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Traumatic head injuries at the emergency department, Tribhuvan University Teaching Hospital, Kathmandu, Nepal

Degree Project in Medicine

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Abbreviations

ED	Emergency Department
TUTH	Tribhuvan University Teaching Hospital
GCS	Glasgow Coma Scale
HDI	Human Development Index
TBI	Traumatic Brain Injury
YLD	Years Lived with Disability
PGCS	Paediatric Glasgow Coma Scale
STI	Soft Tissue Injury
DOPR	Discharged on Patient Request
LAMA	Left Against Medical Advice
IRC	Institutional Review Committee

Abstract

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Background Traumatic head injuries constitute a major cause of morbidity and mortality worldwide. The developing world is particularly affected due to a high prevalence of risk factors and difficulties in enforcing prevention efforts. This study was carried out at the emergency department (ED) at Tribhuvan University Teaching Hospital (TUTH), Kathmandu, Nepal – where head injuries account for five per cent of all emergency visits.

Objective The aim of this study was to describe demographics, cause of trauma, diagnosis, severity according to the Glasgow Coma Scale (GCS) and outcome (admitted, discharged, death) in patients seeking medical care for traumatic head injuries at the ED at TUTH. A secondary aim was to study correlations between age and cause of trauma.

Methods Data from 577 cases of patients seeking medical care for head injuries (including facial injuries) from the 26th of June to the 3rd of October 2019 were collected retrospectively.

Results Traumatic head injuries accounted for 5.2 per cent of all emergency visits. The mean and median age was 25.7 ± 20.6 and 23 years. Patients were predominantly male. Superficial injuries were the most common, followed by concussions. 94.4 per cent were classified as mild (GCS 13-15). The most common cause of trauma was fall accidents (51.3 per cent) followed

by road traffic accidents (19.1 per cent). The median age differed significantly depending on the cause of trauma (asymptotic sig. 2-sided test, p=0.000). 44.9 per cent of the patients were from outside Kathmandu Valley. Around a tenth (12.1 per cent) were admitted to the hospital.

Conclusion Traumatic head injuries remain a pressing issue as an important and preventable cause of morbidity and mortality in Nepal. Falls account for the majority of the accidents, followed by road traffic accidents. Most injuries are superficial. The median age differs significantly depending on the cause of trauma.

Key Words Head injury, traumatic brain injury, epidemiology, Nepal

1. Background

1.1 Setting

This study was carried out at Tribhuvan University Teaching Hospital (TUTH) in Kathmandu, Nepal – a country famous for the magnificent Himalayas, where eight out of ten of the highest mountain peaks on Earth resides. Landlocked between China and India, Nepal stretches alongside the southern borders of the Himalayas. Kathmandu, the capital and largest city, is located in the central region of the country. Nepal is one of the least developed countries in the world, facing many challenges including limited accessibility to safe drinking water and sewage systems, underdeveloped transportation infrastructure, difficult topography and inconsistent electrical supply [1, 2]. These challenges are especially troublesome in rural areas, where 80.3 percent of the population lives. With only 19.7 percent of the population living in urban areas, Nepal is one of the least urbanised countries in the world [3]. However, in recent years Kathmandu Valley has experienced rapid urbanisation with a growth rate of around 4 per cent per year, making the city one of the fastest growing metropolitan areas of South Asia [4].

While Nepal has made successful strides in reducing poverty, 21.6 per cent of the population still lived below the poverty line in 2015 [5]. The life expectancy at birth is 70 years, 52 per cent of the population is under 25 years old and only 6 per cent is over 65 years old. In more developed regions such as Europe, the life expectancy is 78 years, only 26 per cent of the population is below 25 and 20 per cent is above 65 [6]. Nepal ranked 149 of 189 countries on the Human Development Index (HDI) in 2018, a composite index of three indicators on human development; gross national income per capita, life expectancy at birth and education [7]. The health care system in Nepal is based on a combination of out-of-pocket spending, government

health spending, prepaid private health spending (such as private health insurances and fee-for-service non-governmental agencies) and development assistance for health (financial resources from development agencies such as UNICEF), where out of-pocket spending stands for 47.7 per cent of the total health spending [8].

Despite substantial progress in modernising rural health care in recent decades, large inequalities between the urban and rural areas of Nepal still remains. Modern health care facilities with specialised care is concentrated in urban areas while rural areas often have limited availability to basic health care. Around a fifth of the population in rural areas have to travel more than an hour in order to reach the nearest government health care facility, compared to 6.7 per cent in urban areas. Although more than half of the urban population has access to government health care facilities within 30 minutes, the availability is pressured by rapid urbanisation, particularly affecting the poor [9, 10]. In 1983, TUTH, one of the largest hospitals in Nepal, was established in Kathmandu in association with Tribhuvan University. Since then, the hospital has increased the number of beds from 300 to 656 and serves more than 2000 patients daily in the outpatient department. The hospital provides a large range of services from general check-ups to highly specialised and advanced treatments such as intensive care and major surgeries. The ED serves around 140 patients a day and has 51 beds (including 23 beds at the emergency observation ward), commonly bearing up to four patients each. [11-13].

Though many challenges still remain, Nepal has made some successful strides in e.g. reducing road traffic accidents (a common cause of head trauma) in recent years. Due to the high incidence of road injuries, a “No Drinking and Driving” policy was enforced in 2011 by the

Metropolitan Traffic Police, Kathmandu, which resulted in a decrease in injury and fatality ratio by 23 per cent the following year [14]. While the policy constituted an important step, lots of work remains. For example; traffic rules, road design standards for pedestrian safety, road maintenance and vehicle standards are poorly maintained and regulated. The national motorcycle helmet law requires both the driver and pillion riders to wear a helmet, but the law is poorly implemented, and motorcycles are commonly seen carrying one or more passengers without helmets. Additionally, motorcycle helmets are not required to be fastened by law and no helmet standards are specified. The rate of people actually wearing motorcycle helmets is unknown. As of 2017, road traffic accidents was the seventh most common cause of death in Nepal [15, 16].

1.2 Head trauma – worldwide and in Nepal

Traumatic head injuries (particularly traumatic brain injuries or TBI, a subgroup of head injuries not including superficial injuries) constitute a major cause of morbidity and mortality worldwide [17, 18]. In 2016 there were 27.08 million new cases of TBI globally and 55.50 million prevalent cases, causing 8.1 million years of life lived with disability (YLD) around the world [18]. The burden of TBIs is particularly prominent in developing countries, which usually face more challenges regarding higher prevalence of risk factors, difficulties in enforcing prevention efforts and unequal care due to e.g. financial reasons and a limited number of modern health care facilities in rural areas.

Age and gender differences in the incidence of head injuries have been noted in previous studies worldwide. Males are consistently showing higher ratios with incidence peaks in early

childhood, young adulthood and in the elderly [17, 19]. Falls and road traffic accidents are the most important causes of non-fatal TBI globally [18]. Falls dominates among the causes of injuries in children and the elderly while road traffic accidents and violence are common among young and middle aged adults [17]. Though only a few studies have been published on head injuries in Nepal specifically, the results regarding cause of injury and gender seem to coincide with studies elsewhere [20, 21]. However, the age distribution seems to differ slightly. According to a former study conducted in 2003 at the ED at TUTH by S. McClennan and C. Snider, half of the head injured patients were between 20 and 44 years old, and no incidence peak was found in older age groups. This was interpreted as the result of the shorter life span in Nepal compared to more developed countries. The study also showed head injuries accounted for five per cent of all emergency visits and 30 per cent of the emergency room mortalities [21].

Very few studies regarding the most common types of head injuries have been published in Nepal. One study by Adhikari K., Gupta M.K., Pant A.R. and Rauniyar R.K., on cranio-cerebral trauma in Dharan, Eastern Nepal, showed that scalp lesions were the most common type of injury followed by fractures and cerebral contusions [22]. Among TBIs, concussions are the most common [19]. A study on TBIs conducted in the same city by Bajracharya A., Agrawal A., Yam B., Agrawal C. and Lewis O., showed that cerebral contusions were the most common pathological find on CT scans (20.5 per cent), followed by intracranial hematomas and fractures [23]. However, the study did not include either superficial scalp nor facial injuries and concussions are not visible on CT-scans. Because of varied inclusion criteria among studies, comparisons are often problematic and uncertain. Unfortunately, the quality and quantity of data differs widely around the world [17]. The possibilities of doing standardized, bigger scale

studies are much greater in high income countries with modern health care systems and digitalised documentation of medical records. In developing countries like Nepal, where stored documentation generally is limited and in paper form, this proves a challenge. However, smaller studies can still provide useful information, particularly for the hospitals and departments where the research is conducted.

1.3 Definition of traumatic head injuries

The unspecific terminology regarding traumatic head injuries is a central issue in research. The term "traumatic head injury" is commonly used synonymously with "traumatic brain injury" by both researchers and clinical physicians [24]. However, many injuries classified as "head injury" have no neurological involvement. For example, a skull fracture – while a head injury – might not involve trauma to the brain. The Demographics and Clinical Assessment Working Group of the International and Interagency Initiative toward Common Data Elements for Research on Traumatic Brain Injury and Psychological Health has defined TBI as "an alteration in brain function, or other evidence of brain pathology, caused by an external force" [25]. At the ED at TUTH, the slightly antiquated umbrella term "mild head injury" – covering patients suffering from concussions, skin abrasions, contusions and lacerations – is used instead. Due to the different terminology in Nepal, this study defines head injury as any trauma to the head including superficial injuries to the scalp or face.

1.4 Severity

The severity of head injuries is usually determined by the patients' score on the Glasgow Coma Scale (GCS), an objective neurological scoring system used to assess a patient's level of

consciousness. The scale is composed of three tests rating the best eye, verbal and motor response separately. The sum of the three tests give a highest possible score of 15 (wide awake, fully responsive) and a lowest of 3 (deep coma, death). 15-13 counts as a mild head or brain injury (commonly called concussion), 12-9 as moderate and 8-3 as severe. An equivalent scale – the Paediatric Glasgow Goma Scale (PGCS) – is used to assess children, especially under the age of 36 months. Another way of classifying the severity (however not used in this study) is by using the length of loss of consciousness. If the patient lost consciousness for under 30 minutes the severity is classified as mild, between 30 minutes and 24 hours is classified as moderate and over 24 hours as severe. The severity of traumatic head injuries is thus completely based on clinical symptoms and mild head or brain injury often occurs with normal neuroimaging [26].

1.5 Complications

Unlike superficial head injuries, TBIs are known to have both short- and long-term complications. Among the most common short-term complications are headaches, seizures, cognitive impairment, sensory and communication processing difficulties, cerebrospinal fluid leakage, cranial nerve and vascular injuries, tinnitus and brain swelling leading to increased intracranial pressure. Long-term effects include post-concussion syndrome, but also to a lesser extent Alzheimer's and Parkinson's disease, dementia pugilistica and posttraumatic epilepsy. In addition, psychiatric complications such as depression are common, and many studies even suggest an increased risk of suicide after TBI [19]. Most TBI patients recover in the first three months, but up to a third of the patients report symptoms persisting beyond six months [27].

2. Aim

The aim of the study was to describe and characterise patients seeking medical care for traumatic head injuries at the ED – focusing specifically on demographics, cause of trauma and type of injury as well as severity. Auxiliary aims were to examine possible correlations between age and cause of trauma and interval time (time between injury and arrival to the ED) depending on patient district of residence. The results were then compared to prior research in the field.

3. Material and Methods

In this descriptive study, information regarding patients seeking medical care for traumatic head injuries was collected retrospectively from medical records at the ED, TUTH, Kathmandu, Nepal. Patients diagnosed with intracranial hematomas, cerebral contusions, concussions/mild head injuries, fractures, STIs (soft tissue injuries, which includes skin abrasions and contusions) and lacerations to the head and/or face were included. Patients with dental, ear or eye injuries were excluded if their GCS was 15. Patients with injuries limited to the cervical spine were also excluded. A total of 577 cases of head trauma were identified and included.

3.1 Variables

The following variables were collected: age, gender, district of residence, date, time, date of injury, time of injury, if the patient was under influence of alcohol or not, GCS, cause of trauma (road traffic accident, violence/physical assault, falls, struck by/against, other), diagnosis and outcome (discharged, discharged on patient request (DOPR), left against medical advice

(LAMA), absconded or death). The patients' blood alcohol concentration was not measured. Instead, patients were either assessed as under the influence of alcohol or not at the triage or on doctors first assessment. Pedestrian accidents were included in road traffic accidents and falls from height were included in falls. The districts of residence were divided into inside or outside Kathmandu Valley. The severity was decided based on the GCS-score determined at the triage or on doctors first assessment. A GCS of 13-15 was defined as mild, 9-12 as moderate and 3-8 as severe.

3.2 Data collection procedures

Patient data was collected from emergency tickets at the ED at TUTH. One emergency ticket per patient is kept and catalogued chronologically into categorised folders: general cases, police cases (road traffic accidents, violence/physical assault cases, suicide attempts etc.), brought dead, mortality and LAMA. Over the course of eight weeks in the fall of 2019, a total of 11 043 tickets from the 26th of June to the 3rd of October 2019 were searched manually. Of these tickets, 577 were identified as patients suffering from injuries to the head by external force and were therefore included in the study. Variables were collected from handwritten carbon paper tickets using a predetermined pro forma (appendices: 11.2).

3.3 Statistical methods

Descriptive statistics, calculations, tables and figures were made in IBM SPSS Statistics 26 or in Excel. In order to evaluate if the age distribution among head injured patients solely depends on the age distribution of the population in Nepal or not, the patient age distribution was normalised by the overall Nepali population age. The patients were divided into age groups

matching those of the United Nations Demographic Yearbook. Each patient age group were then divided by the overall population in the corresponding age group.

In order to evaluate how the median age varies between different causes of trauma, a Mann-Whitney U independent samples median test was conducted. Additionally, data from the test was used to examine pairwise comparisons between the median age among the causes of trauma. This same test was used to evaluate how the time interval between injury and arrival to the ED varied depending on which origin the patient had (inside or outside Kathmandu Valley). When examining alcohol involvement in the different cause of trauma categories, a Chi^2-test was conducted. Since two of the sample groups were very small, Fisher's exact test was used for significance testing.

4. Ethics

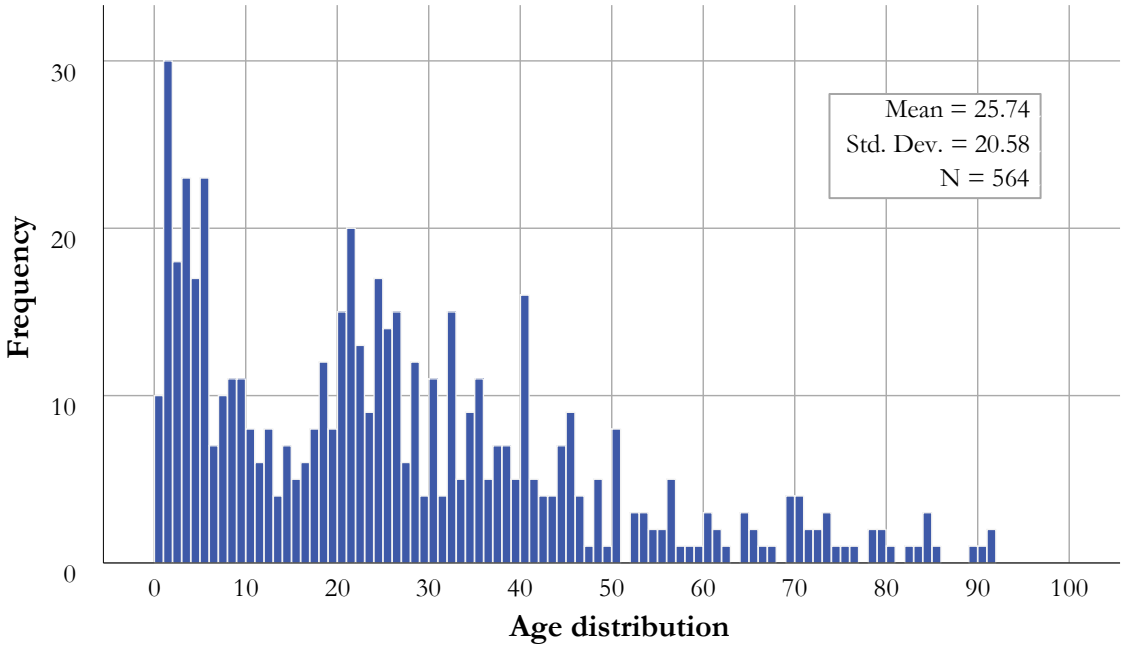
The study was performed according to the Helsinki declaration. Data gathered from medical records were kept safe and anonymous. Personal data such as names and contact numbers were not collected. The data collection did not interfere with the management and treatment of the patients. Prior to the data collection, an ethical approval was granted from the Institutional Review Committee (IRC) at TUTH (appendices: 11.1).

5. Results

Out of 11 043 emergency tickets searched, a total of 577 patients suffering from traumatic head injuries were identified and included in the study, constituting 5.2 per cent of all emergency tickets searched. The ED served approximately 112 patients per day (11 043 emergency tickets over 99 days, 111.5), six of which (577/99, 5.8) were head injuries.

5.1 Demographics

Figure 1. Age distribution histogram



Age distribution in 564 patients. Each bar represents the total number of patients at a specific age. Patients under the age of one year are represented in the first bar. Age was not normally distributed. The mean age was 25.74 years and the median age was 23 years. More than one

fourth of the patients (27.5 per cent) were under eleven years old. In thirteen of the cases, age was not stated on the emergency ticket.

Figure 2. Age distribution normalised by population

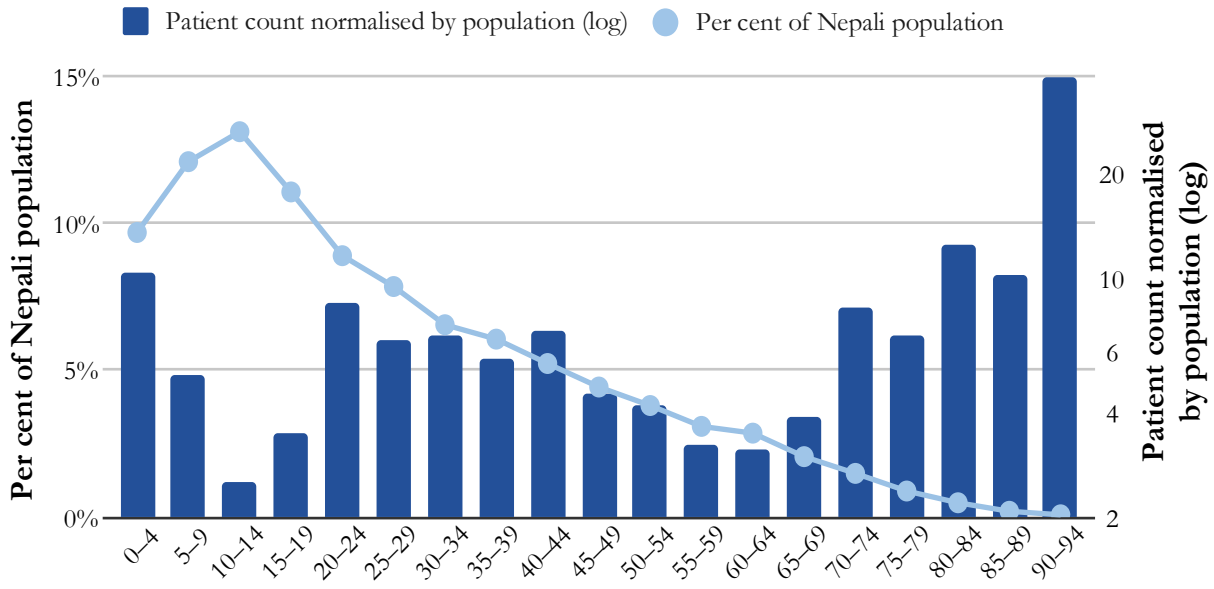


Figure 2: Data regarding population age in Nepal was gathered from the United Nations Demographic Yearbook 2018 [28].

In figure 2, the patient age distribution in figure 1 was normalised by the overall population in Nepal. In order to do so, the patients were divided into age groups matching those of the United Nations Demographic Yearbook. Normalising the age distribution enables the possibility of evaluating how the age patient distribution differs from the general population distribution. As seen in figure 2, the proportion of young patients is lower compared to the general population in Nepal. Additionally, there is a peak among older patients compared to the general population.

As seen in table 1, 68.8 per cent (392/570) of the patients were male and 31.2 per cent (178/570) were female. In seven cases gender was not stated on the emergency ticket.

Table 1. Gender distribution

		Frequency	Per cent	Valid per cent
Gender	Female	178	30.8%	31.2%
	Male	392	67.9%	68.8%
	Total	570	98.8%	100.0%
Missing		7	1.2%	
Total		577	100.0%	

Most of the injuries – 94.4 per cent (408/432) – were classified as mild according to the GCS score (table 2). 3.9 per cent (17/432) of the patients had moderate injuries and 1.7 per cent (7/432) had severe. In 36 cases, GCS was not specified but general neurology was described as "intact" on doctors first assessment. These patients were given a GCS of 15. In 13 cases, the time of injury was not specified further than "morning", "evening" or "night". These timestamps were set to 07:00 (eight patients), 19:00 (four patients) and 01:00 (one patient). In 145 of 577 cases, the GCS score was not stated on the emergency ticket.

Table 2. Injury severity according to GCS

		Frequency	Per cent	Valid per cent
Severity	Severe: GCS 3-8	7	1.2%	1.7%
	Moderate: GCS 9-12	17	2.9%	3.9%
	Mild: GCS 12-15	408	70.7%	94.4%
	Total	432	74.9%	100.0%
Missing		145	25.1%	
Total		577	100.0%	

5.2 Diagnosis

Superficial injuries such as lacerations, abrasions, contusions or cut injuries to the face or scalp were the most common (62.7 per cent, 453/722, see table 3). A majority of these injuries were

facial (38.8 per cent, 280/722). Almost a fourth (23 per cent, 166/722) of the patients suffered from concussions. 6.8 per cent (49/722) of the patients suffered from intracranial hematomas (for an in-depth view on types of hematomas, see table 4). 4.1 per cent (29/722) of the patients had skull or facial fractures. Since one patient could receive more than one diagnosis, the total number of diagnoses exceeds the number of patients included in the study. In 32 cases (4.2 per cent, 32/754), a traumatic head injury was described in the patient history, but no specific diagnosis was given further than e.g. "head trauma". These patients are categorised as "missing" in table 3. The "other"-category includes e.g. one case of penetrating brain injury and one case of diffuse axonal injury.

Table 3. Diagnosis

		Frequency	Valid per cent	Per cent of cases
Diagnosis	Concussion	166	23.0%	30.5%
	Superficial scalp injury	160	22.2%	29.4%
	Superficial face injury	280	38.8%	51.4%
	Superficial injury, unspecified	13	1.8%	2.4%
	Facial fracture	12	1.7%	2.2%
	Skull fracture	17	2.4%	3.1%
	Intracranial hematoma	49	6.8%	9.0%
	Cerebral contusion	16	2.2%	2.9%
	Pneumocephalus	3	0.4%	0.6%
	Other	6	0.8%	1.1%
	Total	722	100%	132.5%
Missing		32		
Total		754*		

**Since one patient can receive several diagnoses, the total number of diagnoses exceeds the total number of patients.*

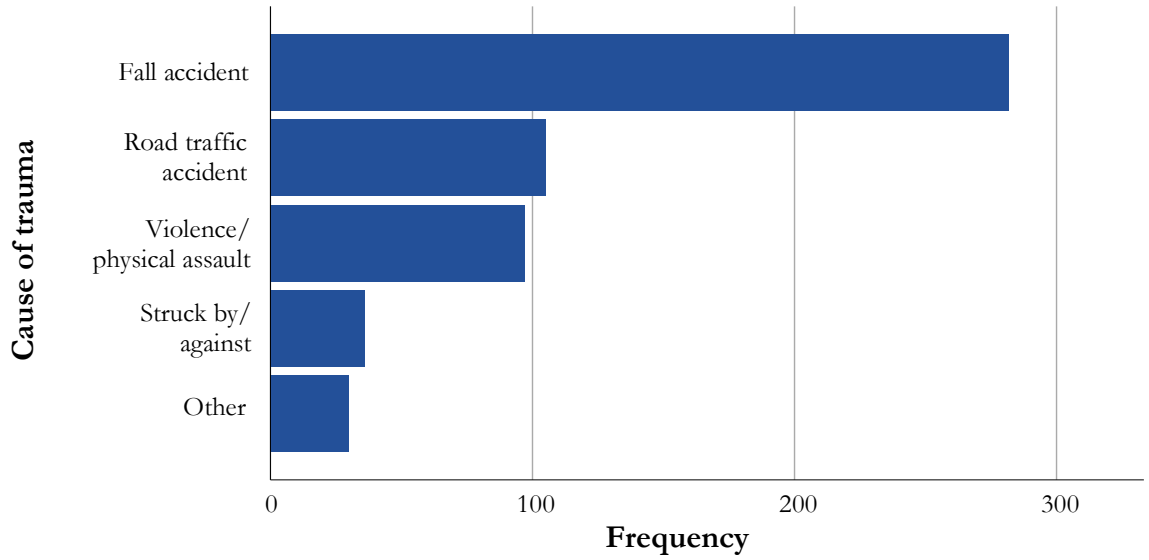
The most common type of intracranial hematoma was subdural hematoma (44.9 per cent, 22/49, see table 4), followed by epidural hematoma (24.5 per cent, 12/49). 16.3 per cent (8/49) of the hematomas were unspecified.

Table 4. Intracranial hematomas

		Frequency	Per cent
Diagnosis	Subdural hematoma	22	44.9%
	Epidural hematoma	12	24.5%
	Subarachnoid hematoma	6	12.2%
	Cerebellar hematoma	1	2.0%
	Intracranial hematoma, unspecified	8	16.3%
Total		49	100%

5.3 Cause of trauma and alcohol involvement

Figure 3. Cause of trauma



The causes of trauma are showed in figure 3 and table 5. The most common cause of trauma was falls (51.3 per cent, 282/577), followed by road traffic accidents (19.1 per cent, 105/577) and violence/physical assault (17.6 per cent, 97/577). 6.5 per cent (36/577) of the patients had been struck by or against an object, for example while working at a construction site. "Struck by/against" also includes patients that were injured while playing or practicing sports. The category "other" includes animal bites, burns, cuts and one gunshot. 27 patients had no cause of trauma noted on the emergency ticket.

Table 5. Cause of trauma

		Frequency	Per cent	Valid per cent
Cause	Fall accident	282	48.9%	51.3%
	Road traffic accident	105	18.2%	19.1%
	Violence/physical assault	97	16.8%	17.6%
	Struck by/against	36	6.2%	6.5%
	Other	30	5.2%	5.5%
	Total	550	95.3%	100.0%
Missing		27	4.7%	
Total		577	100.0%	

As seen in table 6, 10.2 per cent (56/550) of the patients were assessed as "under the influence of alcohol" at the triage or on doctors first assessment. In 13.3 per cent (14/105) of the road traffic accidents, 9.2 per cent (26/282) of falls and 14.4 per cent (14/97) of violence/physical assaults, the patient was assessed as "under the influence of alcohol". There was no significant difference between the causes of trauma and the influence of alcohol (p=0.149, Fisher's exact test).

Table 6. Alcohol intake by cause of trauma

		Alcohol		
		Yes	No	Total
Cause of trauma	Road traffic accident	14	91	105
	Fall accident	26	256	282
	Violence/physical assault	14	83	97
	Other	1	29	30
	Struck by/against	1	35	36
	Total	56	494	550
Missing				27
Total				577

5.4 Median age differences by cause of trauma

Figure 3. Median age by cause of trauma

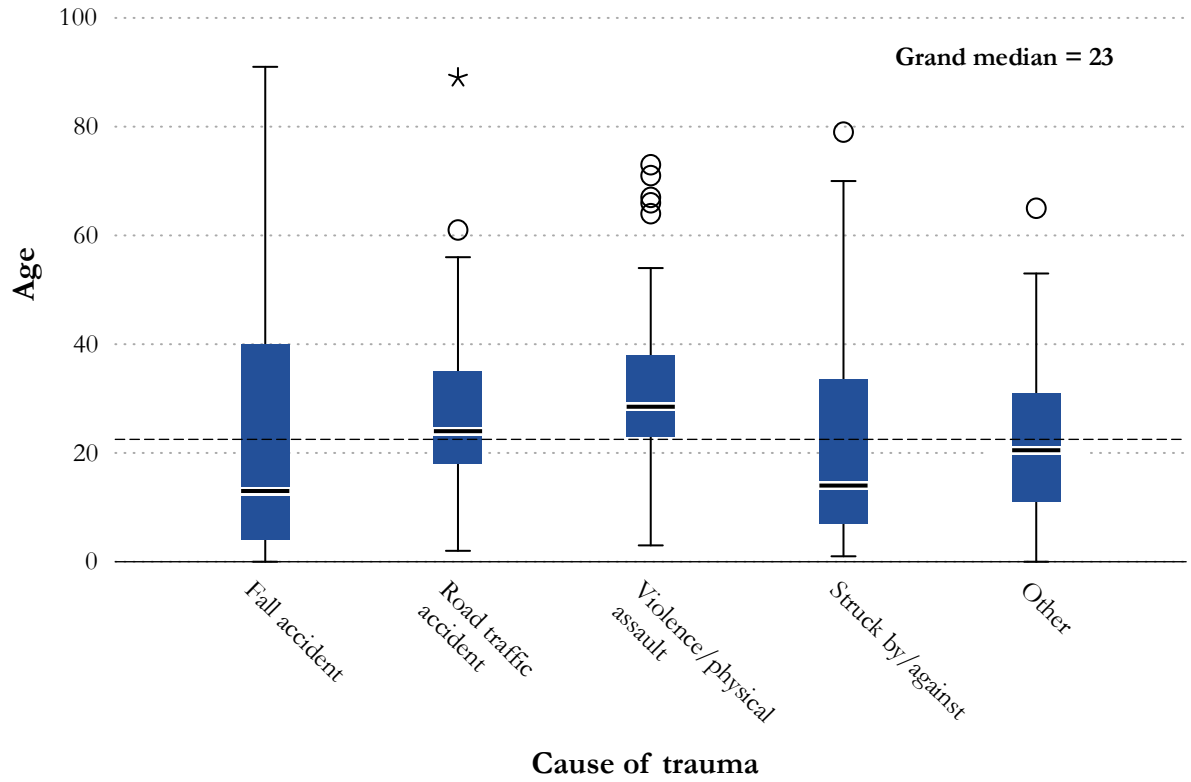


Figure 3: The grand median is represented by the dashed line. Blue bars contain 50 per cent of the patients in each cause of trauma-category. Lines below and above the blue bars each represent 25 per cent of the patients. The continuous line within each bar represent the median age in each category. Circles represent outliers. Stars represent extreme, far out values.

In order to evaluate how the median age varies between different causes of trauma, a nonparametric Mann-Whitney U independent samples median test was conducted on 538 patients. The dotted line shows the grand age median of all patients included (23 years). The blue bars contain 50 per cent of the patients in each category. Circles and stars represent outliers (extreme, far out values are marked with a star). There was a significant difference between the median ages in the different cause of trauma-categories (asymptotic sig. 2-sided test, p=0.000). As shown in figure 3, falls had the lowest median age (13 years), followed closely by struck

by/against (14 years), other (20.5 years), road traffic accidents (24 years) and violence/physical assault (28.5 years). Falls had the broadest age distribution, from 0 to 91 years. Pairwise comparisons of the median age are showed in table 6. There was a significant difference in median age in patients suffering from falls compared to road traffic accidents (p=0.000), violence/physical assault (p=0.000) and other (p=0.050), as well as struck by/against compared to violence/physical assault (p=0.002) and road traffic accidents compared to violence/physical assault (p=0.011).

Table 6. Pairwise comparison of the median age by cause of trauma

Cause 1 – Cause 2	Test statistic	Sig.
Fall accident – Struck by/against	0.126	0.723
Fall accident – Other	3.850	0.050
Fall accident – Road traffic accident	14.714	0.000
Fall accident – Violence/physical assault	42.704	0.000
Struck by/against – Other	2.200	0.138
Struck by/against – Road traffic accident	3.739	0.053
Struck by/against – Violence/physical assault	9.778	0.002
Other – Road traffic accident	0.304	0.582
Other – Violence/physical assault	1.632	0.201
Road traffic accident – Violence/physical assault	6.435	0.011

Each row tests the null hypothesis that the Cause 1 and Cause 2 distributions are the same. Asymptotic significances (2-sided tests) are displayed. The significance level is 0.05.

5.5 Patient residence – inside or outside Kathmandu Valley

As seen in table 7, 55.1 per cent (270/490) of the patients were from inside Kathmandu Valley and 44.9 per cent (220/577) were from outside Kathmandu Valley. A total of 87 patients had no or an unreadable district of residence logged on their emergency ticket and were therefore excluded in calculations regarding patient residence.

Table 7. District of residence

		Frequency	Per cent	Valid per cent
District	Inside Kathmandu Valley	270	46.8%	55.1%
	Outside Kathmandu Valley	220	38.1%	44.9%
	Total	490	84.9%	100.0%
Missing		87	15.1%	
Total		577	100.0%	

Figure 3. Time between injury and arrival to the emergency department by district of residence

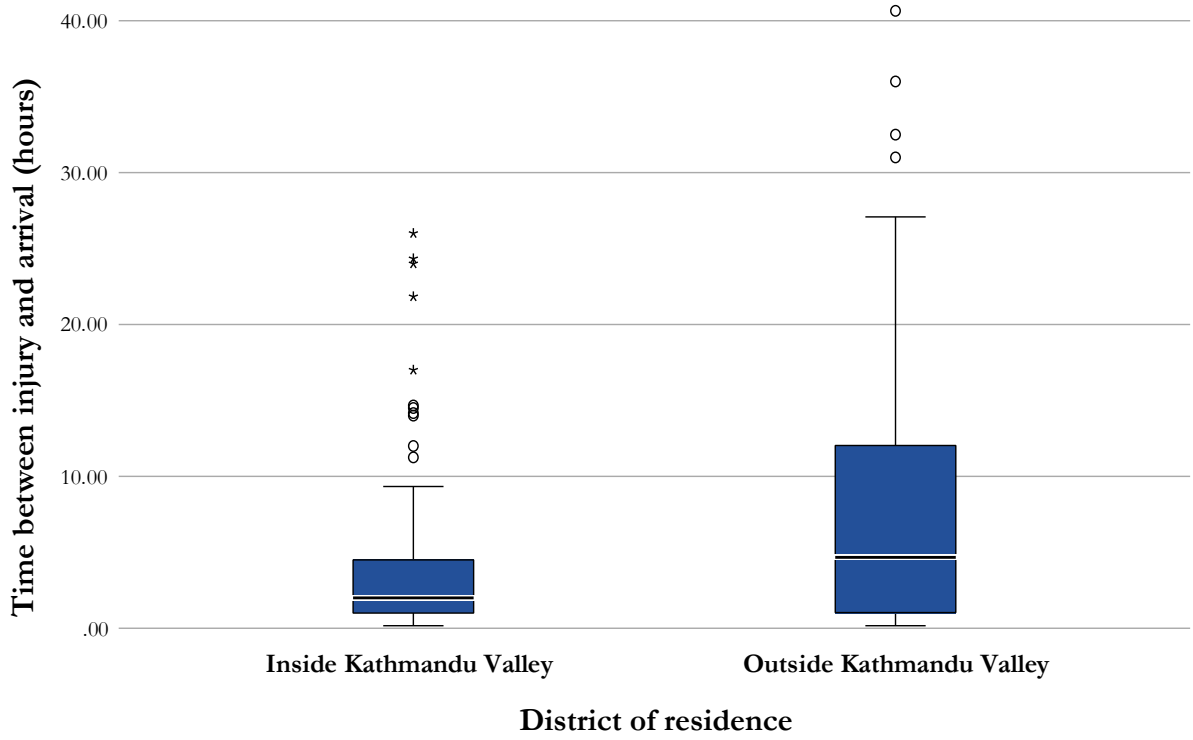


Figure 3: Blue bars contain 50 per cent of the patients in each district-category. Lines below and above the blue bars each represent 25 per cent of the patients. The continuous line within each bar represent the median age in each category. Circles represent outliers. Stars represent extreme, far out values.

In order to evaluate how the time interval between injury and arrival at the ED was affected by the district of residence, a nonparametric Mann–Whitney U test was conducted (p=0.003). Only 132 of 270 patients from inside Kathmandu Valley and 92 of 220 from outside Kathmandu Valley had both the time of injury and time of arrival at the ED logged in their emergency

tickets and could therefore be included in the test. As shown in figure 3, patients from outside Kathmandu Valley generally took longer to arrive at the hospital. It took approximately 4.9 hours for 50 per cent of the patients to arrive from outside Kathmandu Valley compared to 2.0 hours for patients from within Kathmandu Valley. The "outside Kathmandu Valley" category had a wider range of time intervals. As seen in the lowest percentiles of each category in figure 3, the patients who arrived at the ED in the shortest amount of time were both from inside and outside Kathmandu Valley.

5.6 Outcome

Nearly half of the patients (45.2 per cent, 238/527) were discharged from the ED or the observation ward. Almost as many absconded, were discharged on patient request or left against medical advice (41.9 per cent, 221/527). 12.1 per cent (64/527) were admitted to the hospital. One patient was admitted mainly due to a fractured femur and therefore not only because of a head injury. Four patients died at the ED during the study period (0.8 per cent, 4/527).

Table 8. Outcome

		Frequency	Per cent	Valid per cent
Outcome	Discharged	238	41.2%	45.2%
	Admitted	64	11.1%	12.1%
	DOPR/LAMA	170	29.5%	32.3%
	Absconded	51	8.8%	9.7%
	Death	4	0.7%	0.8%
	Total	527	91.3%	100.0%
Missing		50	8.7%	
Total		577	100.0%	

DOPR: Discharged on patient request. LAMA: left against medical advice.

6. Discussion

The purpose of this study was to examine the demography and epidemiology in head injured patients at the ED at TUTH, Kathmandu, Nepal. Since developing countries are particularly affected by these injuries and similar investigations are few, more exploratory research is necessary in order to survey the patient group and develop preventative strategies.

6.1 Key findings

Traumatic head injuries accounted for 5.2 per cent of all emergency tickets searched. The ED served approximately 112 patients per day, around six of which were head injuries. Patients were predominantly male and around a fourth of the patients were between zero and eleven years old. Most injuries were superficial to either the face or scalp and were classified as mild according to the GCS-score. The most common cause of trauma was fall accidents followed by road traffic accidents and the median age differed significantly depending on the cause of trauma. Roughly half of the patients were from outside Kathmandu Valley and had generally travelled for longer in order to reach the hospital. Only around a tenth (12.1 per cent) of the patients were admitted to the hospital. 45.2 per cent were discharged and 41.9 absconded, were discharged on patient request or left against medical advice. 0.8 per cent of the patients died at the ED.

6.2 Discussion of the results compared to prior research

Traumatic head injuries accounted for 5.2 per cent of all emergency tickets searched, agreeing with the findings of a similar study by S. McClennan and C. Snider at TUTH in 2003. Roughly

a fourth (27.5 per cent) of the patients were between zero and eleven years old and, as seen in figure 1, a majority of the patients were under 50 years old. In studies conducted in more developed countries, an incidence peak can usually be seen in the elderly as a result of an increased risk of fall injuries. A corresponding peak is not present in table 1, most likely due to the shorter life span in Nepal (70 years compared to 82 in e.g. Sweden) where about half of the population is below 25 years old [6]. However, when normalising the age distribution by the overall population in Nepal, a peak was found among the elderly (figure 2). This indicates that though a minority of the patients seeking medical care for head injuries at the ED at TUTH are elderly, the injuries appear to be common when considering the small proportion of the population they comprise. It would be interesting to compare the age adjusted population to that of a more developed country. While a similar peak among elderly patients should exist, it would probably be less prominent due to a larger proportion of elders.

Similar results regarding age distribution were also found in prior studies in Nepal, where head injuries have shown to be most common among young adults around 20–40 years old [20-23, 29]. As seen in figure 1, many of the observed patients are about this age. However, because of different inclusion criteria and various categorisation of age groups, comparisons are somewhat unreliable. Additionally, in accordance with prior studies around the world, males were exposed to head injuries at a higher rate than females. The gender ratio at birth in Nepal is the same (1.06 males/female) as in many other developed countries such as Sweden, Australia, Canada, Japan and Ireland [1]. However anecdotally, due to gender roles in Nepal (and globally), men are overrepresented in both high-risk occupations such as construction work and in perilous

activities such as driving cars and riding bikes or motorcycles, which might explain why they are more prone to sustain head injuries.

Regarding the injury severity, most of the patients had mild injuries according to the GCS-score (94.4 per cent, see table 2). These results differed from the findings of S. McClennan and C. Snider, who found that 77 per cent of the observed patients had minimal or mild injuries. Another study on head injuries from Pokhara by Ghimire P., Yogi N. and Acharya GB. showed similar results (80.5 per cent). The difference in per centage is most likely due to the fact that patients with facial and scalp lacerations were excluded if their GCS was 15 in S. McClennan and C. Snider's study. Another potential reason might be the large amount of missing GCS-score data (145 of 577 cases), possibly altering the results. Furthermore, loss of consciousness and GCS-scores were not consistently recorded by the same physician, which compromises the classification. Additionally, GCS-score was gathered from either the triage notes or from the doctors first assessment which might be hours apart.

Most of the injuries were superficial to either the face or scalp. The second most common injury was concussion followed by intracranial hematoma and fracture to either the face or skull. As previously mentioned, there is little consensus in what constitutes a head or brain injury among researchers and clinical physicians. The wide spread of inclusion criteria in both older and more recent studies on traumatic head/brain injuries complicates comparisons. That being said, while looking at TBIs specifically (superficial injuries excluded), concussion is the most common diagnosis according to previous studies [19]. One study on cranio-cerebral trauma by Adhikari K, Gupta MK, Pant AR and Rauniyar RK in Dharan, Eastern Nepal, showed that scalp lesions

were the most common type of injury followed by fractures and cerebral contusions [22]. Another study on head injuries conducted in the same city by Bajracharya A., Agrawal A., Yam B., Agrawal C. and Lewis O. showed that cerebral contusions were the most common pathological find on CT scans (20.5 per cent) in TBI patients, followed by intracranial hematomas and fractures [23]. The difference in contusion rate (20.5 per cent compared to 2.2 per cent) might be due to missing or noncomprehensive descriptions of CT-scan findings on the emergency tickets at TUTH. Additionally, not all patients underwent a CT-scan, which might obscure the real amount of contusions in this study. The number of concussions and superficial injuries is an underestimation since many of these patients never seek medical help, perhaps due to financial and/or transportation issues. Therefore, the true impact of head injuries is likely much higher than estimated.

Similar studies on head trauma in Nepal and globally have repeatedly reported falls or road traffic accidents as the main cause of injury. In this study, one half of the injuries were caused by falls (51.3 per cent, 282/577), compared to south Asia in general where falls constitute around 40 per cent of all TBIs. In regions such as central and eastern Europe, falls account for over 50 per cent of all TBIs, possibly due to an older population more prone to falls and an overall smaller proportion of road traffic accidents [18]. Road traffic accidents were the second most common cause of trauma on 19.1 per cent, considerably lower than previous studies with reported per centages of around 38-44 per cent. The large differences in per centages might be due to different inclusion criteria among studies. For example, none of the compared studies included superficial facial injuries. Also, Kathmandu experienced heavy rains causing severe flooding in the city during the study period which might have lowered the amount of road traffic

accidents. Hopefully, a portion of the reduced amount of accidents are because of improving road safety and enforced traffic policies such as the "No Drinking and Driving" campaign mentioned previously. 17.6 per cent of the observed injuries were caused by violence or physical assault, agreeing with the results of similar studies from Nepal [20-23]. A possible improvement to the study would be to further categorise causes by distinguishing e.g. falls from height from falls and pedestrian and motorcycle or bike accidents from road traffic accidents. However, due to missing data and inconsistent documentation, this was not possible.

Around ten per cent of the patients were assessed as "under the influence of alcohol" at the triage or on doctors first assessment (table 6). However, since the precise blood alcohol concentration was not measured and patients with impaired driving due to drugs other than alcohol were not included, these results are inconclusive. Also, many of the injured patients were children, and therefore most likely not under the influence of alcohol – lowering the rate of impaired driving. In 13.3 per cent of the road traffic accidents, the patient was assessed as under the influence of alcohol. This suggests there has been an increase in impaired driving since 2010. However, due to the inconclusiveness of the results in this study and the fact that there are no prior studies on impaired driving and its relationship with head trauma in Nepal, it is difficult to draw any conclusions. Additionally, the inclusion of pedestrian accidents in the "road traffic accidents" category further impairs the results. An interesting comparison would be studying the blood alcohol concentration in trauma patients from before and after the "No Drinking and Driving" policy was introduced in 2011. Unfortunately, no such data is available.

The median age differed significantly between the cause of trauma categories (asymptotic sig. 2-sided test, p=0.000). Falls had the lowest median age of 13 years but the broadest age distribution with a span of 0 to 91 years. If the expected lifespan in Nepal had been longer, the median age of falls probably would have been higher because of the increased risk of falls among the elderly. The median age of falls might also be affected by the fact that falls from height were included in the category, which foremost seemed (solely by reading the emergency tickets) to happen to children falling from buildings or adults working at construction sites. In Nepal, men are commonly seen working on high elevations without any safety gear such as harnesses or helmets. Violence/physical assault had the highest median age of 28.5 years and the narrowest age range. As figure 3 shows, violence or physical assaults were the most common among adults between 20 and 40 years old, suggesting that children and the elderly are not commonly affected by these injuries. As expected, the pairwise comparisons showed significant differences in median age in falls compared to several other categories due to the high number of young children suffering from falls. The median age of "struck by/against" also differed significantly from "violence/physical assault", probably because many of the patients who were struck by or against something were children injured while playing or practicing sports. By using median age combined with an overview of age distribution, the results of this study will be easier to compare with prior and future studies. Another way of evaluating ages among different causes of trauma would be to divide the observed patients into age groups. However, since there is little consensus on the categorisation of age groups among prior studies, this would complicate comparisons.

Roughly half (55.1 per cent) of the patients were from inside Kathmandu Valley. As shown in figure 3, patients from outside Kathmandu Valley took approximately five hours to reach the ED, compared to two hours for patients within Kathmandu Valley. The large number of patients coming from outside Kathmandu Valley illustrates the deficient health care facilities in rural areas. Many patients are forced to travel long distances from the countryside on faulty roads in order to reach modern health care facilities.

Only about 10 per cent of the patients were admitted to the hospital. However, some of the patients who were discharged had spent 24 hours at the observation ward. There was a large number of patients who either left the hospital, were discharged on patient request or left against medical advice. Possible reasons might be overcrowding at the emergency, long waiting times, financial problems or congested wards. Some patients were advised to seek medical help at other hospitals due to the intensive care unit being full. In proportion to the rapidly growing population in Kathmandu, hospitals are increasingly challenged by overcrowding and must quickly adapt despite limited recourses.

In order to lower the burden of head injuries in Nepal, preventive actions must be enforced. By decreasing the amount of accidents causing these injuries, health care facilities could instead focus on other public health problems. However, this demands major strides in traffic regulations, road maintenance, general infrastructure, health care services in rural areas and safety regulations in construction work – all of which will prove challenging in a developing country such as Nepal.

6.1 Methodological considerations

One major aspect that needs to be taken into consideration is the general condition of the emergency tickets. The stored tickets were handwritten copies on carbon paper. Many of them were difficult to interpret due to smudging and fragments of text scattered across the ticket from doctors and nurses writing notes on other documents on top of the carbon paper. Additionally, if the original and the copy of the emergency ticket had not been perfectly aligned, there was a risk of misinterpreting checkboxes on the copy. To avoid misinterpreting emergency tickets, uncertain data was not included. Additionally, the storing system of the tickets is anything but optimal. Many of the folders containing the tickets were damaged and not properly catalogued.

The results of this study would be easier to compare with international studies if the more contemporary and specific term TBI had been used as an inclusion criteria and superficial facial injuries had been excluded. Most studies on head trauma choose to focus on TBIs solely or TBIs and superficial scalp injuries. Only a few includes injuries to the face as well. However, because of the diagnosis classification system at the ED at TUTH, where for example the slightly antiquated umbrella term "mild head injury" (which covers both superficial injuries and concussions) is used instead, this was not possible. Additionally, abrasions and contusions are also covered in another umbrella term – STI, further complicating the terminology. Fortunately, because superficial injuries were usually described on the emergency ticket – even if they were not included as a final diagnosis – it was possible to distinguish superficial injuries from concussions.

While evaluating how the patient origin affected the interval time between injury and arrival to the ED, 13 of the 490 included patients had estimated timestamps. The emergency tickets of

these patients had only stated morning, evening or night as the time of injury and estimated timestamps were therefore set. These are probably not completely correct. Additionally, many the other 487 timestamps were unspecific estimations too, made by either the patient or patient relatives. This compromises the certainty of the results. Another important consideration is the patient origin, which is based on patient residence – not place of injury. This means the patient might have been injured inside Kathmandu Valley and therefore reached the hospital in a short amount of time – even if the emergency ticket states an address from outside Kathmandu Valley. This might explain why some of the patients in the "outside Kathmandu Valley" category took very little time to reach the hospital.

Lastly, while evaluating the age distribution normalised by population seen in figure 2, the sample size among the elderly was small which could compromise the certainty of the results. In other words, the proportion of injuries among elderly could be an overestimation. However, this figure was made to illustrate how the age distribution among the patients depends on the overall population age in Nepal and is not statistically sound.

7. Conclusions and Implications

Traumatic head injuries remain a pressing issue as an important and often preventable cause of morbidity and mortality in Nepal. Falls account for most of the accidents, followed by road traffic accidents and violence/physical assaults. Many of these injuries could probably have been prevented if proper preventative measures had been enforced. However, lowering the burden of these injuries demands major strides in traffic regulations, road maintenance, general

infrastructure and the general view on safety in e.g. traffic and work environments, which proves a challenge in a developing country such as Nepal. In order to survey the patient group and draw accurate conclusions on possible risk groups, more epidemiological research is necessary. Almost half of the patients were from outside Kathmandu Valley, which illustrates the deficient heath care facilities in rural areas – forcing patients to travel long distances in order to reach modern health care facilities. Only a tenth of the patients were admitted, most were discharged or left the hospital on patient request, possibly due to long waiting times, financial problems or congested wards. A possible continuation of the study could be further investigating the admitted patients regarding e.g. demographics, diagnosis, possible interventions, potential surgeries and outcomes. It would also be interesting to examine possible gender differences between the cause of trauma categories.

8. Populärvetenskaplig sammanfattning

Traumatiska huvudskador på akuten i Kathmandu, Nepal.

Traumatiska huvudskador orsakar årligen ett stort antal dödsfall världen över. Många av patienterna måste dessutom leva med både kort- och långsiktiga komplikationer. Utvecklingsländer är särskilt utsatta för skadorna och dess följder, delvis på grund av en större förekomst av riskfaktorer men även eftersom sjukvårdsinrättningar ibland kan vara både underutvecklade och svåra att nå. Den här studien undersöker huvudskador i Nepal, ett av världens minst utvecklade länder. Studien genomfördes på Tribhuvan University Teaching Hospital i Kathmandu, där huvudskador utgör cirka fem procent av alla akutbesök.

Syftet med studien var att utforska patientgruppen avseende demografi, diagnos och allvarlighetsgrad, vilken orsak till trauma som var vanligast samt om patienten blev inlagd på sjukhuset eller inte. En annan viktig frågeställning var att undersöka om det fanns någon skillnad i ålder beroende på traumaorsak. För att besvara frågeställningarna granskades 11 043 journalblad från akutmottagningen. Av dessa patienter inkluderades 577 i studien.

Resultaten visar att traumatiska huvudskador utgjorde 5.2 procent av alla akutbesök. Medianåldern var 23 år. Precis som i tidigare studier var patienterna övervägande av manligt kön, vilket troligtvis beror på traditionella könsroller i Nepal. Sannolikt kör män bil eller motorcykel oftare än kvinnor och utsätter sig över huvud taget för större risker, i både yrkesliv och privatliv. En stor majoritet av skadorna graderades som milda. Ytliga hudskador i ansiktet och på skalpen var vanligast följt av hjärnskakningar, hjärnblödningar och frakturer. De flesta hade råkat ut för ett fall, men trafikolyckor och misshandel var också vanligt.

Det fanns signifikanta skillnader i ålder mellan de olika traumaorsakerna. I mer utvecklade länder brukar små barn, unga vuxna och äldre vara generellt överrepresenterade. Bland de patienter som fallit utgjordes majoriteten av barn. Det fanns dock en stor åldersspridning i gruppen. Åldersspridningen indikerar att medianåldern troligtvis varit högre om medellivslängden i Nepal varit längre, eftersom fall erfarenhetsmässigt är vanligt i hög ålder.

Nästan hälften av patienterna kom från områden utanför Kathmandudalen, vilket tyder på att många patienter måste resa långt för att komma till moderna vårdinrättningar. Endast en tiondel

av patienterna blev inlagda på sjukhuset. Många lämnade sjukhuset på egen begäran, troligen på grund av ekonomiska skäl, långa väntetider och fulla avdelningar.

Traumatiska huvudskador utgör en viktig orsak till lidande i Nepal och skadorna kan i många fall förebyggas genom olika preventiva åtgärder, som t.ex. kontroll av att trafiklagstiftningen efterlevs, bättre vägunderhåll, ökad hjälmanvändning bland motorcyklister samt ett allmänt ökat säkerhetstänk i trafiken och på exempelvis byggarbetsplatser. Genom att dessutom införa fler moderna vårdinrättningar på landsbygden hade antalet patienter som tvingats resa lång väg för att få vård kunnat minska. Patienter med lindriga skador hade då kunnat få snabbare vård på plats och därigenom hade belastningen på sjukhusen i Kathmandu minskat.

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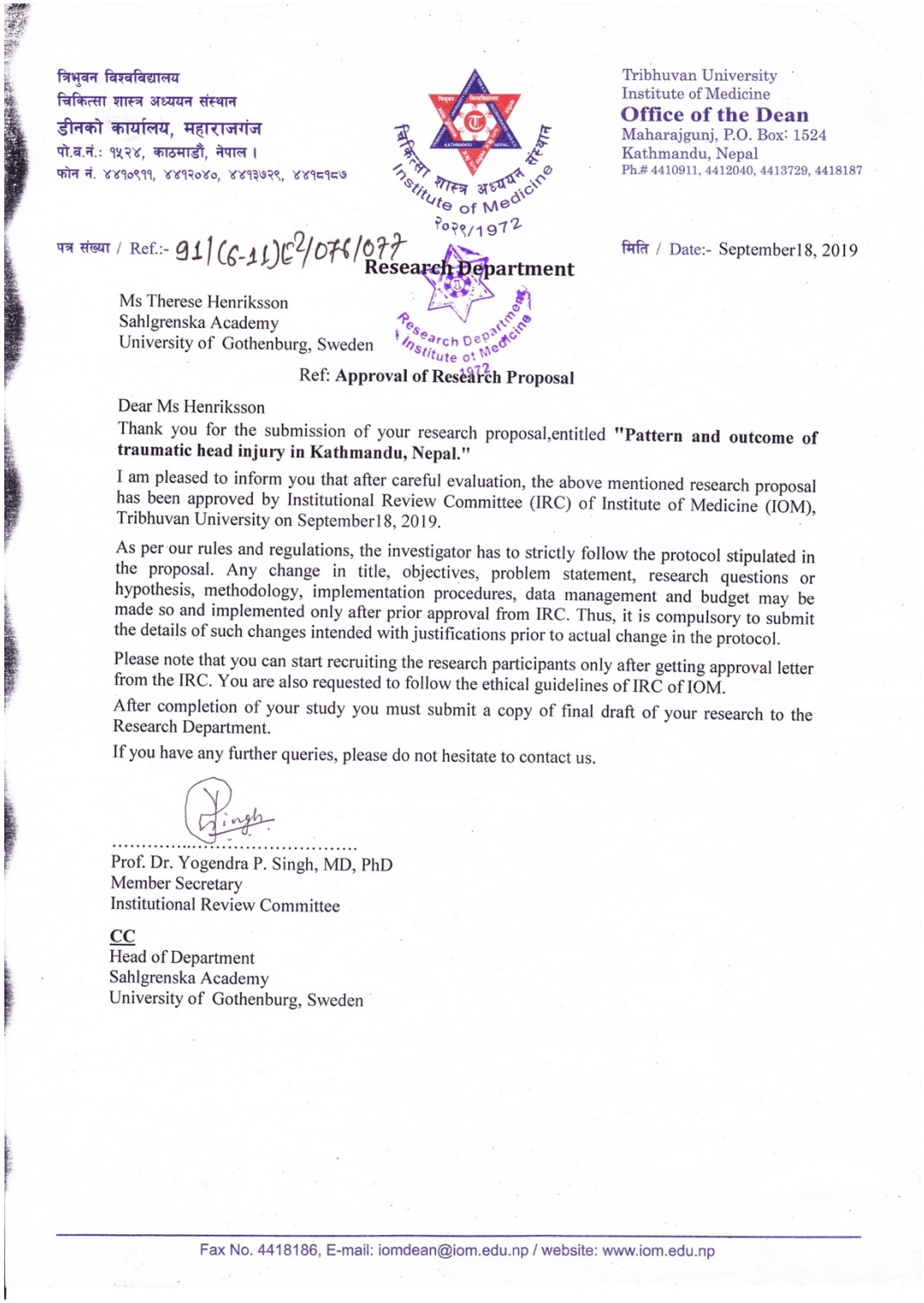
11. Appendices

11.1 Ethical approval



त्रिभुवन विश्वविद्यालय
चिकित्सा शास्त्र अध्ययन संस्थान
डीनको कार्यालय, महाराजगंज
पो.ब.नं.: १५२४, काठमाडौं, नेपाल।
फोन नं. ४४१०९११, ४४१२०४०, ४४१३७२९, ४४१८१८७

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पत्र संख्या / Ref.:- 91(6-11)E2/076/077

मिति / Date:- September18, 2019

Research Department

Ms Therese Henriksson
Sahlgrenska Academy
University of Gothenburg, Sweden

Ref: **Approval of Research Proposal**

Dear Ms Henriksson

Thank you for the submission of your research proposal,entitled **"Pattern and outcome of traumatic head injury in Kathmandu, Nepal."**

I am pleased to inform you that after careful evaluation, the above mentioned research proposal has been approved by Institutional Review Committee (IRC) of Institute of Medicine (IOM), Tribhuvan University on September18, 2019.

As per our rules and regulations, the investigator has to strictly follow the protocol stipulated in the proposal. Any change in title, objectives, problem statement, research questions or hypothesis, methodology, implementation procedures, data management and budget may be made so and implemented only after prior approval from IRC. Thus, it is compulsory to submit the details of such changes intended with justifications prior to actual change in the protocol.

Please note that you can start recruiting the research participants only after getting approval letter from the IRC. You are also requested to follow the ethical guidelines of IRC of IOM.

After completion of your study you must submit a copy of final draft of your research to the Research Department.

If you have any further queries, please do not hesitate to contact us.

Prof. Dr. Yogendra P. Singh, MD, PhD
Member Secretary
Institutional Review Committee

CC
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11.2 Pro forma

Age:

Gender:

District:

Date of arrival: Time of arrival:

Date of injury: Time of injury:

Alcohol (yes/no):

Triage category (red/yellow/green):

GCS-score:

LOC (loss of consciousness: yes/no and duration):

Vomiting (yes/no and count):

Cause of trauma (fall, road traffic accident, violence/physical assault, struck by/against, other):

If categorised as “other”, what was the specific cause?

Diagnosis:

X-ray/CT-skull (yes/no/information missing):

Outcome (admitted/transferred to ward/death/absconded/left against medical advice/discharged on patient request):

Date of admission: Time of admission:

Date of discharge: Time of discharge:

Referred to another clinic (yes/no):

If referred, why?

Referred from another clinic (yes/no):

If referred, why?

File category (general/police cases/left against medical advice/mortality/brought dead) and date: