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ORIGINAL RESEARCH

Outcome of Poisoning and Associated Factors Among Patients Admitted at Referral Hospitals in Northwest Ethiopia, 2022: A Multicenter Retrospective Study

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Background: Poisonings are the most common reason for visiting emergency departments and hospitals globally. Poisoning-related mortalities increase instantly, and it is a principal public health problem in Ethiopia. Hence, understanding the treatment outcome and identifying the associated factors is necessary to reduce poisoning-related mortality.

Objective: To assess outcome of poisoning and associated factors among patients admitted to Referral Hospitals in Northwest Ethiopia, 2022.

Methods: An institutional-based retrospective cross-sectional study was conducted in Western Amhara referral hospitals from June 2019 to May 2022. A total of 400 medical charts were reviewed. A stratified sampling technique was used. The data were entered into Epi Info version 7.2.1.0 and exported to SPSS version 25.0 software for analysis. Multivariable binary logistic regression analysis was used to determine factors associated with the outcome of poisoning.

Results: The mortality rate of poisoning was 18% (95% CI: 14.4–22.1). Being rural dwellers (AOR=2.65, 95% CI: 1.07–6.63), being unconscious (AOR=4.86, 95% CI: 1.89–12.48), not treated in triage area (AOR=4.64, 95% CI: 1.608–13.407), transport by Bajaj (AOR=6.78, 95% CI: 1.86–24.73), spo_2 <95% (AOR=4.42, 95% CI: 1.19–10.78), and stayed >48 hours in the hospital (AOR=0.08, 95% CI: 0.02–0.36) were significantly associated with a mortality of poisoning.

Conclusion: The mortality rate from poisoning was considerably high. Residence, level of consciousness, treatment at the triage area, mode of arrival, Spo2, and prolonged hospital stay were significantly associated. All stakeholders should focus on planning and improving care for patients with poisoning. Improving ambulance service in rural areas and providing treatment at the triage area for all patients are recommended.

Keywords: emergency departments, poisoning, referral hospital, treatment outcome

Introduction

The term "poison" refers to any chemical substance, solid, liquid, or gas upon accidentally or intentionally ingesting that can affect the body's health and lead to death.[1] Globally, studies have stated that poisoning is still a principal public health problem.[2–4] In the USA alone, mortality rates increased from 25% to 40%, leading to a six-fold increase in mortality rates and ranking suicide tenth among the top 10 leading causes of death.[5] According to the Global Burden of Disease (GBD), unintentional poisoning accounted for 0.14% of global deaths, and self-harm accounted for 1.34%.[6] In Ethiopia, studies have shown that the mortality rate from poisoning ranges from 0.3% to 27.6%.[1,7–16] According to studies of sub-Saharan Africa, in Ethiopia, unintentional poisoning was 3.3 per 100 000.[17] A report by the WHO estimated that nearly 200000 people die of unintentional poisoning annually. On the other hand, intentional poisoning

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outweighs unintentional poisoning in that one-third of a million people die of poisoning, which is highly linked to suicidal attempts.[18]

Poisonings affect the community by leading to frequent emergency room visits, prolonged hospital admissions, and sharply increasing mortality rates.[2–4] The outcome of poisoning negatively affects the community's physical, emotional, and spiritual well-being and alters the quality of life of patients and their families.[19,20] It affects the productive age group and the task forces of agricultural development, leading to low economic growth and poor agricultural reproduction yield.[8,11,21] Ethiopia's economy majorly depends on agriculture, and 85% of the population depends on agriculture as a farmer. Organophosphates (OPs) are the most common cause of poisoning because they are often available and widely used as herbicides by farmers.[16,22]

Studies have shown that, for instance, personal, environmental, organizational, and clinical factors have a significant effect on the outcome of poisoning. In particular, these factor types of poison, routes, mode of transmission, source of poison, season that occurred, place of residence, dose of poisoning, level of consciousness, time of arrival, modes of transportation, triage category, gender, marital status, and duration of hospital stay.[1,7,8,10,12,19,23]

Timely and effective prevention and management of poison-related morbidity and mortality requires a concerted effort from all stakeholders to reduce its negative impacts. Prevention is always the best option, as are prevention of exposures, early identification and recognition, supportive and symptomatic care, decontamination, elimination of absorption, and provision of antidotes. Poison control centers should put into practice the provision of education, training, and toxic surveillance for early prevention.[1,2,24–27] Eventually decreasing the complications and mortality rates of poisoning.[19] Untreated poisoned patients will lead to stress and anxiety for patients and their families.[8,11,21]

Even though different studies investigated several factors affecting the outcome, the mortality rate is still high due to poisoning and is dramatically increasing. Hence, it remains a public health problem in Ethiopia. Therefore, this study identifies factors associated with the outcome of poisoning at the emergency department in Northwest Ethiopia.

Methods

Study Design and Period

A multicenter retrospective cross-sectional study design was conducted among poisoned patients admitted from June 2019 to May 2022, and the actual data collection or extraction period was from May 1 to 31, 2022.

Study Setting

This study was conducted at five public university referral hospitals (University of Gondar, Debre Markos, Tibebe Ghion, Felege Hiwot, and Debre Tabor comprehensive specialized hospital), located in the Western Amhara regional state, Northwest Ethiopia. Each hospital provides health-care services to more than 5 million people in Tibebe Gion, Debre Tabor, and Debre Markos comprehensive specialized hospitals. Felege Hiwot and the University of Gondar Comprehensive specialized hospital give health-care services to more than 7 million people. There were 3713 poisoned cases in the 5 Western Amhara referral hospitals from June 1, 2019, to May 31, 2022.

Populations

All poisoned patients admitted to the emergency department of Western Amhara referral hospital were the source population. Poisoned patients whose charts were available during data collection from June 1, 2019, to May 31, 2022, were the study population. However, those with incomplete medical records were excluded.

Sample Size Determination

For the independent variables: The required sample size for this particular study was determined using a single population proportion formula, and the proportion was taken from a previous study conducted in Debre Tabor referral hospital, the proportion of mortality of poisoning = 18.6%.[8] Considering the following assumptions, A 95% confidence level, margin of error (0.04), and P = 18.6% were substituted in the following single population proportion formula.

$$n = \frac{(z\frac{\alpha}{2})^2 x\ pq}{d^2}$$

Where; n = required sample size, P = Mortality rate of poisoning from previous study = 18.6%, d = margin of error = 4%, q = 1-p, Z = critical value for normal distribution at 95% confidence level, which equals to 1.96 (z value at α = 0.05). Adding 10% to the calculated sample size was added to compensate for incomplete and missing patient cards.

$$n = \frac{(3.8416)0.186x(0.814)}{0.0016} = 364$$

Therefore; from all calculated sample sizes the largest was 364. To get the final sample size, add 15% contingency to incomplete or missing patient cards. Therefore, the total sample size for this study was 419.

Sampling Technique and Procedure

A stratified sampling procedure was used to select the study participants in each stratum from each ED of the five Western Amhara referral hospitals. From each stratum, the calculated sample size was proportionally allocated to the study participants. The first lists each poisoned patient that was found in each Western Amhara referral hospital and determines how many poisoned patients in each stratum, which use proportionally allocated and the medical charts of poisoning cases were selected by a simple random sampling technique were implemented (Figure 1).

Operational Definition

Improved: Those poisoned patients discharged upon improvement.[7]

Death: Those poisoned patients have a death certificate.[7]

Data Collection Tool and Procedure

The data were collected using a data collection checklist adapted from various previous literature with slight modifications.[1,7,10–12,16] The checklist was prepared by addressing possible important variables for the study. Then, checking the completeness and consistency of the variables in the chart was performed. Five trained emergency and critical care nurses collected the data and one MSc nurse was selected to supervise the data collection period. Then, by using a computer-

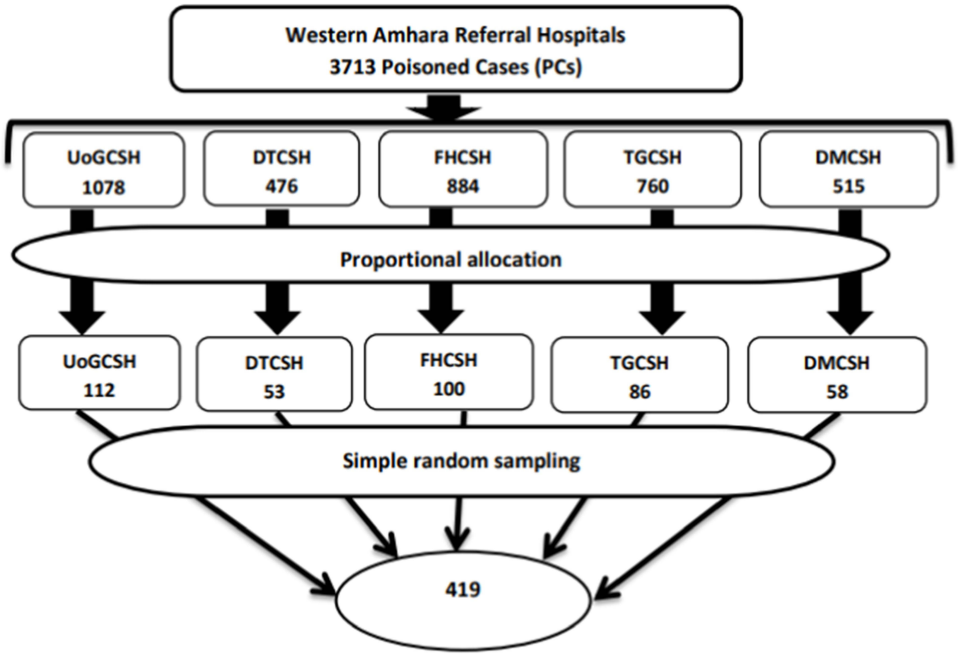

Figure 1 Schematic presentation of sampling procedure of poisoning patients to the emergency department of referral hospitals in Western Amhara 2022.

generated random number, they selected the required medical record number after listing the medical card number of poisoning cases from the ED patient's registration books. The data collectors filtered the patient's chart from the medical record room and collected the necessary information from patients' medical records using a prepared data collection checklist. The checklist was filled by searching for appropriate information. The collected data was examined for completeness, consistency, and accuracy during data collection to ensure the checklist was filled appropriately.

Data Quality Assurance

First careful modifications of the data collection checklist from previous research were done. To ensure the quality of data, check the availability of variables on 15 randomly selected medical charts from UoGCSH to ensure the agreement of the data abstraction format with the objective of the study. After checking the availability of variables in medical charts, amendments were conducted. Then data collectors and supervisors were recruited based on their experience in research, and one-day training was given on the objective of the study, data collection tool, and data collection procedures by the principal investigator. Supervision was conducted by the principal investigator and supervisors daily. The supervisors and principal investigator reviewed the collected data daily and checked for completeness, accuracy, and consistency immediately after collection and appropriately arranged and kept in a secure place for compilation and analysis.

Data Processing and Analysis

The collected data were checked for completeness and consistency and then entered into Epi Info version 7.2.1.0. The entered data were exported, cleaned, and analyzed using SPSS Version 25 statistical software. Frequencies and cross-tabulations were used to summarize descriptive statistics of the data. Both bivariable and multivariable logistic regression analyses were performed to identify factors associated with the treatment outcome of poisoning. The variables in bivariate analysis with $p < 0.2$ were entered into multivariable logistic regression. The strength of the association of factors associated with the treatment outcome of poisoning was demonstrated by computing an adjusted odds ratio (AOR) with a 95% confidence interval (CI). Finally, the analyzed data were organized and presented in tabular, graphical, and descriptive forms accordingly. After adjusting their effect on the outcome variable, those variables with a P-value <0.05 with a 95% confidence interval were considered as factors significantly associated with the treatment outcome of poisoning.

Results

Socio-Demographic Characteristics

A total of 419 poisoned patients' medical charts were reviewed retrospectively. Of these, 400 (95.5%) patients' medical charts had complete information. About 238 (59.5%) were females, 192 (48.0%) were in the age group of 19–34 years, and 203 (50.7%) lived in rural areas (Table 1).

Table 1 Socio-Demographics Characteristics of Poisoned Patients Admitted at the Emergency Department of Western Amhara Referral Hospitals, Northwest Ethiopia, 2022 (n=400)

Variables	Frequency (n)	Percentage (%)
Sex		
Male	162	40.5
Female	238	59.5
Age in years		
< 19	106	26.5
19–34	192	48.0
≥ 35	102	25.5
Place of Residence		
Rural	203	50.7
Urban	197	49.3

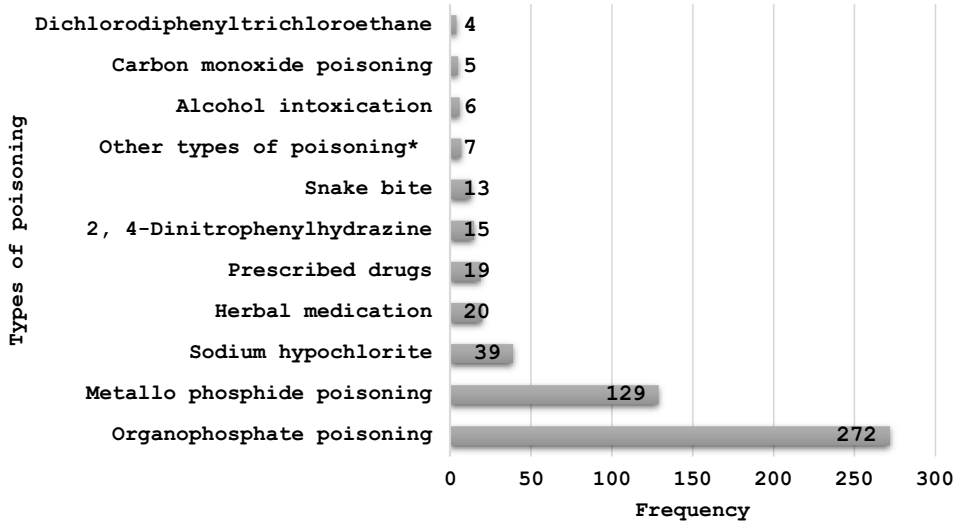

Figure 2 Types of poisoning used by the patients admitted in emergency department of Western Amhara referral hospitals, Northwest Ethiopia, 2022.

Poisoning Related Factors

Of all poisoning cases, organophosphate poisoning (OPP) and metallo phosphide poisoning (MPP) were 272 (68.0%) and 129 (32.3%), respectively (Figure 2), 359 (89.8%) happened unintentionally, 260 (65.0%) were in liquid form, 380 (95.0%) were ingested orally, 241 (60.3%) sustained poisoning at day time, 323 (80.8%) poisoning incidents occurred at home, and 169 (42.3%) pharmaceutical agents were the source of poisoning (Table 2). Among the reasons reported by the poisoned patient's family disharmony and unwanted pregnancy were 129 (32.3%) and 7 (1.8%), respectively (Figure 3).

Clinical-Related Factors

In total, 279 (69.8%) were conscious upon arrival, 17 (4.3%) had comorbidities, 141 (35.3%) developed complications, 14 (3.5%) attempted suicide, 148 (37.0%) were accompanied by ambulances, 241 (60.3%) had not received pre-hospital care, 336 (84.0%) received triage treatment, 328 (82.0%) stayed at the hospital for less than 48 hr, and 337 (84.3%) arrived after 1 hr (Table 3).

Table 2 Poison-Related Characteristics of Poisoned Patients Admitted at the Emergency Department of Western Amhara Referral Hospitals, Northwest Ethiopia, 2022 (n=400)

Variables	Frequency (n)	Percentage (%)
Intention of poisoning		
Unintentional (accidental)	359	89.8
Intentional (suicidal attempt)	41	10.3
Dosage form		
Liquid	260	65.0
Solid	135	33.8
Gas	5	1.3
Route of poisoning		
Oral	380	95.0
Bite	13	3.3
Inhalational	7	1.8

(*Continued*)

Table 2 (Continued).

Variables	Frequency (n)	Percentage (%)
Time of poisoning		
Day time	241	60.3
Night time	159	39.8
Place of poisoning		
Home	323	80.8
Work place	42	10.5
Hotel	35	8.8
Source of poisoning agents		
Pharmacy	169	42.3
Shop	138	34.5
Home	70	17.5
Other[a]	23	5.8

Notes: Other[a] indicates healthcare facilities, laboratories, and hotels.

Treatment Outcome of Poisoning

From 400 reviewed patients' charts, 72 (18.0%) (95% CI: 14.4–22.1) and 328 (82.0%) (95% CI: 77.9–85.6) died and improved, respectively (Figure 4).

Bivariate and Multivariate Analysis of Factors Affecting Poisoning

In the bivariable analysis, a total of 24 variables were used. However, in the multivariable binary logistic regression analysis, only seven variables were significantly associated with the outcome. These include the place of residence, the marital status of the patient, the level of consciousness at the time of arrival, the mode of transport to the hospital, the treatments given at the triage area, the level of oxygen saturation, and the length of stay in the hospital (Table 4).

Discussion

This study aimed at determining treatment outcomes and associated factors in poisoning cases. The mortality rate of the current study was 18% (95% CI: 14.4–22.1). This finding is consistent with studies conducted in Hiwot Fana, Eastern Ethiopia 16.7%,[28] and Debre Tabor 18.6%.[8] Possible reasons could be similarity in types of poisoning agents, modes of

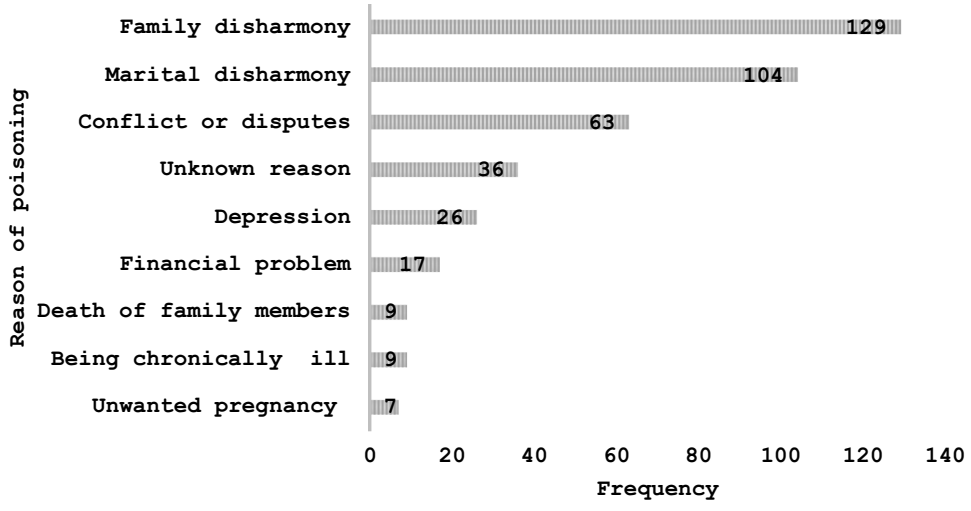

Figure 3 Reason for poisoning among poisoned patients admitted in emergency department of Western Amhara referral hospitals, Northwest Ethiopia, 2022.

Table 3 Clinical Related Factors of Poisoned Patients Who Had Been Admitted at the Emergency Department of Western Amhara Referral Hospitals, Northwest Ethiopia, 2022 (n=400)

Characteristics	Responses	Frequency (n)	Percentage (%)
Level of consciousness at arrival	Conscious	279	69.8
	Unconscious	121	30.3
Presence of comorbidity	No	383	95.8
	Yes	17	4.3
Presence of complications	No	259	64.8
	Yes	141	35.2
History of suicidal attempt	No	386	96.5
	Yes	14	3.5
Methods of transportation used	Ambulance	148	37.0
	Private car	54	13.5
	Bajaj	57	14.2
	Public taxi	141	35.3
Triage category	Red	265	66.3
	Orange	59	14.8
	Yellow	76	19.0
Pre hospital care given	Yes	159	39.8
	No	241	60.3
Treatment given at Triage	Yes	336	84.0
	No	64	16.0
Duration of hospital stay	Less than 48 hours	328	82.0
	Greater than 48 hours	72	18.0
Time of arrival to the hospital	Less than one hour	63	15.8
	Greater than one hour	337	84.3

poisoning, time of arrival to the hospital after exposure, the season of poisoning, and similar socio-demographic characteristics.

This finding is also in line with studies conducted in South India 14.6%,[29] in West Bengal, India, 15.03,[30] and in the tertiary care hospital, India, 18.6%.[21] One possible reason might be sample size variation: the majority were rural dwellers, time of arrival to the hospital after exposure, nature of poisoning, and referral status.

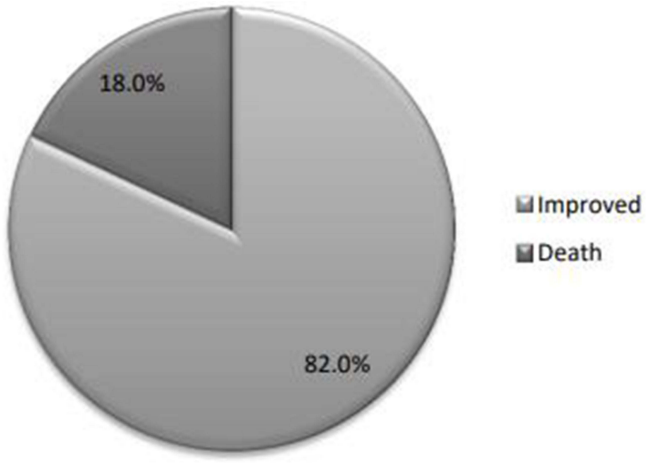

Figure 4 Treatment outcome of poisoning patients admitted in emergency department of Western Amhara referral hospitals, Northwest Ethiopia, 2022.

Table 4 Bivariate and Multivariate Analysis of Factors Associated with Treatment Outcome of Poisoning Among Patients Admitted at the Emergency Department of Western Amhara Referral Hospitals Northwest Ethiopia, 2022 (n=400)

Variables	Outcome		COR (95% CI)	AOR (95% CI)	P-value
	Improved	Death			
Place of residence					
Rural	157	46	1.92 (1.137–3.265)	2.65 (1.065–6.628)	0.036*
Urban	171	26	1	1	
Level of consciousness at arrival					
Conscious	253	26	1	1	
Unconscious	75	46	5.96 (3.459–10.299)	4.8 (1.895–12.483)	0.001*
Oxygen saturation					
< 95%	89	50	6.10 (3.495–10.657)	4.42 (1.816–10.784)	0.001*
> =95%	239	22	1	1	
Duration of hospital stay					
< 48 Hours	262	66	1	1	
≥48 Hours	66	6	0.36 (0.150–0.869)	0.084 (0.020–0.358)	0.001*
Methods of transportation used					
Ambulance	118	30	1	1	
Bajaj	51	6	0.46 (0.181–1.180)	6.78 (1.862–24.733)	0.004*
Private car	39	15	1.51 (0.738–3.101)	1.13 (0.231–5.580)	0.875
Public taxi	120	21	0.68 (0.373–1.270)	0.73 (0.268–2.038)	0.559
Treatment given at triage					
Yes	290	46	1	1	
No	38	26	4.31 (2.396–7.765)	4.64 (1.608–13.407)	0.005*

Note: *Significantly associated.
Abbreviations: AOR, Adjusted odds ratio; CI, Confidence Interval; COR, Crude odds ratio.

The mortality rate of this study is lower than studies conducted in India 24%,[31] 35%,[32] in Egypt 25%[33] and in Ethiopia 27.6%.[16] The possible justification could be due to the difference in a study setting, type of poison exposure, the season of poisoning, the time elapsed from exposure to arrival to the hospital, proper assessment of the severity of poisoning, availability of life-saving measures, and transport services.

The mortality rate of the current study is higher when compared with studies conducted in China (6.7%), Addis Ababa (10.2%), Black lion (8.6%), Dessie (6.6%), and Wolega (7.10%).[10–12,15,34] The possible justification could be due to sample size difference, the severity of poisoning agents, a lack of early diagnosis and treatments, difference in the poisoning agent, a season of poisoning, and pre-hospital care.

Those poisoned patients who live in rural areas were 2.65 times more likely to die as compared to poisoned patients who lived in urban areas. This study is inconsistent with a study conducted in Wollega.[10] One possible justification for this might be that most of the participants were urban dwellers. However, the current study shows rural dwellers predominantly presented with poison cases. That was to time on arrival, and unable to get early advanced and pre-hospital care.

Being unconscious was 4.86 times more likely to die than compared to being conscious during arrival to ED. The result of this study was in line with studies conducted in Royal, London,[35] and Adada, Turkey.[36] This result is congruent with study of Sweden.[37] A possible justification could be the presence of hypoxia or hypercarbia, respiratory distress, hypoglycemia, and decreased airway protection posed to aspiration, hence leading to airway obstruction. Moreover, unconscious patients are at risk of developing multi-organ failure.

In this study, poisoned patients whose Spo_2 was less than or equal to 95% were 4.42 times more likely to die compared to those whose Spo_2 >95%. This finding is agreeable with studies conducted in Norway[38] and Peru.[39] A possible justification could be that brain tolerates only 4–6 min without oxygen, an imbalance between oxygen demand and supply. In fact, the mortality rate increases with decreasing oxygen saturation levels.

Poisoned patients who stayed longer than 48 hr in the hospital were 91.6% less likely to die compared to those who spent less than 48 hr. This study is different from a study conducted in Ambo.[1] One possible reason could be late arrival to the hospital after exposure and advanced care.

Poisoned patients transported to hospital by Bajaj were 6.78 times more likely to die from poisoning, with poisoned cases transported by ambulance. This result is in line with a study by Ohio State University Medical Center.[40] The possible reason may be the difference in the health-care providers' preparedness and approach to receiving patients who come by private car and ambulance, number of patients come by Bajaj, whereby drivers do not respond to the call, finish benzene or oil on the way, and the distance from health facility lead to late arrival to the hospital.

In this study, poisoned patients who never received treatment in triage areas are 4.64 times more likely to die related to those who received treatment in triage areas. This result is in agreement with a study conducted in Belgium. An appropriate triage reduces overcrowding, delays the management of patients, reduces the length of stay in the emergency unit, and improves the management of patients and total time spent in the ED.[41]

Limitations

The retrospective nature of the study design prohibits the necessary variables, like laboratory data, to determine the severity of the cases as a determinant of the treatment outcome of poisoning.

Conclusion

In this study, the mortality rate from poisoning was considerably high. This problem should require the stakeholder to give more attention to planning and improving care for poisoning at the hospital. Improved ambulance services are needed in rural areas. Give treatment at the triage area for all poisoned patients, and frequently follow the unconscious and poisoned patients whose Spo2 is less than 95% and treat them accordingly in ED.

Abbreviation

AOR, Adjusted Odd Ratio; CI, Confidence Interval; COR, Crude Odd Ratio; DMCSH, Debre Markos Comprehensive Specialized Hospital; DTCSH, Debre Tabor Comprehensive Specialized Hospital; ED, Emergency Department; EMCCN, Emergency Medicine and Critical Care Nursing; FHCSH, Felege Hiwot Comprehensive Specialized Hospital; OP, Organophosphate; OPP, Organophosphate Poisoning; PR, Pulse Rate; RBS, Random Blood Sugar; RR, Respiration Rate; SRS, Simple Random Sampling; SOB, Shortness of breath; SPSS, Statistical Package for Social Science; SBP, Systolic Blood pressure; TGCSH, Tibebe Gion Comprehensive Specialized Hospital; UoGCSH, University of Gondar Comprehensive Special Hospital; WHO, World Health Organization.

Data Sharing Statement

All relevant data are available within the manuscript.

Ethical Approval and Consent to Participate

Ethical approval was obtained from the School of Nursing, College of Medicine and Health Science, University of Gondar Research and Ethics Committee (Ref No: S/N/245/2014). Since it was a retrospective cross-sectional study, informed consent was waived by the ethics committee. All procedures were made according to the Helsinki declaration. Confidentiality was maintained at all levels of the study.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising, or critically

reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors have declared that they have no competing interests in this work.

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