters, ventilation systems, and gas appliances to reduce the risk of CO poisoning. Regarding the importance of having a CO detector in their houses, 51% of them said yes (Figure 4).

The mean ± SD for prevention practices score was (1.95±1.13). Among the participants, 43.7% shown good behaviors, while 30% exhibited poor practices, and 26.3% displayed moderate activities (Table 5). Regarding the correlation between the knowledge and attitude scores, the present study detected a statistically significant positive association (p=0.001& r= 0.222) as illustrated in table 6 and figure 5.

Table (1): Distribution of Socio-demographic data of the 600 participants in the current study

Questions	N	%
Gender		
Male	251	41.8
Female	349	58.2
Age		
18-30	231	38.5
31-40	223	37.2
41-60	146	24.3
Level of education		
Uneducated	120	20.0
Secondary or below	145	24.2
University degree	237	39.5
Postgraduate	98	16.3
Employment Status		
Employee	249	41.5
Worker	112	18.7
Student	60	10.0
Not working	179	29.8
Residence		
Urban	398	46.3
Rural	202	33.7

N= number

Table (2): Distribution of Knowledge among the 600 participants in the current study

Questions	N	%
Does carbon monoxide have a characteristic smell for its emission?		
Yes	186	31.0
No	199	33.2
I don't know	215	35.8
Does carbon monoxide have a distinctive color?		
Yes	88	14.7
No	323	53.8
I don't know	189	31.5
Does carbon monoxide poisoning increase in certain seasons of the year?		
Yes	184	30.7
No	63	10.5
I don't know	353	58.8
What is the source of carbon monoxide?		
Fire smoke	60	10.0
Coal combustion	103	17.2
Car exhaust	74	12.3
Smoking/Hookah	14	2.3
Heater/Fireplace	267	44.5
I don't know	172	28.7
Which of these marks or signs makes you suspect carbon monoxide poisoning?		
Fatigue, headache and loss of concentration	136	22.7
Nausea/vomiting	123	20.5
Loss of consciousness	157	26.2
I don't know	184	30.7
If carbon monoxide poisoning is suspected, the first action that will be taken is:		
Removal of the person from the place of poisoning	142	23.6
Open windows and doors to allow air circulation	286	47.7
I don't know	172	28.7
Total knowledge score (Mean ±SD)	3.30 ±1.85	
The level of knowledge		
Poor	208	34.7
Moderate	197	32.8
Good	195	32.5

N= number, SD: standard deviation

Table (3): Chi-square statistical analysis of association between the level of knowledge and demographic characterization of the 600 participants in the current study

Questions	Level of knowledge						χ^2	P
	Poor		Moderate		Good			
	N	%	N	%	N	%		
Gender								
Male	114	54.8%	85	43.1%	52	26.7%	32.96	<0.001**
Female	94	45.2%	112	56.9%	143	73.3%		
Age								
18-30	76	36.5%	75	38.1%	80	41.0%	15.55	0.004*
31-40	64	30.8%	76	38.6%	83	42.6%		
41-60	68	32.7%	46	23.4%	32	16.4%		
Level of education								
Uneducated	90	43.3%	22	11.2%	8	4.1%	144.79	<0.001**
Secondary or below	38	18.3%	72	36.5%	35	17.9%		
University degree	62	29.8%	79	40.1%	96	49.2%		
Postgraduate	18	8.7%	24	12.2%	56	28.7%		
Employment Status								
Employee	62	29.8%	89	45.2%	98	50.3%	45.90	<0.001**
Worker	66	31.7%	32	16.2%	14	7.2%		
Student	22	10.6%	20	10.2%	18	9.2%		
Not working	58	27.9%	56	28.4%	65	33.3%		
Residence								
Urban	130	62.5%	128	65.0%	140	71.8%	4.136	0.126
Rural	78	37.5%	69	35.0%	55	28.2%		

N= number, χ2 Chi square test, p<0.05*significant, p<0.001** highly significant

Table (4): Mean and Standard Deviation of attitude score and level among the 600 participants toward CO poisoning in the present study

Total attitude score (Mean ±SD)	3.47 ± 0.86	
The level of attitude		
Negative	26	4.3
Neutral	51	8.5
Positive	523	87.2

SD: standard deviation

Table (5): Mean and Standard Deviation of practice score and level among the 600 participants toward CO poisoning in the present study

Total practice score (Mean ±SD)	1.95 ±1.13	
The level of practices		
Poor	180	30.0
Moderate	158	26.3
Good	262	43.7

SD: standard deviation

Table (6): Correlation of knowledge score and attitude score among 600 participants in the current study

	Total knowledge score	
Total attitude score	**r**	**P**
	0.222	**<0.001****

(r) Correlation Coefficient, p<0.001** highly significant

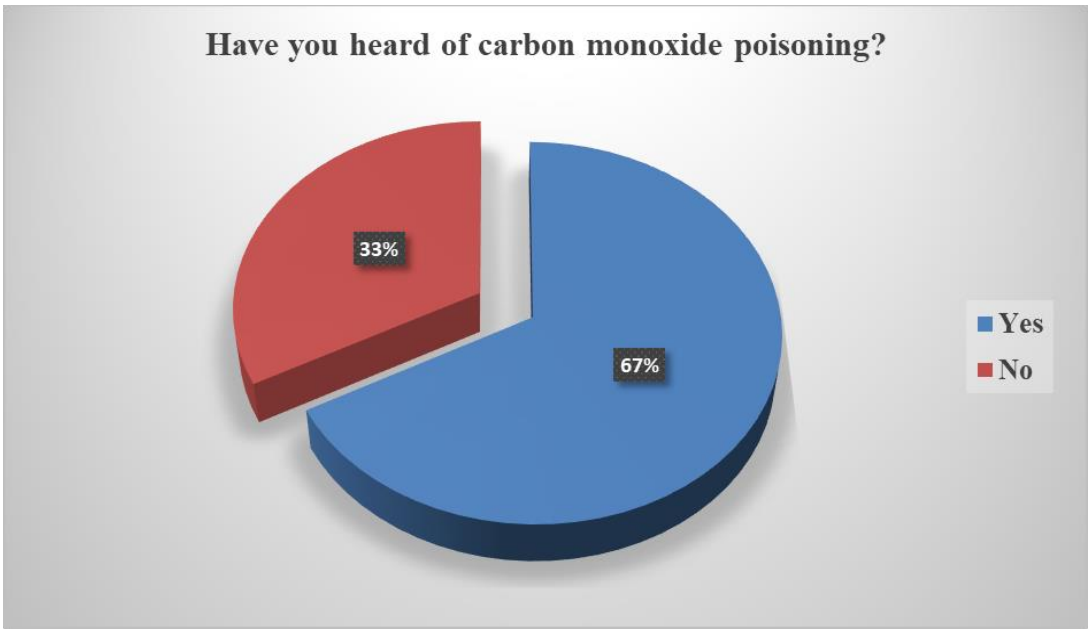

Figure (1): Percentage of participants who had heard about CO poisoning

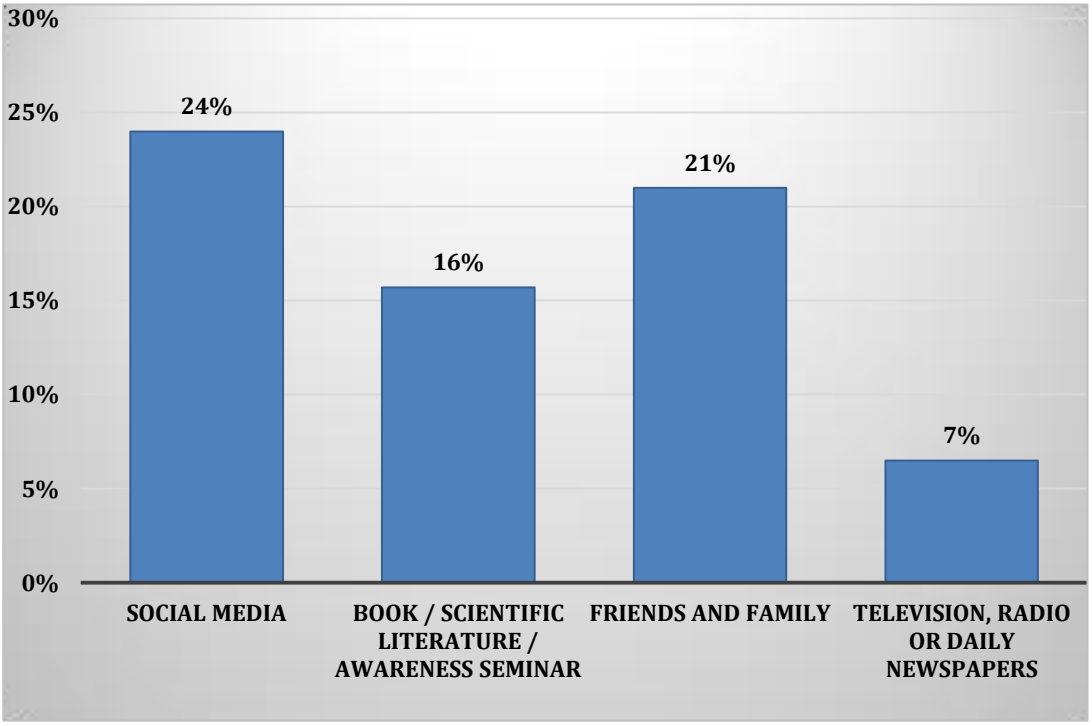

Figure (2): Sources of information about CO poisoning

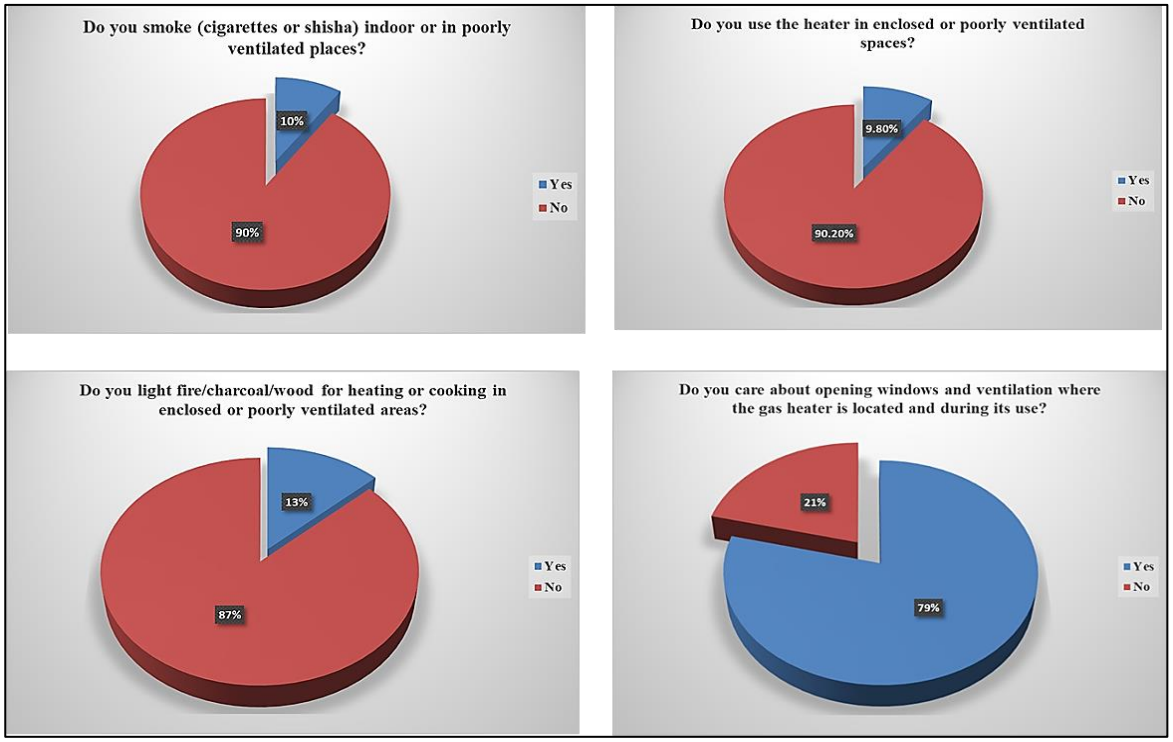

Figure (3): Assessment of participants' attitude toward CO poisoning

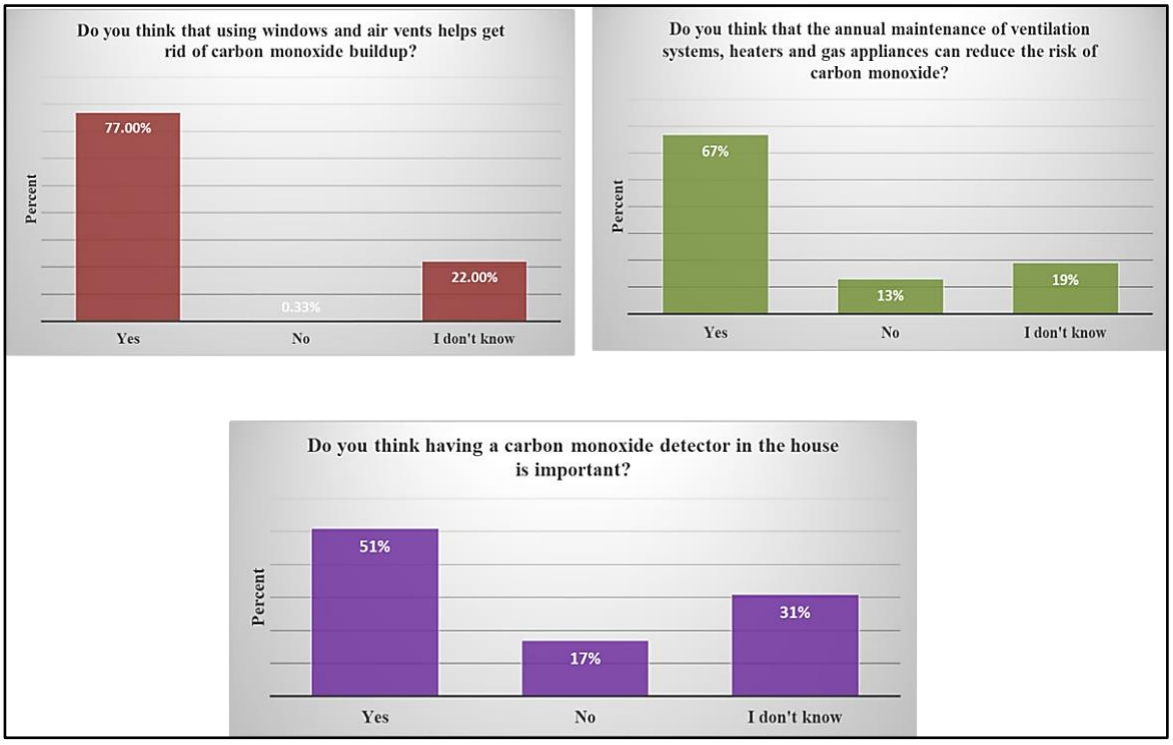

Figure (4): Assessment of participants' prevention practices about CO poisoning

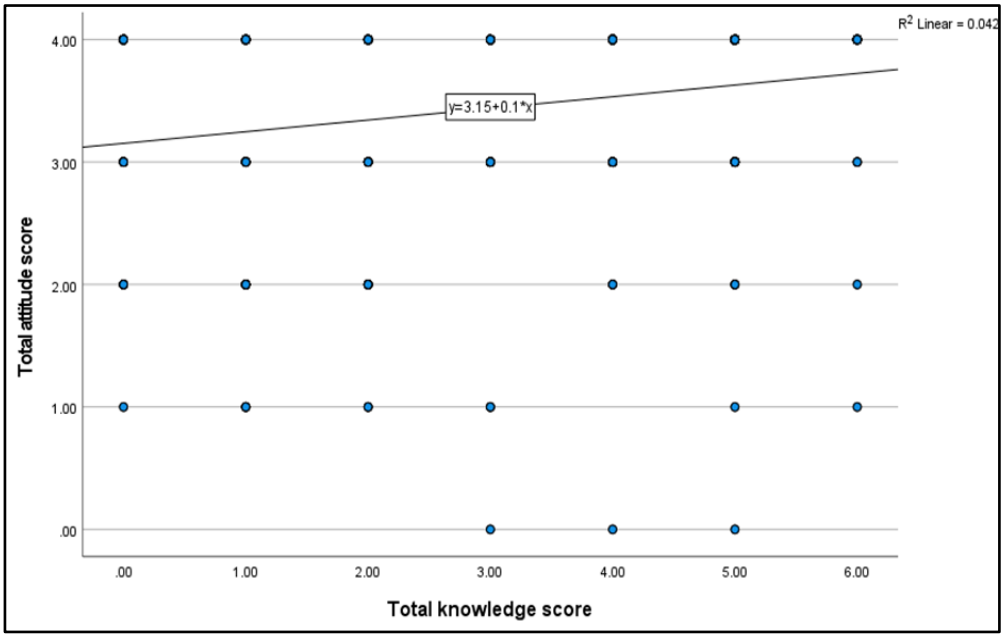

Figure (5): Correlation of knowledge and attitude scores

Discussion

Carbon Monoxide is one of the most common environmental causes of acute intoxication globally. Despite the lethality of CO poisoning and growing importance of increasing knowledge, attitude and preventive practices toward CO poisoning, no researches in Egypt studied the level of awareness of people toward it.

About two-thirds of the respondents in the study had heard of CO poisoning. Compared to males, the majority of them were female. Half of them had a bachelor's degree. Additionally, it was observed that half of them worked as employees. Compared to just one-third of rural urban participants were the most likely to be heard. The most reliable source of information about CO poisoning was social media, followed by friends and family. AlMulhim et al. (2022) mentioned this before in previous study among Saudis, explained the expanding influence of social media on the people.

As regard participants' awareness of Co poisoning, just 33% and 53% of them correctly answered that CO doesn't have a distinctive color or smell, while over one-third of them are unaware of this fact. This was verified by study in Poland by Popiolek et al. (2021), who observed that most of people are unaware of the characteristics of CO gas. This showed some people's lack of knowledge about the physical characteristics of CO that could raise the danger of poisoning.

A third of participants in Germany in a study carried out by Jungnickel et al., (2019) believed they could identify CO by color or odor. This false information gave them a false sense of security against CO poisoning. More than 50% of the participants were unaware that CO-poisoning increases throughout specific seasons. Unfortunately, the population's poisoning rate could rise, as winter has been found to be the season most common for CO poisoning cases (Alharthy et al., (2024). Hence there is a great concern to explain that to the participants. It was notable that over half of the participants were aware of the hazardous role that gas heaters and fireplaces play in producing CO gas, while coal combustion coming in next (17.2%). Unfortunately, one-third of those surveyed were unaware of the source of CO gas. This increases the danger of CO poisoning among them, since the annual frequency of CO poisoning owing to the use of gas heaters increases in North Africa and the Middle East (Alberreet et al., 2019).

This present conclusion was supported by Alajai et al., (2023), who discovered that approximately 43% of respondents' answers were heater and fireplace.

Hajjar et al., (2016) found that the predominant CO source among Saudis was the combustion of coal or firewood. Approximately two-thirds of people were aware of various CO poisoning symptoms. One-quarter of participants thought that loss of consciousness was an indication of poisoning. About 22% indicated that loss of concentration, headache, and exhaustion were the initial indicators of CO poisoning. The remaining 20% of participants chose nausea and vomiting as frequent CO poisoning symptoms.

According to a research by Alharthy et al., (2024) in Riyadh, CNS manifestation was mentioned as the most prevalent signs and symptoms of CO poisoning worldwide.

Regarding the degree of knowledge convergent findings were often seen. Of the participants, 34% were classified as having very little information, 33% as having a moderate level of awareness, and just 32% as having a high level of comprehension. Participants with a bachelor's degree had a better knowledge score than others. This demonstrates that knowledge increases as one's level of education increases. Popiolek et al. (2021), found comparable results among medical and non-medical respondents in Kraków in

Poland. As regard participant's attitude toward CO poisoning, more than three quarters had positive attitude. Only 4% had poor attitude.

Most of the participants had good attitude mentioned that they didn't smoke indoor or use heater in poorly ventilated space and they didn't light fire or charcoal in closed space. Opening of windows and good ventilation were an important method for avoiding CO poisoning. More than three quarter of participants do that. The increase in percentage of participants had good attitude could be due to instructions of usage gas heater and the awareness campaign on TV and social media directed toward good ventilation of places in presence of source of emission of CO poisoning.

Alajai et al., (2023), found a negative attitude among respondents, which opposes the findings. This might be owing to the great lack of knowledge exhibited by 67.6% of participants.

Concerning the preventive practices, nearly half of participants were noticed to have good level of practice as compared to 26% and 30% had moderate and poor level of practice. This was in accordance with AlMulhim et al., (2022), who noticed that more than half of respondents in Saudi Arabia had good level of practice.

Notably, the average proportion of participants were aware that proper ventilation aids in removing CO buildup, that yearly ventilation system maintenance lowers the danger of CO poisoning, and that CO detectors are essential. These were supported by findings reported by Al-Mulhim et al., (2022) and Emami-Razavi et al., (2014) among participants in Saudi Arabia and Iran who observed that a significant portion of individuals had the same viewpoint.

As regard correlation of knowledge and attitude the study found a statistically significant positive association between knowledge and attitude scores. This meant that as the level of education increase more positive attitude will present.

Conclusion

There was lack in level of knowledge among participants in the present study regarding CO poisoning. In spite of that the level of good attitude and good prevention practice were encouraging. It was noticed that as the level of education increases, the awareness among population increases.

Recommendations

Carbon monoxide poisoning is a severe issue in society, it is crucial that the public is made aware of it. It results in very significant health issues. The study's findings clarify the gaps in awareness campaigns regarding CO-poisoning symptoms, signs, risk factors, and preventive measures. As a result, more public health education campaigns are advised for students in schools and universities as well as for workplaces. The doctors in Ministry of health hospitals should talk with people about the danger of CO poisoning specially in winter. Also, more efforts toward awareness of CO poisoning should be increased on social media and television because of their expanding roles. More researches to determine how such efforts affect people's knowledge and attitudes must be carried out.

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مستوى المعرفة والتصرف والممارسات الوقائية للسكان فيما يتعلق بالتسمم بأول أكسيد الكربون: سوهاج، مصر

آيه مجدى القاضى و هند محمد أحمد و هند جمال عارف [١]

الملخص العربى

المقدمة: التسمم بأول أكسيد الكربون هو مشكلة صحية خطيرة في جميع أنحاء العالم وهو أحد حالات التسمم التى تؤدي إلى الوفاة في مصر. لذلك، من الأهمية بمكان أن يكون الناس على دراية به.

الهدف من الدراسة: كان هدف هذه الدراسة هو تقييم مستوى المعرفة والتصرف والممارسات الوقائية تجاه التسمم بأول أكسيد الكربون في عينة من السكان في محافظة سوهاج، مصر.

طريقة البحث: شملت هذه الدراسة المقطعية ٦٠٠ مشارك من سكان محافظة سوهاج. تم استخدام استبيان باللغة العربية عن طريق المقابلة. يتكون الاستبيان من ثلاثة أقسام: المعرفة والموقف والممارسات الوقائية فيما يتعلق بالتسمم بأول أكسيد الكربون.

النتائج: أظهر تقييم مستوى معرفة المشاركين تجاه التسمم بأول أكسيد الكربون أن ٣٤.٧٪ و ٣٢.٨٪ و ٣٢.٥٪ منهم لديهم مستويات معرفة ضعيفة ومتوسطة وجيدة على التوالي. كما أظهر غالبية المشاركين (٨٧.٢٪) موقفًا إيجابيًا، بينما كان لدى ٨.٥٪ موقف محايد، وأظهر ٤.٣٪ فقط موقفًا جيدًا. وبالنظر إلى الممارسات الوقاية، أظهر ٤٣.٧% من المشاركين سلوكيات جيدة، بينما أظهر ٣٠% ممارسات سيئة، وأظهر ٢٦.٣% سلوكيات معتدلة.

الإستنتاج: كانت معرفة المشاركين بالتسمم بأول أكسيد الكربون محدودة، لكن موقفهم الإيجابي وممارساتهم الوقائية كانت مشجعة.

التوصيات: يوصى بزيادة حملات التثقيف الصحي في المدارس وفي مستشفيات وزارة الصحة وزيادة الوعي على وسائل التواصل الاجتماعي والتلفزيون.

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