Cross-Sectional Study

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A cross-sectional study measuring injury mortality and its associated factors among adult patients in comprehensive specialized hospitals in Amhara National Regional State, Ethiopia

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Background: Injury has become a life-threatening community health problem related to vital morbidity and mortality worldwide. Approximately 90% of injury-related deaths occurred in low-income and middle-income countries. There are limited data that address the outcomes of injuries in adult trauma patients at the time of discharge to improve the outcome of trauma care in developing countries, including Ethiopia. Therefore, this study aimed to determine the mortality following injury and its associated factors among adult patients in comprehensive specialized hospitals in Amhara's national regional state.

Methods: An institution-based cross-sectional study was conducted among 596 adult trauma patients admitted between 1 January 2018 and 30 December 2020. A systematic random sampling technique was employed to select the study participants. Data were collected from patient charts and registry books by using a data extraction tool. Data were entered into Epi-data version 4.6, and analysis was done using Stata version 16. The binary logistic regression model was fitted, and both bi-variable and multi-variable logistic regression analyses were employed.

Result: A total of 581 adult trauma patient charts with a recorded rate of 97.5% were included in the final analysis. The overall mortality outcome of injury at discharge was found to be 8.3% (95% CI: 6–10.5%). Age 26–40 years [adjusted odds ratio (AOR): 3.35 (95% CI: 1.35–8.33)], revised trauma score 10 [AOR: 3.11, (95% CI: 1.39–6.99)], duration of time before arrival in hospital more than 24 h [AOR: 3.61 (95% CI: 1.18–11.02)], and surgical management in hospital [AOR: 0.25 (95% CI: 0.12–0.54)] were predictors of mortality in patients with injuries.

Conclusion: In this study, the mortality outcome of injury is considerably high, and the middle age group, late presentation to the hospital, lower revised trauma score, and surgical management were significantly associated with the mortality outcome of injury on discharge from the hospital. Therefore, it is better if clinicians emphasize traumatically injured patients, especially for middle age groups, and lower revised trauma scores.

Keywords: cross-sectional, Ethiopia, injury

Introduction

Injuries are most commonly classified as unintentional, which include those caused by road traffic accidents, falls, drowning, and burns, and intentional, which includes those caused by self-damage, social violence, war, and conflict[1]. The WHO Global Burden of Disease project estimates one billion trauma patients requiring healthcare annually worldwide, which represents' 12% of the global disease burden. Injury has become a life-threatening community health problem associated with significant morbidity and mortality worldwide; it accounts for over six million deaths globally, with ~90% of injury-related mortality occurring in low-income and middle-income countries[2,3].

Previous studies done on the mortality outcome of injuries in South India showed that mortality related to injury among adult trauma patients in the hospital was 2.3%[4]. Hospital-based studies continue to show that injury is a major cause of morbidity and mortality in Africa. For instance, it is responsible for 27.4%

HIGHLIGHTS

- In this study mortality outcome of injury is considerably high.
- Middle age group, late presentation to the hospital, lower revised trauma score, and surgical management were significantly associated factors.
- Injury has become a life-threatening community health problem.

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of injury-related deaths in South Africa[5]; in Rwanda, among trauma patients, the overall mortality of trauma patients at the hospital discharge was 5.5%[6]; and at Kenyatta National Hospital, Kenya, the overall mortality of injury in the hospital was 4.4%[7]. In Ethiopia, injuries are a major public health challenge. For instance, Jimma revealed that the overall mortality of injury at the time of discharge was 31 (14.7%)[8], and Gedeo Dilla revealed that the overall mortality of injury at the time of hospital discharge was 23 (6%)[9].

From the previous study, factors associated with mortality in trauma patients were productive age, rural residence, occupation, living condition, origin of referral, the mechanism of trauma, site of trauma, the duration of time before arriving at the hospital, length of stay in the hospital, a low Glasgow coma score, comorbidity, first aid, and conservative and surgical management as predictors of mortality in injured patients[4,9–14].

As far as my search goes, inadequate studies have been undertaken so far in these study areas regarding the mortality outcome and associated factors of among adult trauma patients at hospital discharge. Therefore, this study aimed to assess the mortality outcome of injuries and their associated factors at the time of hospital discharge among adult trauma patients in Amhara National Regional State Comprehensive Specialised Hospitals.

Method and material

Study area, design and period

The study was conducted in one of the Ethiopian regional states in selected five comprehensive hospitals, with an estimated area of 159 173.66 square kilometres. The region is administratively organized into 12 zones with 3 city administrations and 83 districts[15]. The multicenter cross-sectional study design was conducted from 1 January 2020 to 1 April 2020, and the study is registered in the Research Registry with UIN 8820. The methodology in this study has been reported according to STROSS guidelines 2021[16].

Population

Source population

All trauma patients visited Amhara National Regional state comprehensive specialized hospitals from 1 January 2018 to 30 December 2020.

Study population

All recorded adult trauma patients who visited in Amhara National Regional state comprehensive specialized hospitals during the past three years from 1 January 2018 to 30 December 2020.

Eligibility criteria

Inclusion criteria

Recorded adult trauma patients who visited Amhara National Regional State comprehensive specialized Hospitals during the past three years. From 1 January 2018 to 30 December 2020 were included in this study.

Exclusion criteria

Recorded adult trauma patients who have been referred to other health centres, died on arrival, and self-discharged against medical advice were excluded.

Sample size determination

The required sample size was calculated using the single population proportion formula. The expected proportion ($P = 0.06$) is taken from the previous research that was done on the mortality outcomes of trauma patients in Dila University's Referral Hospital[9]. The confidence interval = 95% and the margin of error (d) = 2% in order to increase the precision of the study. Hence, the required sample size was:

$$n = \frac{(Z_{\alpha/2} \quad)^2 \times (P(1 - P)}{d^2}$$

n = the minimum sample size required,
P = estimated proportion (6%) = 0.06
z = the standard value of the confidence level of = 95%
d = the margin of error between the sample and the population (0.02).

$$n = \frac{(1.96)^2 \times 0.06 \quad (1 - 0.06)}{(0.02)^2} = 542$$

By considering a 10% drop rate (incomplete data), the final sample size was 542 + 54 = 596.

The sample size was calculated for the most significant independent variables by using a double proportion formula. Factors that were strongly associated with the outcomes of trauma are taken from the previous study conducted at the Dila University Referral Hospital; these were a 10 Revised Trauma Score (RTS) and a 3–8 Glasgow Coma Score. By using Epi-Info version 7 at a 95% confidence level, 80% power was obtained, and the ratio of exposed to unexposed was 1:1. The largest number of those computed from the above was taken as the final sample size. Therefore, the final sample size was 596 based on the single proportion formula.

Sampling technique

A systematic random sampling technique was employed to select the study participants. A proportional allocation technique was used to allocate the samples from each hospital. The total estimated number of adult trauma patients who visited the comprehensive specialised hospitals in the Amhara national regional state from 1 January 2020 to 1 April 2020 was 51 616. First identified MRN from surgical emergency department (ED), ICU, operation room theatre (ORT), surgical ward, and orthopaedics ward (OW) registry books, then the study samples were taken by using a systematic random sampling technique from the card office of each hospital within the study period, and then every k patient chart was selected until the desired sample size was obtained and the first participant was selected by using the lottery method (Fig. 1).

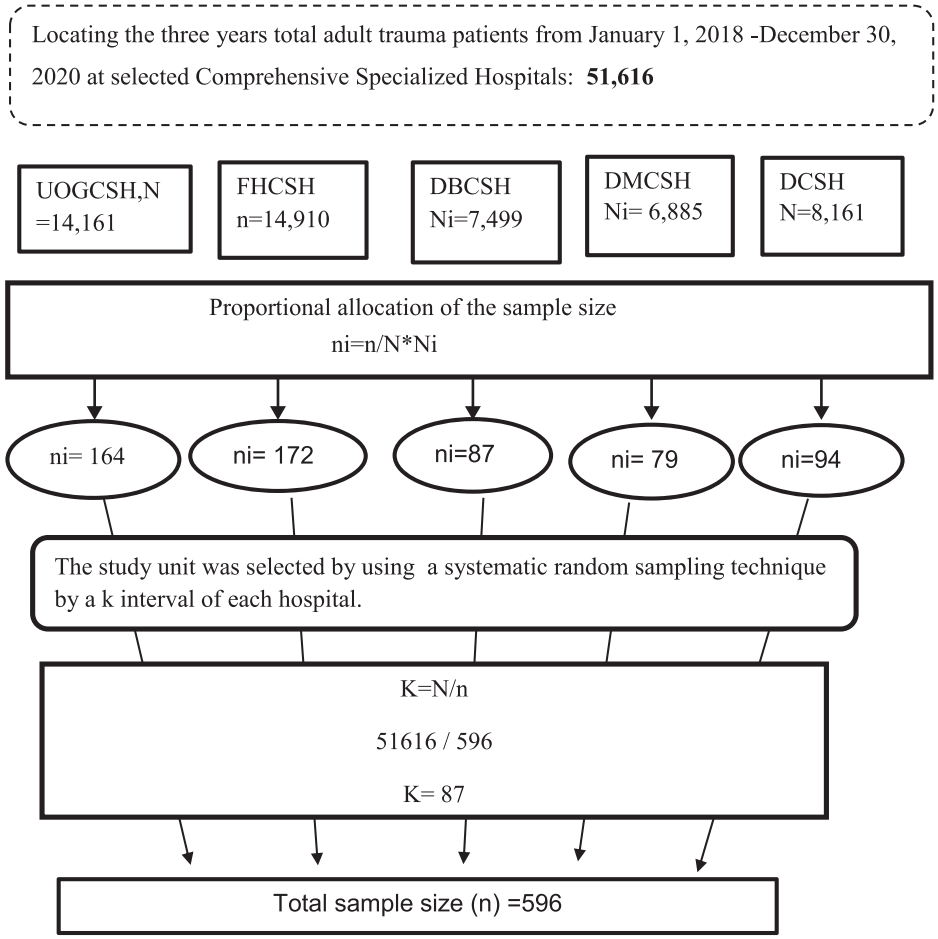

Figure 1. Sampling procedure for the outcome of injury and its associated factors among adult trauma patients in Amhara national regional state Comprehensive Specialized Hospitals, Ethiopia, 1 April to 15 May 2021. DBCSH, stands for Debre Birhan Comprehensive Specialized Hospital; DCSH, stands for Dessie Comprehensive Specialized Hospital; DMCSH, stands for Debre Markos Comprehensive Specialized Hospital; FHCSH, stands for Felege Hiwot Comprehensive Specialized Hospital; UOGCSH, stands for University of Gondar Comprehensive Specialized Hospital.

Variables

Dependent variable

Mortality outcome (yes or no).

Independent variables

Age, sex, occupation, residence, mode of transportation, Glasgow Coma Scale (GCS), RTS, and co-morbidity, including the site of injury, mechanism of injury, length of time spent at the hospital, length of time spent in the hospital, pre-hospital, and at the hospital.

Operational definition

Mortality outcome at discharge indicates the intent of the injury that results in the discharge being improved or death.

Adult patient: a patient aged starting from 18 years[17].

The RTS is a score used to calculate the severity of injury by using three components such as GCS, respiration rate (RR), and systolic blood pressure (SBP) and by following its standard definition[18,19].

Disability means that, due to injury, a person has a physical or mental problem that makes it difficult or impossible for a person to walk, see, hear, speak, learn, or do other important things[20].

Polytrauma means a severely injured patient usually with an associated injury (i.e. two or more open fractures in at least two areas of the body).

Basic first aid means an assessment of the airway, breathing, circulation, disability, and cardiovascular resuscitation (CPR) of the patient in any situation[21].

Data collection tools and procedure

A structured checklist questionnaire was adapted from the WHO fatal injury surveillance guideline (2012), which is validated for low- and middle-income countries, and from different related literatures[8–10,12,14,20,22–24]. It used to collect the following data: socio-demographic data (age, sex, place of residence, living conditions, and occupation), site and mechanism of trauma, revised trauma score, GCS, length of stay (LoS) at the hospital, and outcome status at hospital discharge. The data were collected by six BSc nurses and supervised by three MSc nurses. A pre-test

was conducted among 5% of participants' charts at University of Gondar College of Health Science (UoGCSH).

Data quality control

To maintain data quality, training was provided for data collectors regarding data collection tools and procedures. Pre-testing of the questionnaire was done at the University of Gondar Comprehensive Specialized Hospital. The pre-test Cronbach's alpha result was 0.72. During the data retrieval process, regular monitoring and supervision of the overall activity were done by the supervisor and principal investigator to check for completeness and ensure the quality of the data.

Data processing, analysis and presentation

After completion, the data was manually cross-checked, and missed data were handled by taking mean of existing data. It was entered and documented in Epi-data version 4.6, and it was cleaned, coded, and analyzed in STATA version 16. Descriptive statistics like frequency, percentage, and measures of central tendency with their corresponding measures of dispersion were used for the presentation of socio-demographic and other variables. The other ones, like tables, graphs, and texts, were used to present the findings. The outliers for continuous data were checked via box plot graphs, and multi-collinearity data were checked by variance inflation factors (VIF) and tolerance. The association of trauma-related variables and demographic characteristics with the outcome of the patient at discharge was analyzed by χ^2, and binary logistic regression analysis was applied to identify factors associated with the outcome variable. All variables with a p value of 0.25 in the bi-variable logistic regression analysis were entered into the multi-variable logistic regression analysis. An odds ratio was calculated to determine the strength of the association between dependent and independent variables. A P value of 0.05 was considered statistically significant in multi-variable logistic regression.

Ethical considerations

The study was approved by the University of Gondar, College of Medicine and Health Sciences, School of Nursing Ethical and Research Review Committee on behalf of the Institutional Review Board (IRB), with an ethical clearance number of S/N/164/7/2013 given to the investigator preceding the study's implementation. An official letter was sent to the selected comprehensive specialized hospitals of the Amhara national regional state in which the study was conducted. Then a support letter was obtained from the Medical Director's office of each hospital for retrieving retrospective data from the database and records. All the information was kept confidential, and no individual identifiers were collected.

Results

Descriptive result of mortality outcomes of injuries among adult trauma patients who visited in Amhara national regional state Comprehensive Specialized Hospitals from 1 January 2018 to 30 December 2020 ($n = 581$).

Five hundred eighty-one cases had completed documentation from 596 included samples, giving a recorded rate of 97.5%. The median ages of study participants were 29 (IQR, 24–44). In this study, the youngest and the oldest trauma victims were 18 years old and 75 years old, respectively. The majority of the victims were in the age range of 26–40 years, 206 (35.46%), whereas 42 (7.23%) cases were in the age range of >60 years old. A higher proportion of males, 452 (77.8%), were injured than females, with a male-to-female ratio of 4:1. Of which factors related with injuries sever GCS 267 (45.96%), RTS less than ten 69 (22.20%), and then co-morbidity 95 (16.35%) were common factors. The median duration of time to arrive at the institution was 12 h (IQR, 3–24). Most of the patients, 338 (58.18%), seek healthcare within 2–24 h, and 149 (25.65%) of the subjects seek healthcare more than 24 h, and 94 (16.18%) within less than or equal to 1 h. The median length of hospital stay was 10 days, IQR[7–14]. The majority length of time spent at the hospital was greater than seven days [357 (58.00%)], followed by 2–7 days [186 (32.01%)].

This study also found that the prevalence of mortality among adult trauma patients over three years was 8.3% (at 95% CI; 6–10.5%). Among 581 patients, pre-hospital intervention was provided for 364 (62.65%), of those patients who had received pre-hospital interventions, 315 (86.54%) received basic first aid immediately after the injury occurred, followed by 304 (83.52%) who received medication like tetanus toxoid, anti-pain. Surgical treatment was successful in 397 (68.33%) of cases, including, suturing, cleaning, and dressing of the wound, followed by only conservative treatment, which was successful in 184 (31.67%) of cases, including, antibiotics, tetanus toxoid, fluid replacement, analgesics, and physiotherapy (Table 1).

Patterns of injury

An assault was the commonest mechanism of injury (226, 38.9%), followed by RTA (191, 32.87%), whereas other injuries like machine and self-injury were the lowest mechanisms of injury (35, 6.02%). The commonest site of injury was polytrauma [135 (28%)], followed by lower extremity [128 (23%)], and head injury [113 (19%)], whereas upper extremities were found to be the lowest type of injury. (Fig. 2).

Factors associated with the mortality outcomes of injuries

The age of the respondents from 26 to 40 years old had 3.35 times higher odds of developing mortality from injury as compared to the age of the respondent from 18 to 25 years [adjusted odds ratio (AOR) = 2.46; 95% CI, 1.35–8.33]. Adult trauma patients' revised trauma score less than ten was 3.11 times more likely to develop mortality than those patients' revised trauma score greater than or equal to ten (AOR = 3.11; 95% CI, 1.39–6.99). The odds of mortality among adult trauma patients who came to the hospital after a victim's stay was longer than 24 h were 3.61 times more likely to develop mortality than those patients who came to the hospital after a victim's stay was less than or equal to one hour (AOR = 3.61; 95% CI, 1.18–11.02). The odds of being adult trauma patients who had taken surgical management after arriving at the hospital were 75% less likely to develop mortality than those patients who had taken conservative management (AOR = 0.25; 95% CI, 0.12–0.54) (Table 2).

Table 1

Descriptive result of mortality outcomes of injuries among adult trauma patients who visited in Amhara national regional state Comprehensive Specialized Hospitals from 1 January 2018 to 30 December 2020 ($n = 581$)

		Outcomes		
Variable	Category	Died	Improved	Total, *N* (%)
Age	18–25	10	181	191 (32.87)
	26–40	26	180	206 (35.46)
	41–60	11	131	142 (24.44)
	> 60	1	41	42 (7.23)
Sex	Male	41	411	452 (77.8)
	Female	7	122	129 (22.2)
Occupations	Govt. Employee	7	87	94 (16.18)
	Merchant	8	94	102 (17.56)
	Farmer	10	100	110 (18.93)
	Daily labourer	8	73	81 (13.94)
	Housewife	4	57	61 (10.50)
	Student	5	74	79 (13.60)
	Other[a]	6	48	54 (9.29)
Resident	Urban	37	330	367 (63.17)
	Rural	11	203	214 (36.83)
Living condition	Home	46	527	573 (98.62)
	Street	2	6	8 (1.38)
	From the scene	19	90	209 (35.97)
Origin of referral	From hospital	8	100	108 (18.59)
	From health centre	15	176	191 (32.87)
	From private health institution	6	67	73 (12.56)
GCS	Mild (13–15)	5	123	128 (22.03)
	Moderate (9–12)	7	179	186 (32.01)
	Sever (3–8)	36	231	267 (45.96)
	Other[b]	6	32	38 (6.54)
Co-morbidity	Yes	9	86	95 (16.35)
	No	39	447	486 (83.65)
Time to arrive at the institution	< 1 h	6	88	94 (16.18)
	2–24 h.	19	319	338 (58.18)
	> 24 h.	23	126	149 (25.65)
	First aid(basic)	21	294	315 (86.54)
Types of care before arrive at hospital	Resuscitation	6	186	192 (52.75)
	Medication (anti-pain…)	11	293	304 (83.52)
	Other[a]	3	36	39 (10.68)

GCS, Glasgow Coma Scale.
[a]Means private worker, unemployed, non-Government Organization.
[b]Means mode of arrival by on foot, horse, holding by people.

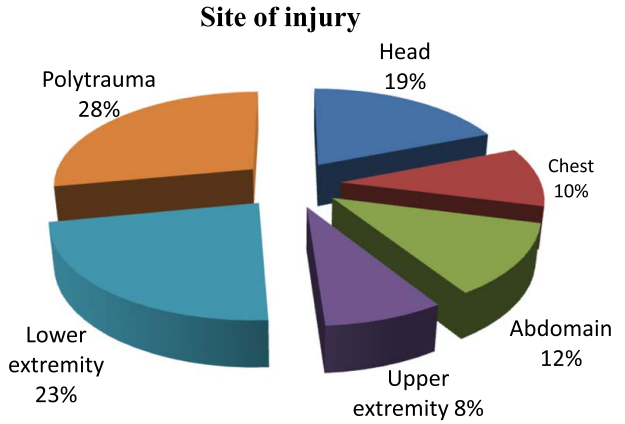

Figure 2. Site of injury among adult trauma patients who visited in Amhara national regional state Comprehensive Specialized Hospitals from 1 January 2018 to 30 December 2020 ($n = 581$).

Discussion

This section discusses the findings from the present study with other literature. It focused on the outcomes of injuries among adult trauma patients as well as factors associated with the outcomes of injuries, like socio-demographic characteristics, patterns of injury, clinical-related, time-related, and management-related factors in Amhara National Regional State Comprehensive Specialized Hospital, Ethiopia.

This study found that the prevalence of mortality among adult trauma patients over three years was 8.3% (95% CI: 6–10.5%). The result was consistent with a study conducted at Dila University Referral Hospital in Gedeo, Ethiopia, of 6%[9]. The result of this finding is inconsistent with the result reported by a study conducted at Jimma University Referral Hospital (14.7%)[8]. this discrepancy might be due to the study period. The current study was conducted using three years of documented data. But the Jimma University Referral Hospital was conducted on six-month documented data, and the high mortality might be due high number of patients follow during that period.

The finding of this study was also inconsistent with the study conducted at Minilik II Specialized Hospital, Adiss Ababa, Ethiopia (1.5%)[11]. The possible discrepancy might be due to the difference in the socio-demographic characteristics of the study population, for instance, the age of the study population. This study focused only on adult trauma patients greater than or equal to 18 years old, however, in Minilik's II Specialized Hospital Study, all age groups were included. The finding of this study was also higher than the finding of the University of Kigali Teaching Hospital in Rwanda among adult trauma patients (5.5%)[6]. The possible explanation might be due to the difference in the study settings. In Rwanda, there are pre-hospital care services established by establishing a pre-hospital emergency care system, the availability of medical equipment like computed tomography (CT) scans and MRIs, and a better referral linkage system than in our study settings. The mortality rate of injuries in one of the Indian tertiary hospitals was lower than half of ours. This discrepancy might be due to the establishment of an advanced tertiary care centre and the specialized trauma teams operating in the emergency department[25].

This study revealed that the age of respondents from 26 to 40 years old had 2.46 times higher odds of developing mortality among trauma patients compared to the age of patients from 18 to 25 years old. This finding is comparable with the study conducted in the accident and emergency department of the combined military hospital in Pakistan revealed that factors significantly associated with the mortality outcome of injury were between the age group of 25–45[10]. Because they are going through a lively, active, and difficult time in life, actively participating in outdoor labour to make a living and learning how to live independently, this age group is more exposed to the outside world. Since the most productive age group is the one with the highest rate of injuries, the economic impact of injuries can be anticipated. However, this result cannot be compared to the Tanzanian result[26]. This deference might be due to the socio-

Table 2

Bivariable and multi-variable logistic regression for factors associated with mortality outcomes of injury among adult trauma patients who visited in Amhara national regional state Comprehensive Specialized Hospitals from 1 January 2018 to 30 December 2020 ($n = 581$)

		Outcomes					
Variables	**Category**	**Died**	**Improved**	**CoR (95% CI)**	**P.v.**	**AoR (95% CI)**	***P***
Age	18–25	10	181	1		1	
	26–40	**26**	**180**	**2.61 (1.23–5.58)**	**0.01**	**3.35 (1.35–8.33)**	**0.01***
	> 40	12	172	1.26 (0.53–2.9)	0.25	1.87 (0.70–5.04)	0.21
Sex	Male	41	411	1.74 (0.76–3.97)	0.19	1.54 (0.61–3.90)	0.36
	Female	7	122	1		1	
Resident	Urban	37	330	2.07 (1.03–4.15)	0.04	1.45 (0.66–3.18)	0.35
	Rural	11	203	1		1	
Mode of arrival	Ambulance	25	247	0.79 (0.29–2.18)	0.65	0.71 (0.23–2.50)	0.60
	Bajaj	5	39	1		1	
	Taxi	12	215	0.44 (0.15–1.30)	0.14	0.46 (0.12–1.68)	0.34
	Others*	6	32	1.46 (0.41–5.24)	0.56	2.10 (0.44–9.93)	0.38
GCS	3–	36	231	3.83 (1.46–10.01)	0.01	2.47 (0.75–8.12)	0.14
	9–12	7	179	0.96 (0.30–3.10)	0.95	0.94 (0.25–3.59)	0.93
	13–15	5	123	1		1	
RTS	< 10	**17**	**52**	**5.07 (2.63–9.79)**	**0.01**	**3.11 (1.39–6.99)**	**0.01***
	> 10	31	481	1		1	
Duration of time	< 1 h	6	88	1		1	
	2–24 h	19	319	0.87(0.34–2.25)	0.78	0.87 (0.30–2.54)	0.80
	> 24	**23**	**126**	**2.67 (1.05–6.84)**	**0.04**	**3.61 (1.18–11.02)**	**0.02***
Hospitalization	< 1 day	5	53	1		1	
	2–7 days	6	180	0.35 (0.10–1.20)	0.10	0.24 (0.06–1.02)	0.052
	> 7 days	37	300	1.30 (0.49–3.47)	0.59	1.18 (0.34–4.09)	0.79
Rx before arrival	Yes	18	337	1		1	
	No	30	139	1.62 (0.89–2.91)	0.12	1.65 (0.80–3.41)	0.18
Rx after arrival	Conservative Rx	25	159	1		1	
	Surgery Rx	**23**	**374**	**0.39 (0.22–0.71)**	**0.01**	**0.25 (0.12–0.54)**	**0.01***

Bold values refer to statistically significant confidence intervals.

AOR, adjusted odds ratio; COR, crude odds ratio; GCS, Glasgow Coma Scale; Rx, treatment; Pv indicate p value.

*Other includes: arrived on foot, by Hoarse and holding by people in bed.

demographic characteristics of the patients. For instance, in this study, the age of the patient started at 18 years, while in Tanzania, the study was conducted in all age groups of the population.

This study showed that the lower revised trauma score was significantly associated with patient mortality. The odds of patient's mortality who had a revised trauma score of less than ten were 3.11 times more likely to develop mortality than patients with a revised trauma score greater than or equal to ten. This finding is supported by a study conducted at Dila University Referral Hospital[9]. The similarity of this result might be that the severity of injury can significantly affect the outcome of trauma patients.

This study showed that patients who arrived after 24 h of injury had higher mortality rates than patients who arrived less than or equal to 1 h. This finding was in agreement with the studies conducted at Minilik the second specialized hospital, Addis Ababa, Ethiopia revealed that the patients were present over 6 h after injury was a significant factor in the mortality of injury[11] and Tanzania[26]. This can be due to the victim's health-seeking behaviour and the lack of sufficient healthcare facilities nearby, which could be the reason for their late presentation to the hospital.

Our study showed that the odds of patient mortality among adult trauma patients who had taken surgical intervention after arriving at the hospital were 75% less likely to predict mortality as compared to patients who had taken only conservative intervention. This finding is supported by a study conducted at the Tertiary Teaching Hospital of Kigali in Rwanda[26].

Conclusion and recommendation

The study found that the mortality outcomes of injuries were considerably higher in Amhara national regional state comprehensive specialized hospitals when compared with other studies conducted in similar settings, and took the lives of the most productive age groups of the population.

Surgical intervention was the major treatment modality in the present study, though more than one-third of the patients were treated by conservative management techniques like pain management, fluid resuscitation, antibiotics, and physiotherapy.

The age of the patients between 26 and 40 years old, late presentation to the hospital after an injury, and a lower revised trauma score were the most important predictors of mortality related to trauma. Therefore, it is better to create awareness in society about health-seeking behaviour and enhance healthcare services to reduce the mortality rate from injury.

Limitation of the study

Since the study was a retrospective documentary review, all information was taken from the patient's chart and registry book. However, incomplete patient charts and registry books were the

major challenges to getting relevant information for the study. As this is a cross-sectional study, it doesn't show a cause-and-effect relationship.

Ethical approval

Ethical approval was secured from the University of Gondar institutional review board.

Consent

No individual or sensitive data is available on request.

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Author contribution

W.M. has made substantial contributions to conception, Writing —review and also contributed in editing of the manuscript drafts for scientific merit and depth

Conflicts of interest disclosure

The authors declare no conflicts of interest.

Research registration unique identifying number (UIN)

1. Name of the registry: Researchregistry.com.
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Guarantor

Wondossen Mulugeta.

Data availability statement

Data will be available.

Provenance and peer review

Not commissioned, externally peer-reviewed.

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