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Epidemiological Trends of Traumatic Nervous System Injuries in a Tertiary Health Institution during the First Year of the Coronavirus Disease 2019 Pandemic in Turkey

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ABSTRACT

AIM: Traumatic nervous system injuries (TNSIs) remain one of the most debilitating injuries globally, including in Turkey. Despite its popularity, epidemiological studies revealing the true incidence of TNSIs in our country are scarce. This study aims to document the epidemiological trends of TNSIs in the first year of the coronavirus disease 2019 pandemic in Çorum, Turkey.

MATERIAL and METHODS: This retrospective cohort study was conducted to analyze the incidence of TNSIs in patients admitted to the emergency department (ED) of a tertiary hospital in Çorum from March 1, 2020, to February 28, 2021.

RESULTS: Of the 107,100 patients admitted to the ED, 492 (0.4%) were diagnosed with TNSIs. Traumatic head injuries (THIs, including scalp and calvarial injuries), traumatic brain injuries (TBIs, excluding scalp and calvarial injuries), traumatic spinal injuries (TSIs), and traumatic peripheral nerve injuries were detected in 262 (53.2%), 141 (28.6%), 268 (54.4%), and 9 (1.8%) patients, respectively. Overall, male predominance was 2/1 (male/female), with a mean age of 45 years. The main cause of trauma was falling (61%), followed by motor vehicle collisions (26%). THIs were mostly scalp injuries (59%) and calvarial fractures (42%), while subdural (12.8%) and subarachnoid (11.1%) hemorrhages were the predominant TBIs. The majority of TSIs were detected in the lumbar spine (66%). Conservatively treatment was administered to 432 (88%) patients, and 424 (86%) patients recovered completely, while 33 (7%) survived with some degree of motor, sensory, or sphincter deficits, and 35 (7%) died.

CONCLUSION: This study reveals findings that will effectively guide the steps to increase public health awareness and preventive measures regarding TNSIs in our country.

KEYWORDS: Nervous system injury, Trauma, Traumatic brain injury, Traumatic peripheral nerve injury, Traumatic spinal injury

ABBREVIATIONS: ASIA: American Spinal Cord Injury Association, **CNS:** Central nervous system, **ED:** Emergency department, **GCS:** Glasgow coma scale, **SLICS:** Subaxial injury classification and severity, **TBI:** Traumatic brain injury, **THI:** Traumatic head injury, **TLICS:** Thoracolumbar injury classification and severity, **TNSI:** Traumatic nervous system injury, **TPNI:** Traumatic peripheral nerve injury, **TSI:** Traumatic spinal injury

INTRODUCTION

Trauma is one of the leading causes of death each year, especially in developing countries such as Turkey. Central nervous system (CNS) injuries are the cause of 78% of post-traumatic deaths from motor vehicle collisions (14). Traumatic nervous system injuries (TNSIs), including traumatic head injuries (THIs), traumatic brain injuries (TBIs), traumatic spinal cord injuries (TSIs), and traumatic peripheral nerve injuries (TPNIs), remain the most debilitating injuries worldwide, including in Turkey. Head injuries have been identified as the most unfavorable predictive factor for the survival of patients with multi-trauma (6).

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The number of TNSIs is increasing for several reasons, including population growth and an increased number of motor vehicles on the roads (2). The United States reported approximately 1.5 million people annually who present to the emergency department (ED) with TBI-related problems, approximately 300,000 are admitted for care, and more than 50,000 die from head injuries. Furthermore, approximately 10,000 patients annually suffer a spinal cord injury (2). The majority of head and spinal cord injuries are caused by automobile accidents or falls, with the latter being most common among children and the elderly (2,5).

Despite its popularity, epidemiological studies revealing the true incidence of TNSI are scarce both in Turkey and in Çorum.

Additionally, many trauma centers have been converted into pandemic hospitals during the first year of the coronavirus disease 2019 (COVID-19) pandemic, from March 2020 to March 2021. However, we would like to draw attention to the fact that, despite national and long-term lockdowns, traumatic injuries continued to demand the best care and treatment from these centers throughout this year. Therefore, we aimed to document the epidemiological trends of TNSI based specifically on gender and age differences, as well as the distribution of trauma mechanism, management choices, and outcomes in the first year of the COVID-19 pandemic in Çorum, Turkey.

MATERIAL and METHODS

This retrospective cohort study analyzed the incidence of TNSI in patients admitted to the ED of a tertiary hospital in our province from March 1, 2020, to February 28, 2021, during the first year of the COVID-19 pandemic. This study was conducted in the only tertiary hospital in our province, which has always functioned as a trauma center and served as a pandemic hospital in the first year of the COVID-19 pandemic. The first COVID-19 case in Turkey was diagnosed in March 2020.

This study included patients with confirmed TNSIs. The actual incidence of brain injury may be overestimated in the literature because many studies include scalp lacerations, hemorrhages, and facial injuries when reporting the incidence of TBI. TNSIs were allocated into the groups of THIs, TBIs, TSIs, and TPNIs to avoid such an overestimation in our study. TBIs consisted of only epidural, subdural, parenchymal and intraventricular hematomas, parenchymal contusions, subarachnoid hemorrhages, and diffuse axonal injuries (DAIs); whereas, THIs included scalp lacerations, scalp hematomas, and skull fractures in addition to the components of TBIs. TSIs included both spine and spinal cord injuries while isolated spinal muscle strains with no apparent fracture, ligament injury, or spinal cord injury were excluded.

The causes and types of injuries, demographic characteristics, and neurological examinations of patients were assessed in further analysis**.** Glasgow Coma Scale (GCS) was used in patients with TBI for neurological examination while the American Spinal Cord Injury Association (ASIA), Thoracolumbar Injury Classification and Severity (TLICS), and Subaxial Injury Classification and Severity (SLICS) scales were used in patients with TSI.

RESULTS

Of 107,100 patients who applied to the emergency department in the first year of the pandemic, 492 (0.4%) were diagnosed with TNSI. This study reviewed and analyzed data from 492 patients with confirmed TNSIs. THIs, TBIs, TSIs, and TPNIs occurred in 262 (53.2%), 141 (28.6%), 268 (54.4%), and 9 (1.8%) patients, respectively. The overall results of the study are summarized in Tables I-IV.

A male predominance of 2/1 (male/female) was observed among patients with TNSI, with a mean age of 45 years and a median age of 50 years (Table I). Additionally, 89 (18%) patients were children under the age of 18 years (0–17 years of age), 32 (6%) patients were newborns or infants (≤1 year of age), and 137 (27%) patients were elderly people (>65 years of age).

Scalp injuries (155 patients; 31.5%) and calvarial fractures (110 patients; 22.3%) comprised the majority of THIs. TBIs were most commonly located in the supratentorial compartment (99%), with subdural (63 patients; 12.8%) and subarachnoid hemorrhages (55 patients; 4.4%) being the most common TBIs (Table II). Diffuse axonal injury (DAI) was clinically suspected in more patients with low GCS scores, but it was detected radiographically in only 2 (0.4%) patients. DAIs were

Table I: Demographical Features of 492 Patients with Confirmed Traumatic Nervous System Injuries

No. of patients	492
Sex (F/M)	156 (31.7%) / 336 (68.3%)
Mean age	45.9 years (range, 1 months – 99 years)
Median age	50 years

Table II: The Distribution of Traumatic Head Injuries

	Patients (n)	% of cases†
Traumatic head injuries	262	53.2
Supratentorial	255	51.8
Infratentorial	23	4.6
Scalp injuries	155	31.5
Calvarium fractures	110	22.3
Traumatic brain injuries	141	28.6
Subdural haemorrhage	63	12.8
Epidural haemorrhage	22	4.4
Subarachnoid haemorrhage	55	11.1
Parenchymal haemorrhage	42	8.5
Intraventricular haemorrhage	6	1.2
Diffuse axonal injury	2	0.4

†of 492 patients with traumatic nervous system injuries.

Table III: The Distribution of Traumatic Spinal and Peripheral Nerve Injuries

	Patients (n)	% of cases†
Traumatic spinal injuries	268	54.4
Traumatic spine injuries	267	54.2
Cervical spine	40	8.1
Thoracic spine	52	10.5
Lumbar spine	179	36.3
Sacrum	15	3
Coccyx	1	0.2
Traumatic spinal cord injuries	8	1.6
Cervical cord	3	0.6
Thoracic cord	4	0.8
Lumbar cord	2	0.4
Traumatic peripheral nerve injuries	9	1.8

†of 492 patients with traumatic nervous system injuries.

not documented radiologically because of the lack of magnetic resonance imaging (MRI) studies in intubated patients. Therefore, the actual rate of DAIs might have been higher than found.

TSI was most frequently detected at the lumbar level (180 patients; 36.5%), followed by the thoracic (54 patients; 10.9%) and cervical levels (43 patients; 8.7%). L1 (98 patients; 20%) and L2 (17%) injuries were most common among lumbar TSIs (Figure 1). TSIs mostly affected the vertebrae corpus (40%) and transverse process (15%) (Figure 2). The predominant TSIs were major injuries (76% of TSIs), with compression fractures as the most common type (79% of major TSIs) (Figure 3). The spine injuries were far more common than the spinal cord injuries (267 [54.2%] patients vs. 8 [1.6%] patients) of all trauma patients (Table III).

The main cause of trauma was falling (61%), followed by motor vehicle collisions (26%), and the site of trauma was mostly at home (47%) or on the street (39%). Traumas tended to occur in the summer (39%) and fall (35%), with two peaks in July (17%) and October (16%) (Figure 4).

Clinical examination revealed that the majority of cases were neurologically intact (79%) and presented with mild TBI (GCS: 13–15; 92%) or TLICS/SLICS scores below 4 points (92.8%). Conservative treatment was administered in 432 (88%) patients, and 424 (86%) recovered completely, 33 (7%) survived with some degree of motor, sensory, or sphincter deficits, and 35 (7%) died (Table IV). Of the individuals who died, 14 (40%), 10 (28.5%), and 11 (31.5%) had isolated TBI, TSI, and both TBI and TSI, respectively.

Table IV: Clinical Findings of 492 Patients with Confirmed Traumatic Nervous System Injuries

	n	% of cases†
Neurological Findings		
Normal	389	79
Cranial nerve palsy	4	0.8
Monoparesis/monoplegia	5	1
Hemiparesis/hemiplegia	13	3
Paraparesis/paraplegia	17	3
Quadriparesis/quadriplegia	2	0.4
Peripheral nerve palsy	5	1
Sensorial deficits	16	3
Lethargy/stupor/coma	57	12
Glasgow coma scale (GCS)		
GCS 13-15 (mild traumatic brain injury)	453	92
GCS 9-12 (moderate traumatic brain injury)	8	1.7
GCS 3-8 (severe traumatic brain injury)	31	6.3
TLICS/SLICS* score		
≤3	457	92.8
4	10	2.1
≥5	25	5.1
Treatment		
Conservative	432	87.8
Surgical	60	12.2
Outcome		
Complete recovery	424	86.2
Recovery with motor/sensorial/sphincter deficit	33	6.7
Death	35	7.1

†of 492 patients with traumatic nervous system injuries
**Thoracolumbar Injury Classification and Severity Scale/Subaxial Injury Classification and Severity Scale*

DISCUSSION

This article describes the nature, severity, and frequency of TNSIs in a single trauma center in Turkey during the first year of the COVID-19 pandemic. This study confirms that, in a population of over 500,000, approximately 40 patients with TNSI can be expected to be admitted to a trauma center each month, with increasing numbers during the summer and autumn seasons even during the pandemic.

Few studies have examined the impact of the COVID-19 pandemic on trauma admissions to trauma centers in the last 3 years (3). Preliminary data from a Level-1 Trauma Center revealed that major traumas did not disappear during the pandemic and were as frequent as in some of the quieter periods of the past decade (3). A temporary decline in TNSI admissions was experienced in our province in the first month of the pandemic in our country when lockdowns were not been implemented yet. However, the statistics for the following months revealed an increase in TNSIs despite repeated and long-term lockdowns.

Most of the trauma articles published in the literature are about sports-related traumas. Therefore, TNSIs were predominantly seen in young males according to the demographic analysis of traumatic injuries in the literature (2,15). A previous study, similar in design to our study, was conducted in Puerto Rico by Brau et al. by analyzing information from 3,202 patients with CNS injuries (4). Their series had a male predominance (75%), a mean age of 42 years, and a median age of 40 years. Overall, the study results were similar to ours.

Previous studies in the literature have generally found a relatively higher THI rate and a lower TSI rate than ours regarding the TNSI subtypes. Some publications reported TBIs in 20%–78%, TSIs in 2%–25%, and TPNIs in 0.8% of patients with trauma admitted to the ED (4,7,9,12). Unlike our

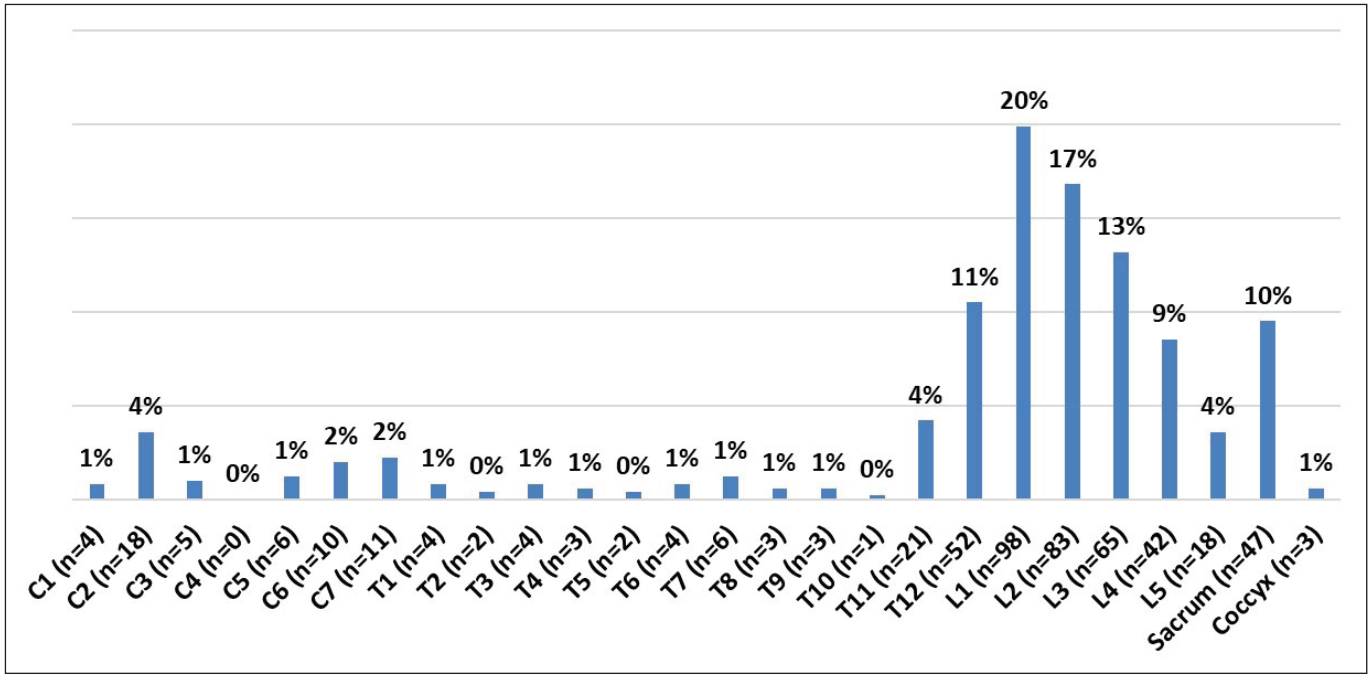

Figure 1: The distribution of traumatic spinal injuries by spinal level.

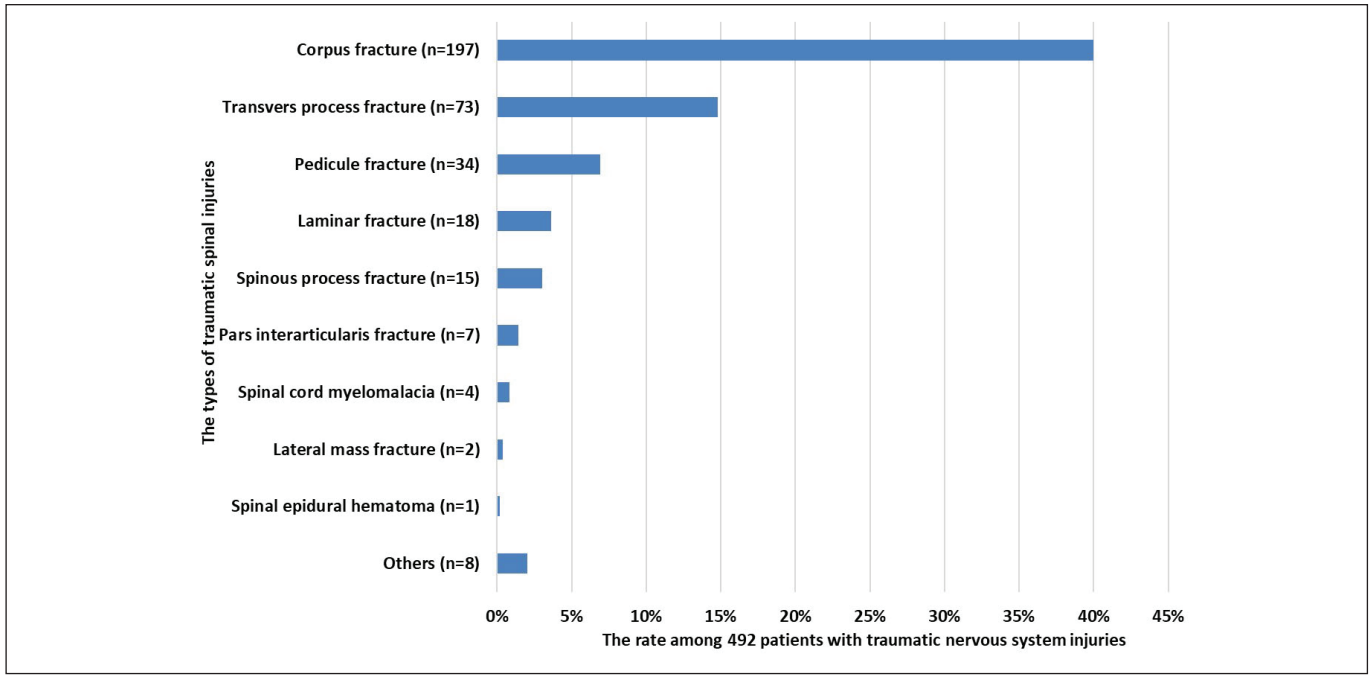

Figure 2: The distribution of traumatic spinal injuries in frequency among 492 patients with traumatic nervous system injuries.

results, Brau et al. revealed a rate of 78.8% for TBI, 25.9% for spine injuries, and 6.2% for spinal cord injuries (4). Analysis of CNS injuries was reported in the study of Özdöl et al. on 540 patients who applied to the ED after a motorcycle accident. Of these, 59% presented with head trauma and 9.6% with spinal fractures (13). A clinical analytical study of 73 pediatric patients who were injured after falling from the back of a pickup truck reported neurological injuries in 73% of patients; of these, 64% suffered from isolated head injuries, 15% from isolated spinal injuries, 4% from isolated peripheral nerve injuries, 9.4% from both spine and head injuries, and 2% from three types of combined injuries (8). In this study, skull fracture and thoracic spine fracture were the most common abnormal computed tomography (CT) findings of the head and spine, respectively (8).

Several studies are reporting different rates for the dominance of the trauma-affected spinal level. Ouden et al. (11) and Amoreira Gepp et al. (2) revealed that the majority of spine fractures occurred at the thoracic level, in contrast to our

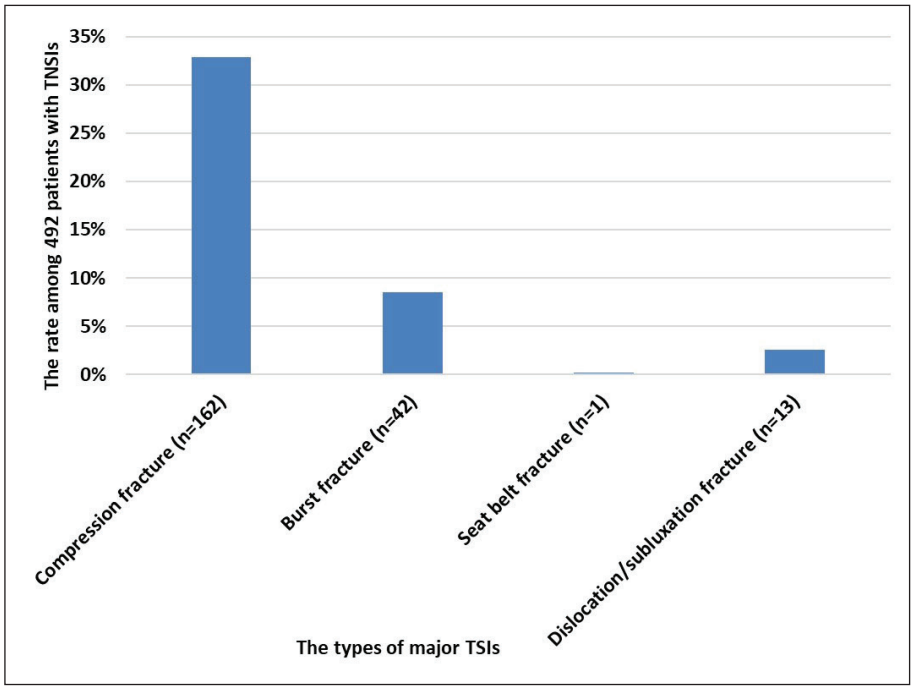

Figure 3: The frequency of major traumatic spinal injuries (TSIs) among 492 patients with traumatic nervous system injuries (TNSIs).

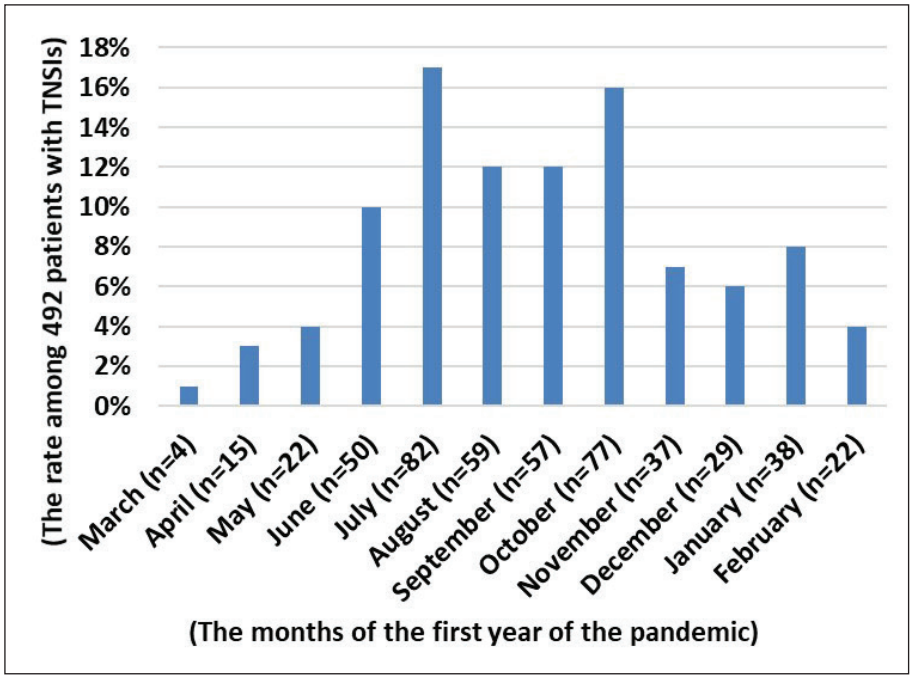

Figure 4: Distribution of emergency department admissions of patients with traumatic nervous system injuries (TNSIs) throughout the first year of the coronavirus disease 2019 pandemic.

study, where the lumbar spine was frequently fractured (11). Another series revealed a fairly even anatomical distribution of spinal injuries between cervical, thoracic, and lumbar injuries (10).

Many studies, as well as our study, report that the most common cause of injury was falling from a height, followed by traffic accidents (4,11,15). Brau et al. revealed that nearly half of the injuries occurred due to falls (47.5%), followed by motor vehicle accidents (35.2%) (4). Over 90% of all cases were injured at home (42.8%) or on the street (49.1%). However, an epidemiological and clinical analysis of the causes of traumatic deaths revealed traffic accidents as the predominant mechanism of fatal injuries, followed by falls (6).

The clinical significance of TNSIs is well-acknowledged in the literature (15). The GCS scores revealed that the majority of TBIs are mild (4), but post-traumatic deaths are most commonly attributable to CNS injuries, as the highest incidence of injury in fatal traumas, including blast injuries, sports injuries, falling, or traffic accidents, is to the head (42%–88%) (1,6,9,10,17–19); while the main causes of permanent disability are spinal injuries (10). Conversely, TPNIs occur infrequently and are mostly associated with concomitant orthopedic trauma (10).

The proper management of patients with trauma commences with prehospital care, including airway maintenance, adequate ventilation, and hypoxia and hypotension correction, which are crucial to prevent secondary injuries (16). Thereafter, aggressive resuscitation in the ED is recommended before deciding on further supportive care, because this is associated with increased survival. The decision for surgery depends on the GCS, age, pupil size and reaction, TLICS/SLICS and ASIA scores, and imaging features on the CT or MRI scan (16).

CONCLUSION

Generally, how injuries tend to occur must be accurately described to implement preventive measures in public health. Furthermore, the need to uncover the epidemiology of TNSIs during an epidemic stems from the need to make the right decisions on converting the trauma centers to designated hospitals for pandemic-related infections and facilitate a scientifically-based pandemic action plan in case of future recurrence of a similar situation. Our data revealed that trauma cases did not cease during the outbreak although our region experienced a significant but temporary decline in the first month of the pandemic.

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Ethical Approval

All procedures performed in the study involving patients were following the ethical standards of our institution and any personal information of patients was not disclosed.

AUTHORSHIP CONTRIBUTION

The author (AA) confirm responsibility for the following: study conception and design, data collection, analysis and interpretation of results, and manuscript preparation.

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