

# Factors affecting mortality of hospitalized facial trauma patients in Al-Ain City, United Arab Emirates

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## Research Article

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# Abstract

**Background:** Facial injuries affect one third of severely injured patients. These injuries have devastating long-term negative impact on quality of life. We aimed to study the epidemiology of facial injuries and factors affecting mortality of hospitalized facial trauma patients in Al-Ain City, United Arab Emirates

**Methods:** This is a retrospective analysis of a prospectively collected data from Al-Ain Hospital Trauma Registry. All patients with facial injury who were hospitalized for more than 24 hours or who died after arrival at the hospital during the period from January 2014 to December 2017 were studied. Univariate analysis was used to compare patients who died and those who survived. Significant factors were then entered into a backward logistic regression model to define factors affecting mortality.

**Results:** 408 patients having a mean age of 31.9 years were studied, 87.3% were males. The main mechanisms of injury were road traffic collisions (45.1%) and fall from height (11.3%). 289 (70.8%) patients had associated injuries which were mainly in the head and chest. The backward logistic regression model showed that GCS was the only factor that predicted mortality,  $p < 0.0001$  with the best cut-off point of 7.5 having a sensitivity of 0.972 and a specificity of 0.8. The ROC had an area under the curve of 0.924.

**Conclusions:** Majority of facial injury patients in our setting are young males who were involved in road traffic collisions or falls from height. The most important factor predicting mortality of these patients was the low GCS. Those having GCS of 8 and more had a better chance for survival. This information is very important when counselling patients or their relatives for facial surgery.

## Introduction

Trauma is a major public health problem. One third of the severely injured patients have facial injuries [1]. These injuries have devastating long-term negative impact on quality of life and may need multiple reconstructive and plastic surgery with lengthy hospital stay [2,3,4]. They are usually associated with life-threatening serious injuries of the head and chest [5,6]. Their mechanism of injury include road traffic collisions (RTCs), assaults, sports injuries, falls, industrial injuries [2-4], and animal-related injuries [7]. The epidemiology of facial injuries varies worldwide including the prevalence, cause, injury pattern, severity, and clinical outcome depending on the socio-economic status and culture of the population [8]. Studies on the pattern and predictors of mortality of facial trauma are generally sparse. This information is important to provide a basis for comparison, improve patient management including counselling, and develop injury prevention strategies. We aimed to study the epidemiology of facial injuries and factors affecting mortality of hospitalized facial trauma patients in Al-Ain City, United Arab Emirates (UAE).

## Patients And Methods

*Ethical considerations:* The Human Research Ethics Committee of Al-Ain Hospital, Al Ain, UAE gave an ethical approval for this study (AAHEC-03-20-008). The patients or their caregivers signed an informed consent giving permission to use their anonymous clinical data in research projects.

*Study design:* This is a retrospective analysis of prospectively collected data from Al-Ain Hospital Trauma Registry for a cohort of trauma patients who were followed till discharge from the hospital or death on arrival or during their stay in the hospital.

*Patients:* All patients having a facial injury who were hospitalized in Al-Ain Hospital for more than 24 hours or who died after their arrival to the hospital during the period from January 2014 to December 2017 were studied.

*Setting:* Al-Ain Hospital is a major university-affiliated hospital specialized in trauma and acute care. It treated approximately 80% of the hospitalized trauma patients in Al-Ain City during the study period. It is located in Al-Ain City, which has a population of 738,000 inhabitants [9].

*Studied variables:* These included demography, transportation mode, mechanism of injury, anatomical location and severity of the injury, associated injuries, vital signs, Glasgow Coma Scale (GCS) on admission, ICU admission, length of hospital stay, and clinical outcome. The severity of the injury of an anatomical region was assessed by the Abbreviated Injury Severity Score (AIS). Overall injury severity was evaluated using the Injury Severity Score (ISS) and New Injury Severity Score (NISS). Both were calculated manually using the AIS 2008 handbook [10].

*Statistical analysis:* Data were presented as mean (SD) for continuous data, median (range) for ordinal data, or number (%) for categorical data. Pearson's Chi-square or Fisher's Exact test as appropriate was used to compare categorical data of two independent groups and Mann–Whitney U-test for continuous or ordinal data for two independent groups. Univariate analysis was used to compare patients who survived and those who died. Significant factors were then entered into a backward stepwise logistic regression model. A p-value of < 0.05 was accepted as significant. Receiver operator curve (ROC) analysis was applied for significant ordinal or continuous factors to define the best point predicting mortality and its sensitivity and specificity. Statistical analyses were performed using the Statistical Package for the Social Sciences (IBM-SPSS version 26, Chicago, IL).

## Results

Four hundred eight patients were studied; 356 (87.3%) were males. The mean (SD) age was 31.9 (16.2) years; sixty-one patients (15%) were children under the age of 18. Ninety-four patients (23%) were UAE nationals. The most common mechanism of injury was road traffic collision (RTC) in 184 patients (45.1%). Other etiologies were falling from height (11.3%), falling (10.5%), and motorcycle accidents (4.7%). The majority of patients (49.9%) were injured on the street or highway, 22.7% at home, and 15.2% at the workplace (**Table 1**). The most frequent time for face injuries was at around 7 p.m. The weekly profile of facial injuries showed no difference in the incidence of injuries between the days of the week. Face injuries peaked in the winter months; December, January, and February (**Figure 1**).

One hundred nineteen (29.2%) patients sustained isolated face injury, while 289 (70.8%) patients had associated injuries in other regions. The median (range) Face AIS was 1 (1-3). The most commonly injured body regions associated with the face injury were the head (49.4%), followed by the chest (39.7%). The median (range) ISS was 5 (5-75), and the median (range) GCS was 15 (3–15). Patients stayed for a median (range) of 3 (1–95) days in the hospital. Fifty-two patients (12.7%) were admitted to the Intensive Care Unit (ICU). Eleven patients died (overall mortality 2.7%).

Univariate analysis (**Table 2, Table 3**) showed that patients who died had significantly lower GCS, significantly higher ISS, significantly higher percentage of chest injury (63.6%), and significantly higher ICU admission (81.8%). The backward logistic regression model (**Table 4**) showed that the model was highly significant ( $p < 0.0001$ , R squared 0.46). GCS was the only factor that predicted mortality,  $p < 0.0001$ . **Figure 2** shows the ROC curve of GCS in predicting survival. The best cut-off point of GCS that predicted survival was 7.5, with a sensitivity of 0.972 and a specificity of 0.8. The ROC had an area under the curve of 0.924. The R squared of 0.46 indicates that the GCS can explain 46% of the variation of the model.

## Discussion

Our study has shown that more than 55% of those having facial injuries in our setting are young males who were involved in road traffic collisions or falls from height. Severe injuries that necessitated admission to the ICU with reduced GCS were highly significant in those who died. The most important factor predicting mortality of patients having facial injuries was the low GCS. Those having GCS of 8 and more had a better chance for survival. This can be explained by the association between facial and head injuries. This information is very important when counselling patients or their relatives for facial surgery.

Similar to others, young males were the highest risk group for facial injuries in our study [1-3]. Nevertheless, the male-to-female ratio was 6.8:1 which is much higher than other studies [13-15]. The demography of our setting is very unique. The fast economic growth of the UAE required the employment of male foreign workers for construction projects. They constitute 78% of the population [9]. Similar to others, RTC is the leading cause of facial injuries [3,11,12]. RTC is the second cause of death in the UAE [16] which is caused by aggressive driving and poor seatbelt compliance [17, 18]. This was followed by fall from height which is caused by low safety measures in the workplace [19].

The highest number of injuries occurred around 7:00 p.m because Al-Ain City traffic is highly active during this time. Our City is spread horizontally over an area of 30 km by 25 km because it is not allowed to have more than four storey buildings in the residential areas. There are wide highways of 3-lanes having a speed limit of 80km/hour within the city. In contrast to others [20,21], there was no increase in the incidence of facial injuries during the weekends. Furthermore, facial injuries peaked in winter. Winter in the UAE is the most pleasant season with a nice weather encouraging families to have desert sport activities using quad bike riding which has high frequency of facial injuries [22]. In contrast, facial injuries are more common in the summer months in China and Canada [20,21].

Associated injuries are common in patients having facial injuries [6, 5, 23]. They occurred in around 70% of our patients. There is a strong association between the presence of concomitant injuries and the trauma mechanism [5, 24, 25]. Head and chest injuries are common in our study. They occur in high speed RTCs when not using seatbelts [26]. Traumatic brain injury (TBI) occurs in around 35% of facial trauma patients. Therefore, a high index of suspicion of TBI should be raised when evaluating patients with facial injuries [23, 27, 28]. Alvi et al. found that chest injury was the second most common associated injury and occurred in around 30% of facial trauma patients. Accordingly, trauma CT of the head and chest should be performed in patients with severe facial injuries [2].

The median length of hospital stay in our study was three days compared with 7.5 days of Mijiti et al. [24]. Those with pan facial fractures and cranial injuries stay longer in the hospital [2-5]. The overall mortality in our study was 2.7% which is similar to others [5, 23]. The univariate analysis showed that low GCS, increased ISS, associated chest injury, and ICU admission were significantly more in those who died similar to other studies [23, 27]. Nevertheless, the logistic regression model showed that GCS was the only significant factor predicting death, the best threshold being below 8. This is supported by others [5, 23]. In contrast to other studies [8], age had no effect on mortality in our study. This can be explained by our young population because majority of expatriate workers return back to their home country when they become old.

There is a need for more injury prevention strategies in our community targeting RTCs and work-related injuries. This includes vehicle speed monitoring, strict penalties against road traffic violations, compulsory usage of seatbelts, helmet usage by motorcyclists, and construction of cycle tracks [18, 26, 29]. Furthermore, enforcing safety in workplaces is pivotal [19]. Labourers using machines are at risk of sustaining work-related facial trauma more than office workers.

## Limitations

We have to acknowledge that our study has certain limitations. *First*, it a retrospective study which can be affected by missing data. *Second*, our study did not include patients who died before arriving to the hospital or those who were treated at the Emergency Department and discharged home which has the risk of selection bias. *Finally*, the current study stemmed from one trauma center limiting its generalizability to the whole UAE. Nevertheless, the results provide useful information to guide strategies for counselling and injury prevention.

## Conclusions

Majority of patients having facial injures in our setting are young males who were involved in road traffic collisions or falls from height. The most important factor prediciting mortality of these patients was the low GCS. Those having GCS of 8 and more had a better chance for survival. This information is very important when counselling patients or their relatives for facial surgery.

## Abbreviations

AIS: Abbreviated Injury Severity Score

GCS: Glasgow Coma Scale

ICU: Intensive care unit

ISS: Injury Severity Score

NISS: New Injury Severity Score

ROC: Receiver operator curve

RTC: road traffic collision

TBI: Traumatic brain injury

UAE: United Arab Emirates

## Declarations

### Authors' contributions

MAA, DOA, and FAZ contributed to the study conception and design. DOA, and FAZ contributed to the acquisition and coding of data. FAZ analyzed the data and wrote the results section. MAA drafted the first version of the paper. FAZ critically edited the paper. MAA, DOA, and FAZ critically reviewed the manuscript. All authors read and approved the final manuscript.

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**Availability of data and materials:** There are no additional data available to share with the readers. Data can be shared with the Editor of the Journal if requested.

**Ethics approval and consent to participate:** The Human Research Ethics Committee of Al-Ain Hospital, Al Ain, UAE gave an ethical approval for this study (AAHEC-03-20-008). The patients or their caregivers signed an informed consent giving permission to use their anonymous clinical data in research projects.

**Consent for publication:** Not applicable

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

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## Tables

**Table 1:** Demography of the hospitalized facial injury patients (n = 408) who were treated at Al-Ain Hospital, Al-Ain City, United Arab Emirates, during the period of 2014-2017

Variable	Study population
Age	31.9 (16.2)
Gender	
Male	356 (87.3%)
Female	52 (12.7%)
Nationality	
UAE nationals	94 (23%)
Non-UAE	314 (77%)
Mechanism of injury	
RTC	184 (45.1%)
Fall from height	46 (11.3%)
Fall down	43 (10.5%)
Motorcycle	19 (4.7%)
Heavy object	16 (3.9%)
Bicycle	10 (2.5%)
Others	90 (22.1%)
Location of trauma	
Street/Highway	200 (49.9%)
Home	91 (22.7%)
Work	61 (15.2%)
Public area	25 (6.2%)
Others	24 (6%)
Dead	11 (2.7%)

Data are presented as mean (SD) for continuous data and number (%) for categorical data. The valid percentages are from those available data and not the overall population.

RTC: road traffic collision

**Table 2:** Univariate analysis comparing the demography of hospitalized facial injury patients who died and those who survived during the period of 2014-2017 at Al-Ain Hospital, Al-Ain City, United Arab Emirates

Variable	Alive n= 397	Dead n= 11	P-value
Age (years)	31.8 (16.3)	37.6 (11.7)	0.14
Gender			0.99
Male	346 (87.2%)	10 (90.9%)	
Female	51 (12.8%)	1 (9.1%)	
Nationality			0.99
UAE nationals	92 (23.2%)	2 (18.2%)	
Non-UAE	305 (76.8%)	9 (81.8%)	
Mechanism of injury			0.63
RTC	176 (44.3%)	8 (72.7%)	
Fall from height	44 (11.1%)	2 (18.2%)	
Fall down	43 (10.8%)	0 (0%)	
Motorcycle	19 (4.8%)	0 (0%)	
Heavy object	16 (4%)	0 (0%)	
Bicycle	10 (2.5%)	0 (0%)	
Others	89 (22.4%)	1 (9.1%)	
Location of trauma			0.52
Home	90 (23.1%)	1 (9.1%)	
Street/Highway	191(49%)	9 (81.8%)	
Work	60 (15.4%)	1 (9.1%)	
Public area	25 (6.4%)	0 (0%)	
Others	24 (6.2%)	0 (0%)	

Data are presented as mean (SD) for continuous data and number (%) for categorical data. The valid percentages are from those available data and not the overall population.

RTC: road traffic collision

**Table 3:** Univariate analysis comparing the severity markers of hospitalized facial injury patients who died with those who survived during the period of 2014-2017 at Al-Ain Hospital, Al-Ain City, United Arab Emirates

Variable	Alive n= 397	Dead n= 11	P-value
SBP (mmHg)	136.5 (20.6)	108.9 (61.2)	0.32
Heart rate	89.1 (18.5)	89.3 (40)	0.7
Respiratory rate	19.35 (3.2)	21.5 (10.6)	0.15
GCS	15 (3-15)	4.5 (3-15)	<0.0001
Head injury	137 (34.5%)	6 (54.5%)	0.2
Head AIS	2 (1-5)	3.5 (2-5)	0.06
Chest injury	108 (27.2%)	7 (63.6%)	0.014
Chest AIS	3 (1-4)	3 (1-4)	0.4
Spo2	98.3 (3.1)	89.6 (29.9)	0.17
ISS	5 (1-75)	18.5 (5-45)	0.001
NISS	6 (1-75)	17 (9-50)	0.001
ICU admit	2 (0.5%)	9 (81.8%)	<0.0001

Data are presented as mean (SD) for continuous data, median (range) for ordinal data, and number (%) for categorical data. The valid percentages are from those available data and not the overall population.

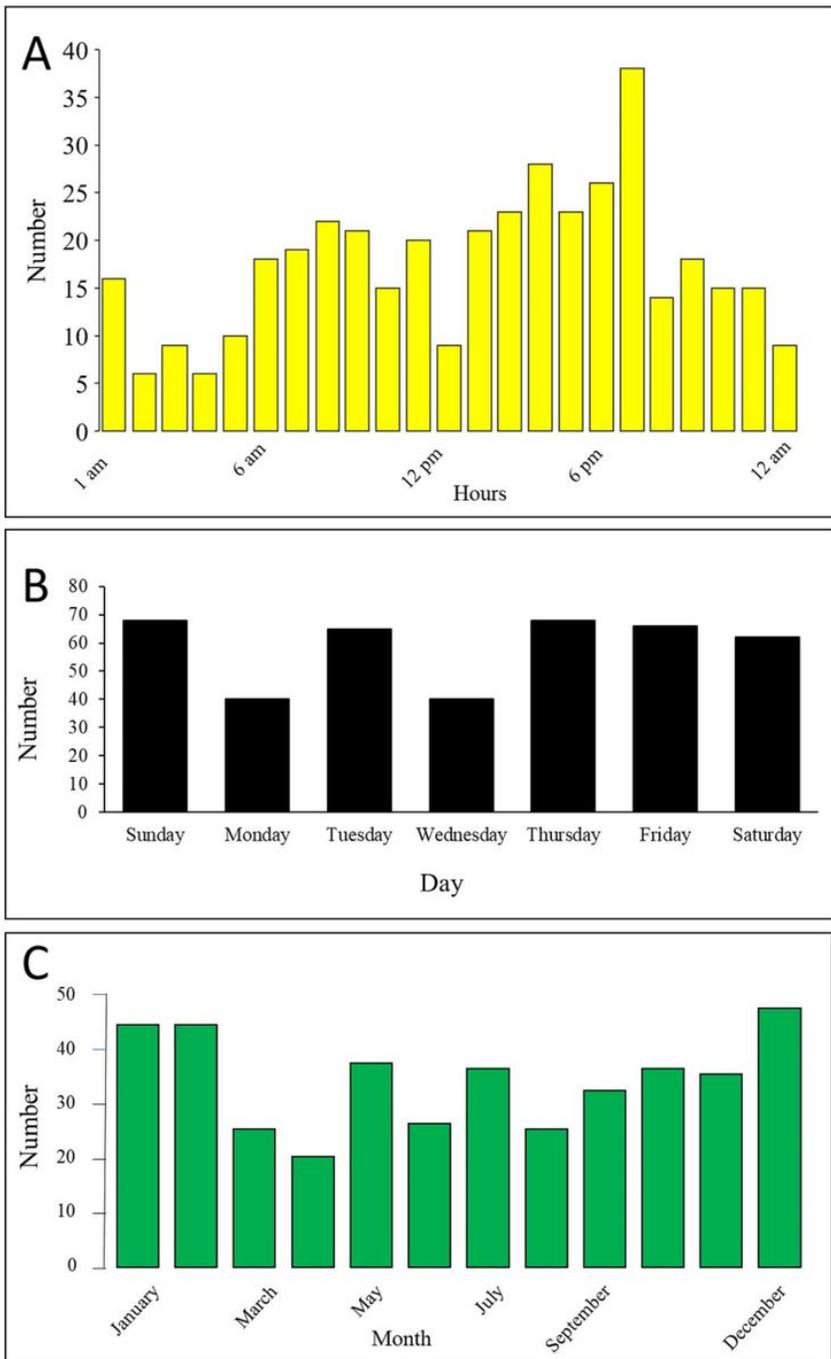
SBP: Systolic blood pressure, ICU: intensive care unit, GCS: Glasgow Coma Scale, ISS: Injury Severity Score; NISS: New Injury Severity Score

**Table 4:** Backward logistic regression model showing the predicting factor of mortality in patients having facial injuries.

Variable	B	S.E.	Wald	Sig.	Exp (B)	95% CI Lower limit	95% CI Upper limit
GCS	-0.48	0.08	32.6	<0.0001	0.64	0.55	0.75
Constant	1.415	0.71	3.92	0.05	4.12		

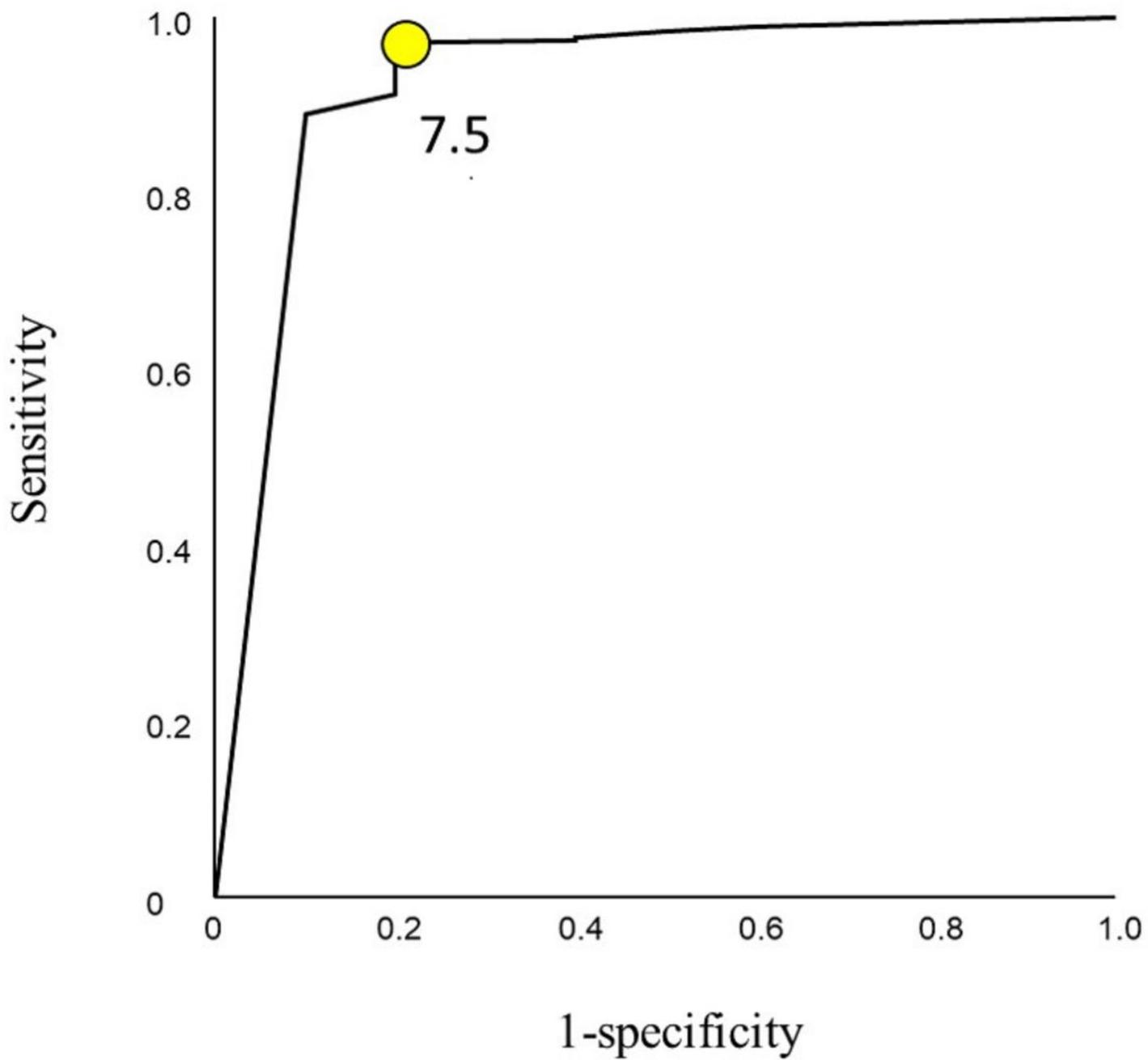
GCS: Glasgow Coma Scale

**Figures**



**Figure 1**

Distribution of hospitalized face trauma patients (n=408) by time (A), day (B) and month (C), Al-Ain Hospital, Al-Ain, United Arab Emirates, during the period of 2014-2017.



**Figure 2**

Receiver Operating Characteristic (ROC) curve for the best cut-off point of Glasgow Coma Scale (GCS) that predicts survival.