Original Article

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Pattern and trend of trauma-related deaths in the Emergency Medicine department of Tikur Anbessa Specialized teaching hospital, 2014-2016

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ABSTRACT

Background: *Trauma is a major global public health problem and a leading cause of death and disability. Despite evidence that timely prehospital care can reduce trauma-related mortality, access to such services remains limited in many low- and middle-income countries, including Ethiopia. Data describing trauma-related deaths and prehospital care are scarce. This study aimed to assess the patterns of trauma-related deaths presenting to the emergency department (ED) of a tertiary hospital and describe factors associated with mortality.*

Objective: *To describe the patterns of injury and characteristics of trauma-related deaths among patients presenting to the Emergency Department of Tikur Anbessa Specialized Hospital (TASH).*

Methods: *A retrospective descriptive study was conducted at the Emergency Department of Tikur Anbessa Specialized Hospital. Medical records and trauma sheets of all 113 eligible trauma-related deaths occurring during six-month intervals (April to September) between 2014 and 2016 were reviewed (46 in 2014, 36 in 2015, and 31 in 2016). Patients who arrived alive at the ED and subsequently died from traumatic injuries, excluding poisoning and burn injuries, were included. Data were analyzed using SPSS version 20.0, and descriptive statistics were summarized using frequencies, percentages, means, tables, and figures.*

Results: *Males accounted for the majority of trauma-related deaths across the three six-month study periods (April–September of 2014, 2015, and 2016: 84.8%, 80.6%, and 83.9%, respectively). The mean age of male victims was 42.6, 39.2, and 38.3 years, while the mean age of female victims was 32.1, 45.6, and 47.2 years. Trauma-related deaths represented 17.6%, 13.9%, and 10.9% of total ED deaths during the respective periods. Only 45.6%, 27.8%, and 25.8% of victims arrived at the ED within six hours of injury. Motor vehicle accidents (MVAs) were the leading mechanism of injury (65.2%, 55.6%, and 80.6%), followed by assault and falls. Blunt trauma was the predominant injury mechanism (93.4%, 97.2%, and 100%), with blunt head injury being the most common anatomical injury (89.1%, 88.9%, and 74.3%), followed by poly-trauma and maxillofacial injuries. The mean Revised Trauma Score (RTS) on arrival was 5.29 ± 1.74, 5.02 ± 1.77, and 5.43 ± 1.90. Head injury was the leading cause of death (82.6%, 83.3%, and 67.7%), followed by sepsis/multiple organ failure syndrome, hemorrhagic shock, and respiratory failure.*

Conclusion: *Trauma-related deaths predominantly affected males of productive age. A relatively small proportion of patients reached the hospital within six hours of injury, indicating potential delays in accessing definitive care. Although the overall trend of trauma-related mortality decreased during the study period, deaths resulting from motor vehicle accidents increased. These findings highlight the need to strengthen injury prevention strategies, improve prehospital and emergency trauma care, and optimize the trauma care system to reduce preventable trauma-related deaths.*

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Keywords:Trauma mortality, emergency medicine, injury patterns, motor vehicle accidents, prehospital care, Ethiopia.

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1. Introduction

Trauma and physical injuries represent a major global public health challenge, accounting for more than five million deaths annually, approximately 9% to 10% of global mortality, and nearly 16% of the global burden of disease. [1, 2] An injury is conventionally defined as physical damage resulting from the acute transfer of energy (mechanical, thermal, electrical, chemical, or radiant) or the sudden deprivation of vital elements such as oxygen. [3] Injuries are broadly categorized by intent into unintentional injuries (such as road traffic accidents, falls, drowning, burns, and poisoning) and intentional injuries (including interpersonal violence, self-harm, and armed conflict). [1, 4] Globally, trauma is the leading cause of mortality among individuals under 40 years of age and disproportionately affects young adults aged 15–29 years. [2, 5]

Timely prehospital care and organized emergency medical services (EMS) are critical determinants of trauma survival. [2, 6] In high-income settings, established trauma systems utilizing Advanced Trauma Life Support (ATLS) guidelines, built around rapid transportation, structured resuscitation (the ABCDE approach), and dedicated trauma teams, have significantly reduced preventable deaths. [7] Conversely, in low- and middle-income countries (LMICs), a substantial proportion of trauma-related deaths occur before patients reach a healthcare facility due to fragmented prehospital care, inadequate ambulance infrastructure, prolonged transport times, and inefficient referral pathways. [2, 6]

In Ethiopia, the burden of trauma is high, yet emergency care systems remain underdeveloped. [8] Many health facilities lack dedicated emergency departments, essential resuscitation equipment, and healthcare providers formally trained in emergency and trauma care. [8] Consequently, trauma victims face significant delays in diagnosis, triage, and definitive management. [8] To address these systemic gaps, Tikur Anbessa Specialized Hospital (TASH), Ethiopia's principal tertiary referral center, established its Emergency Department in 2010, establishing a foundation for standardized emergency care in the country. [8] However, despite this milestone, the hospital continues to face operational challenges driven by surging patient volumes, resource limitations, and the absence of a coordinated national trauma network. [8]

Despite the substantial impact of trauma in Ethiopia, empirical evidence describing the detailed epidemiology of trauma mortality remains scarce. [1, 8] Existing literature provides limited data regarding injury mechanisms, anatomical injury patterns, time elapsed from injury to presentation, physiological severity at arrival, and immediate causes of death in emergency departments. [1, 8] Furthermore, longitudinal data evaluating trends in trauma-related mortality over time are lacking. [1] Understanding these factors is crucial for identifying systemic bottlenecks, informing targeted injury prevention policies, and strengthening prehospital and hospital-based trauma care. [1]

Therefore, this study aimed to assess the patterns, clinical characteristics, and multi-year trends of trauma-related deaths among patients who died from traumatic injuries at the Emergency Department of Tikur Anbessa Specialized Hospital during the six-month study periods (April–September) between 2014 and 2016. Specifically, the study evaluated the socio-demographic profile of trauma victims, determined the distribution of injury mechanisms and anatomical patterns, identified the immediate clinical causes of death, and assessed the temporal relationship between time of injury, presentation, and mortality.

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2. Method

Study Area

The study was conducted at the Emergency Department (ED) of Tikur Anbessa Specialized Hospital (TASH) in Addis Ababa, Ethiopia. TASH is the country's largest tertiary referral and teaching hospital and serves as the primary clinical training site for the College of Health Sciences at Addis Ababa University. The hospital receives high-acuity referral patients from all regions of Ethiopia and provides specialized surgical, medical, pediatric, and subspecialty care. During the study period, the facility operated with approximately 800 inpatient beds and over 130 specialist physicians.

The Emergency Department was established in 2010 within the Department of Emergency Medicine and Critical Care and provides 24-hour emergency and trauma resuscitation services for adult patients. Emergency medicine residents, general practitioners, interns, and emergency nurses deliver care under the direct supervision of consultant emergency physicians. Clinical care follows standardized international guidelines, including Advanced Trauma Life Support (ATLS) protocols. The department is equipped for critical trauma resuscitation, initial stabilization, emergency surgical decision-making, and definitive care or subspecialty admission.

Study Period

The study reviewed trauma-related deaths occurring over three consecutive years, focusing on a standardized six-month period (April 1 to September 30) for each year from 2014 to 2016. The April–September window was purposefully selected as it encompasses the transition through the primary heavy rainy season (*Kiremt*) in Ethiopia, a period characterized by increased road traffic hazards, altered transportation dynamics, and heightened trauma risks. Utilizing an identical six-month timeframe across all three years controlled for seasonal confounding, enabling a standardized evaluation of multi-year temporal trends.

Study Design

A retrospective descriptive study was conducted through review of medical records of trauma-related deaths that occurred in the Emergency Department of TASH during the study period. Information was obtained from patients' medical charts, emergency department records, and trauma registration forms maintained by the hospital medical records unit.

The study included all eligible trauma-related deaths that fulfilled the predefined inclusion criteria during the study period.

Study Population

The study population comprised all trauma victims who presented alive to the ED of TASH and subsequently died while receiving emergency care during the study period.

Criteria for Determining Trauma-Related Death

A death was classified as directly resulting from trauma if it met the following standardized clinical criteria based on retrospective review of emergency medical records, triage logs, resuscitation sheets, and official death summary reports:

1. **Direct traumatic etiology:** The primary anatomical injury or acute physical energy transfer (e.g., severe traumatic brain injury, traumatic asphyxia, massive hemorrhage, or poly-trauma) was documented by the attending emergency or surgical team as the main trigger leading to cardiac arrest or death.
2. **Acute traumatic complications:** Death resulted directly from secondary systemic

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complications that directly stemmed from the primary traumatic event during the ED stay, including acute hemorrhagic shock, refractory traumatic shock, acute respiratory distress secondary to chest trauma, or rapid post-traumatic sepsis/multiorgan failure.

3. **Exclusion of primary medical Events:** Patients were excluded if clinical evaluation indicated that an underlying non-traumatic acute medical event (e.g., primary myocardial infarction, cardiac arrhythmia, or cerebrovascular accident) preceded and directly caused the collapse or secondary minor injury, or if trauma was incidental to the cause of death. Patients who were Dead on Arrival (DOA) without undergoing ED resuscitation were also excluded.

Eligibility Criteria

Inclusion Criteria

The study included all patients who fulfilled the following criteria:

1. Patients with trauma-related deaths who presented alive to the Emergency Department of TASH Hospital during the study period.
2. Patients whose deaths resulted from traumatic injuries other than burns and poisoning.
3. All eligible trauma-related deaths occurring during the study period (April to September for each year from 2014 to 2016).

Exclusion Criteria

The following patients were excluded from the study:

- Patients who were declared dead on arrival at the Emergency Department.
- Patients whose deaths resulted from burn injuries or poisoning.
- Medical records with incomplete or missing information required for the study.

Study Variables

The study collected information on patients' demographic characteristics, injury characteristics, clinical findings, and hospital-related variables.

Data Collection Procedure

A structured data abstraction form was developed to collect information from patients' medical records and trauma registration sheets. Medical charts of all eligible trauma-related deaths were retrieved from the hospital medical records department and reviewed systematically.

Information regarding demographic characteristics, injury mechanism, anatomical site of injury, clinical findings, treatment, complications, and causes of death was extracted from the patients' records. Records with incomplete documentation or missing essential information were excluded from the analysis.

Data Management and Analysis

The collected data were checked for completeness and consistency before data entry. Data were entered, cleaned, and analyzed using Statistical Package for the Social Sciences (SPSS) version 20.0.

Descriptive statistical methods were used to summarize the study findings. Continuous variables were summarized using means and standard deviations where appropriate, while categorical variables were presented as frequencies and percentages. Results were presented in tables, charts, and graphs to facilitate interpretation.

Ethical Considerations

Ethical approval for the study was obtained from the Institutional Review Board of TASH. The relevant hospital authorities granted permission to

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access patients' medical records before data collection.

Patient confidentiality was maintained throughout the study by collecting data anonymously and excluding personal identifiers from the data collection tool. The information obtained from medical records was used solely for research purposes.

Operational Definitions

Hospital stay: The duration of hospitalization before death was categorized as acute if death occurred within 48 hours of admission, delayed if death occurred between 3 and 7 days, and late if death occurred more than 7 days after admission. [13]

Mechanism of injury: The external cause responsible for the injury, including motor vehicle accidents, falls from height, assault (excluding sexual assault), and other traumatic events.

Other mechanisms of injury: Injuries resulting from machinery, animal bites, war-related injuries, and other mechanisms not included in the predefined categories.

Unknown mechanism of injury: Cases in which the mechanism of injury could not be determined because the patient was brought by police, bystanders, or other individuals without reliable information regarding the incident.

Self-referral: Patients who presented directly to the Emergency Department either by themselves or accompanied by family members or friends without referral from another health facility.

Referred patient: Patients transferred from another healthcare facility with an official referral document.

Source of referral – Other: Patients for whom no referral document or documentation regarding the source of referral was available in the medical record.

Revised Trauma Score (RTS): A physiological trauma scoring system calculated using the Glasgow Coma Scale (GCS), systolic blood pressure (SBP), and respiratory rate (RR). The weighted RTS is calculated using the formula:

Weighted RTS = (0.9368 × GCS score) + (0.7326 × SBP score) + (0.2908 × RR score)

RTS is the Revised Trauma Score. It is calculated using GCS, SBP, and RR (tin17 (10), 706).

The raw RTS score ranges from 0 to 12

Weighted RTS = 0.94 × RTS GCS +0.73RTS SBP +0.29RTS RR and max score 7.84 and min score is

- Maximum is 7.84
- Minimum is 0
- Survival correlation
- 80% with RTS of *5*
- 50% with RTS of 3.5
- 20% with RTS of 23

4. Result

Across the three six-month study periods (April 1 to September 30 in 2014, 2015, and 2016), a total of 5,433 trauma patients presented to the Emergency Department (ED) of Tikur Anbessa Specialized Hospital (TASH), comprising 1,761 patients in 2014, 1,819 in 2015, and 1,853 in 2016. Overall, trauma admissions accounted for approximately one-quarter of total ED patient volume across each study period (24.1% in 2014, 24.6% in 2015, and 24.8% in 2016).

During the study periods, 113 trauma-related deaths occurred in the ED. Trauma deaths represented 17.6% (n = 46/262) of total ED mortality in 2014, 13.9% (n = 36/259) in 2015, and 10.9% (n = 31/282) in 2016 (Figure 1).

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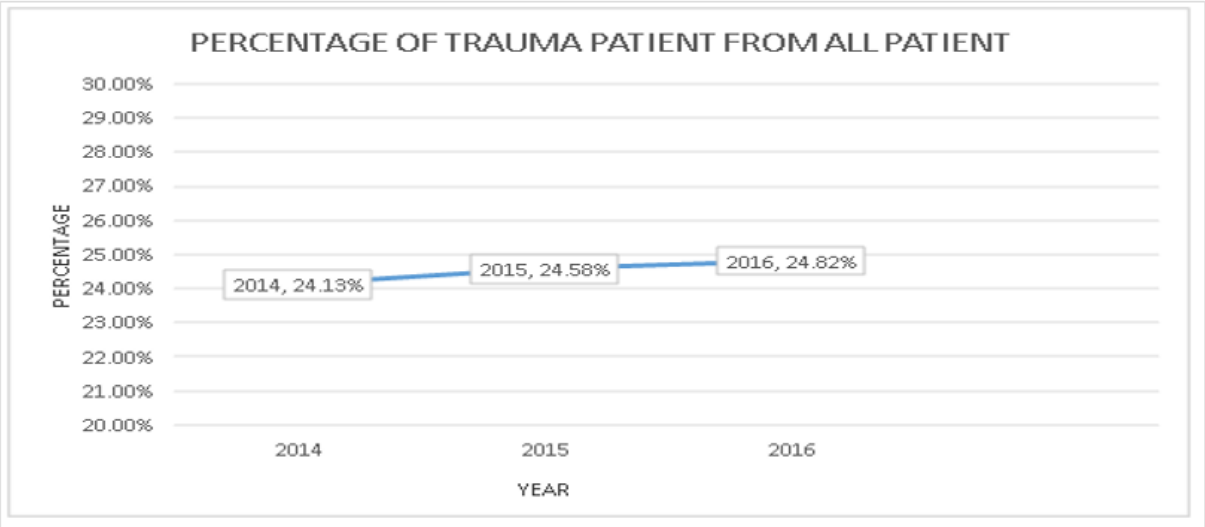

Figure 1: Percentage of trauma patients from all patients

Among all presenting trauma cases, the overall trauma case-fatality rate was 2.1% (113/5,433), showing a downward trend across the three study periods from 2.6% (46/1,761) in 2014 to 2.0% (36/1,819) in 2015 and 1.7% (31/1,853) in 2016 (Figure 2, 3).

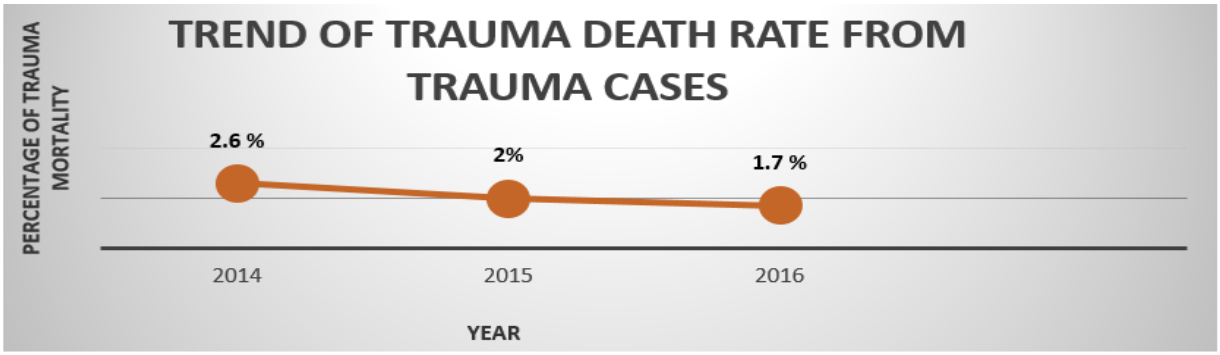

Figure 2: Trend of trauma death rate from trauma cases

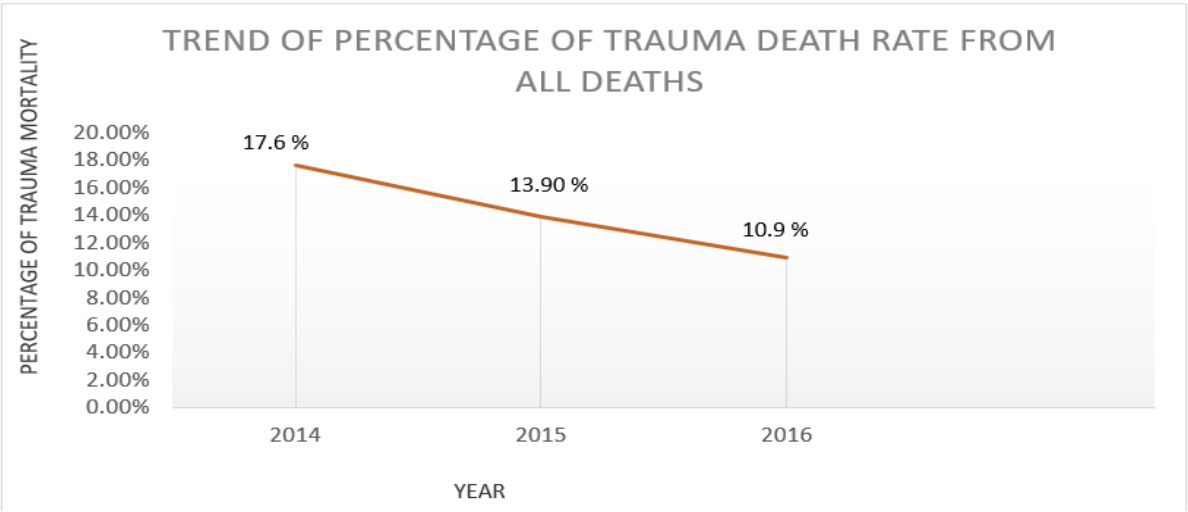

Figure 3: Trend of percentage of trauma death rate from all deaths

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Table 1 Socio-demographic characteristics and base line vital signs upon arrival among trauma-related deaths (N = 113) at the Emergency Department of Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia (April–September, 2014–2016).

Demographic & clinical variable	Characteristics	2014n(%)	2015n(%)	2016n(%)
Gender	Male	39(84.8%)	29 (80.6%)	26 (83.9%)
	Female	7(15.2%)	7 (19.4%)	5 (16.1%)
Age (Years)	<18 year	6(13.0%)	2 (5.6%)	0 (0%)
	18-55 year	25(54.3%)	27 (75.0%)	24 (77.4%)
	>55 year	15(32.6%)	7 (19.4%)	7 (22.6%)
Mechanism of Injury	MVA	30(65.2%)	20 (55.6%)	25 (80.6%)
	Fall down accident	6(13.0%)	5 (13.9%)	2 (6.5%)
	Assault/fighting, bullet, sharp injury, stab injury etc./	8(17.4%)	8 (22.2%)	2 (6.5%)
	Unknown	1(2.2%)	1 (2.8%)	1 (3.2%)
	Other	1(2.2%)	2 (5.6%)	1 (3.2%)
Source of Referral	Self-Referral	3 (6.5%)	4 (11.1%)	1 (3.2%)
	Referred from other health institution	37 (80.4%)	25 (69.4%)	28 (90.3%)
	Unknown	6 (13.0%)	7 (19.4%)	2 (6.5%)
Mode of Arrival	Ambulance	19 (41.3%)	11 (30.6%)	11 (35.5%)
	Taxi	10 (21.7%)	12 (33.4%)	8 (25.8%)
	Private car	7 (15.2%)	1 (2.8%)	4 (12.9%)
	Police Car & Other	10 (21.7%)	12 (33.4%)	8 (25.8%)
Systolic Blood Pressure	>=90 mmHg	35 (76.1%)	30 (83.3%)	27 (87.1%)
	<90 mmHg	11 (23.9%)	6 (6.7%)	4 (12.9%)
Respiratory Rate	<10 breath/min	3 (6.5%)	1 (2.8%)	1 (3.2%)
	10-29 breath/min	33 (71.1%)	22 (61.1%)	15 (48.4%)
	>29 breath/min	10 (21.7%)	13 (36.1%)	15 (48.4%)
GCS	>=9	17 (37%)	8 (22.2%)	13 (41.9%)
	<9	29 (63%)	28 (77.8%)	18 (58.1%)

The most common triage classification in 2014 was orange, followed by red, yellow, and green, at 22 (47.8), 15 (32.6%), 8 (17.4), and 1 (2.2%), respectively. For the year 2015 both red and orange were equal at 13 (36.1%) each followed by yellow and green at 7(19.4%) and 3 (8.4%) but for the year 2016 red was the commonest 22 (71%) followed by orange and yellow at 7 (22.8%) and 2 (6.5%) (Figure 4).

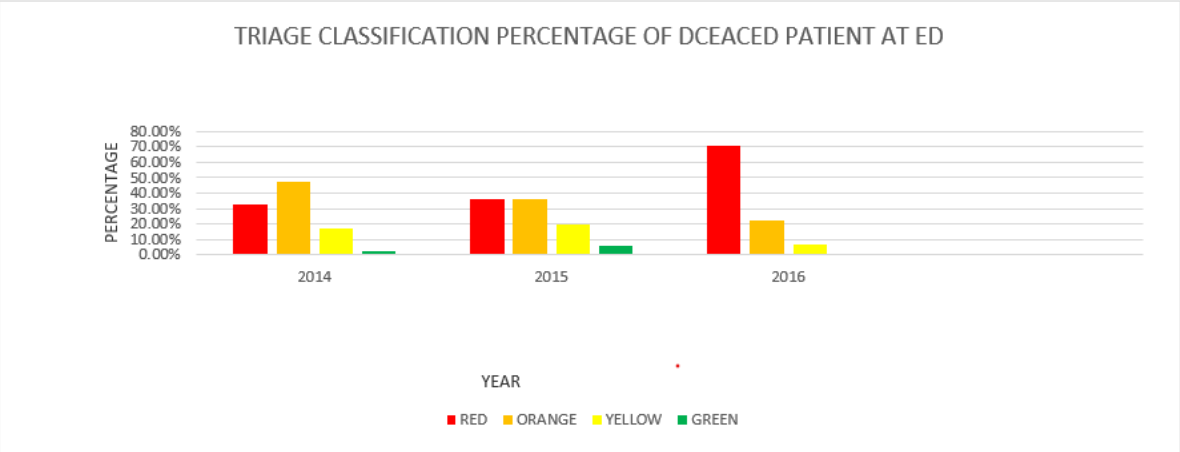

Figure 4: Triage classification percentage of deceased patient at ED

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Males were most affected by trauma deaths in all the study periods, accounting for 39 (84.8%), 29 (80.6%), and 26 (83.9%), with a male-to-female ratio of (5.57:1), (4.14:1), and (5.2:1), respectively. The mean ages were (38.13+/-14.34), (40.22+/-16.52), and (39.74+/-18.99), respectively. The age group most affected by the trauma deaths was between the ages of 18-55 years, accounting for 25 (54.3%), 27 (75%), and 24 (77.4%), respectively. The mean age for males was 42.62, 39.17, and 38.31, and the mean age for females was 32.14, 45.57, and 47.20. In all three years, the 18–55-year age group accounted for the largest proportion of trauma deaths, increasing from approximately 55% in 2014 to 75% in 2015 and 78% in 2016. Deaths among people older than 55 years represented about 32% in 2014, decreasing to 20% in 2015, before increasing slightly to 22% in 2016. The under-18 age group had the lowest proportion, accounting for approximately 13% in 2014, 6% in 2015, and almost none in 2016 (Figure 5).

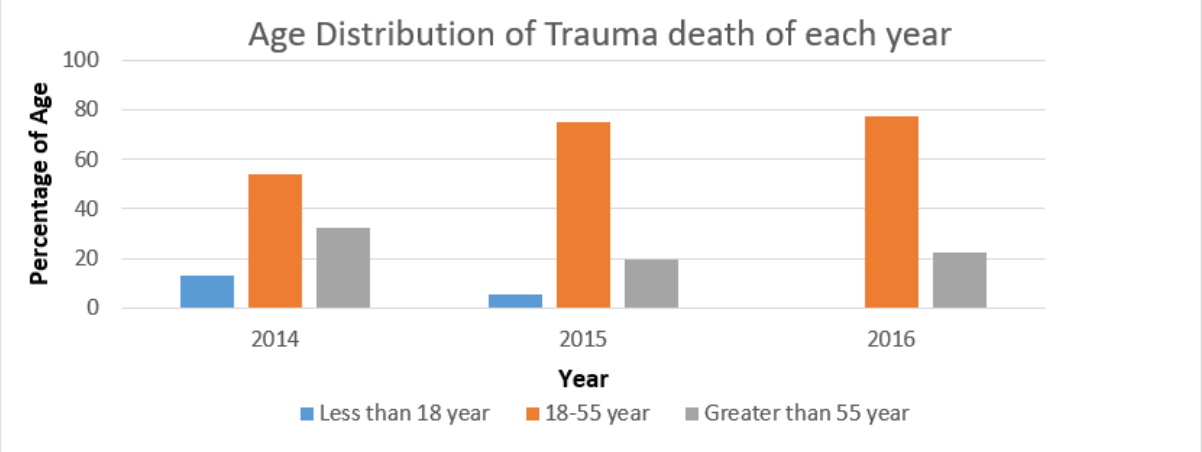

Figure 5: Age distribution of trauma death of each year

The general demographic distribution of the study period is shown in Table 1)

Addis Ababa and Oromia were the regions which contributed for most of the deaths followed by Amhara at [23 (50%) ; 17 (37%) ; 4 (8.7%)], [12 (33%); 12 (33%) ;6(16.7%)] and[8 (25.8%); 10((32.3%) ;12.9%]in all the study periods (Figure 6).

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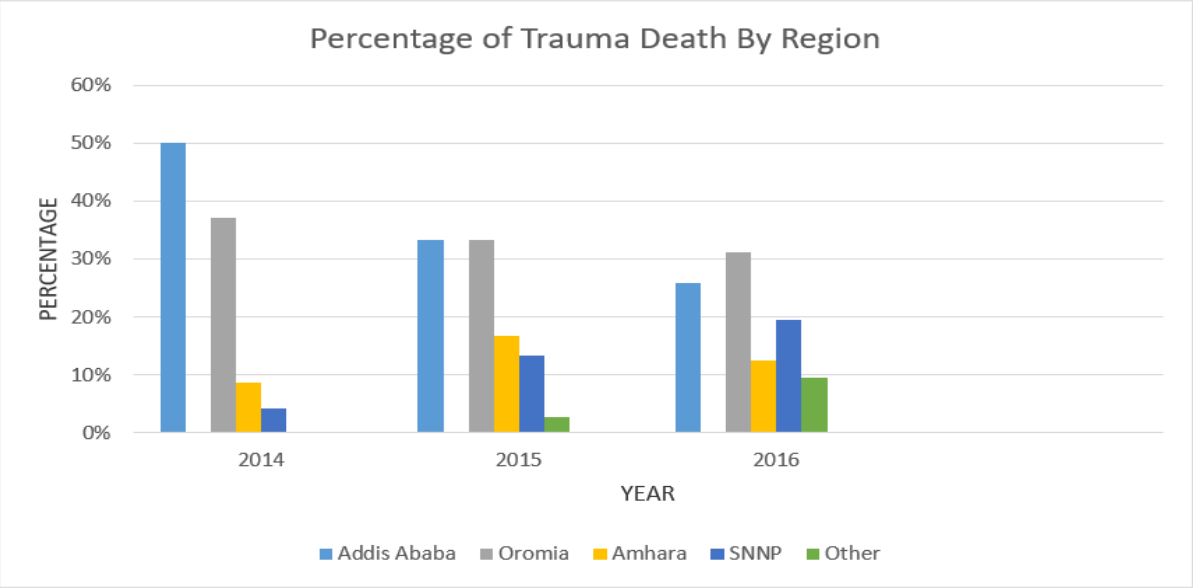

Figure 6: Percentage of trauma death by region

Across the three study periods, the majority of fatal trauma victims were referred from government or private health facilities before presenting to the ED: 80.4% (n = 37/46) in 2014, 69.4% (n = 25/36) in 2015, and 90.3% (n = 28/31) in 2016 (Figure 7).

In 2014 and 2016, ambulance transport was the primary mode of arrival (41.3%, n = 19 and 35.5%, n = 11, respectively), followed by commercial taxis (21.7%, n = 10 and 25.8%, n = 8, respectively). In contrast, in 2015, commercial taxis were the predominant arrival modality (33.3%, n = 12), followed by ambulance transport (30.6%, n = 11) (Figure 7).

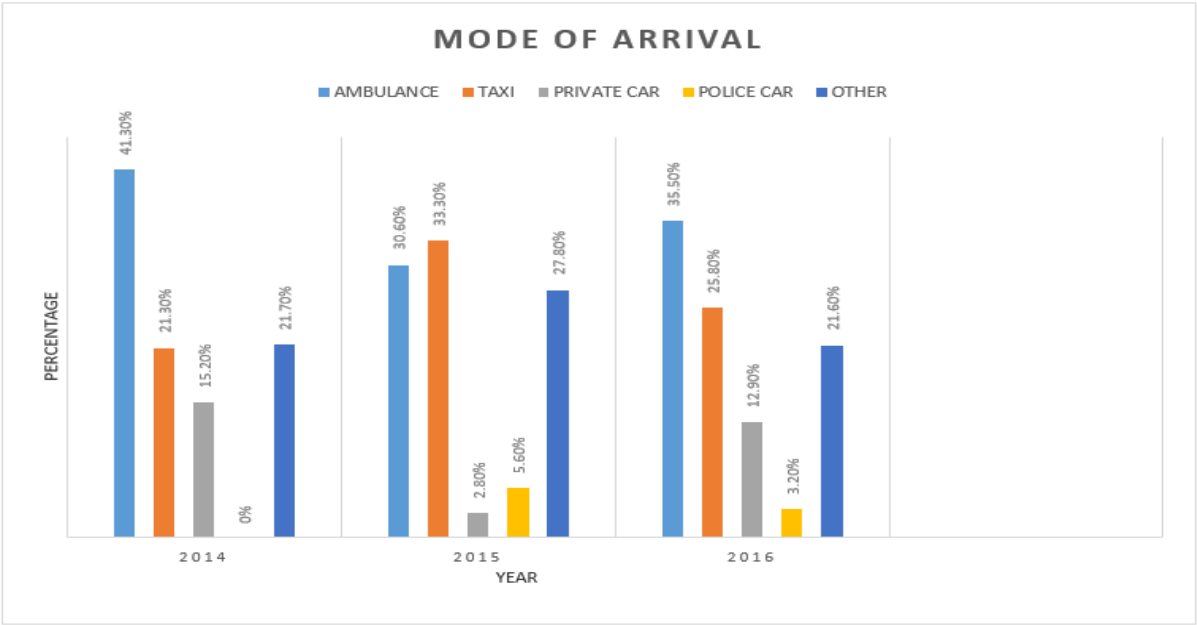

Figure 7: Mode of arrival

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Overall, fewer than half of the fatal trauma victims reached the ED within six hours of injury: 45.6% (n = 21/46) in 2014, 27.8% (n = 10/36) in 2015, and 25.8% (n = 8/31) in 2016. Complete time-interval records were documented for 108 of the 113 patients. The mean time elapsed from injury to ED presentation was 23.89 ± 39.20 hours in 2014, 36.08 ± 54.96 hours in 2015, and 34.30 ± 50.33 hours in 2016. As detailed in Table 3, the majority of victims died within 48 hours of ED arrival across all three periods: 65.2% (n = 30) in 2014, 80.6% (n = 29) in 2015, and 71.0% (n = 22) in 2016. The mean length of ED stay was 58.94 ± 87.19 hours in 2014, 54.58 ± 97.31 hours in 2015, and 32.41 ± 35.94 hours in 2016, while the overall mean time from initial injury to death was 86.70 ± 101.91 hours, 87.78 ± 109.29 hours, and 65.17 ± 61.72 hours across the respective study periods.

The most common mechanism of trauma deaths is Motor Vehicle Accidents (MVAs), accounting for 30 (65.2%), 20 (55.6%), and 25 (80.6%) for the study years, respectively (Figure9). Assault was the next most common mechanism, accounting for 8 (17.4%), 8 (22.3%), and 2 (6.5%) deaths, and falls from height accounted for 6 (13.2%), 5 (13.9%), and 2 (6.5%). Most deaths in the age group 18-55 were due to MVAs during the study period, with 14 (30.43%), 14 (38.88%), and 20 (64.51%).

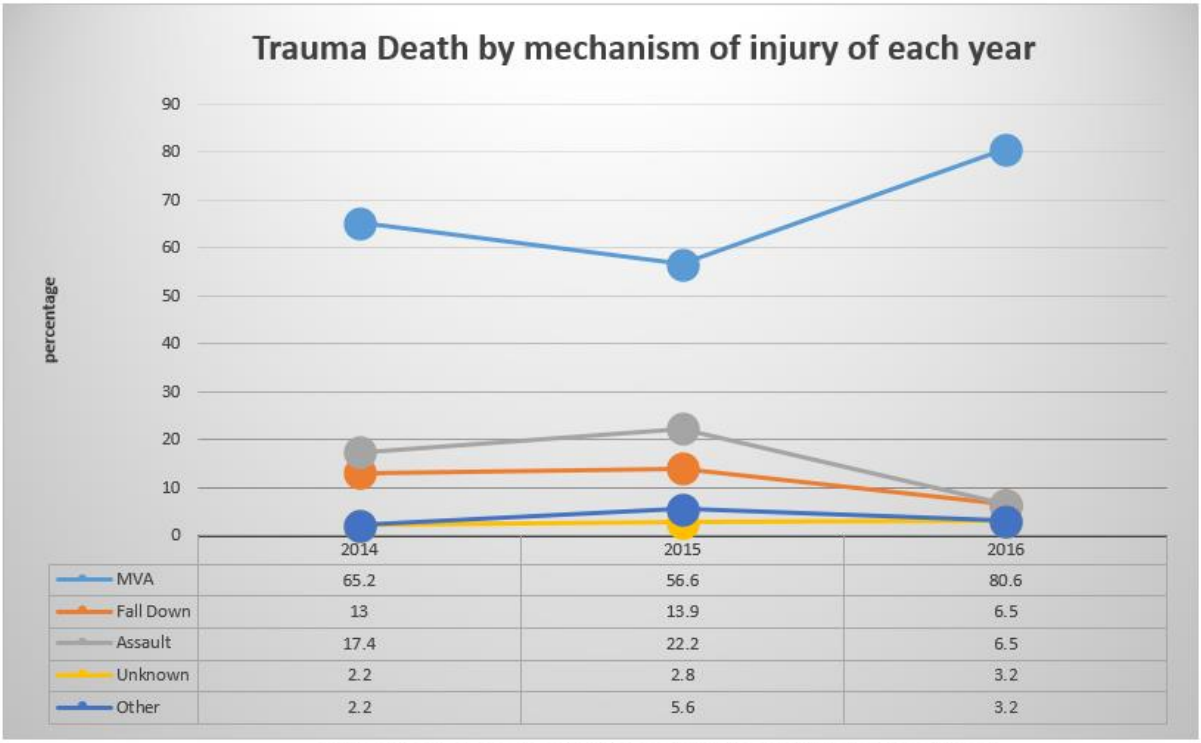

Figure 9: Trauma death by mechanism of injury of each year

Blunt trauma is the most commonly encountered mechanism among the deceased during the study periods, accounting for 43 (93.4%), 35 (97.2%), and 31 (100%). Blunt trauma from MVAs was the most common. Penetrating trauma only occurred in 3 (6.5%), 1 (2.77%), and 0 (0%) of the deceased patients. Of the 3 penetrating traumas that occurred in 2014, 2 were stab injuries to the chest and the other one was a gunshot wound to the head. The other penetrating trauma in 2015 was an axe injury to the head.

Blunt head injury is the most common injury anatomically occurring in 41 (89.1), 32 (88.9%) and 23 (74.3%) respectively followed by poly-trauma and maxillofacial injuries at in [21 (45.7%); 19

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(41.9%)], [27 (75%) ; 20 (55.6)]and [21 (67.7%);17 (54.8)] respectively (T**able 2).**

Most patients who died initially presented with systolic blood pressure of more than 90 mmHg in 34 (73.9%), 30 (83.3%), and 27 (87.1%) cases, respectively. Most patients who died had an initial GCS of less than 9 in 29 (63.0%), 28 (77.8%), and 18 (58.1%) cases. Most patients who died had RR between 10 and 29 in 33 (71.7%), 22 (61.1%), and 15 (48.4%).

Table 2 Anatomy of trauma

Anatomical Location of injury	Year	Year	Year
	2014	2015	2016
Head Injury	44(93.4%)	32(88.9%)	23(74.2%)
Maxillofacial Injury	19(41.3%)	20(55.6%)	17(54.8%)
Neck Injury	0(%)	6(16.7%)	0(%)
Chest Injury	8(17.4%)	5(13.9%)	5(16.1%)
Abdominal Injury	5(10.9%)	2(5.6%)	1(3.2%)
Pelvic Injury	2(4.3%)	0(0%)	0(0%)
SCI	2(4.3%)	5(13.9%)	12(38.7%)
Long Bone Injury	7(15.2%)	4(11.1%)	2(6.5%)
Poly-trauma	21(45.7%)	27(75%)	21(67.7%)
Other site injury	7(15.2%)	3(8.3%)	4(12.9%)

The mean RTS and ISS on arrival to the ED were (5.29+/-1.74; 38.13+/-14.34), (5.02+/-1.77; 32.33+/-7.79), and (5.43+/-1.90; 30.83+/-9.91), respectively.

CT was done in 23 (50%), 23 (63.9%), and 22 (71.0%), respectively. FAST/EFAST was done and documented for only 18 (39.1%), 19 (52.8%), and 10 (32.3%). FAST/EFAST was positive in 8 (17.4%), 4 (11%), and 3 (11.1%), respectively. Documentation on whether FAST/EFAST was performed during the study periods was missing in 28 (60.9%), 17 (47.2%), and 21 (67.7%) cases.

In the study periods, head injury is the most common cause of death, accounting for 38 (82.61 %), 30 (83.33%), and 21 (67.74%), respectively, followed by sepsis/MOFS, hemorrhagic shock, and respiratory failure (**Table 4**).

Table 3: Distribution of demographic and injury mechanism, according to Hospital stay.

Variables	**Characteristics**	**Hospital Stay of the Patient**								
		2014	2014	2014	2015	2015	2015	2016	2016	2016
		Acute	Early	Late	Acute	Early	Late	Acute	Early	Late
Gender	Male	25(54.4%)	11(23.9%)	3	22(61,1%)	5(13.30	2	19(61.3)	7	0
Gender	Female	5(10.9%)	2	0	7(19,4)	0	0	3	2	0
Mechanism of injury	MVA	22(47.8%)	8	0	18(50%)	1	1	17(54.80	8	0
Mechanism of injury	Fall from height	2	2	2	3	1	1	1	1	0
Mechanism of injury	Assault	4	3	1	6	2	2	2	0	0
Mechanism of injury	Unknown	1	0	0	0	1	0	1	0	0
Mechanism of injury	Other	1	0	0		0	0	1	0	0

Table 4 Clinical condition leading to Death

Clinical diagnosis	2014	2015	2016
Head Injury	38(82.61%)	30 (83.33%)	21(67.74%)
Hemorrhagic shock	10 (21.74%)	4 (11.11%)	7 (22.58%)

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RF	2 (4.35%)	9 (25.00%)	11(35.48%)
Sepsis/MOFS	15 (32.61%)	12 (33.33%)	9 (29.03%)

5. Discussion

Understanding the patterns and trends of trauma-related mortality is essential for improving injury prevention strategies, optimizing trauma care systems, and guiding future trauma research. The three fundamental pillars of trauma management include injury prevention, effective trauma care, and trauma research. [25] In Ethiopia, information regarding trauma-related mortality remains limited, largely due to the absence of comprehensive trauma registries and inadequate documentation systems. This study therefore provides valuable information on the epidemiology and trends of trauma-related deaths among patients presenting to the Emergency Department (ED) of Tikur Anbessa Specialized Hospital (TASH).

The proportion of trauma-related deaths was highest during 2014 and 2015, with a noticeable decline observed in 2016. Although the mortality rates during the first two years were higher than the current global estimate of approximately 9%, [1,13] the proportion of trauma-related deaths progressively decreased over the study period. This was consistent with the 2016 Federal Ministry of Health health indicators. [20,24] Furthermore, the proportion of trauma-related deaths observed in this study was lower than that reported in previous studies conducted in Ethiopia and Tanzania, where mortality rates of 27% and 16.7%, respectively, were documented. [17,20] The declining trend in trauma mortality despite a relatively stable trauma patient load may reflect improvements in emergency care following the establishment of the Department of Emergency Medicine at TASH, including the increasing availability of trained emergency physicians, residents, and emergency nurses.

Triage plays a critical role in the early identification and management of severely injured patients. In the present study, a considerable proportion of patients who subsequently died had initially been triaged into lower-acuity categories (yellow or green). Specifically, 19.6%, 27.8%, and 6.5% of trauma-related deaths in 2014, 2015, and 2016, respectively, had initially received lower-priority triage classifications. Although substantial improvement was observed in 2016, these findings suggest the need for continuous evaluation of triage practices, regular training for emergency nurses, and periodic revision of triage protocols to improve the identification of critically injured patients. Frequent staff turnover may also contribute to inconsistencies in triage performance, emphasizing the importance of continuous professional development and standardized training.

The majority of patients who died during the study period were referred from government or private health institutions. Compared with an earlier Ethiopian study, which reported referral rates of approximately 55%, [20] the present findings suggest some improvement in the referral system. However, this study did not assess the appropriateness or timeliness of referrals. Ambulances and taxis were the most common modes of transportation to the hospital. Although ambulance utilization appeared to have increased compared with previous reports, a substantial proportion of patients still arrived by taxi, private vehicle, or other informal means of transportation. This finding highlights persistent deficiencies in Ethiopia's prehospital emergency medical services and suggests that many trauma victims do not receive appropriate stabilization before reaching hospital care. Strengthening emergency medical services, improving ambulance availability, and increasing public awareness of safe trans-

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portation for injured patients are essential measures to improve trauma outcomes.

Consistent with previous studies conducted both internationally and within Africa, males accounted for the majority of trauma-related deaths in the present study. [10,12,13,17,18,22] The predominance of male victims may be explained by greater occupational exposure, increased participation in outdoor activities, and higher involvement in road traffic and interpersonal violence. In many low-income countries, including Ethiopia, men are more frequently engaged in occupations that require travel and expose them to greater risk of injury. [17,18] Furthermore, the majority of trauma-related deaths occurred among individuals within the economically productive age group, highlighting the substantial social and economic consequences of trauma for affected families and the country. This observation is consistent with previous reports demonstrating that traumatic injuries disproportionately affect young adults. [13,17,18,22]

Blunt trauma was the predominant mechanism of injury throughout the study period, accounting for the overwhelming majority of trauma-related deaths. This finding is consistent with reports from Malaysia and other low- and middle-income countries. [13] In contrast, studies from South Africa have demonstrated relatively similar proportions of blunt and penetrating trauma, reflecting regional differences in injury epidemiology and interpersonal violence. [15]

Motor vehicle accidents were the leading mechanism of trauma-related death in all three study periods. This finding is consistent with previous studies conducted in Ethiopia and other countries, where road traffic injuries remain the principal cause of fatal trauma. [9,15,17,18] Similarly, a systematic review conducted in Ethiopia reported that road traffic accidents and assault were the leading causes of trauma-related mortality. [22] Although the overall number of trauma-related deaths declined over the study period, deaths resulting from motor vehicle accidents showed an increasing trend, particularly in 2016. This finding underscores the urgent need for comprehensive road safety interventions. Effective prevention requires coordinated efforts involving the transport, health, education, and law enforcement sectors to improve road infrastructure, strengthen enforcement of traffic regulations, enhance vehicle safety standards, and promote safer road-user behavior.

Assault represented the second leading mechanism of trauma-related death in this study. The proportion of assault-related deaths was higher than that reported by the WHO and in studies from Nigeria, [1,16] although lower than reports from Kenya and Tanzania. [17,18] Because violence is largely preventable, reducing assault-related mortality requires coordinated interventions involving healthcare providers, law enforcement agencies, community organizations, and policymakers. Public education, conflict prevention programs, and strengthened legal enforcement may contribute to reducing violence-related injuries and deaths.

Falls from height were also an important contributor to trauma-related mortality. The proportion of deaths resulting from falls was higher than that reported by the WHO and Nigerian studies, [1,16] although lower than findings from Tanzania. [17] Preventive measures such as enforcing occupational safety regulations, implementing building safety standards, and improving the safety of recreational facilities could substantially reduce fall-related injuries and deaths.

Timely access to definitive trauma care is a critical determinant of survival. Previous studies have demonstrated that prolonged emergency department length of stay is associated with increased mortality among trauma patients. [9] In the present study, the mean length of stay in the Emergency Department was substantially longer than the 3.2-hour average reported in previous

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studies, with mean stays of 59.0, 54.6, and 32.4 hours during the three study periods. Conversely, the majority of deaths occurred within 48 hours of hospital admission, indicating shorter in-hospital survival compared with previous reports. [13] The relatively short survival following admission may reflect delayed presentation to hospital, as only a small proportion of patients reached the Emergency Department within six hours of injury. This finding contrasts with previous reports in which approximately 73.8% of trauma patients arrived within six hours. [16]

The classical trimodal distribution of trauma mortality describes immediate deaths occurring within minutes of injury, early deaths occurring within the first few hours, and late deaths occurring days to weeks after injury (14). This study could not demonstrate this pattern because most patients presented to the Emergency Department more than six hours after injury. Delayed referral, poor transportation infrastructure, long travel distances, inadequate prehospital care, and shortages of trained personnel may all contribute to delayed presentation and reduce opportunities for timely life-saving interventions.

Head injury was the leading cause of trauma-related death throughout the study period, a finding that is consistent with previous studies conducted in Ethiopia and other countries. [5,13,14,17,18] Other important causes of death included sepsis and multiple organ failure syndrome, hemorrhagic shock, and respiratory failure, all of which have been commonly reported among severely injured trauma patients. [13,14] These findings highlight the need for early recognition and aggressive management of traumatic brain injury, hemorrhage, and secondary complications to reduce preventable trauma-related mortality.

Limitations

This study has several limitations. First, its retrospective design relied on review of medical records, some of which contained incomplete or missing information, resulting in unavoidable data limitations. Second, the study was conducted in a single tertiary referral hospital, limiting the generalizability of the findings to other healthcare facilities in Ethiopia. Third, the relatively short study period may have reduced the representativeness of the findings and limited the ability to evaluate long-term trends in trauma mortality.

In addition, Tikur Anbessa Specialized Hospital serves as a tertiary referral center that primarily manages severely injured patients. Consequently, the proportion of trauma-related deaths observed in this study may be higher than that seen in general hospitals. Finally, the study evaluated trauma-related deaths only after the establishment of the Emergency Department and therefore could not assess changes in mortality before implementation of organized emergency medicine services.

6. Conclusion and recommendation

This study demonstrates that the epidemiological characteristics of trauma-related deaths at Tikur Anbessa Specialized Hospital are consistent with findings reported in other national and international studies. Young adult males constituted the majority of trauma-related deaths, with blunt trauma and motor vehicle accidents representing the predominant mechanisms of injury. Head injury was the leading cause of death throughout the study period.

Although the overall number and proportion of trauma-related deaths decreased over the three-year study period, deaths resulting from motor vehicle accidents continued to increase. In addition, most patients presented to the Emergency Department more than six hours after injury, indicating significant delays in accessing definitive trauma care.

The findings suggest that continued improvements in trauma prevention, prehospital care,

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referral systems, emergency department management, and trauma system organization are essential for reducing preventable trauma-related mortality in Ethiopia. The establishment of the Department of Emergency Medicine at Tikur Anbessa Specialized Hospital and the increasing availability of trained emergency care providers appear to have contributed to improvements in trauma outcomes during the study period.

Recommendations

Based on the findings of this study, the following recommendations are proposed:

1. Government agencies should strengthen national road safety strategies through coordinated interventions involving the health, transport, police, and education sectors to reduce motor vehicle accidents.
2. Public awareness programs should promote injury prevention and encourage safe behaviors to reduce road traffic injuries, interpersonal violence, and falls.
3. Prehospital emergency medical services should be strengthened by improving ambulance availability, standardizing triage systems, establishing timely referral mechanisms, and enhancing training for emergency medical personnel.
4. Emergency department staff should receive continuous education and competency-based training to improve triage accuracy and early recognition of critically injured patients.
5. Healthcare institutions should strengthen trauma care systems by establishing well-equipped emergency departments, expanding access to trained emergency medicine professionals, and ensuring the availability of essential trauma care resources.
6. Future multicenter prospective studies with larger sample sizes should be conducted to characterize trauma-related mortality and evaluate the effectiveness of trauma care systems in Ethiopia.

All data collection, statistical analyses, clinical evaluations, and final draft approvals were conducted independently by the authors, who maintain full accountability for the entire work.

Abbreviations

ATLS: Advanced Trauma Life Support
DOA: Dead on Arrival
ED: Emergency Department
EMS: Emergency Medical Services
FAST/EFAST: Focused Assessment with Sonography for Trauma / Extended FAST
GCS: Glasgow Coma Scale
ISS: Injury Severity Score
LMICs: Low- and middle-income countries
MOFS: Multiple organ failure syndrome
MVAs: Motor vehicle accidents
RR: Respiratory rate
RTS: Revised Trauma Score
SBP: Systolic blood pressure
SPSS: Statistical Package for the Social Sciences
TASH: Tikur Anbessa Specialized Hospital
WHO: World Health Organization

Author Contributions

HT conceptualized the study, conducted data collection, performed statistical analysis, and drafted the initial manuscript. NM, AA, and SK contributed to clinical evaluations, data interpretation, and critical revision of the manuscript. All data collection, statistical analyses, clinical evaluations, and final draft approvals were conducted independently by the authors, who maintain full accountability for the entire work.

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Competing interests

The authors declare that they have no competing interests.

Data Availability

The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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