EMERGENCY NURSES' KNOWLEDGE AND ATTITUDE TOWARDS CARING FOR CARBON MONOXIDE POISONED PATIENTS IN ISMAILIA GOVERNORATE, EGYPT

BY

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ABSTRACT

Introduction: Reduced fuel supply, rising electricity prices, and rising demand for home heating fuel in the winter will prompt many people to use wood and charcoal for warmth, consequently will rise fears of increasing carbon monoxide (CO) intoxication. Emergency nurses need to be knowledgeable about this threatening condition to satisfactorily deal with it. **Objective(s):** To assess the emergency nurses' level of knowledge and attitude toward caring for carbon monoxide poisoning. **Methods:** A cross-sectional study was utilized. It was conducted on all nurses in the emergency department of Ismailia University Hospitals. Ninety-seven nurses were recruited as a convenient sample. Data were collected via questionnaire from April to September 2022. The questionnaire assessed nurses' demographic data, level of knowledge as well as attitude towards caring for carbon monoxide poisoned patients. **Results:** The findings of this study revealed that extra than of two third (68%) of the studied nurses had unsatisfactory knowledge's level, while 46.4% had a negative attitude score towards caring for carbon monoxide poisoned patients. The total knowledge score was a significant predictor of nurses 'attitude score. **Conclusions:** Even though the majority of the nurses in the survey had good attitude scores, the study found that more than two-thirds of them had insufficient knowledge levels. **Recommendations:** This study supports the necessity for in-service training courses continuity for emergency nurses to enhance their level of knowledge and attitude. Generalizing the findings, more research should be conducted on a wider scale, large probability sample and different geographical area.

Keywords: *Attitude, Carbon Monoxide Poisoning, Emergency Nurses, Knowledge, Incomplete combustion, Toxic asphyxiation*

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INTRODUCTION

Reduced fuel supply, rising electricity prices, and rising demand for home heating fuel in this winter will prompt many people to use wood and charcoal for warmth. Notably, incomplete combustion of wood will rise fears of increasing carbon monoxide (CO) intoxication ***(Stromberg, 2020; Gandidzanwa and Togo, 2022).*** Globally, CO poisoning is a major factor in morbidity and mortality**.** In many developing nations, it continues to pose a severe health concern. It is one of the leading causes of poisonings that result in death in Egypt. CO poisoning occurs more frequently than is acknowledged ***(Hess, 2017; Abdel Aziz et al., 2021).*** The number of CO-related deaths is significantly unrecorded, or the majority of these instances were misdiagnosed by healthcare professionals ***(El-Gharbawy and Khalifa, 2019).*** Accordingly, the actual number of fatal CO poisonings is therefore undisclosed. Undiagnosed patients might constitute a silent pandemic of enormous proportions with catastrophic social and financial repercussions***(APCMG, 2017).***The patient will have the best probability of surviving if the critical care nurse keeps a raised degree of doubt ***(Ruth-Sahd, et al., 2011; Gözübüyük, 2017).*** Considering its physical and chemical characteristics, CO continues to be a sneaky and quiet murderer ***(Mureşan, et al., 2019).*** Such a colorless, odorless gas is produced when carbon-containing things burn incompletely ***(Ho, et al., 2012; Gözübüyük, 2017).***

Numerous proteins that contain ferrous heme bind to CO with a high degree of affinity. The affinity for hemoglobin (Hb), which CO binds to create carboxyhemoglobin (HbCO), is the most significant of these affinities. Hemoglobin's affinity for CO is 218 times larger than its affinity for oxygen ***(Sönmez, et al., 2015; Harding, et al., 2019).*** As a result, CO promotes hypoxia by lowering both the oxygen carrying capacity and

the O2 delivery to tissues. Such CO-induced tissue hypoxia affects a number of organs. Beyond the hypoxia brought on by HbCO, other processes also contribute to CO toxicity. A multitude of pathways contribute to the direct cellular alterations brought on by CO poisoning, including immunological or inflammatory damage.

The discovery that the clinical presentation frequently does not match with the blood HbCO level is elucidated by these CO-induces toxic effects ***(Gözübüyük, 2017; Hess, 2017; Kinoshita, et al., 2020).*** Accidental and deliberate CO poisonings is thought to be widespread. Unattended running automobiles, malfunctioning gas heating systems, generators, kitchen appliances, methylene chloride in paint removers, and fire are some common sources of CO poisoning. The increase in unintentional CO home poisoning incidents throughout the winter could be attributed to the colder temperatures and power outages, which result in a greater reliance on gasoline generators and other alternative heating sources, in addition to the decrease in home ventilation ***(Ho, et al., 2012; Lisbona and Hamnett, 2018).***

Patients with CO poisoning and its consequences can have better results with prompt diagnosis and treatment. To ensure proper treatment, healthcare professionals should be aware of the warning signs and symptoms of CO poisoning as well as its terrifying repercussions ***(Quinn, et al., 2009).*** Uncertainty surrounding the diagnosis may encourage unfavorable results, even disastrous ones, with some patients being returned to the poisonous environment they were initially exposed to ***(Mattiuzzi and Lippi, 2020).*** Because of its exceedingly vague and confusing symptoms, CO poisoning frequently results in diagnostic mistakes ***(Davico and Notari, 2016).*** Accordingly, acute care nurses must hold a strong degree of concern in order to commence early patient management ***(Ruth-Sahd, et al., 2011).***

The optimal clinical triad for determining whether someone has CO poisoning is: (1) symptoms that are compatible with CO poisoning; (2) a history of current CO exposure; and (3) increased COHb values. These standards are not stringent ***(Rose, et al. 2017).*** CO poisoning is a multisystem illness that can generate a perplexing set of clinical characteristics and appear with a wide variety of symptoms. It typically exhibits vague symptoms resembling flu-like conditions. Clinically, the cardiovascular system and the central nervous system (CNS) are the highly involved. Delayed neurological sequelae (DNS) may arise in certain individuals with acute CO following an asymptomatic lucid phase ***(Ho, et al., 2012; Afolayan, et al., 2014; Sönmez, et al., 2015; Gözübüyük, 2017).*** A structured treatment plan with sufficient follow-up and neuropsychiatric exams is advised to identify DNS related to CO poisoning ***(Chan et al., 2016).***

Complications in CO poisoned individuals are thought to be difficult to predict, but if they are caught early and treated effectively, they may be avoided ***(Elhawary and Sagah, 2022).*** As regards health history taking, the patient's heating system or any other potential CO poisoning risk factors must be brought up by the acute critical care nurse. Finding the precise time and location of acquiring the patient's symptoms might aid in locating a CO source. The critical care nurse must consider whether other family members have the same symptoms and are also unwell. If any indoor pets are acting strangely, the nurse should inquire about it as well. Unfortunately, many patients are discovered unconscious or very unwell, making it impossible to get their histories ***(Ruth-Sahd, et al., 2011; Rose, et al., 2017).***

Concerning the COHb level, the detection of high COHb levels in the blood should validate the exposure-related diagnosis ***(Harding, et al., 2019).*** High COHb levels may be missed by conventional pulse oximetry, which is why pulse CO oximetry values should be verified by laboratory measurements ***(Rose et al., 2017; Harding, et al., 2019).*** Despite the regular monitoring of blood COHb levels in CO poisoning patients, the clinical presentation frequently diverges from the level. That's why a diagnosis should be supported by clinical data ***(Gözübüyük, 2017; Hess, 2017).***

The crucial phase is diagnosis, considering that it will encourage the healthcare providers to begin proper therapy as soon as possible, this alone might have a significant therapeutic impact. The patient must be removed from a hazardous environment as the first step in care. Emergency nurse starts to monitor patient vital signs to ensure stabilizing the patient's vital signs in the following stage. If the patient is in a critical state, resuscitation should be started right away. For CO poisoning, oxygen is the cure either normobaric or hyperbaric oxygen therapy (HBOT). Complications need to be handled if they exist. Neuropsychological evaluations should be performed on all patients at baseline and periodically thereafter ***(Ho, et al., 2012; Sönmez, et al., 2015; Gözübüyük, 2017).***

When it comes to CO poisoning, the phrase that "prevention is better than treatment" is particularly applicable. The following criteria are necessary for the prevention: reducing exposure,

early diagnosis, and patient education of the hazards associated with CO poisoning. The critical care nurses' toolkit of interventions must include patient education ***(Ruth-Sahd, et al., 2011; Afolayan, et al., 2014; Al-Matrouk, et al., 2021).*** Several barriers stand in the path of healthcare workers as they attempt to prevent, identify, and treat CO poisoning; among them are a lack of awareness and a knowledge gap. If we want to drastically lower the incidence of CO poisoning, these constraints must be addressed ***(APCMG, 2017).***

Every scenario of poisoning consists of two components: Medical and medico-legal obligations. To aid the investigative authority in case of poisoning, adequate samples' preservation and accurate documentation are vital ***(Hinkle and Cheever, 2018).*** The investigation into the poisoning case may be hampered by the healthcare professional's ignorance of the medico-legal responsibilities, and thus, may also face legal repercussions for breaching legal obligations. In a legal proceeding, ignorance of the law is not a valid excuse ***(Millo, et al., 2017).*** Emergency nurses plays a central role in the treatment and management of CO poisoned patients, which should focus on the following areas once the patient admitted to emergency department: emergency stabilization by nursing triage, administer prescribed oxygen therapy, electrocardiography, monitoring vital signs, lab tests aspiration, monitoring level of conscious, decontamination, and enhanced comfort level (***Hinkle and Cheever, 2018; Harding, et al., 2019).*** They work together with other nurses, physicians, social workers, as multidisciplinary team to help patient for promotion sense of wellbeing, support their families and develop a care plan for them ***(Sole and Klein, 2020; Saad, et al., 2021).***

Furthermore, there is unaccountable statistics available in Ismailia governorate on emergency nurses' knowledge and attitude towards caring for carbon monoxide poisoned patients.

AIM OF THE WORK

This study aimed to assess emergency nurses' knowledge and attitude towards caring for carbon monoxide poisoned patients in Ismailia governorate, Egypt. This study's aim was accomplished by:

- Assess the studied nurses' level of knowledge toward caring for carbon monoxide poisoned patients.
- Determine the studied nurses' level of attitude toward caring for carbon monoxide poisoned patients.
- Assess the relation between the studied nurses' level of knowledge, attitude, and demographic profile.
- Assess the correlation between the studied nurses' level of knowledge, and attitude toward caring for carbon monoxide poisoned patients.

SUBJECTS AND METHODS

I. Design and sample

Across-sectional survey was conducted. All Nurses in the Emergency department of an Egyptian University hospital (Both the Teaching and Specialized hospitals) were included in the study (23 at the Specialized hospital, 74 at the Teaching hospital) in Ismailia governorate. The participants were recruited as a convenient sample. The survey was conducted from April to September 2022 using an online questionnaire that was shared with the participating nurses individually away from their rooster time using different social networking packages.

II. Measures

Researchers developed the questionnaire based on previous literature ***(Ruth-Sahd, et al., 2011; Afolayan, et al., 2014; Millo, et al., 2017; Sole, et al., 2020; Cappelletto and Jarman, 2021).*** It was in a simplified Arabic language, the native language of the studied nurses. It consisted of the subsequent three sections.

Section (I): Demographic data and expert characteristics(age, gender, marital status, level of education, years of experience, working hospital and receiving specific training regarding caring for CO poisoning).

Section (2): knowledge about CO poisoning and the related medico-legal considerations. It consisted of 30 items. Assessed using True/False and Multiple-choice questions. The knowledge score varied from 0-30 grades; the correct response received as a one grade, while incorrect received a zero grade. Every sum of the item scores for each knowledge area is added together, and the result is divided by the number of items to produce the mean score. If the percent score was above 70%, the knowledge level was deemed satisfactory; if it was below 70 %, it was deemed unsatisfactory ***(Abebe, et al., 2019).***

Section (3): attitude towards caring for CO poisoning and the related medico-legal considerations. It consisted of 16 items. Assessed using five-point Likert scale; 5="strongly agree", 4=" agree", 3="neutral", 2= disagree" and to 1="strongly disagree". The attitude score varied from 16-80 grades. Every sum of the item score is added together and the result is divided by the number of items to produce the mean score. Percentage score that was below 70%, the attitude level was deemed negative; while if it was above 70 %, it was deemed positive ***(Aloushan, et al.,***

2019). Time spent to fill up in the online form was 12:15 minutes.

- **Questionnaire validation and reliability:** content validity was assessed by a panel of five experts in the field of Medical Surgical Nursing (three), Forensic Medicine and Clinical Toxicology and Emergency Medicine (two). There were no items that needed to be removed or modified. A pilot testing of the questionnaire was carried out on ten emergency nurses. To promote comprehensive understanding, necessary changes were made. For content reliability, coefficient of reliability was measured by Cronbach's alpha to check the internal consistency of the used questionnaire which showed good reliability (test of Cronbach's Alpha was 0.882 for knowledge's level section and 0.755 for attitude section)".
- **Ethical considerations:**
  Ethical approval was obtained from Research Ethics Committee (REC), Faculty of Medicine, Suez Canal University, Ismailia, Egypt (April 2022, Reference # 4887). The informed consent was sought from the whole participating nurses. All administrative approvals were also attained. The purpose of the study, potential benefits, and risks were clarified to the studied nurses pre-starting. The studied nurses were assured of maintaining confidentiality. They were informed that they had the option to decline or withdraw from a participation without giving any explanation and/or any negative consequences that their participation was voluntary.

STATISTICAL ANALYSIS:

Using a basic statistics application; IBM Corp. Released 2015. IBM SPSS Statistics for Windows, (SPSS 2015; version 23.0. Armonk, NY: IBM Corp) all data were gathered, tabulated, and statistically examined. Quantitative data were expressed as the Mean±SD and qualitative data were expressed as frequencies (n) and percentages (%). The scoring system for the knowledge section was as follows: The total score ranged from zero to 30 grade. Each correct answer was given one grade and the incorrect and do not know answers were given zero grade. The statements were gathered into subsections. For each subsection, the level of knowledge was considered satisfactory if the total score ≥ 70%. The following was the scoring formula for the attitude section that the overall score varied between16 to 80 grades.

Scores for positive attitude statements ranged from 1 for "strongly disagree" to 5 for "strongly agree," whereas the opposite was done for negative attitude statements. Overall positive attitude was considered if its total score ≥ 70%. Chi-square test was used to assess the association between the demographic and expert characteristics on one side and the overall knowledge and attitude scores on the other side. Pearson' correlation coefficient was calculated to assess relationship between overall knowledge score and (overall attitude score, age, educational level, and years of experience), (+) sign indicated direct correlation and (-) sign indicated inverse correlation, also values near to 1 indicated strong correlation & values near 0 indicated weak correlation. Multiple linear regression was used to assess the predictors for the studied nurses' attitude towards caring for CO poisoning. P-value < 0.05 was considered statistically significant.

RESULTS

Table (1): shows that 51.5% of the studied nurses were aged ≥27 years, with mean±SD (27.2±5). 52.6% were male, 48.5% were single and27.8% had less than three years of experience. Most of the participants 76.3% are working at teaching hospitals. Furthermore, less than two third 59.8% had a technical institute, while less than one quarter 4.1% had a technical bachelor **(Figure 1)**. Notably, only 12 % of nurses had received formal clinical or medicolegal courses regarding caring for CO poisoned patients **(Figure 2)**.

The highest knowledge score to be attained was 30. The overall knowledge's level score was classified as satisfactory when the score was 21 (≥70%). Participants who scored equal to or greater than that overall score were considered of satisfactory knowledge about caring for CO poisoning and its related medico-legal considerations. Only 32% of the participating nurses had satisfactory knowledge. In concerns of attitude, the ultimate positive attitude score to be achieved was 80. The overall attitude score was classified as positive when the score was 56 (≥70%). About 53.6% of the participating participants had a positive attitude's level. The mean score of the attitude was 55.6±7.8 (**Figure 3)**.

Mean score and standard deviation of participating emergency nurses' overall knowledge scores toward caring for CO poisoned patients is illustrated in **(Table 2)**. Clarifies that the mean± SD regarding the participating nurses' answers of definition was 0.53±0.5, while was 0.68±0.46regardingtheir answers about predisposing factors. Moreover, the mean±SD regarding the participating nurses' knowledge of prevention measures was 1.3±0.8, and about 0.38±0.48regarding their response of indicator symptom of severe carbon monoxide poisoning.

Association of the participating emergency nurses' overall knowledge scores with their

demographic and expert characteristics is described in (**Table 3)**. Males (41.2%) had significantly satisfactory knowledge score than females (21.7%). There was no evidence of an association between the knowledge scores and the other variables examined. Participating emergency nurses with previous formal clinical and medico-legal training background regarding caring for CO poisoning had satisfactory knowledge score than those without such training.

Association of the participating emergency nurses' overall attitude scores with their demographic and expert characteristics is described in **(Table 4)**. There was a positive statistically significant relation between overall emergency nurses' attitude score and years of experience with p-value=0.04. There were no statistically significant association between the attitude scores and the other factors examined. Participating emergency nurses without previous formal clinical and medico-legal training background toward caring for CO poisoning had a positive attitude score than those that with such training courses.

Table (5): clarifies that there was a statistically significant positive correlation between the knowledge and attitude scores of all participating emergency nurses, while there was a negative statistically significant correlation with education degree.

Table (6): demonstrates that the overall knowledge score is the only significant predictor for predicting the participating emergency nurses' attitude towards caring for CO poisoning.

Table (1): Demographic and expert characteristics of the studied nurses. (n=97)

Variables	Categories	Frequency (n)	Percentage (%)
Age	▪ <27	47	48.5
	▪ ≥27	50	51.5
	▪ Mean±SD ▪ Range	27.2±5 19-43	
Sex	▪ Males	51	52.6
	▪ Females	46	47.4
Marital Status	▪ Married	46	47.4
	▪ Single	47	48.5
	▪ Divorced	4	4.1
Years of experience	▪ 1- years	27	27.8
	▪ 3- years	26	26.8
	▪ 6- years	22	22.7
	▪ 10-years	22	22.7
Working hospital	▪ Specialized University hospital	23	23.7
	▪ Teaching University hospitals	74	76.3

Table (2): Mean score and standard deviation of participating emergency nurses' overall knowledge scores towardcaring for CO poisoned patients. (n=97).

No.	Knowledge Items	Mean ±SD
1.	Definition.	0.53±0.5
2.	Sources.	0.47±0.5
3.	Predisposing factors.	0.68±0.46
4.	Mechanismof occurrence.	0.33±0.47
5.	Clinical pictures.	5.2±2.2
6.	Diagnostic studies.	1.9 ±1
7.	Emergency assessment and management.	2.1±1
8.	Complications.	1.9±0.83
9.	Preventionmeasures.	1.3±0.8
10.	Factors leading to severe monoxide poisoning.	0.66±0.48
11.	Indicator symptom of severe carbon monoxide poisoning.	0.38±0.48
12.	Pattern ofcarbon monoxide intoxication.	0.59±0.49

13.	Medoc-logical considerations of carbon monoxide poisoning.	1.1±0.7

Table (3): Association of participating emergency nurses' overall knowledge scores regarding with their demographic and expert characteristics. (n=97)

Variables	Overall emergency nurses' knowledge score				n.	χ^2	P-value
	Satisfactory (n=31)		Unsatisfactory (n=66)				
	No.	%	No.	%			
Age group							
▪ <27	17	36.2	30	63.8	47	0.74	0.39
▪ ≥27	14	28.0	36	72.0	50		
Gender							
▪ Males	21	41.2	30	58.8	51	4.2	0.04*
▪ Females	10	21.7	36	78.3	46		
Marital Status							
▪ Married	14	30.4	32	69.6	46	2.31	0.32
▪ Single	17	36.2	30	63.8	47		
▪ Divorced	0	.0	4	100.0	4		
Education Level							
▪ Diploma	4	25.0	12	75.0	16	4.19	0.24
▪ Technical institute	22	37.9	36	62.1	58		
▪ Technical bachelors	2	50.0	2	50.0	4		
▪ Bachelors	3	15.8	16	84.2	19		
Years of Experience							
▪ 1- years	9	33.3	18	66.7	27	3.8	0.28
▪ 3- years	8	30.8	18	69.2	26		
▪ 6- years	10	45.5	12	54.5	22		
▪ 10-years	4	18.2	18	81.8	22		
Working Hospital							
▪ Specialized Suez Canal hospital	6	26.1	17	73.9	23	.48	0.49
▪ Teaching Suez Canal hospitals	25	33.8	49	66.2	74		
Receiving Training course							
▪ Yes	5	41.7	7	58.3	12	.59	0.44
▪ No	26	30.6	59	69.4	85		

*χ^2 Chi square test *p<0.05*

Table (4): Association of participating emergency nurses' overall attitude scores with their demographic and expert characteristics. (n=97)

Variables	Total Emergency Nurses' Attitude Score				n.	χ^2	P-value
	Positive (n=52)		Negative (n=45)				
	No.	%	No.	%			
Age group							
▪ <27	26	55.3	21	44.7	47	0.107	0.74
▪ ≥27	26	52.0	24	48.0	50		
Gender							
▪ Males	32	62.7	19	37.3	51	3.61	0.06
▪ Females	20	43.5	26	56.5	46		
Marital Status							
▪ Married	24	52.2	22	47.8	46	5.33	0.07
▪ Single	28	59.6	19	40.4	47		
▪ Divorced	0	.0	4	100.0	4		
Education							
▪ Diploma	7	43.8	9	56.3	16		0.68
▪ Technical institute	34	58.6	24	41.4	58	1.53	
▪ Technical bachelors	2	50.0	2	50.0	4		
▪ Bachelors	9	47.4	10	52.6	19		
Years of Experience							
▪ 1- years	18	66.7	9	33.3	27	8.51	0.04*
▪ 3- years	12	46.2	14	53.8	26		
▪ 6- years	15	68.2	7	31.8	22		
▪ 10-years	7	31.8	15	68.2	22		
Working Hospital							
▪ Specialized Suez Canal hospital	10	43.5	13	56.5	23	1.244	0.27
▪ Educational Suez Canal hospitals	42	56.8	32	43.2	74		
Receiving Training course							
▪ Yes	4	33.3	8	66.7	12	2.26	0.13
▪ No	48	56.5	37	43.5	85		

*$\chi 2$ Chi square test*p<0.05*

Table (5): Correlation matrix between overall participating emergency nurses' knowledge score with overall attitude score, age years, education, and years of experience. (n=97).

Variables	Overall emergency nurses' knowledge score	
	r	P
▪ **Overall emergency nurses' attitude score**	0.352	0.0001*
▪ **Age**	-0.092	0.372
▪ **Education**	-0.203	0.046*
▪ Years of experience	0.028	0.789

***(r)** Correlation Coefficient*
** Correlation is significant at the 0.05 level (2-tailed).*
*** Correlation is significant at the 0.01 level (2-tailed).*

Table (6): Multivariate linear regression for predicting participating emergency nurses' attitude score towardcaring for CO poisoned patients.(n=97)

Predictors	β	Std. Error	t	Sig.	R	R^2
▪ **Knowledge score**	.503	.134	3.754	.0001*	0.389	0.151
▪ **Experience years**	-1.144	.660	1.733	.086		

β= regression coefficients square= 15.1% of predictors
*ANOVA model=8.4*p<0.05*

List of Abbreviations:

Abbreviation	Meaning
CO:	Carbon monoxide
HB:	Hemoglobin
HbCO:	Carboxyhemoglobin
CNS:	Central nervous system
DNS:	Delayed neurological sequelae
HBOT:	Hyperbaric oxygen therapy
NBOT:	Normobaric oxygen therapy

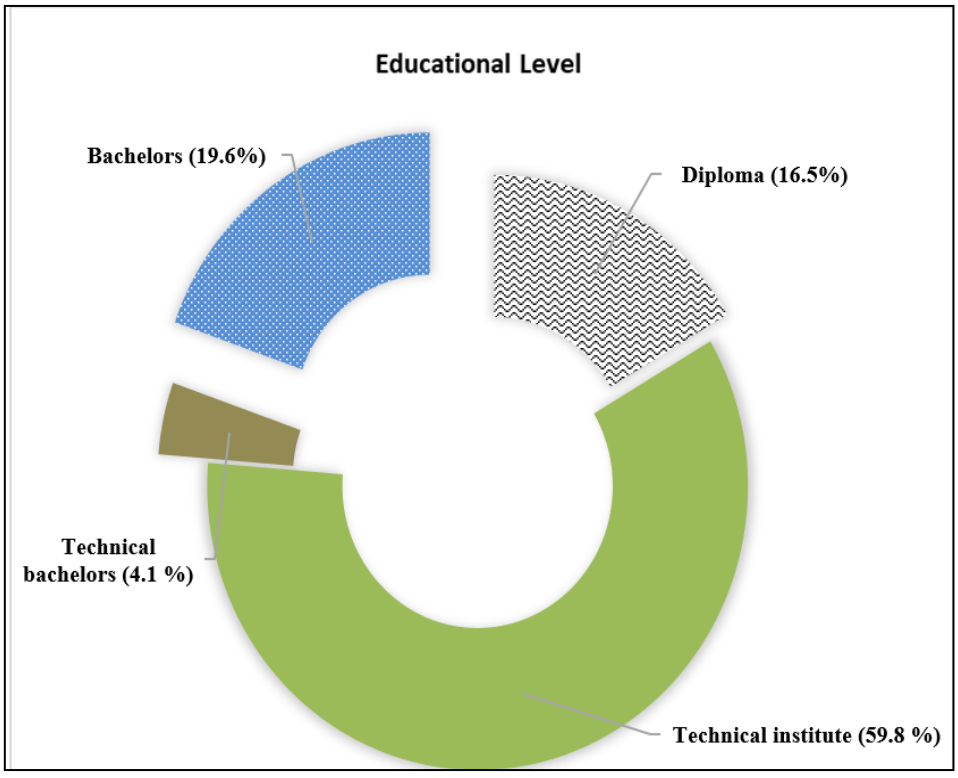


Figure (1): ***Studied nurses' educational level toward caring for CO poisoned patients. (n=97).***

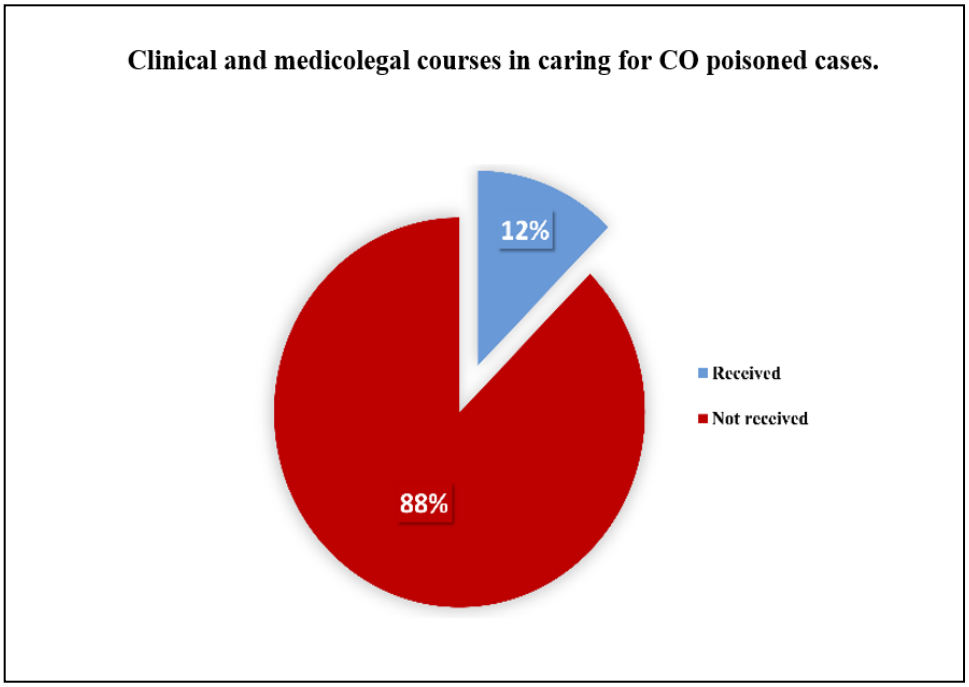
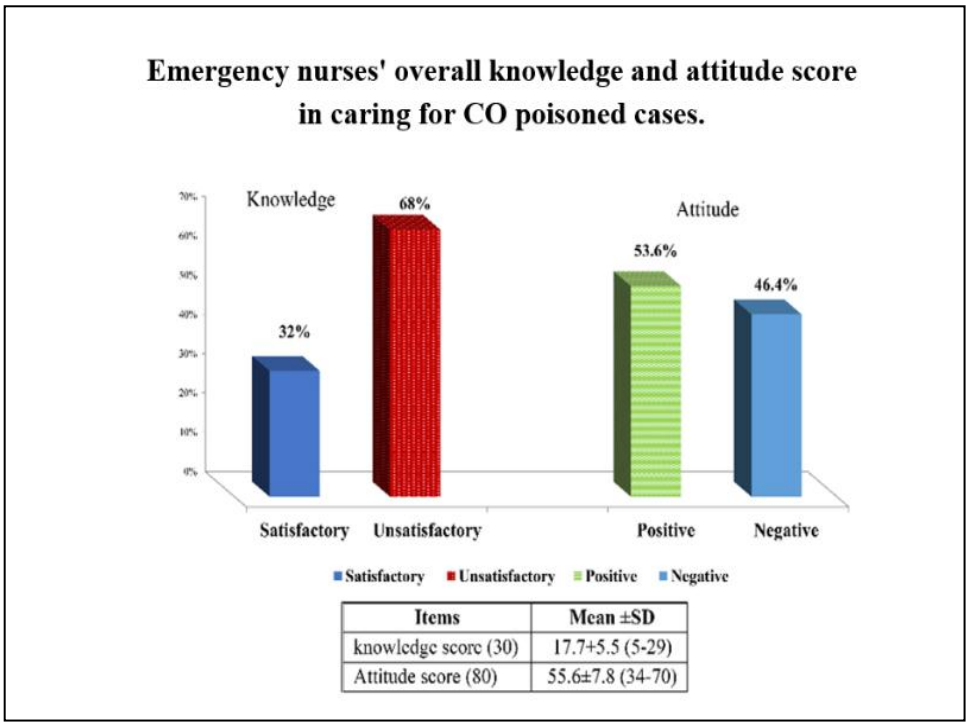


Figure (2): Studied nurses' receiving training background toward caring for CO poisoned patients (Formal clinical and Medico-legal training). (n=97).



Items	Mean ±SD
knowledge score (30)	17.7+5.5 (5-29)
Attitude score (80)	55.6±7.8 (34-70)

Figure (3): Studied Emergency nurses' overall satisfactory knowledge and positive attitude score toward caring for CO poisoned patients (n=97).

DISCUSSION

In emergency rooms, nurses are on the front lines, caring for a wide range of traumatized, intoxicated, and diseased patients ***(Nigatu, et al., 2022).*** Handling poisoned cases, particularly those with CO, is considered a challenging case nowadays that requires immediate medical intervention. To the best of our knowledge, no previous studies had been undertaken in Egypt to determine the depth of knowledge, and attitude of emergency nurses regarding caring for CO poisoning and its related medico-legal considerations to make it easier to handle such cases appropriately.

The current study showed that more than half of the studied nurses were aged ≥27 years, while more than two quarter of them were male. About more than one third were single and more than one quarter had less than three years of experience. Furthermore, less than two third had a technical institute. Less than one quarter of nurses had received formal courses regarding caring for CO poisoned patients. According to the researcher's point of view, the majority of the examined nurses were newly graduated and hired after completing their internships. It's also important to note that more women than men were registered as nursing staff in Egypt.

Additionally, recently got technical institute diploma and single. This result was reinforced by ***(Saad, et al., 2021)*** clarified almost two-thirds of the nurses in the study were female and had more than eight years of experience, which is contradicted with ***(Wang, et al. , 2021)***that they discovered that more than two-thirds had fewer than five years of experience, were married, and had a bachelor's degree.

In the knowledge concerns, only more than one third of the participating emergency nurses had satisfactory knowledge with mean knowledge score was 17.7±5.5. The researcher's point of view; This can be due to a lack of time for continuing education, the omission of this subject from school curriculum, or a focus on helping nurses enhance their practical skills rather than their knowledge. This result was, to some extent, in line with (***Aloushan, et al., 2019).*** They found a clear knowledge gap on CO poisoning management among the participants, the majority of whom were nurses. Accordingly, if a healthcare professional is not cognizant about the possibility of CO poisoning, a diagnosis may be overlooked ***(Sönmez, et al., 2015).***

A crucial component of the cultural background of emergency healthcare workers is their understanding of the properties of CO and their capacity to analyze the environmental scenario as possible as accurately. It is not always possible to refer the diagnosis to emergency medical personnel when the source of exposure is clear and is not taken into account ***(Fucili, and Brauzzi, 2022).*** Notably, CO poisoning incidents are more common in the winter because people, particularly in rural areas, use heaters or charcoal and close their windows when the weather is cold ***(Pan, et al., 2019).***

Related ***(Wang, et al., 2021)*** discovered a greater prevalence of accidental CO poisoning throughout the winter which is in turn directly connected to high indoor CO concentrations caused by poor heating system installation and usage. It is also essential to understand that some population groups are more vulnerable to CO exposure. Age, gender, genetic differences such as hemoglobin anomalies, pregnancy, and individuals with underlying disorders that restrict the availability of oxygen to tissues are some of the vulnerable groups with raised risk of CO exposure ***(Lisbona, and Hamnett, 2018).***

The uncertainty in CO poisoning diagnosis are linked to indefinite complaints, vague and absence of specific symptoms and signs ***(Desola, 1993; Prockop, and Chichkova, 2007; and Zorbalar, et al., 2014).***

Misdiagnosis is life-threatening, as respiratory and delayed neurological sequelae are the most expected long-term complications in patients intoxicated with CO that remarkably alter patient quality of life ***(Bhagwat and Bruxner, 2017; Rose, et al., 2017).***

Even though the update in CO pathophysiology data responsible for acute toxicity is still proceeding, there are knowledge gaps, and emergency health professionals are not updated on the issue ***(Liao, et al., 2021).*** It is also essential to understand medico-legal responsibilities since failing to do so might jeopardize the legal authorities' investigation into the poisoning case. Ignorance is not a valid defense in a court of law ***(Millo, et al., 2017).***

In terms of attitude, Positive attitudes were present among the participants in 53.6% of case and the mean attitude's score was 55.6±7.8. The view point of researcher, this could be attributed to the effect of unsatisfactory knowledge on attaining negative attitude and vice versa. Such association between knowledge and attitude was confirmed by this study as a statistically significant correlation between the overall participants emergency nurses' knowledge and attitude score. Moreover, the overall knowledge score was the only significant predictor for predicting the

participating emergency nurses' attitude towards caring for CO poisoning and its related medico-legal considerations.

Consequently, if healthcare practitioners are adequately knowledgeable about addressing CO poisoning and have a positive attitude on doing so, effective therapy may be initiated as soon as feasible. The keystones of the CO management will be assessment of the medical history, identification of clinical picture, performing basic investigations (the carboxyhemoglobin values from analysis of blood gas and CO-oximeter) and expect the complication ***(Fucili and Brauzzi, 2022).*** CO poisoning has no recognized antidote. However, oxygen therapy (either normobaric oxygen therapy (NBOT) or HBOT) could be considered the antidote and enhance CO elimination ***(Santos, et al., 2018).*** Furthermore, adequate knowledge and positive attitude could aid in the development of preventative measures to reduce the incidence of CO poisoning. In their 2013 study, (***Rupert, et al., 2013)*** concluded that; participants' CO risk behaviors are influenced by their knowledge, and attitudes. Fixing such misunderstandings, may help to promote more preventative measures. Healthcare workers may spread awareness about CO poisoning among the public more effectively after gaining an insight into why householders might engage in risky behaviors. They are supposed to be a primary source of knowledge on public health issues ***(Afolayan, et al., 2014).***

The result of this study agrees with (***Afolayan, et al., 2014)*** who conducted a survey of health workers at a referral hospital in Nigeria to assess knowledge and attitudes regarding the risks of CO poisoning and concluded; the existence of knowledge gap regarding CO poisoning. About 55% of those polled could not name any signs of CO poisoning. The possibility of CO poisoning leading to death was only known to one responder. Moreover, health professionals who participated in that survey had a limited understanding of the health risks associated with CO poisoning brought on by using electrical generators indoors ***(Afolayan, et al., 2014).*** Additionally, ***Emami-Razavi, et al., (2020)*** assessed Iranians' knowledge of CO poisoning symptoms and preventative strategies; denoted that 80.1% of those participants at the Imam Khomeni hospital reported knowing the CO poisoning symptoms. However, not all the symptoms of CO poisoning are well-known to them. They recommended the need for public education and awareness campaigns regarding CO risks as one method to decrease CO poisoning.

On the other hand, the results of this study are not in line with other studies on different population. According to ***(Hajjar, et al., 2016)*** findings, despite that a significant portion of Saudis are aware of the risks of CO poisoning and its symptoms but fail to take safety precautions, such as owning CO alarms and having routine maintenance performed on their heating appliances. In ***Popiołek, et al. (2021)*** study to determine how likely it is that students in Kraków, one of Poland's main academic cities, will be exposed to CO and their awareness level, the majority could correctly identify both the common and serious signs of CO poisoning.

The possible associated leading factors for unsatisfactory knowledge and negative attitude were shortage of training programs, absence of continuous supervision and evaluation, excessive workload and absence of guidelines ***(Abebe, et al., 2019; Aloushan, et al., 2019) .*** These factors were supported by the present study as only 12 % of emergency nurses had received clinical or medicolegal training courses regarding caring for CO poisoning cases. Participating emergency nurses with previous training background had satisfactory knowledge score than those without such training. This shows how crucial training is to narrow the knowledge gap. Participation in clinical training was found to be strongly linked to develop nurses' knowledge ***(Brekelmans, et al., 2016).***

On the other hand, participating emergency nurses without previous training background had positive attitude score than those with such training. This can be related to the quality of the training received as it's so challenging for people to change their attitudes.

There was a negative statistically significant correlation of total emergency nurses' knowledge score with education degree in present study. This indicates the need to increase education initiatives to overcome the knowledge gap. Education about the proper use and following preventive measurements is considered a pivotal public health policy to prevent accidental CO poisoning ***(King, and Damon, 2011).*** Accordingly, all emergency nurses should get formal training on caring for CO poisoning to facilitate proper and timely management of such cases.

Limitations of the study

The study had some flows. First, recall bias and social desirability effects may be present in self-reported questionnaires, which may prejudice their usage. Second, the study research design does not show the cause-and-effect association and the current results can't be generalized.

CONCLUSION

The findings of this study showed that even though the majority of the participating emergency nurses in the survey had good attitude scores, the study found that more than two thirds of them had insufficient knowledge levels. The total attitude score and the total knowledge score for emergency nurses showed a statistically significant positive correlation.

RECOMMENDATIONS

Relied on the results of the present study, this study recommended that:

- Primitive endorsed updated nursing care guideline toward caring for carbon monoxide poisoned patients prior recruiting for emergency nurses.
- Supports the necessity for in-service training courses continuity for emergency nurses to enhance their level of knowledge and attitude.
- Generalizing the findings, more research should be conducted on a wider scale, large probability sample and different geographical area.

Funding: The authors did not receive support from any organization for the submitted work.

Conflict of Interests: The authors have no relevant financial or non-financial interests to disclose.

Data availability statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Author Contributions: All authors contributed to the study conception and design. Data collection was performed by: Mohamed G. Elbqry, Nashwa M. Abdelgeleel and Fatma M. Elmansy. All authors contributed to the study formal analysis and interpretation. The first draft of the manuscript was written by Shaimaa A. Shehata, Mohamed G. Elbqry, Enas M. A. Mostafa and Fatma M. Elmansy, and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

ACKNOWLEDGEMENTS

We honestly would like to thank the nursing staff members in the emergency department at the study settings. Special thanks to the experts' committee for their effort and time in data collection tools revision.

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معلومات وسلوك تمريض الطوارئ تجاه رعاية مرضى التسمم بأول أكسيد الكربون في محافظة الإسماعيلية، مصر

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الملخص العربى

المقدمة : سيؤدي انخفاض إمدادات الوقود، وارتفاع أسعار الكهرباء، والطلب المتزايد على وقود التدفئة المنزلية في فصل الشتاء، إلى دفع العديد من الناس إلى استخدام الخشب والفحم من أجل الدفء، وبالتالي ستزيد المخاوف من زيادة التسمم بأول أكسيد الكربون. يجب أن يكون تمريض الطوارئ على دراية بهذه الحالة الخطيرة للتعامل معها بشكل مرض.

الهدف من لبحث:كان الهدف من هذه الدراسة هو تقييم معلومات وسلوك تمريض الطوارئ تجاه رعاية مرضى التسمم بأول أكسيد الكربون. **تصميم البحث:** تم استخدام تصميم بحث وصفي عرضي. **جمع العينات:** شاركت عينة ملائمة من كل التمريض الموجود بقسم الطوارئوكان عددهم٩٧ ممرضوممرضه في هذه الدراسة.**استُخدمت الدراسة استبانة ذاتية من ثلاث أجزاء لتجميع البيانات**: لتقييم البيانات الاجتماعية، مستوى المعلومات، وسلوكتمريض الطوارئ تجاه رعاية مرضى التسمم بأول أكسيد الكربون. **النتائج:** أظهرت النتائج أن مستوى معلومات تمريض الطوارئ المشارك بالدراسةكان غيرمُرضى (٦٨%) .بينما (46.4%)منهم كان سلوكهم سلبيتجاه رعاية مرضى التسمم بأول أكسيد الكربون. وجود علاقة ذات دلالة إحصائية بين مستوى معلومات وسلوك التمريض المشارك بالدراسة.

الخلاصة: لخَصت الدراسة أنه على الرغم من أن غالبية الممرضات في الاستطلاع حصلن على درجات جيدة في السلوك، وجدت الدراسة أن أكثر من ثلثيهم ليس لديهم مستويات معرفة كافية.

التوصيات: تدعم هذه الدراسة ضرورة تقديم برامج تدريبيةلتمريض الطوارئ لزيادة معرفتهم وتعزيز سلوكهم تجاه رعاية مرضى التسمم بأول أكسيد الكربون.

الكلمات الدالة: السلوك، التسمم بأول أكسيد الكربون، تمريض الطوارئ، المعلومات، الاحتراق غير الكامل، الاختناق السام.