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RESEARCH ARTICLE OPEN ACCESS

Epidemiology and Implications of Traumatic Brain Injury in Patients Admitted to Intensive Care Units: A Cross-Sectional Study

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Abstract

Objective: Traumatic brain injury (TBI) is a major worldwide burden and can cause lifelong disabilities. Understanding its vulnerable population in unstable places would be useful in preparedness to reduce the mortality rate and morbidity. This study aimed to determine patients' patterns with TBI and estimate its contribution to injury-related mortality and population-wide mortality.

Methods: This retrospective cross-sectional study included all patients presenting with TBI and admitted to the intensive care unit (ICU) at Al-Sader Medical City/ Al-Najaf and Baghdad Teaching Hospital/ Baghdad from 1st January 2012 to 31 December 2014. All patients' records were reviewed, and the data were extracted and analysed.

Results: A total of 238 individuals with TBI were admitted to the ICU throughout the specified timeframe. Males constituted 89.08% of the cases, and approximately 63% of the patients were aged between 21 and 40 years. The mortality rate was around 20.17%, and the main significant risk factors for increased mortality rate were, respiratory distress (odd ratio OR= 17.53), the conservative treatment (OR= 20.03), a skull fracture (OR= 2.76), hypotension (OR= 10.43), Severe Glasgow Coma Scale (GCS) (OR)= 19.54) with (p-value 0.001), and cerebrospinal fluid leak (OR= 7.19), and (P- value < 0.05).

Conclusion: Males in their 20s and 30s represent the most vulnerable group for TBI, probably due to cultural and religious factors, as women generally have lower participation in military activities and tend to stay home more often in unstable situations. This underscores the need for enhanced preventive policies, improved trauma centres, and better safety measures.

Keywords: Traumatic brain injury, Intensive care unit, Blast-related TBI, Epidemiology, Cross-sectional

Plain English Summary

Brain injury caused by an external force is a major worldwide burden and can cause lifelong disabilities. Understanding those in danger of this condition in unstable places would be useful in preparedness to reduce deaths caused by the condition. This study was focused on determining patients' patterns with Traumatic brain injury (TBI) and estimating its burden in relation to morbidity and deaths among a population. This was a cross-sectional study conducted at Al-Sader Medical City/ Al-Najaf and Baghdad Teaching Hospital/ Baghdad. The data used in this study were hospital records of patients collected from January 1, 2012, to December 31, 2014. Two hundred and thirty-eight individuals were enrolled. Most of the participants were males (89.08%), and more than half of the subjects were between 21 and 40 years. Our

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study found that males in their 20s and 30s represented the most vulnerable group for traumatic brain injuries, largely attributed to blasts, with nearly one-fifth of cases resulting in death during hospitalisation.

Background

Traumatic Brain Injury (TBI) is referred to as the “silent epidemic” due to its significant contribution to global morbidity, mortality, and long-term disability. It accounts for approximately 30%–40% of all injury-related deaths and is a leading cause of neurological impairment worldwide (1, 2). Globally, around 69 million people suffer from TBI annually, with the highest incidence rates observed in Southeast Asia and the Western Pacific. In European countries, the occurrence of hospital-admitted TBIs is assessed at approximately 262 cases per 100,000 individuals (2), while in the United States, it stands at around 200 per 100,000. The true incidence in low- and middle-income countries, including parts of Asia and Africa, is likely underestimated due to underreporting, limited trauma registries, and inadequate access to care (3, 4).

Patterns of TBI vary by region. In high-income countries, falls- especially among the elderly- represent the primary cause of TBI, while in developing countries, road traffic accidents (RTAs) dominate (3). In conflict-affected settings such as Iraq and parts of the Middle East, blast injuries resulting from military activity, explosions, and terrorist incidents are leading contributors (4). These mechanisms are often associated with higher severity, more extensive damage, and increased mortality.

From a pathophysiological perspective, TBI involves structural and functional disruption of the brain due to external forces. It manifests through combinations of clinical signs such as memory loss, loss of consciousness, confusion, and focal neurological deficits (1). The initial or primary injury occurs at the moment of trauma, involving mechanical damage to neural tissue and cerebral vessels, leading to disrupted metabolism and reduced cerebral blood flow, like ischemia. This increases cellular permeability, resulting in oedema and lactic acidosis (5). The secondary phase involves sustained membrane depolarisation and excessive excitatory neurotransmitter release, activating calcium and sodium channels. This ionic influx leads to enzymatic degradation, apoptosis, and neuronal cell death (6).

TBI is also associated with systemic inflammatory responses that can impair extracerebral organs. The U.S. Department of Defence and Department of Veterans Affairs classifies TBI severity based on imaging results, Glasgow Coma Scale (GCS), duration of unconsciousness, mental status changes, and post-traumatic amnesia (7). For ICU management, early stabilisation is critical. Invasive monitoring, including ICP monitoring and arterial catheterisation, is essential within the first few hours of admission. When space-occupying lesions are present, surgical intervention should be prioritised before further treatment escalation (8).

The health consequences of TBI extend beyond the acute phase. Studies have shown a relationship between TBI and subsequent development of psychiatric and neurodegenerative disorders (9, 10, 11), though the association with chronic traumatic encephalopathy (CTE) remains under debate (12). Additionally, the psychosocial impact of TBI- including social withdrawal, caregiver burden, and employment challenges- often surpasses the physical disability (13).

This study aimed to determine patient patterns and risk factors associated with TBI in two Iraqi ICUs and to estimate the contribution of TBI to injury-related mortality. These insights are particularly relevant in conflict zones where trauma from blasts and violence is widespread and severe.

Methods

This was a retrospective cross-sectional study that included all patients with traumatic brain injury (TBI) who presented at the intensive care units (ICUs) of the two main trauma centres: Al-Sader Medical City/ Al-Najaf and Baghdad Teaching Hospital/ Baghdad from 1st January 2012 to 31 December 2014. Both male and female patients of any age were included in the study. However, individuals with psychiatric illnesses, seizures, or those who were dead upon arrival at the ICU were excluded. A total of 238 patients were enrolled in the study.

Data was collected from patient registers, attendance records, discharge summaries, and transfer records over the study period. The extracted information encompassed patients’ sex, age, aetiology, injury severity, time of presentation, and immediate management outcomes in the ICU. TBI severity was assessed based on the patient’s level of consciousness upon ICU entry, using the Glasgow Coma Scale (GCS). Specifically, a GCS score of 13-15 was classified as mild injury, 9-12 as moderate injury, and a GCS score of 8 or lower as severe injury.

Statistical analysis

Data was collected in an Excel database from

Windows 8 (Microsoft Corporation, Redmond, WA, USA). Descriptive statistics were used to analyse the data with the Statistical Package for Social Sciences (SPSS) software version 25. The presentation of variables was as proportions and frequencies for categorical data and mean ± SD for continuous variables. Logistic regression was performed to calculate the odds ratio (OR) with its corresponding 95% confidence interval (CI) for the different predisposing factors and their association with mortality. A p-value of 0.05 or less was considered significant.

Results

The mean age of the 238 patients was 33.35 ± 12.52 years. The predominant vulnerable and impacted age category was 21-30 years (35.71%), followed by 31-40 years (26.89%). The least affected were children less than or equal to 10 years old. Regarding sex, males were the dominant ones with a significant ratio of male to female of almost 8.15. The primary contributor to TBI was the explosions contributed to 39.5% (Table 1).

Table 1: Demographic characteristics of patients and causes of TBI[a]

Variable	Number of cases	Percent
Age (year)		
Less than or equal to 10	17	7.2
11 – 20	29	12.2
21 – 30	85	35.7
31 – 40	64	26.9
41 – 50	22	9.2
Greater than 50	21	8.8
Gender		
Male	212	89.1
Female	26	10.9
Ratio: 8.15	-	
Occupations		
Military	112	47.1
Employer	35	14.7
Private work	43	18.1
Others	48	20.2
Cause of TBI		
Blast	94	39.5
Road traffic accident	61	25.6
Bullet injuries	26	10.9
Assault	24	10.1
Fall from height	22	9.2
Other causes	11	4.6

a: "Others" under Occupation includes students, retirees, housewives, and unemployed individuals. "Other causes" of TBI include industrial accidents, sports-related injuries, and injuries from unknown mechanisms.

Table 1 shows that the least affected group was children aged 10 years or younger. Additionally, there was a significant disparity between genders, with males outnumbering females at a ratio of approximately 8.15 to 1. The primary cause of traumatic brain injuries (TBI) were explosions, which accounted for 39.5% of the incidents.

The clinical characteristics of the patients with TBI at admission are summarised in Table 2. The Glasgow coma scale was moderate in 42.86% and severe in 27.73% of cases. More than half (57.14%) of the cases presented with normal blood pressure. Respiratory distress was reported in 124 (52.1%) patients. On CT exams, unremarkable findings were found in 13.9% of cases, other findings included contusion/oedema (44.96%), hematomas, epidural (12.2%), extradural (24.8%), and intracerebral (4.2%). Most comorbidities (60.5%) are mixed skull fractures and bone fragments. Pupils were fixed in 81 of patients (34.03%) and were asymmetrical in 95 (39.92%) cases. These findings are displayed in Table 2.

Table 2: Patients' clinical characteristics at admission

Variables		Number of patients	Percentage
Glasgow Coma Scale	Mild	70	29.4

	Moderate	102	42.9
	Severe	66	27.7
Blood pressure	Normal	136	57.1
	Hypotension	85	35.7
	Hypertension	17	7.1
Respiratory distress		124	52.1
CT findings	Unremarkable	33	13.9
	Contusion/edema	107	45.0
	Epidural hematoma	29	12.2
	Extradural hematoma	59	24.8
	Intracerebral hematoma	10	4.2
Comorbidities	Skull fracture	66	27.7
	Bone fragment	28	11.8
	Mixed	144	60.5
Pupil	Fixed	81	34.0
	asymmetric	95	39.9

Table 2 shows that 42.86% of patients exhibited moderate impairment based on Glasgow Coma Scale scores. Additionally, over half of the admitted cases (57.14%) had normal blood pressure, while CT scans showed contusions or oedema in 44.96% of the patients, and around 60.5% of patients presented with mixed skull fractures as a comorbidity and 39.92% displayed asymmetrical pupils.

Local complications were reported in all patients, and post-traumatic epilepsy was the most frequent (22.3%), while in 40.3% of cases, the complications were unremarkable. Respiratory complications were the most frequent systemic complications, contributing to 54.2%. Surgical treatment was the common mode of treatment, accounting for 73.1%. In 6% of the cases, hospital stay was less than 30 days. Cases who were discharged were 153 (64.3%), 37 (15.5%) were referred to other centres, and unfortunately, 48 (20.17%) of hospitalised individuals after TBI died during hospitalisation; all these findings are presented in Table 3.

Table 3: **Complications and outcomes of TBI**

Variables		**Number of patients**	**Percentage**
Local Complications	Unremarkable	96	40.3
	Post-traumatic epilepsy	53	22.3
	Cerebrospinal fluid leak	44	18.5
	Meningitis	24	10.1
	Hydrocephalus	21	8.8
Systemic complications	Unremarkable	19	8.0
	Respiratory	129	54.2
	Coagulopathy	29	12.2
	Respiratory + coagulopathy	41	17.2
	Urinary tract infection	20	8.4
Treatment	Surgical	174	73.1
	Conservative	64	26.9
Hospital stays (days)	Less than 30	157	66.0
	Greater than 30	81	34.0
Outcome	Discharged	153	64.3
	Referred	37	15.5
	Died	48	20.2

Table 3 shows that all patients experienced local complications, with post-traumatic epilepsy being the most common. Respiratory complications were the leading systemic issues, comprising 54.2% of cases. Surgical treatment accounted for 73.1% of interventions. Only 6% of patients had a hospital stay of less than 30 days. Of those discharged, 153 (64.3%) went home, 37 (15.5%) were referred to other centres, and 48 (20.17%) of hospitalised patients with traumatic brain injury (TBI) died during their stay.

We assessed the association of the demographic and clinical characteristics of the patients and complications from one side against the outcome from the other side; the results of these analyses are shown in Tables 4, 5, and 6. We found no significant association between outcome and demographic variable except age, where patients younger than less than 30 years old had higher mortality rates (P-value <0.05). Among the different causes of TBI, RTA was significantly associated with discharge (OR= 0.3, 95%=0.13-0.71, p= 0.006) as in Table 4.

Table 4: Association of demographic characteristics with the patient's outcome

Variables	Discharged (number 153)		Died (number 48)		OR (95% CI)	p-value
	No.	%	No.	%		
Age (year)						
Greater than 30	76	83.5	15.00	16.5	2.17 (1.09, 4.32)	**0.038**
Less than 30	77	70.0	33.00	30.0		
Gender						
Male	137	77.0	41.00	23.0	1.46 (0.56, 3.80)	0.435
Female	16	69.6	7.00	30.4		
Occupation						
Military (Reference category)	76	76.8	23	23.2	1.00	1.000
Employer	21	100.0		0.0	0.79(0.27-2.32)	0.664
Private work	34	87.2	5	12.8	0.58(0.22-1.54)	0.283
Others	22	78.6	6	21.4	2.1(0.93-4.76)	0.074
Cause of injury						
Blast (Reference category)	46	63.0	27	37.0	1.00	1.000
RTA	51	85.0	9	15.0	0.3(0.13-0.71)	**0.006**
Assault	14	60.9	3	39.1	0.37(0.1-1.39)	0.139
FFH	16	84.2	4	15.8	0.43(0.13-1.41)	0.161
Bullet	18	81.8	4	18.2	0.38(0.12-1.24)	0.108
Others	8	66.7	1	33.3	0.21(0.03-1.8)	0.155

Table 4 shows that most fatalities were military personnel, and blast injuries were the primary cause of death. Patients under 30 years old recorded higher mortality rates (P<0.05). A significant higher mortality rate associated with severe GCS (OR= 19.54, 95%CI=6.2-61.59, p<0.001), hypotension (OR= 10.43, 95%CI=4.76-22.84, p<0.001), respiratory distress (OR= 17.53, 95%CI= 5.99-51.3, p<0.001), skull fracture (OR= 2.76, 95%CI=1.35-5.62, p= 0.005), and conservative treatment (OR= 20.03, 95%CI= 8.91-45.05, p<0.001), (Table 5).

Table 5: Association of Clinical Characteristics of the patients with the outcome

Variables		Discharged (number 153)		Died (number 48)		OR (95% CI)	p-value
		No.	%	No.	%		
Glasgow Coma Scale	Mild	58	93.5	4	6.5	1	1.00
	Moderate	72	84.7	13	15.3	2.62(0.81-8.46)	<0.001
	Severe	23	42.6	31	57.4	19.54(6.2-61.59)	<0.001
Blood pressure	Normal	113	90.4	12	9.6	1	1.00
	Hypotension	28	47.5	31	52.5	10.43(4.76-22.84)	<0.001
	Hypertension	12	70.6	5	29.4	3.92(0.18-13.04)	0.108
Respiratory distress	Yes	59	57.3	44	42.7	17.53(5.99-51.3)	<0.001
	No	94	95.9	4	4.1		
CT findings	Unremarkable	24	80.0	6	20.0	1	1.00
	Contusion/edema	72	77.4	21	22.6	1.11(0.4-3.09)	0.84
	Epidural hematoma	17	73.9	6	26.1	1.65(0.47-5.78)	0.436
	Subdural hematoma	36	76.6	11	23.4	1.22(0.4-3.75)	0.726
	Intracerebral hematoma	4	50.0	4	50.0	4.0(0.77-20.82)	0.100
Comorbidities	Mixed	103	83.1	21	16.9	1	
	Bone fragment	13	68.4	6	31.6	2.08(0.72-6.04)	0.177

	Skull fracture	37	63.8	21	36.2	2.76(1.35-5.62)	0.005
Pupil fixed	No	91	73.4	33	26.6	0.67(0.33-1.33)	0.251
	Yes	62	80.5	15	19.5		
Pupil asymmetric	No	87	71.9	34	28.1	0.54(0.27-1.09)	0.087
	Yes	66	82.5	14	17.5		
Hospital stays (months)	Less than or equal to 1	108	74.5	37	25.5	0.71(0.33-1.52)	0.383
	Greater than 1	45	80.4	11	19.6		
Treatment	Surgical	131	92.3	11	7.7	20.03(8.91-5.05)	< 0.001
	Conservative	22	37.3	37	62.7		

Table 5 shows that a significantly higher mortality rate is associated with severe GCS in hypotensive patients who had mixed skull fracture and remained on conservative treatment (p<0.001). Among all complications, only cerebrospinal fluid leak was significantly associated with a higher mortality rate (OR= 7.19, 95% CI= 2.79- 18.57, p< 0.001) (Table 6).

Table 6: Association of complications with the outcome

Variables	Discharged (number 153)		Died (number 48)			
	No.	%	No.	%	OR (95% CI)	p-value
Local Complications						
Unremarkable	66	84.6	12	15.4	1.00	1.00
Post-traumatic epilepsy	38	73.1	14	26.9	2.03(0.85-4.83)	0.682
Cerebrospinal fluid leak	13	43.3	17	56.7	7.19(2.79-18.57)	**<0.001**
Meningitis	18	81.8	4	18.2	1.22(0.35-4.25)	0.689
Hydrocephalus	18	94.7	1	5.3	0.31(0.04-2.51)	0.085
Systemic complications				100.0		
Unremarkable	13	72.2	5	27.8	1.00	0.629
Respiratory	92	80.0	23	20.0	0.65(0.21-2)	0.454
Coagulopathy	19	73.1	7	26.9	0.96(0.25-3.68)	0.95
Respiratory and Coagulopathy	22	71.0	9	29.0	1.06(0.29-3.87)	0.925
Urinary tract infection	7	63.6	4	36.4	1.49(0.3-7.39)	0.629

Table 6 shows that only cerebrospinal fluid leaks were significantly associated with a higher mortality rate, yielding a p-value of less than 0.001.

Discussion

The current study found that most cases were males between the ages of 21-30 years. This corroborates the findings of many previous studies, especially in developing countries (14, 15). Almost similar results were reported by Tran et al. (16). However, in most developed countries, the trend is somewhat different, and there is a binomial pattern involving young children and the elderly (17). This variation between developing and developed countries can mainly be attributed to the causes of TBIs. In developing countries, RTA is considered the main cause of TBIs compared to developed countries where fall is responsible for almost half of cases of TBIs (18). The male-to-female ratio in the current study was 8.15:1. This was higher than many older studies that indicated a greater number of males in TBI cases but with a somewhat smaller ratio (19, 20, 21, 22).

This high involvement of young age males can be explained by the fact that males at these ages were the main participants in military forces during the conflict period with potential religious cultural impact decreasing females' mortality through their weaker participation in military activity, prolonged homestay in such situations, and weaker presence in crowded places especially in unstable places. Besides, males comprised the highest rate of motorcycle riders, which is another important cause of TBI. Military occupation accounted for about half of all patients with TBI in the current study, followed by employers (14.71%). This is in contrast with most previous studies where employers and traders were the main constituents of patients with TBI (23, 24). Blasts were the most common cause of TBI in this study, along with road traffic accidents. These results are also not in agreement with most previous studies (22). However, this pattern is different in developed countries (25, 26). Thus, the present study is an exception because it includes military occupation where the blast is the main cause of injuries. Otherwise, there is almost a consensus that RTA and falling are the main causes of TBI in developing and developed countries, respectively (14). These differences can be a result of lower RTA rates in general, with better road networks, adequate safety regulations, laws, and transport systems in developed countries.

In the current research, 48 (20.17%) hospitalised individuals died during hospitalisation. This aligns with the studies of Onwuchekwa et al. (14) in Nigeria and Tran et al. (16) in Uganda (25.8%). Also, there is an agreement with other studies by a mortality rate reported of 19% to 31% (27, 28). At the same time, our present mortality rate was greater than that reported by Reza et al. within Iran (16%) and Karasu et al. (29) in the study conducted in Turkey. The mortality rates were high, which also might be related to severe TBI that results from blasts.

None of the demographic characteristics in the current study were significantly associated with the outcome. In contrast, RTA was significantly associated with discharge, which implies that a TBI patient due to RTA is about three times less likely to die compared to a TBI patient due to blast cause. This outcome seems plausible given that blast injuries are penetrating and accompanied by comorbidities (30). Some studies showed a significant impact of age and gender on TBI outcomes. Some studies indicated that better outcomes in females might be explained through progesterone's neuroprotective impact (31). Contrary to this, poorer outcomes were reported by other studies (32).

In our study, there was a significant association between 5 clinical characteristics with the severe GCS outcome. This result entirely agrees with previous studies that individuals with extreme GCS are more likely to die in contrast with those of moderate or mild GCS (16, 33, 34, 35). Therefore, surviving patients had with more stable level of consciousness in the first hour after trauma than individuals who died. This implies that TBI cases presented with hypotension will be at a 10.4-times risk for death compared with TBI patients presented with normal blood pressure. The study of Tseng et al. agrees with this (36), in which the medical records of 197 Taiwanese patients with TBI were reviewed. Hypotension is associated with poor outcomes and high mortality in those patients (OR= 11.9, 95%CI= 2.1-68.1, p= 0.005).

More recently, Spaite et al. (37) evaluated the relationship between hypotension/hypoxia and with outcome of 13,151 American patients with TBI. The study revealed that the combined hypotension/hypoxia was dramatically associated with increased mortality in those patients, and this effect persisted even after controlling for multiple potential confounders. Some evidence of brain selective vulnerability after trauma to hypotension in animal models was obtained from animal models. This shift doesn't cause brain harm for healthy ones; however, it could cause cell death after the trauma (38).

According to a published guideline, its main focus in TBI individuals is to prevent cerebral hypoperfusion and hypoxia (39). Notably, the avoidance of secondary insults of hypoxia is the central goal through sufficient CPP maintenance and cerebral oxygen delivery. In this regard, the vast majority (91.67%) of dead cases in the current study had presented with respiratory distress compared with 38.56% of discharged patients who had such complaints (OR= 17.53, 95% CI= 5.99-51.3, p<0.001). Thus, when there is respiratory distress, a TBI patient is 17.5 times more likely to die than a patient without such distress. This result agrees with the findings of Martindale et al. (40), although the odds ratio was much less than the present study (OR=3.0).

Mediating respiratory distress mechanisms in the poorer outcome of TBI is not well understood. In the Aisiku et al. study (41), an association was reported in-between respiratory distress and the elevation of IL-10, IL-6, and anti-inflammatory cytokines, and IL-8, in early plasma cytokines. Nevertheless, more research is needed so that this association can be better explained. Skull fracture as a comorbidity was encountered in 43.75% of dead cases in the present study, while this comorbidity was reported in 24.18% of discharged patients (OR= 2.76, 95% CI= 1.35-5.62, p= 0.005). This result agrees with that reported by Tseng et al. (36) among Taiwanese patients in which skull fracture was correlated with a raised mortality rate (OR= 3.2, 95% CI, 1.3– 8.1, p =0.01). In another study, Fabbri et al. (42) found that an unfavourable outcome is strongly predicted by skull fracture in moderate (GCS score 9 - 13) TBI Italian patients. The presence of a skull fracture brings attention to an immediate surgical intervention in those patients. In the European Union, usually, those conditions are managed outside Neurosurgical Units, but with a positive CT, there is an immediate transfer to a specialised centre recommended here (43).

Mortality rates seemed to be increased by conservative treatment as the majority of the fatal cases (77.08%) in the present study had received such treatment before their death, compared with only 14.38% of discharged patients (OR= 20.03, 95% CI=8.91-45.05, p<0.001). In the same context, Mendelow et al. (44) divided a total of 170 British patients into two groups: 82 patients randomised with complete follow-up to an early surgery and 85 patients randomised also with complete follow-up to an initial conservative treatment. The authors did not find a significant association between surgical management and favourable outcome (OR=0.65; 95% CI 0.35, 1.21; p=0.17); however, in the first 6 months, fatality rates had been significantly greater in the initial conservative treatment cluster (33% vs. 15%; p=0.006). In cases of secondary brain injury, surgical intervention is crucial to prevent neurotoxicity caused by extruded blood. Early surgical intervention can salvage the penumbra of the brain associated with larger traumatic intracerebral haemorrhages (44).

The cerebrospinal fluid leak was reported in 35.42% and 8.5% of the fatal and discharged cases, respectively. In a study by Liao et al. (45) where medical records of 174,236 Taiwanese patients with TBI were reviewed, among whom 1,773 had CSF leakage. There were more intense neurological injuries in the CSF leakage group, alongside greater death rates and morbidity (OR= 3.35, 95% CI = 2.75–4.09, p< 0.001). The outcome was the same after controlling for age, GCS, sex, intracranial haemorrhage, related injuries, and cranial nerve lesion. The high mortality rate associated with CSF leakage may be due to a greater predisposition to CNS infection, including brain abscess and meningitis, as well as the recurrence of CSF rhinorrhea even after surgical repair (46). Also, there was higher morbidity and mortality in TBI patients led by intracranial hypertension (45).

Conclusion

The demographic most impacted by traumatic brain injuries (TBI) is young males in their twenties and thirties. Blasts are the primary cause of TBI, responsible for about 40% of reported cases during the study period, predominantly due to military actions. The higher incidence of TBI among young males may suggest a link to cultural factors. It could explain the comparatively lower mortality rates among females from blast-related injuries, which merits further exploration. In summary, blasts from military operations and terrorist activities are significant sources of traumatic brain injuries, frequently occurring in crowded locations where young adult males are present.

We recommend implementing road safety measures such as mandatory crash helmets and seat belts, speed limits, modern safety devices, and improved road rehabilitation. A well-equipped trauma center is urgently needed for patients with hypotension, skull fractures, or cerebrospinal fluid leaks, as they require special surgical attention. To tackle these issues, it is essential to enforce preventive measures for vulnerable groups and high-risk areas, boost healthcare preparedness, and raise awareness about potential terrorist attacks in unstable regions.

List of Abbreviations

TBI: Traumatic brain injury
ICU: Intensive care unit
CTE: Chronic Traumatic Encephalopathy
GCS: Glasgow Coma Scale
SOL: Space-Occupying Lesion
RTA: Road Traffic Accident

Declarations

Ethical approval and consent to participate
The study obtained ethics approval from the Ethical Committee of the Faculty of Medicine, Jabir Ibn Hayyan Medical and Pharmaceutical University (No.461 JMU- June 6, 2022).

Consent for publication
All the authors gave consent for the publication of the work under the Creative Commons Attribution-Non-Commercial 4.0 license.

Availability of data and materials
The data and materials associated with this research will be made available by the corresponding author upon reasonable request.

Competing interests
The authors declare that they have no competing interests.

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Author contributions
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