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Cohort Study

A retrospective cohort study on the aetiology and characteristics of maxillofacial fractures presenting to a tertiary centre in the UK

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ABSTRACT

Introduction: Approximately 3 million facial injuries occur annually, some of which result in maxillofacial fractures. The aim of our study was to evaluate the aetiology and characteristics of maxillofacial fractures presenting to the Queen Elizabeth Hospital in Birmingham.

Methods: The medical records for 809 patients treated for maxillofacial fractures were retrospectively reviewed between the dates of 01/01/2016 to 30/06/2017.

Results: A total of 1381 maxillofacial fractures were recorded. The majority of patients were males (n = 682, 84.3%) with a male:female ratio of 5.59:1. The age group with the highest number of admissions was the 26–50 years age group (n = 395, 48.8%). Assaults was found to be most frequent aetiological factor for maxillofacial fractures in the male cohort and falls was the leading cause of maxillofacial fractures in the female cohort. The most common fractured site in our study was the mandible (n = 599, 43.3%) with the angle and symphysis/parasymphysis regions of the mandible being the most susceptible to injury. Teams that were more frequently involved in the care of these patients included ophthalmology (n = 86) trauma and orthopaedics (n = 53), neurosurgery/neurology (n = 95) teams.

Conclusion: Socioeconomic status plays a significant role in the aetiology of facial fractures. Furthermore, assaults and falls were found to be the leading aetiological factors for maxillofacial fractures in the male and female cohorts respectively. There is a need to develop strategies in preventing falls in care homes, and addressing violence in young people through public awareness campaigns via the public health sector to reduce the incidence of such fractures.

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1. Background

Approximately 3 million facial injuries occur annually [1]. Most of these injuries do not result in maxillofacial fractures however the ones that do, vary in their aetiology and can range from assaults and sports-related injuries to road traffic accidents (RTA) and suicide attempts, and as a consequence, can result in either blunt or penetrating injury to the head. These fractures can occur in isolation or in combination with other injuries such as cranial, spinal, and other soft tissue structures. A multi-disciplinary approach from departments such as neurosurgery and ENT may be required to provide optimum care for the patient.

Fracture characteristics will vary depending on the mechanism of injury. For example, RTAs are more likely to have associated injuries when compared to assault-related injuries. Furthermore, RTAs were the leading cause of frontal sinus fractures [2]. Age is another important factor ithe n type and location of the fracture; for example, a study found nasal and mandibular fractures were more common in patients ≤21 years old [3]. Older individuals >64 years old were more likely to sustain maxillary, nasal and orbital floor fractures but less likely to sustain mandibular fractures [4].

The Queen Elizabeth Hospital Birmingham is a large teaching hospital within the West Midlands region. It is also a regional centre for trauma and burns and has the only comprehensive maxillofacial department in central Birmingham. As a result, this hospital serves both the local population, the West Midlands region, and beyond, thus representing a wide variety of socio-economic groups. The aim of this study

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is to evaluate the aetiology and characteristics of maxillofacial fractures presenting to the Queen Elizabeth Hospital in Birmingham, over an 18-month period from 01/01/2016 to 30/06/2017. Furthermore, we aim to appreciate the importance of the demographics of the patient. We will analyze the social deprivation status of our patient cohort by using the Index of Multiple Deprivation (IMD) to link each patient to their Lower-layer Super Output Area. Since maxillofacial fractures account for 4% of attendances in the emergency department in the United Kingdom, information like this may prove to be vital and could potentially assist the clinician in the emergency department in the assessment and management of such patients [5].

2. Methods

Only patients over the age of 16 with confirmed maxillofacial fractures were included in this study. Patients had to have been seen by a member of the Oral & Maxillofacial surgical team. They were either initially seen in the emergency department or in the trauma clinic through referrals. All relevant patient information was located retrospectively between the dates of 01/01/2016 to 30/06/2017 in either the craniofacial trauma database or the hospital's clinical portal. For each patient, the following information was recorded at their presentation:

1. Age
2. Gender
3. Post-code
4. Mechanism of injury
5. Number of fractures
6. Site of fracture/s
7. Input from other specialties with reason
8. Management plan chosen (surgical or conservative)
9. Post-operative complications

Patients with no radiographic reports confirming the presence of fractures were excluded from the study.

The reporting of this study is compliant with the Strengthening the reporting of cohort, cross-sectional and case-control studies in surgery (STROCSS) criteria [6]. This study was registered with the Research Registry, unique identifying number: researchregistry7712 [7].

2.1. Indices of Multiple Deprivation

The Index of Multiple Deprivation (IMD) is a measure of relative deprivation for small areas in England which are known as Lower-Layer Super Output Areas (LSOAs). All LSOAs have been given a national ranking out of the 32,844 SOAs in England, with 1 being the most deprived and 32,482 being the least deprived nationally. The IMD takes into account a combination of information from seven domains which produce an overall relative measure of deprivation. These domains include:

1. Income deprivation
2. Employment Deprivation
3. Education, Skills and Training Deprivation
4. Health Deprivation and Disability
5. Crime
6. Barriers to Housing and Services
7. Living Environment Deprivation

Each patient was linked to their respective LSOA using their postcode.

3. Results

Between the dates of 01/01/2016 to 30/06/2017, the oral and maxillofacial surgeons managed 809 patients involving a total of 1381 maxillofacial fractures.

3.1. Patient demographics details

A total of 682 patients were males, and 122 were females (5 entries were not recorded). The male: female ratio of patients was 5.59:1. With regards to age groups, there was a wide age range of presentation (16–98 years old). The age groups were divided into four blocks. The age group with the highest number of patients was the 26–50 years group (395 patients) (Fig. 1).

The 26–50 years group was also the peak age group for male and female presentations (352 and 41 patients respectively). This number remained relatively the same for the female cohort throughout the four age groups, however, in the male cohort the number of patients fell to 88 in the 51–75 years group and to 21 patients in the subsequent age group (Fig. 2).

Five main ethnic groups were recorded in this study. The majority was White (n = 495), followed by Asian (n = 114), Black (n = 41), mixed (n = 17), and Middle Eastern (n = 1). 132 patients did not disclose information with regard to their ethnicity. Finally, seven patients were prisoners.

3.2. Aetiology of fractures

Assault was found to be the most common cause of admission in this study (n = 503) (Fig. 3). Assault was also found to be the most common cause of a maxillofacial fracture in the male cohort (67.89% of all male patients). However, the most common cause of a maxillofacial fracture in the female cohort was due to a fall (n = 54.09% of all female patients). With regards to age groups, the three most common causes of maxillofacial fractures in all age groups were assault, road traffic accidents, and falls. Assault was found to be the most common cause of a maxillofacial fracture in both the 16-25- and 26-50-years groups. In the subsequent two groups (51–75, 76–100 years) falls became the most common cause (Fig. 4).

Alcohol was reported to be involved in 6.43% (n = 52) of all admissions, with the majority reported in assaults admissions (n = 31), followed by falls (n = 17) and RTA (n = 2). Domestic violence was reported in 6 admissions (1.1%). Attempted suicide was reported as a cause in 5 admissions (0.62%). Other causes for falls that were reported were due to the patients' medical history (e.g. coughing fit, seizure, cardiac) which was reported in 8 admissions (1.5%). A total of 10 patients died following admission. The causes of admission were due to road traffic accident (n = 5) and fall (n = 5).

3.3. Site of fracture

Of the 1381 fractures reports, the most common fracture site was the mandible (n = 599), followed by the orbit (n = 244) and the zygomatic region (includes the zygomatic body, arch, and process) (n = 192).

With regards to the mandible, the most common fracture site was the angle of the mandible (n = 183) followed by the symphysis/parasymphysis region of the mandible (n = 177) and the condyle/subcondyle region (n = 163). With regards to the orbit, the orbital floor was the most common fractured site (n = 148), followed by the medial orbital wall (n = 63) and the lateral orbital wall (n = 18).

The most common fractured sites in the aetiologies reported in this study were the mandibular, orbital, and zygomatic regions. However, maxillary sinus fractures were more common than zygomatic fractures in presentations caused by RTA's (Fig. 5). With regards to age groups, the most common fracture sites for the three initial age groups (16–25, 26–50, 51–75 year group) were the mandibular, orbital, and zygomatic regions. However, in the 76–100 year's group, the most common fracture sites were the orbital region, mandibular region, and the maxillary sinus (Fig. 6).

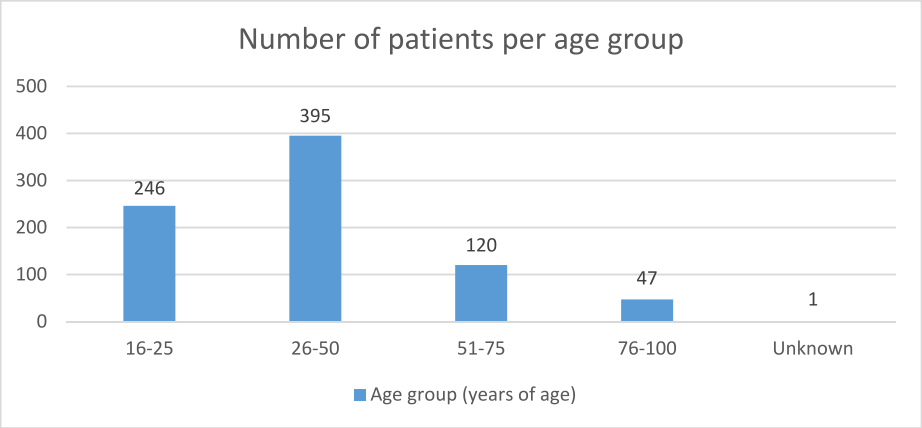

Fig. 1. Number of patients with a maxillofacial fracture in the 16-25, 26-50, 51-75, and 76-100 years-old age groups.

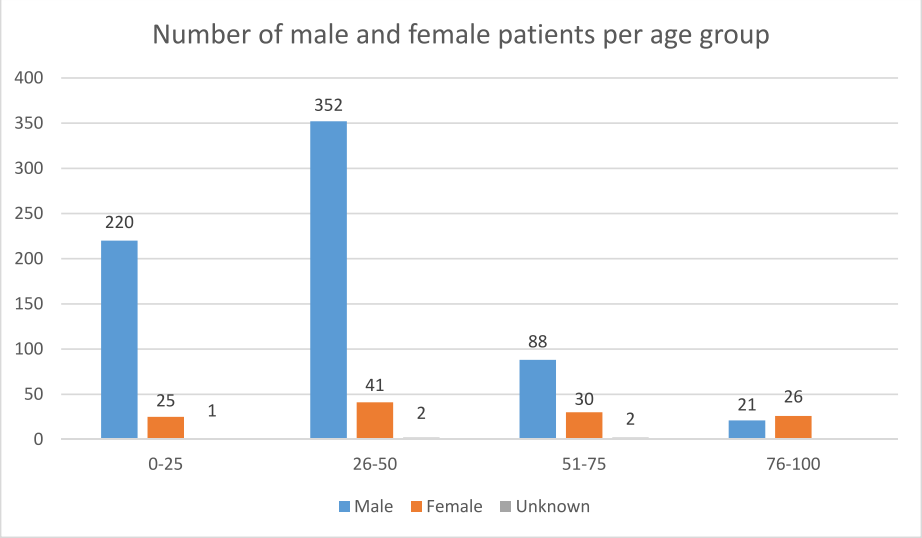

Fig. 2. Number of male and female patients with a mxillofacial fracture in the 16-25, 26-50, 51-75, and 76-100 years-old age groups.

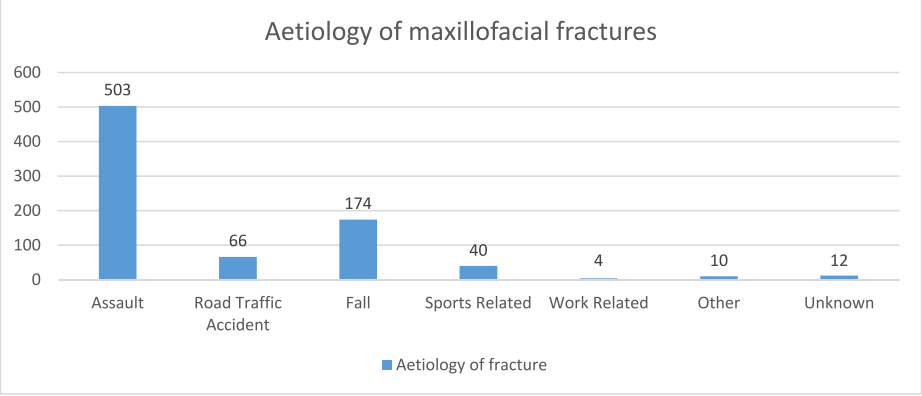

Fig. 3. Aetiology of maxillofacial fractures.

3.4. Management of patients

The majority of patients in this study were treated surgically in our department (n = 385, 47.5%). Other teams were also involved in their care, most of which include ophthalmology (n = 86) trauma and orthopaedics (n = 53) and neurosurgery/neurology (n = 95). The involvement of these teams was dependent on the clinical picture of these patients, examples for each specialty include:

1. Ophthalmology: e.g. diplopia, restrictions in eye movement and general visual assessment.
2. T&O: other fractures in the body.

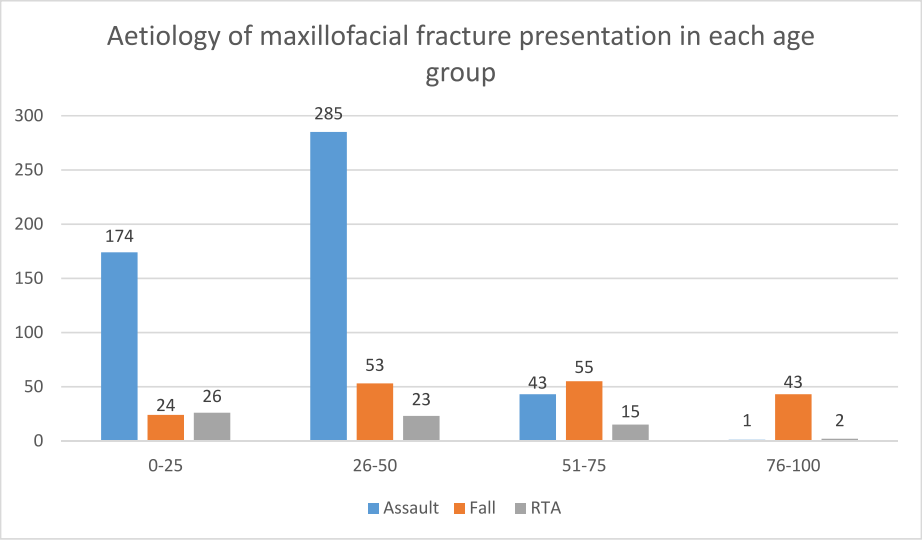

Fig. 4. Aetiology of maxillofacial fractures in the 16-25, 26-50, 51-75, and 76-100 years-old age groups.

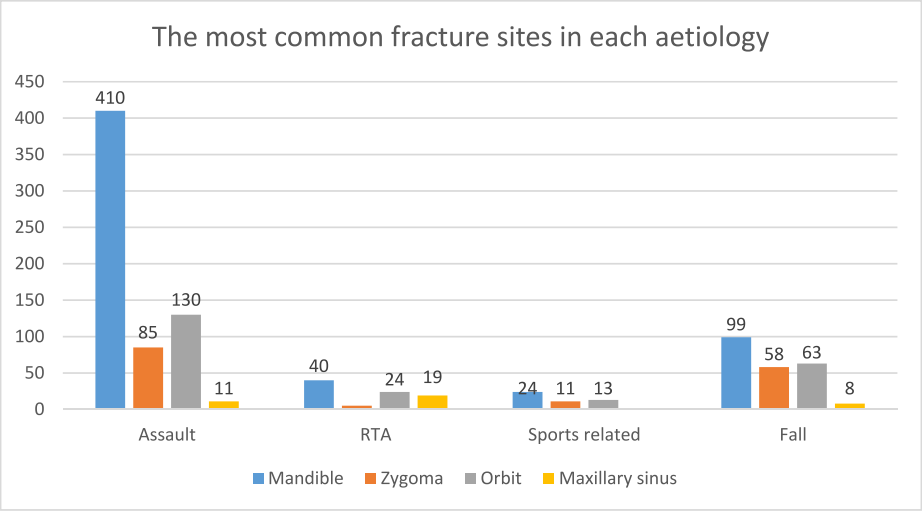

Fig. 5. Most common fractured sites in the aetiologies.

3. Neurosurgery and neurology: e.g. subdural haemorrhage, subarachnoid haemorrhage.

Neurological and neurosurgical input was most common in the frontal bone, frontal sinus, maxillary sinus, supraorbital rim, lateral orbital wall, and orbital roof fractures.

10 patients were reported to have passed away in our study. They were brought in due to either an RTA (n = 5) or a falls accident (n = 5). Neurological/neurosurgical input was required in most of these cases (n = 5). The age range was from 20 to 97 years with the majority being older than 50 (n = 8).

3.5. Index of multiple deprivation

Patients that live in the most deprived 10% of small areas in England (Index of Multiple Deprivation Decile 1) made up 32% (n = 259) of all admissions with an average age of 35.4 years old. They were also more likely to be victims of assault (n = 193), with an average of 32.4 years old, and were more likely to be male (n = 176). 51% of these admissions required a form of surgical intervention.

4. Discussion

Many factors influence the patterns of maxillofacial fractures such as sex of patient, aetiology and age. Multiple studies have been conducted that look into maxillofacial fracture patterns across the globe and similar results have been observed [8,9].

4.1. Incidence

The most common fractured site reported in our study was the mandibular region (n = 599, 43.37%). It was the most common across all aetiologies and age groups except for sport-related, accidents, and the 76–100 years group. An explanation for this could be that even though the mandible is considered to be one of the strongest facial bones, it is the most prominent part of the lower third of the face thus making it the most vulnerable to accidents such as RTA's and assaults. In addition to this, the osteology of the mandible and the presence of developing or completed dentition play a role in the mandibular weakness [10]. Our results are in agreement with other various studies which reveal the predominance of mandibular fractures compared to other sites on the facial skeleton [11–14].

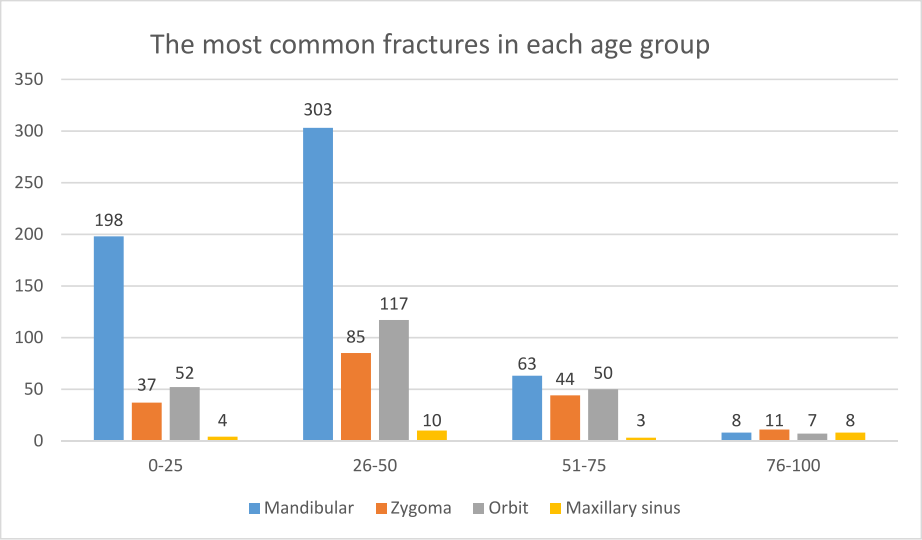

Fig. 6. Most common fractured sites in the 16-25, 26-50, 51-75, and 76-100 years-old age groups.

4.2. Age and gender

Our study revealed that 79.23% of all admissions occurred between the ages of 16–and 50 years. This was in accordance with other studies which also reveal that the majority of maxillofacial fractures occurred in younger patients [15,16]. This is logical as individuals are involved in more outdoor activities during their younger years. This makes them vulnerable to various accidents such as RTA, sports relsports-relatedated injuries and assaults. Our study also reported a male predominance in maxillofacial fractures. This was in accordance with other studies. Our male:female ratio was 5.59:1 which was comparable to ratios from other developed nations such as the USA, Canada and New Zealand [17–19]. 5 patients were not recorded as male or female and this may be due to the restrictions on the hospital database system by only offering two binary options. Some patients may not identify into one of those two categories and may find it restrictive. One Trust in Cornwall has amended their system to identify patients during their booking system prior to patients' being admitted in order to ascertain which ward they should be placed on [20]. The patients looked at in this study were only based on emergency admissions.

When taking into account both age and sex, a correlation appears. Males are more likely to present throughout their younger years. In our study, the peak age group for males was the 26–50 years group (n = 395). The number then drastically reduced to approximately a third of that in the 51–75 years age group (n = 120). On the other hand, even though females peak age of presentation was the 26–50 years age group (n = 41), the number of female admissions remained roughly the same throughout all age groups.

4.3. Aetiology

Our study revealed that the most frequent aetiological factor was assault (n = 503), followed by falls (n = 174) and RTA's (n = 66). This is in accordance with other studies from developed nations which report that assaults and sports-related injuries are the most common aetiological factor for maxillofacial fractures [21]. The majority of these assault cases (56.6%) occurred in the 26–50 years age group. Assault was also the leading cause of male admissions (67.89%). This may be explained by the differences in behaviour between males and females. Numerous studies have demonstrated that males across various age groups tend to express more physical and direct forms of aggression than their female counterparts [22–25].

However, in developing countries the leading cause of maxillofacial fractures is RTAs. A potential explanation for this is due to the presence of more rigorous traffic rules, regulations for driving, and better road conditions in developed countries. These factors, in addition to safety features in vehicles such as airbags and advanced braking mechanisms, may add a layer of protection to the driver and passengers from maxillofacial injury. Recent epidemiological figures report a decreasing trend of maxillofacial injuries due to RTA's in developed countries [26].

Our study also revealed that in older aged patients, the most frequent aetiological factor was falls. It was the leading aetiological factor in both the 51–75 and 76–100 years age groups. It was also the leading cause of admissions in the female cohort (54.09%). Prevention must be targeted accordingly to each cohort to reduce these numbers.

Alcohol abuse has been reported to be involved in maxillofacial injuries from violence in various developed nations (Erdmann et al., 2008; Gerber et al., 2009; McDade et al., 1982). In our study alcohol abuse was involved in 6.43% (n = 52) of all admissions. The majority of alcohol abuse was reported in the assaults admissions (n = 31).

4.4. Site of fracture

As stated in our results, the most common site of fracture was the mandible (n = 599), followed by the orbit (n = 244) and zygomatic region (n = 192). The mandible was the most common fractured site in assault cases. There was variation in specific fracture sites depending on the aetiological factor. Assault patients were more likely to fracture the angle of the mandible. RTA patients were more likely to fracture the maxillary sinus. Patients that have had a sports-related injury were more likely to fracture the zygomatic arch. Finally, falls patients were more likely to fracture the condyle of the mandible. These patterns may reflect the direction and strength of force applied in various aetiological factors.

4.5. Deprivation

The majority of patients with facial fractures were from the 10% of most deprived neighborhoods in England. These results are consistent with other studies conducted in high-income countries which demonstrated a higher incidence of trauma in areas of high socioeconomic deprivation [27,28]. These studies similarly focused on maxillofacial and head injuries and used both the Carstairs index and the Scottish Index of Multiple Deprivation [29,30]. Similar results were observed in other studies which demonstrated an overall higher incidence of all trauma in areas of high socioeconomic deprivation, in both high- and low-income countries [31–35].

Social deprivation can affect all cohorts of patients as studies have shown that socially disadvantaged groups have more risk factors for physical violence such as drug or alcohol abuse [36]. Domestic violence accounts for nearly half of the violence-related maxillofacial injuries in females, with women in their 20s and 30s being the highest risk groups [37]. A study looking at Intimate Partner Violence (IPV) and Socioeconomic Deprivation in England identified that physical violence against females by a male partner appears to be strongly associated with social deprivation [38].

4.6. Ethnicity

Birmingham is a highly diverse city with various ethnicities. The majority is the white ethnic group (57.93%), followed by Asian (26.62%), Black (8.98%), mixed (4.44%), and other (2.03%) [39]. The results from our study mirror that of the demographic information of the city with the cases being predominantly from the White population (n = 495), followed by the Asian (n = 114), Black (n = 41), and the mixed (n = 17) populations.

5. Limitations

Due to the retrospective nature of this study, we were unable to draw valid conclusions on the impact of social history on patterns of maxillofacial fractures. Information such as income, employment status, and household overcrowding would have provided a better picture of our patient cohort. As a result, we relied on the Index of Multiple Deprivation to assign patients to their social groups. There may have also been a degree of documentation error. Alcohol involvement was only reported in 52 cases. This may have been missed on admission, or patients may have chosen not to reveal this information. Domestic violence is another factor that patients may not disclose on admission. Many victims of abuse may choose not to disclose this information due to the fear of being judged and the stigma that might entail, both socially and culturally.

6. Conclusion

Our study has suggested associations of maxillofacial fractures with various factors such as mechanism of injury, age and gender. Our results stress the importance of taking a detailed history and conducting a thorough examination to ensure an accurate diagnosis.

The Public Health sector can play a very important role in overcoming the issues raised by this study. Campaigns and programmes can be designed to help target certain population groups with the aim of reducing the incidence of maxillofacial fractures. For example, prevention of violence in the younger population and reducing falls in the elderly population.

Results from studies such as these should be disseminated to various other departments that would be expected to play a role in the management of patients with maxillofacial fractures, such as the emergency and radiology departments. Awareness of the common fractures associated with each aetiology will enable the health care professional in providing the most adequate care for each patient.

Sources of funding

We did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Ethical approval

No ethical approval was required for this project.

Consent

Not required.

Author contribution

Munir Abukhder:

1. Design of study
2. Data collection
3. Data analysis
4. Writing the paper

Dima Mobarak:

1. Design of study
2. Data collection
3. Editing the paper

Registration of research studies

1. Name of the registry: Research Registry
2. Unique Identifying number or registration ID: researchregistry7712
3. Hyperlink to your specific registration (must be publicly accessible and will be checked): https://www.researchregistry.com/browse-the-registry#home/registrationdetails/6223b013cae24d00241c7956/

Guarantor

Munir Abukhder.

Provenance and peer review

Not commissioned, externally peer reviewed.

Declaration of competing interest

We did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.amsu.2022.103622.

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