



REVIEW ARTICLE

Analysis of the pattern of maxillofacial injuries in Saudi Arabia: A systematic review



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KEYWORDS

Maxillofacial trauma;
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Abstract Objectives: Maxillofacial trauma (MFT) is a serious health problem and in Saudi Arabia is mainly caused by road traffic accidents (RTAs). MFT commonly associated with injuries to the face, head, and jaws and may cause soft tissue lacerations and bruises. MFT can also cause fatal blood loss and airway obstruction. The objective of this review was to determine the prevalence of MFT, identify the major causative factors in males and females in the main cities of Saudi Arabia.

Materials and methods: We performed literature searches of all published studies describing MFT from KSA during the last 20 years.

Results: In Saudi Arabia, males are more prone to MFT than females, although the male: female ratio of MFT varies between different cities. Specifically, Aseer has the highest male: female ratio (10:1), followed by AlHofuf (8.3:1) while AlQurayyat had the least gender ratios of MFT (2:1). Most cases of MFT are associated with RTAs, which accounted for (63%–90.3%) in Medina, (89.1%) in Aseer, (86.1%–87.1%) in Riyadh, (67%–73.1%) in Jeddah, (71%) in Khamis Mushait, (64.2%) in Makkah and (63.3%) in Al-Hofuf. The least percentage of RTA resulting into MFT was recorded in AlQurayyat (24%).

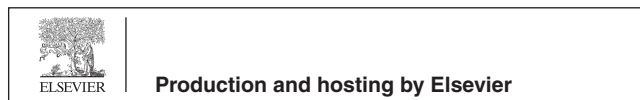
Conclusion: Maxillofacial trauma is a serious health problem in Saudi Arabia. RTAs remain the major cause of maxillofacial injuries especially among males, thus strict implementation of traffic rules is a must to minimize maxillofacial injuries and its physical and psychological impact.

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1. Introduction

Facial injuries are considered as part of the human body injuries and can be defined simply as any injury of the face which include major and minor injuries of the soft tissues, bones, blood vessels, nerves, and any other tissues of the human face.

Maxillofacial injuries follow trauma to the face, head, and jaws, and 51% of road traffic accidents (RTAs) lead to maxillofacial injury (Kheirallah and Almeshaly, 2016). These fractures in some cases may cause blood loss and airway obstruction and can be fatal (Seyfer and Hansen, 2000). Previous studies also show long-term psychological impacts of MFT (Seyfer and Hansen, 2000; Auerbach et al., 2008; Glynn et al., 2007).

Motor vehicle accidents, violence, sport injuries, and falls predominantly cause facial trauma. While in other part of the worlds, MFT in adults is caused mostly by assaults followed by road traffic accidents and sporting injuries (Ceallaigh et al., 2006), but among children, falling from a height is the main cause of maxillofacial injuries (Gassner et al., 2004). Moreover, jaw bone fractures are more commonly the result of trauma than other causes such as osteonecrosis of bone or cancer (Murray, 2013). Likewise, Facial soft tissue injuries mostly caused by dog bites (Bregman and Slavinski, 2012). Eye injuries, such as retrobulbar hemorrhage, can be associated with MFT and can cause blindness, although this is a rare occurrence (Perry and Dancey, 2005). Intracranial hemorrhage also occurs more often in patients with MFT than in patients without MFT (Keenan et al., 1999).

Several epidemiological studies among different population groups have been reported, such as in Austria (Oji, 1999), Australia (Infante et al., 1994), India (Chandra Shekar and Reddy, 2008), Iran (Mesgarzadeh et al., 2011), Pakistan (Cheema and Amin, 2006), Brazil (Chrcanovic et al., 2012), United States (Shere et al., 2004), Scotland (Adi et al., 1990), United Arab Emirates (Al Ahmed et al., 2004), New Zealand (Kotecha et al., 2008), Nigeria (Obuekwe et al., 2005) and Uganda (Kamulegeya et al., 2009).

Assessments of the prevalence of MFT and the severity of the related injuries are required to determine the importance of prevention strategies. There were number of published studies which investigated the patterns and severity of maxillofacial injuries in Saudi Arabia in different cities such as Al-Medina, Riyadh, Aseer, Makkah, Hofuf, Al-Qurayyat and Jeddah (Al Ghamdi, 1998; Ansari et al., 2000; Samman et al., 2018; Almasri, 2013; Abdullah et al., 2013; Jan et al., 2015; Rabi and Khateery, 2002; Lawoyin et al., 1996; Nwoku, 2004;

Alghamdi et al., 2007; Al-Aanazi et al., 2016; Alqahtani, 2018; Al-bokhamseen et al., 2019; Albeshir et al., 2018). Therefore, to gain a clearer picture of the patterns of these fractures in the KSA, the available evidence requires a further refinement. Thus, the aim of the present study was to review the etiologies, patterns and distribution of maxillofacial trauma in Saudi Arabia.

2. Materials and methods

All articles published during the last 20 years (1998–2018) on maxillofacial injuries in the KSA were analyzed. The following databases were used: PubMed/MEDLINE, Scopus, and Google scholar and Web of Science. Relevant studies were identified using the MeSH terms and Boolean operators “maxillofacial trauma” AND “injuries” AND “Saudi Arabia.” “Road Traffic injuries”. The full-texts of all these articles were thoroughly examined by two authors. Further measures such as hand searching on Journals of included studies and personal contacts with investigators of previous studies for missing data were also made. The Boolean operator NOT was used to exclude the following MeSH terms: facial nerve, eye and burns, since a high number of studies are linked with these terms. Inclusion criteria includes; Availability of the full-text article, Retrospective or prospective studies, All age groups and Non pathological type injuries. All retrieved studies which reported trauma to the mandible, maxilla, or facial soft tissue in the KSA, and/or the prevalence, severity, and causality of MFT were retrieved. Data from these studies were used to review the pattern and causes of MFT in the main cities of Saudi Arabia.

Titles and abstracts were screened first then the full texts of relevant publications were obtained and reviewed independently in duplicate by (FA and KB), who also performed the data extraction. For every study, the following information was retrieved and analyzed; etiology of the injury, peak age of incidence, gender predilection, site of injury, period and location of the study. The present systematic review was performed according to PRISMA Statement–Preferred Reporting Items for Systematic Reviews and Meta-analyses and the study protocol was registered with PROSPERO Register# CRD42019122711. The PECO question was used in this review, P (Patient Population of adults and children with maxillofacial injuries), E (Exposure—etiology of maxillofacial trauma), C (Comparison between different cities in KSA), and O (Outcomes, prevalence of maxillofacial trauma for each etiology). Studies that met the inclusion criteria were selected

for further analysis. As outcome variables were not homogeneous across the selected studies, cumulative analysis could not be performed. Ethical approval was obtained from ethical review committee of Ajman University, (Reference Number: D-F-H-19-05-16).

3. Results

A total of 16 full-text articles and abstracts were identified. Three articles not fulfilling our inclusion criteria were excluded. A total of 13 publications published between 1998 and 2018, were therefore included in the review (Fig. 1). These publications were summarized in (Tables 1 and 2). A total of 4571 patients (3841 males and 730 females) with age range between 0 and 97 years who sustained maxillofacial injuries during the study period were included in the analysis (Table 2). In Saudi Arabia, males are more prone to MFT than females, although the male: female ratio of MFT varies between different cities. Specifically, Asser has the highest male: female ratio (10:1), followed by AlHofuf (8.3:1) while AlQurayyat had the least gender ratios of MFT (2:1). Studies have shown that most cases of MFT are associated with RTAs, which accounted for (63–90.3%) in Medina, (89.1%) in Aseer, (86.1–87.1%) in Riyadh, (67–73.1%) in Jeddah, (71%) in Khamis Mushait, (64.2%) in Makkah and (63.3%) in Al-Hofuf. The least percentage of RTA resulting into MFT was recorded in AlQurayyat (24%) (see Table 3).

In KSA road traffic accident (RTA) was the major cause of maxillofacial injuries in both children and adults in all the cities and the other causes represent very low percentages. The peak age of incidence of maxillofacial injuries was 10–29 years in most centers followed by 31–40 years. Among children, injuries occurred mostly in children aged >6 years (Table 1).

4. Discussion

The distribution of maxillofacial injuries may vary widely across countries and is dependent on several cultural and socioeconomic factors (Boffano et al., 2014).

Regarding the etiology of maxillofacial fractures, we found the commonest mode of injury was RTAs. These findings were in agreement with reports from other developing countries in which road traffic accident is considered to be the most common cause of facial trauma (Oji, 1999; Qudah and Bataineh, 2002; Al Ahmed et al., 2004; Nwoku, 2004; Obuekwe et al., 2005; Cheema and Amin, 2006; Chandra Shekar and Reddy, 2008; Kamulegeya et al., 2009; Mesgarzadeh et al., 2011; Chrcanovic et al., 2012) and this may be attributed to the rapid and wide economic expansion of the country economy following the oil discovery (Ansari et al., 2000). Other possible reasons could be due to high speed driving and the ignorance of traffic roles, but the current findings differ from reports published in other parts of the world in which assault was regarded

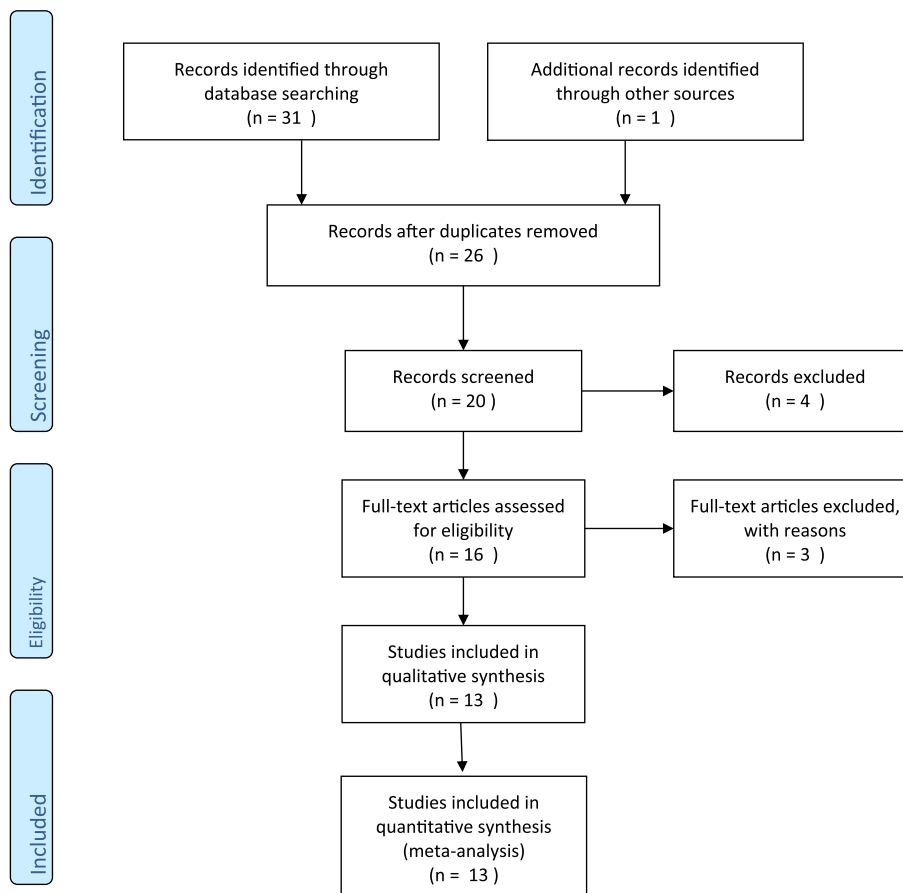


Fig. 1 PRISMA diagram of studies searched and selected. Duplicate articles were removed.

Table 1 Summary of the studies that reported the causes of MFT in KSA.

Author/Year	City	Source of data	Common causes	Fracture site (%)
Lawoyin, 1996	Tabuk	Hospital Records	–	Maxilla
Rabi, 2002	Madinah	Hospital Records	RTA (63.0%) Other (37.0%)	Mandible (41%) Maxilla (59%)
Nwoku, 2004	Riyadh	Hospital Records	RTA (87.1%) Other (12.9%)	Maxilla (61.4) Mandible (38.6%)
Almasri, 2013	Aseer	Hospital Records	RTA (89.1%) Other (10.9%)	Mandible (50.6%) Maxilla (49.4%)
Abdullah, 2013	Riyadh	Hospital Records	RTA (86.1%) Other (13.9%)	Mandible (56.4%) Maxilla (43.6%)
Jan, 2015	Jeddah	Hospital Records	RTA (67.0%) Other (33.0%)	Mandible (58%) Maxilla (42%)
Almasri, 2015	Makkah	Hospital Records	RTA (64.2%) Other (35.8%)	Mandible (54.19%) Maxilla (46.0%)
Alghamdi, 2007	Jeddah	Hospital Records	RTA (73.1%) Other (26.9%)	Mandible (60.4%) Maxilla (37.6%)
Al-Aanazi, 2016	AlQurayyat	Hospital Records	RTA (24.0%) Other (76.0%)	Mandible (21.0%) Maxilla (79.0%)
Samman, 2018	Madinah	Hospital Records	RTA (90.3%) Other (9.7%)	Only Mandibular fractures studied. Condylar (103 out of all fractures)
Al-Qahtani, 2018	Khamis Mushait	Hospital Records	RTA (71.0%) Other (21.0%)	Mandible (27%) Maxilla (8%)
Al-Bokhamseen, 2019	Hofuf	Hospital Records	RTA (63.3%) Other (36.7%)	Mandible (54.6%) Maxilla (45.4%)
Albeshir, 2018	Madinah	Hospital Records	RTA (8.20%) Other (89.7%)	Mandible (7.9%) Soft tissue (71.0%)

Table 2 Gender and age distribution.

Author/Year	City	Male	Female	M:F ratio	Age range	Total
Lawoyin, 1996*	Tabuk	–	–	5.2:1	21–30 Years	980
Rabi, 2002	Madinah	337	66	5.2:1	21–30 Years	403
Nwoku, 2004	Riyadh	828	158	5.2:1	9–70 Years	986
Almasri, 2013	Aseer	92	9	10:1	20–30 Years	101
Abdullah, 2013	Riyadh	172	28	6:1	10–29 Years	200
Jan, 2015	Jeddah	728	125	6:1	3–87 Years	853
Almasri, 2015*	Makkah	–	–	4.4:1	3–97 Years Mean 51 Years	965
Alghamdi, 2007	Jeddah	532	80	6.6:1	11–60	612
Al-Aanazi, 2016*	AlQurayyat	–	–	2.1:1	–	–
Samman, 2018	Madinah	165	32	5.1:1	30–86 Years Mean 28 Years	197
Al-Qahtani, 2018	Khamis Mushait	215	–	Only Males	15–50 Years	215
Al-Bokhamseen, 2019	Hofuf	241	29	8.3:1	2–77 Years Mean 24–29	270
Albeshir, 2018	Madinah	531	334	1.6:1	0–12 Years	865
Total		3841	730	5.2:1	0-97 Years	4571

* Incomplete data.

as the main cause of facial injuries (Shepherd et al., 1987; Huang et al., 1998; Arosarena et al., 2009). Researchers highlighted various causes for RTAs such as over speed and improper turning (Ali Aba Hussein and El-Zobeir, 2007; World Health Organization, 2011; Barrimah et al., 2012; Farah et al., 2015).

The car structure most commonly thought to have been responsible for facial injuries of any severity were the wind-screen and the steering wheel followed by the interior rear-view mirror. It has been shown that seat belts effect protection of the restrained occupant by preventing, or at least reducing the extent of movement away from the seat. In a previous

review of the car occupants, it was shown that there was a substantial reduction in the overall incidence of head injuries amongst the belted occupants (Sabey et al., 1977). In the KSA, seatbelt legislation made the use of seat belt by front occupants mandatory. Bendak (2005) reported that seat belt use rate in two Riyadh suburbs were 33% and 87%, respectively, for drivers and 4% and 41%, respectively, for front-seat passengers which resulted in a significant drop in certain types of injuries due to traffic accidents after the enactment of the seat belt law. Other regions witnessed marked reduction in the casualties' involved car users after the introduction of seat belt legislation (Perkins and Layton, 1988). Other

Table 3 Summary of the studies which described causes of MFT in relation to gender in the main Cities of Saudi Arabia.

Author	City	Main cause of MFT in males	Main cause of MFT in females	Other causes	Total
Almasri	Aseer	Road Traffic Accidents (88.7%)	Road Traffic Accidents	Physical Violence (6%) and Sport injuries (2%)	101
Abdullah	Riyadh	Road Traffic Accidents (86.1%)	10–29 years – > Road Traffic Accidents 0–9 years > Falls	Falls (50%) of causes in males aged from 0 to 9 years Falls (60%) of causes in females aged from 0 to 9 years	200
Almasri	Makkah	Road Traffic Accidents	Road Traffic Accidents	–	965
Samman	Madinah	Road Traffic Accidents (90.35%) (178 patients)	Road Traffic Accidents	Falls (6.09%) (12 patients) Physical Violence (2.53%) (5 patients) Sport Injuries (1.01%) (2 patients only)	197
Alghamdi	Jeddah	Road Traffic Accidents	Road Traffic Accidents	–	612
Albeshir	Madinah	Road Traffic Accidents 7.1%	Road Traffic Accidents 1.0%	Fall 89.1% Violence/abuse in 1.38% Sport 0.46%	865

investigators highlighted other contributing factors such as prolonged exposure to heat, adverse weather conditions and driver errors as possible causes for RTAs (Nofal and Saeed, 1997). In One report, Hypoglycemia was identified as possible cause of RTA (Ahmed, 2010).

The other etiological factors of maxillofacial injuries in the present study include falls, assault and sport related injuries which constituted only limited number of the facial fractures, for example assault was reported only by 6% of patients at Aseer, and 2.5% at Madina as the cause of the facial injuries, but assault largely replaced RTAs as the main cause of maxillofacial injuries in other part of the world (Oji, 1999; Infante et al., 1994; Arosarena et al., 2009). This difference may be explained by the conservative nature of Saudi culture and cultural differences among countries. Huang et al. (1998), reported an inadequate documentation of assaulted female patients with maxillofacial injuries and patient interviews failed to satisfactorily identify and/or document the alleged assailant in 68% of cases.

Falls accounted for 6% (Samman et al., 2018) to 89.1% (Albeshir et al., 2018) of the facial injuries' cases. The injuries may occur either in the elderly patients who may fall and sustain injuries of the fragile edentulous mandible, or among young adult who falls forward onto the chin and often sustained bilateral condylar fracture.

Sports related injuries are uncommon in the reviewed studies and range between 0.4% in Madinah (Albeshir et al., 2018) to 2.0% in Aseer (AlMasri, 2013). Previous reporters confirmed a significant proportion of sports related facial fractures (Perkins and Layton, 1988; Adi et al., 1990).

Industrial causes of facial fractures were not described in the reported studies from KSA, however, reports from other part of the world documented accidents at work to be of 6% in male adults (Voss, 1982) or 4.5% of all facial bone fractures (Lizuka et al., 1990).

In this study a significant proportion of maxillofacial injuries were identified among younger age groups, which coincide with the incidence of facial injuries in the other countries (Iida et al., 2001; Al Ahmed et al., 2004; Obuekwe et al., 2005; Kamulegeya et al., 2009; Al Ghamdi, 1998; Ansari et al., 2000; Samman et al., 2018; Almasri, 2013). This is most likely attributed to the fact that younger age group are more mobile,

prone to more risks and may performs exercises, dangerous sports and may involve in violence (Arslan et al., 2014). Therefore, more attention should be directed to this age group. However, in the current study, facial fractures are rare in children perhaps a reflection of the resilience of the facial bones in young children, likewise, the proportion of facial fractures among the elderly are also uncommon in the reviewed studies.

In this study, males outnumbered females by a ratio of 5.2:1 with the highest ratio reported at Aseer city (Almasri, 2013) and the lowest reported at Madinah (Albeshir et al., 2018). Other researchers reported male to female ratios ranged between 3:1 to 5.4:1 (Chrcanovic et al., 2012; Lee, 2012), but our findings are lower than the ratio reported by Al Ahmed et al. (2004) from UAE. This is probably attributed to the greater involvement of men in outdoor activities and their greater exposure to violent interactions, also it may reflect the conservative and religious nature of KSA. Boffano et al. (2014), reviewed different etiologies of maxillofacial fractures over 30 years with emphasis on gender distribution and etiology of maxillofacial trauma worldwide and concluded that in American, African, and Asian studies road traffic crashes were the predominant cause but, in European studies the etiology varied, with assaults and road traffic crashes being the most important factors, furthermore, in all the reviewed studies men outnumbered women with a ratio of 2:1.

Most of the fractures of maxillofacial skeleton involve the mandible, these results were similar to reports from other part of the world (Brown and Cowpe, 1985; Al Ahmed et al., 2004; Erol et al., 2004), this may be attributed to the fact that the mandible has less bony support than the maxilla also the shape and the mobility of the mandible have been implicated as the reason for high vulnerability of mandible to injuries (Oji, 1999; Nwoku, 2004). In contrast to our findings, other investigators reported that midfacial bone fractures were more common than mandibular fractures (Gassner et al., 2004).

5. Conclusion

The limitations of the study are those characteristics of the retrospective design or methodology which included, incomplete records, missing patient information and inadequate documentation of patients. Other limitation of this study, as outcome

variables were not homogeneous across the selected studies, cumulative analysis could not be performed.

Maxillofacial trauma is a serious health problem in Saudi Arabia. RTAs remain the major cause of maxillofacial injuries especially among younger males, but less common among females. To minimize maxillofacial injuries and its physical and psychological impact on the society, more coordinated strategies for action by various actors are warranted.

Ethical statement

Ethical approval to carry out this study was obtained from ethical committee of the Ajman University.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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