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Research Article

Evaluation of Carbon Monoxide Poisoning Cases Brought to the Emergency Department in Turkey: A Retrospective Cross-Sectional Study

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KEYWORDS

carbon monoxide poisoning
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ABSTRACT

Objective: This study aimed to evaluate the demographic, clinical, and laboratory characteristics of patients presenting to the emergency department with carbon monoxide (CO) poisoning in Turkey and to compare the findings with data from the literature. Materials and Methods: This retrospective, cross-sectional, descriptive study included 30 patients admitted to the emergency department with CO poisoning between June 1, 2023 and June 1, 2025. Demographic characteristics, causes of exposure, presenting complaints, vital signs, blood gas parameters (pH, PO2, PCO2, COHb, lactate), treatments, observation periods, and outcomes were retrospectively reviewed. Descriptive statistical analyses were performed using IBM SPSS Statistics version 27.0. Results: Nineteen patients (63.3%) were male and 11 (36.7%) were female; the mean age was 28.9 ± 18.9 years. The most common cause of exposure was stove use (66.7%). The most common presenting complaints were shortness of breath (40.0%) and nausea-vomiting (33.3%). Physical examination findings were normal in all cases. The mean COHb level was 7.4 ± 7.9%. The most frequently administered treatment was oxygen therapy via a non-rebreather reservoir mask (43.3%). Nearly all patients were discharged (96.7%); hyperbaric oxygen therapy was planned for only one patient, but the patient refused treatment. Conclusion: Carbon monoxide poisoning is an important emergency condition whose mortality can be reduced by early diagnosis and treatment. The predominance of stove-related exposure emphasizes the need for public awareness regarding indoor heating systems. Carboxyhemoglobin measurement supports clinical assessment, while normobaric oxygen therapy remains the principal initial treatment and hyperbaric oxygen therapy should be considered in appropriately selected severe cases.

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1. Introduction

Carbon monoxide (CO) is a colorless, odorless, tasteless, and non-irritating gas produced by incomplete combustion of carbon-containing materials. Because its clinical manifestations are often nonspecific, CO poisoning may be overlooked and remains an important cause of preventable morbidity and mortality. In Turkey, indoor heating systems, particularly stoves, remain important sources of exposure [1-4,10,12].

The clinical presentation of CO poisoning ranges from mild symptoms to life-threatening neurological and cardiovascular toxicity. Headache, dizziness, nausea-vomiting, weakness, altered mental status, and dyspnea are commonly reported. Blood gas analysis and carboxyhemoglobin (COHb) measurement support diagnosis and treatment planning; however, COHb should not be interpreted in isolation from the clinical picture [1,2,4,6-9,11].

The toxicity of CO is multifactorial. CO binds to hemoglobin with substantially greater affinity than oxygen, reducing oxygen transport and tissue delivery; it can also bind to myoglobin and interfere with mitochondrial oxidative metabolism, contributing to cellular hypoxia and organ dysfunction [2,4].

In this study, we aimed to retrospectively evaluate the epidemiological, clinical, and laboratory data of patients who presented to the emergency department with a diagnosis of CO poisoning and to compare the findings with the current literature from Turkey. We hypothesized that stove-related exposure would remain the predominant source of CO poisoning in our region, that the observed clinical and laboratory profile would be broadly comparable with recent Turkish emergency-department series, and that most patients would have favorable outcomes following normobaric oxygen-based management.

2. Materials and Methods

2.1. Study Design

This study was conducted at the Emergency Department of Hatay Mustafa Kemal University Research and Training Hospital, Turkey, and included patients presenting between June 1, 2023 and June 1, 2025. It was designed as a retrospective, cross-sectional, descriptive study using routinely recorded clinical data. The reporting and methodological description were guided by the STROBE recommendations for observational studies and by contemporary literature on the quality and limitations of retrospective chart-review datasets [14,15]. After ethics committee approval, data were obtained from patient files and the hospital information management system (HIMS). Data extraction and evaluation were conducted by the four investigators: Hakan Ercan, Barbaros Metin Yıldırım, Ali Karakuş, and Mustafa Polat.

2.2. Patient Selection

Thirty patients admitted to the emergency department with a diagnosis of CO poisoning were included in the study. The inclusion criteria were defined as a history of CO exposure and/or a diagnosis of CO poisoning based on clinical evaluation. Poisonings due to other etiologies, cases with insufficient clinical records, and children younger than 18 months were excluded.

2.3. Evaluated Parameters

Demographic data (age and sex), smoking history, presence of chronic disease, cause of CO exposure (stove, fire, waterpipe/hookah), mode of admission (self-admission/ambulance), presenting complaints, vital signs (blood

pressure, pulse rate, SpO2), physical examination findings, arterial blood gas parameters (pH, PO2, PCO2, COHb, lactate), treatment approaches, duration of observation in the emergency department, and clinical outcomes were recorded.

2.4. Statistical Analysis

Data were analyzed using IBM SPSS Statistics for Windows, version 27.0 (IBM Corp., Armonk, NY, USA) [18]. Version 27 has continued to be used in contemporary retrospective medical research published after 2022 [19]. Numerical variables were summarized using mean, standard deviation (SD), minimum, and maximum values; categorical variables were summarized using frequencies and percentages. This descriptive approach was selected because the study aimed to characterize the regional case profile rather than estimate causal associations. The presentation of observational data followed STROBE principles, while the retrospective nature of the dataset was considered when interpreting completeness and potential data-quality limitations [14,15].

3. Results

3.1. Demographic Characteristics

Of the 30 patients included in the study, 19 (63.3%) were male and 11 (36.7%) were female. The mean age was 28.9 ± 18.9 years (range: 1-80 years). Pediatric cases (≤18 years) constituted a considerable proportion of all cases. Seven patients (23.3%) had a history of smoking and seven (23.3%) had a history of chronic disease. Hypertension (HT) and diabetes mellitus (DM) were the most common chronic diseases. Demographic data are presented in Table 1.

Table 1. Demographic and general characteristics.

Characteristic	n	%
Sex: Male	19	63.3
Sex: Female	11	36.7
Mean age (±SD)	28.9 ± 18.9 years	-
Age range	1-80 years	-
Smoking: Yes	7	23.3
Smoking: No	23	76.7
Chronic disease: Yes	7	23.3
Chronic disease: No	23	76.7

3.2. Causes of Exposure and Mode of Admission

The most common source of exposure was stove use (66.7%, n=20), followed by fire (23.3%, n=7) and waterpipe/hookah use (10.0%, n=3). Most patients presented by self-admission (76.7%), while seven patients (23.3%) were brought by 112 emergency ambulance (Table 2).

Table 2. Sources of exposure and mode of admission.

Exposure / Admission	n	%
Stove	20	66.7

Fire	7	23.3
Waterpipe/hookah	3	10.0
Admission: Self-admission	23	76.7
Admission: 112 ambulance	7	23.3

3.3. Presenting Complaints

The most common presenting complaint was shortness of breath (40.0%). This was followed by vomiting (33.3%) and nausea (26.7%). Of the patients, 13.3% presented asymptomatically (no active complaint). Dizziness was observed in 13.3%, chest pain in 10.0%, and headache in 6.7%. Weakness, chills, and numbness were among the other presenting complaints. The distribution of presenting complaints is summarized in Table 3.

Table 3. Distribution of presenting complaints.

Presenting complaint	n	%
Shortness of breath	12	40.0
Vomiting	10	33.3
Nausea	8	26.7
No active complaint (asymptomatic)	4	13.3
Dizziness	4	13.3
Chest pain	3	10.0
Headache	2	6.7
Other (weakness, chills, numbness)	3	10.0

3.4. Clinical and Laboratory Findings

Physical examination findings were considered normal in all cases. Summary statistics of vital signs and arterial blood gas parameters are presented in Table 4. The mean pulse rate was 90.1 ± 8.9 beats/min (range: 73-108), and the mean SpO2 was 97.0 ± 2.4% (range: 91-99%). The mean pH was 7.39 ± 0.04, mean PO2 was 83.0 ± 9.3 mmHg, mean PCO2 was 42.6 ± 5.3 mmHg, and mean lactate was 1.65 ± 0.92 mmol/L. The mean COHb level was 7.4 ± 7.9% (range: 0-26.2%); hyperbaric oxygen therapy was planned for the patient with the maximum COHb level of 26.2%, but the patient refused treatment.

Table 4. Summary statistics of vital signs and arterial blood gas parameters.

Parameter	Mean	SD	Min	Max
Age (years)	28.9	18.9	1	80
Pulse rate (beats/min)	90.1	8.9	73	108
SpO2 (%)	97.0	2.4	91	99
pH	7.39	0.04	7.33	7.55
PO2 (mmHg)	83.0	9.3	59	96
COHb (%)	7.4	7.9	0	26.2

PCO2 (mmHg)	42.6	5.3	35	53
Lactate (mmol/L)	1.65	0.92	0.7	5.6

3.5. Treatment and Clinical Outcome

The most frequently administered treatment was oxygen therapy via a non-rebreather reservoir mask (43.3%). This was followed by hydration plus antiemetic therapy (20.0%) and observation (13.3%).

Of the patients, 46.7% were observed for 8 hours, 36.7% for 4 hours, and 16.7% for 2 hours. Twenty-nine patients (96.7%) were discharged from the emergency department. Hyperbaric oxygen therapy (HBO) referral was planned for only one patient (3.3%); however, this patient refused treatment and was discharged after normobaric oxygen therapy. No mortality was detected in our study. Treatment approaches and outcomes are presented in Table 5.

Table 5. Treatment approaches, observation periods, and clinical outcomes.

Treatment / Outcome	n	%
Non-rebreather reservoir oxygen mask	13	43.3
Hydration + antiemetic	6	20.0
Observation	4	13.3
Hydration	3	10.0
Non-rebreather oxygen + hydration + antiemetic	3	10.0
Non-rebreather oxygen + hydration	1	3.3
Observation duration: 2 hours	5	16.7
Observation duration: 4 hours	11	36.7
Observation duration: 8 hours	14	46.7
Discharged	29	96.7
Hyperbaric oxygen referral (patient refusal)	1	3.3

4. Discussion

CO poisoning is an important public health problem that commonly presents to emergency departments, may be overlooked because of the nonspecific nature of its symptoms, and can cause serious morbidity and mortality if timely intervention is not provided. The findings obtained in this study are generally consistent with the literature from Turkey, while also showing certain distinctive features.

In our study, male sex was slightly predominant (63.3%). Sex distribution varies across CO-poisoning cohorts and may reflect differences in exposure setting, household heating practices, occupation, and case selection. Recent Turkish emergency-department studies likewise show that demographic distributions are not uniform across regions and severity groups [11,12].

The mean age was 28.9 years, and pediatric patients constituted a considerable proportion of the cohort. Toklucu et al. reported 167 pediatric CO-poisoning cases, with winter predominance and nausea-vomiting, headache, and dizziness among common manifestations [5]. Tekeli et al. later evaluated 162 pediatric emergency patients and similarly reported winter predominance and frequent gastrointestinal and neurological symptoms; higher COHb and lactate values were associated with impaired consciousness [9]. A more recent pediatric study by Akkaya et al. also

emphasizes the ongoing clinical importance of CO poisoning in children [13]. These findings support careful assessment of pediatric patients, particularly when neurological symptoms or abnormal laboratory markers are present.

Our finding that stove exposure was the leading source of exposure (66.7%) is consistent with the continuing importance of household combustion sources in Turkey. The national prevention program identifies heating-related exposures as a major preventable public-health problem [3]. Alpaslan reported that CO-poisoning presentations in Cappadocia were concentrated in winter and were influenced by meteorological conditions [10]. Eraybar et al. found coal-stove exposure in 60% of patients with COHb levels above 20% [6]. Most directly comparable, Yılmaz and Kalıntaş analyzed 377 emergency-department patients in Gaziantep and reported stove smoke as the source in 75.6% and fire smoke in 23.8% [12]. Together, these data support regional variation while confirming that heating and combustion sources remain prominent.

Shortness of breath was the leading presenting complaint in our cohort (40.0%), whereas 13.3% of patients were asymptomatic at presentation. Published series and reviews describe headache, dizziness, nausea-vomiting, weakness, dyspnea, and neurocognitive symptoms as common manifestations, with substantial variation according to exposure intensity, duration, age, and host factors [1,2,4,5,9]. This variability supports active screening when several people share a possible exposure, even if some are minimally symptomatic.

Although the mean COHb level was 7.4%, one patient had a COHb level of 26.2% and was considered for hyperbaric oxygen therapy (HBO). COHb concentration does not invariably parallel clinical severity, and treatment decisions should incorporate neurological status, cardiovascular involvement, metabolic abnormalities, exposure history, pregnancy status, and other risk factors rather than relying on a threshold alone [6-8,11]. Eraybar et al. specifically concluded that HBO candidacy should be assessed clinically and not solely according to COHb concentration [6]. İncekaya et al. likewise emphasized oxygen treatment and the continuing debate regarding HBO indications [8].

Normobaric oxygen delivered by a non-rebreather reservoir mask was the most frequently used treatment in our cohort. Oxygen therapy remains the cornerstone of initial management, whereas HBO is generally reserved for selected patients with severe clinical features or increased risk of neurological and cardiac complications [2,4,6,8,11]. In the 2024 Turkish study by Vural and Dolanbay, severe CO intoxication was evaluated according to normobaric and hyperbaric oxygen strategies, with emphasis on both early and delayed adverse outcomes [11]. In the 2025 Gaziantep series, 79.0% of patients were discharged and 6.1% received HBO; in our smaller cohort, 96.7% were discharged and one patient was referred for HBO but refused treatment [12]. These differences are compatible with variation in case severity and COHb burden between cohorts.

Comparison with research published since 2022 further contextualizes our findings. [9] reported a pediatric cohort in which winter presentations and gastrointestinal and neurological symptoms were prominent [9]. Alpaslan (2023) demonstrated the relationship between seasonal/meteorological conditions and CO-poisoning presentations in Cappadocia [10]. Vural and Dolanbay (2024) showed that severe CO intoxication should be assessed using both clinical outcomes and treatment strategy rather than COHb alone [11]. Yılmaz and Kalıntaş (2025) reported stove smoke as the dominant exposure source in a 377-patient Gaziantep emergency-department cohort and documented HBO use in a minority of patients [12]. Akkaya et al. (2026) provide additional contemporary pediatric evidence from Turkey [13]. Collectively, these studies support the continuing importance of household combustion exposure while showing substantial variation in severity, laboratory findings, and need for HBO.

The limitations of our study include its single-center and retrospective design, the relatively small sample size, and the possibility of information and observation bias because symptoms and clinical findings were abstracted from records generated during routine care. Bias in observational research has long been recognized as a threat to validity

[16]. More recent work on retrospective chart-review datasets has demonstrated that coding, data-entry, missing-data, and abstraction errors remain relevant methodological concerns [15], while analyses of electronic health records show that ascertainment can vary according to how completely historical information is captured [17]. STROBE also recommends explicit discussion of potential sources of bias and imprecision in observational studies [14]. In the present study, incomplete or non-standardized documentation may have led to under-recording of symptoms or exposures, and the small sample limits generalizability. Nevertheless, the study provides a regional description of CO-poisoning presentations and management.

5. Conclusions

The aim of this study was to characterize the epidemiological, clinical, laboratory, treatment, and outcome profile of emergency-department patients with CO poisoning in Turkey and to compare these findings with the literature. Our hypothesis was largely corroborated: stove-related exposure was the predominant source (66.7%), most patients had favorable short-term outcomes with oxygen-based management, and 96.7% were discharged, while only one patient was considered for HBO. The clinical profile was broadly compatible with recent Turkish studies, although differences in symptom distribution, COHb burden, and HBO use reflect variation in population and severity. CO poisoning remains an important preventable emergency health problem. Correct assessment of clinical severity and risk factors in addition to COHb is essential, and appropriate use of normobaric and hyperbaric oxygen should be individualized. Continued public awareness regarding heating systems, adequate ventilation, and CO detector use may reduce preventable exposures.

Author's Contributions

All authors contributed to the study design, data evaluation, preparation and critical review of the manuscript, and approved the final version.

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Data Availability

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

Conflicts of Interest

The authors declare that there is no conflict of interest.

Ethics Approval Statement

Hospital permission for the study was obtained from Hatay Mustafa Kemal University Health Practice and Research Hospital on September 22, 2026 (Permission No: E-14096738-108.02-704103). Patient data were evaluated retrospectively and handled in accordance with confidentiality principles.

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