Review Article

The Causes and Prevalence of Maxillofacial Fractures in Iran: A Systematic Review

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ABSTRACT

Background: Maxillofacial fractures are a common type of injury that can result in significant morbidity and mortality. We aimed to systematically review the literature on the prevalence and causes of maxillofacial fractures in Iran to estimate the overall prevalence of maxillofacial fractures and the most common causes.

Methods: A systematic search of PubMed, Cochrane Library, Web of Science (WS) and Google Scholar (GS) electronic databases was conducted to identify relevant articles published up to January 2023. Studies reporting the prevalence and causes of maxillofacial fractures in Iran were included in the analysis. MOOSE guidelines were adopted for the current systematic review. No data or language restriction were applied. Risk of bias across the articles was assessed.

Results: A total of 32 studies comprising 35,720 patients were included in the analysis. The most common cause of maxillofacial fractures was road traffic accidents (RTAs), accounting for 68.97% of all cases, followed by falls (12.62%) and interpersonal violence (9.03%). The prevalence of maxillofacial fractures was higher in males (81.04%) and in the age group of 21-30 years (43.23%). Risk of bias across studies was considered low.

Conclusion: Maxillofacial fractures are a significant public health problem in Iran, with a high prevalence and RTAs being the leading cause. These results highlight the need for increased efforts to prevent maxillofacial fractures in Iran, especially through measures to reduce the incidence of RTAs.

KEYWORDS
Iran; Middle East; Maxillofacial Fractures; Prevalence; Systematic Review

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INTRODUCTION

Maxillofacial fractures are a common form of trauma and pose significant morbidity, loss of function, and work disabilities for the afflicted individual[1,2]. They are a major socioeconomic burden for society and can also lead to the development of psychosocial disorders[3–5]. The treatment goals of these injuries serve to preserve the integrity of vital structures, restore function, and improve facial esthetics. Rapid urbanization and industrial development have led

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to profound lifestyle changes, which continue to inflict physical injury, including people with maxillofacial trauma[6,7]. Obtaining a competent insight into the epidemiology and etiology of maxillofacial fractures is integral to appropriate planning both on a clinical and management level. Maxillofacial fractures can occur due to a variety of causes, including motor vehicle accidents, assault, gunshot wounds, falls, and sports injuries. The incidence of maxillofacial fractures varies across different regions, and it is influenced by factors such as age, sex, cultural practices, and socioeconomic status[8]. The facial skeleton consists of multiple bones that can be affected by fractures, such as the maxilla, mandible, nasal bones, zygomatic arch, and orbital bones. Of these, the mandible is the most commonly affected bone in maxillofacial fractures[9].

Iran has a high rate of road traffic accidents, interpersonal violence, and sport-related injuries. Every year Iranian hospital facilities manage a large caseload of physical injuries[10]. In Iran, maxillofacial fractures are a major public health issue, and their prevalence is a growing concern. Several studies have investigated the causes and prevalence of maxillofacial fractures in Iran[11–17]. However, the findings of these studies have been inconsistent, and there is a need for a comprehensive and systematic review of the available literature. Such a review can provide valuable insights into the epidemiology and risk factors associated with maxillofacial fractures in Iran and help in the development of effective prevention and treatment strategies.

Therefore, the objective of this study was to conduct a comprehensive systematic review of the available literature on the causes and prevalence of maxillofacial fractures in Iran.

METHODS

Study design

This Systematic Review was conducted according to the recommendations by the Cochrane Group [18] and the book "Systematic reviews in health care: meta-analysis in context" [19]. A search protocol was specified in advance and registered at PROSPERO (International Prospective Register of Systematic Reviews) nr. 400498. This review was conducted according to MOOSE Reporting Guidelines for Meta-analyses of Observational Studies.

Focused question

We intended to perform an epidemiological study on maxillofacial fractures etiology besides the quality of Iranian studies through a risk of bias assessment. In summary, the main outcome was to perform a critical review of maxillofacial fractures in Iran, assessing number of occurrences, treatment options in addition to the risk of bias and quality of studies.

Eligibility criteria

Only maxillofacial fractures studies performed in Iranian soil were added. No language restriction was applied. Records that fulfilled the following items were considered: a) maxillofacial fractures, b) studies performed in Iran; c) studies performed by at least one Iranian researcher.

Records including only results about: a) soft tissue trauma, b) studies performed outside Iran even partially, c) studies performed by Iranian foreigners, d) trauma not located on maxillofacial region were not considered, e) unpublished clinical trials, f) case reports, reviews, editorials, letters and comments, g) articles published before 2002.

Search strategy

The first hit was conducted online by two independent reviewers (SS and RG) in PubMed, Cochrane Library, WS and GS from inception until January of 2023. The following strategy was used: (Mandibular Fractures[MeSH Terms] OR Maxillary Fractures [MeSH Terms] OR Orbital Fractures[MeSH Terms] OR Zygomatic Fractures[MeSH Terms] OR Nose Fracture OR Facial Injuries[MeSH Terms] OR Maxillofacial Injuries[MeSH Terms]) AND Iran.

Because the search algorithm is different, an adaptation of the strategy was performed on GS: (mandibular maxillary orbital zygomatic nose +fractures "facial injuries" "maxillofacial injuries" +iran -"case report" -"systematic review" -meta-analysis -comments). Since it is possible to perform a bibliographic search according to the country of origin, Iran term was suppressed in WS search. A manual search was performed sought in the included articles.

Studies Selection

In the first screening procedure, titles and abstracts were screened by three independent reviewers (F.S., S.S. and R.G.). All articles that were considered

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eligible at the first screening procedure underwent a full-text evaluation. If disagreements arose during the two steps evaluation process, it was resolved by consensus. Studies that met the inclusion criteria or those with doubtful information either in the title or abstract were selected for full-text assessment in this review's second round. Reasons for rejection of studies were recorded for each report. Animal studies and comparative studies but with no relation to proposed theme were excluded, as so care reports and series, comments, letters, expert opinions, and reviews. Only studies for which the full text was available were considered as eligible.

Data Extraction

In this systematic review, the data from the selected articles was extracted by one researcher and the accuracy of the data extraction was verified by another researcher. The desired information included the names of the authors of the study, the city and province in which the studies were conducted, the year of publication of the articles, the number of patients, the age range of patients with fractures, the sex of the participants in the studies, as well as the causes of the fractures (including Motor Vehicle Accident, Assault, Gunshot, Fall, Sports, and unknown causes). Additionally, data on the specific bones affected by the fractures were extracted, including the distribution of fractures in specific bones such as the mandible, Parasymphysis, Symphysis, Angle, Condyle, Body, Dentoalveolar, Coronoid Process, complex, and Ramus[20].

Statistical analysis

T-Student was performed with RStudio. Shapiro-Wilkes test was used to assess if data deviate from a normal distribution. Results were considered significant only with a 95% confidence interval.

Risk of bias across studies

To assess the studies' quality, risk of bias was assessed according to MOOSE Reporting Guidelines[21]. Data were added to Microsoft Excel and a heat map was created using low and high risk. The queries of the included studies are briefly explained as follows:

a. Background: definition of the problem under study,
b. Search: reporting of the search strategy,
c. Methods: checklist section with appropriateness of quantitative summary of the data,
d. Results: reporting of results (charts, tables, sensitivity tests, subgroup analysis),
e. Discussion: publication bias, confounding and quality,
f. Conclusion: consideration of alternative explanations for observed results and appropriate generalizations of the conclusion.

Data collection process

The reviewers RG and SS separately submitted all eligible studies to a qualitative synthesis using an extraction data table, including mainly: geographic region, age range, gender, etiology, and anatomic region injured. Subsequently, extraction data table with the results of each included study were verified together to calibrate this process's validity and reliability.

ETHICAL APPROVAL

The present study was approved by the Research Ethics Committees of School of Dentistry – Mashhad University of Medical Sciences under the number IR.MUMS.DENTISTRY.REC.1401.111.

RESULTS

Study selection

The first hit retrieved 536 records from databases. The searched records distribution and the number of studies finally selected were (Figure 1). Excluded studies and reasons for refusal are shown in Table 1. A total of 32 articles were included in the present systematic review[10–17,22–45].

Two articles did not evaluate the age range from 0 to 10 years, joining all patients under the age of 20 into the same age range[24,30]. Unclear or unreported data on age range were found in 10 articles[12,13,25,27,32,34,39,41,43,44]. One article used charts instead of tables, which made it difficult to identify some data that was not described in the text[15]. Few articles had crossed some data, such as the anatomical region and the type of treatment, gender or the etiology of the fracture, but a statistical comparison was not possible. Seven articles had clearly separated traffic accidents as motor vehicle and motorcycle accidents[12,16,24,27,38,41,44].

Results of individual studies and synthesis of results study selection

Overall, a total of 35,720 patients were added to this study. Table 2 shows the geographic distribution

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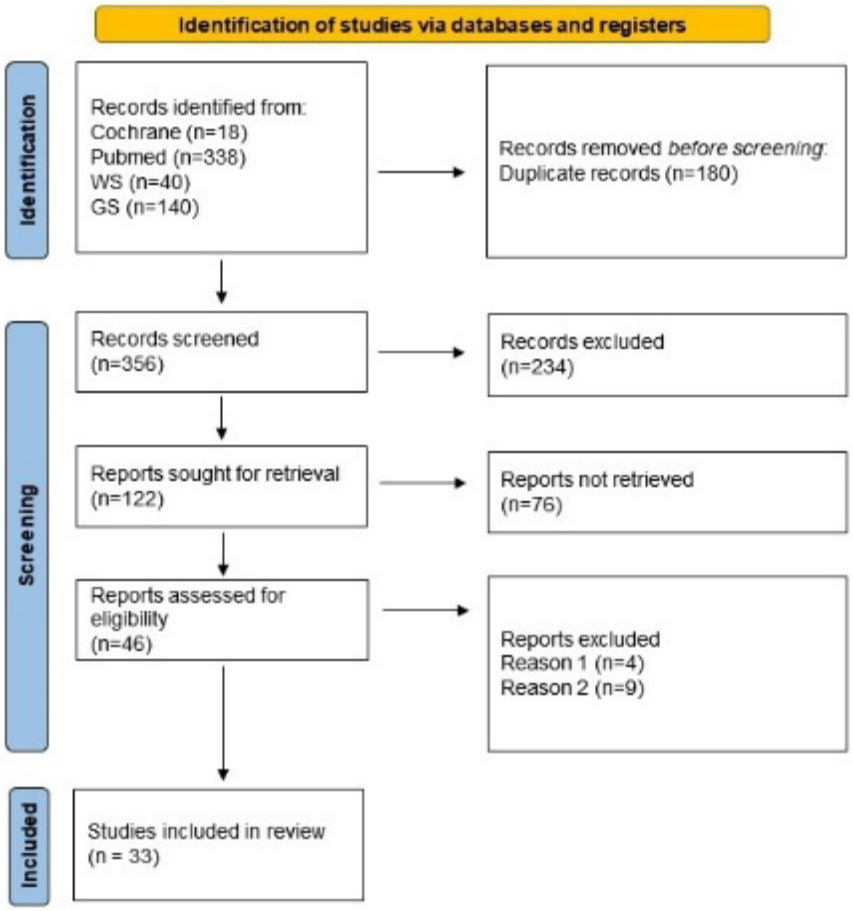


Figure 1: Flowchart of included articles

Table 1: Excluded articles and their reasons

Reason	Reference
1. Not exclusive to maxillofacial fractures	Borna et al[66]; Ghorashi et al[67]; Hajiesmaello et al[68]; Kashkooe et al[69]; Mansouri et al[70]
2. Type of study	Barach et al[71]; Gandjalikhan-Nassab et al[4]; Hennocq et al[72]; Hesamirostami et al[73]; Jahromi et al[74]; Khaqani et al[75]; Khiabani et al[76]; Khiabani et al[77]; Nasser et al[78]

Table 2: Distribution of patients in the included articles allover Iranian territory in alphabetic order

Ahwaz	272
Hamedan	4718
Isfahan	1677
Kerman	221
Kermanshah	1727
Mashhad	502
multicenter	8818
Rasht	7663
Shiraz	2236
Tabriz	3567
Tehran	5713
Urmia	635
Yazd	311

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of patients allover Iranian territory, not normally distributed (w=0.81903, p=0.00652). In several studies the number of fractures was higher than the number of patients. This can easily be explained as some patients had multiple fractures. The most affected patient´s age range was 21-30 years in 43.23% of the patients, not normally distributed (w=0.80479, p=0.03221) (Figure 2).

In all articles whenever data was available, male patients suffered more maxillofacial trauma than female patients (t=2.6191, df=29.31, P=0.01382), in complete agreement with the literature. Male suffered more trauma at a ratio of 4:1 (mean=81.04%) compared to female [68.38%-98.43%]. The vast majority of etiology was due to road traffic accidents (68.97%) while some articles has not reported etiology of maxillofacial fractures (Figure 3). When available motorcycle was the most usual vehicle

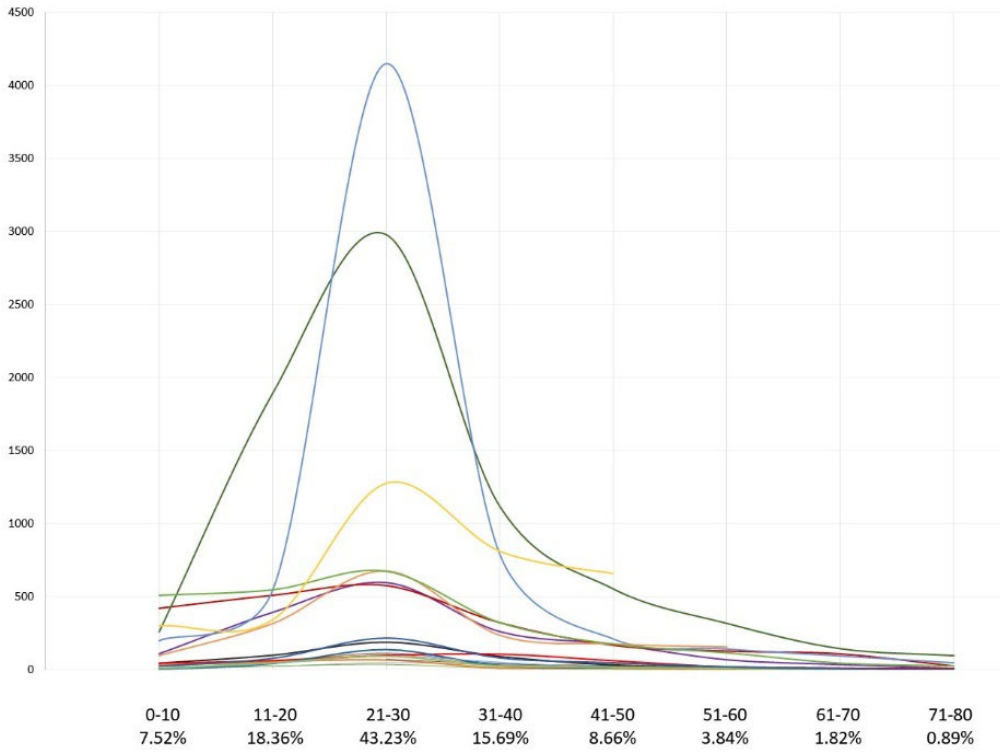


Figure 2: Age range distribution. Each colored line represents one included article

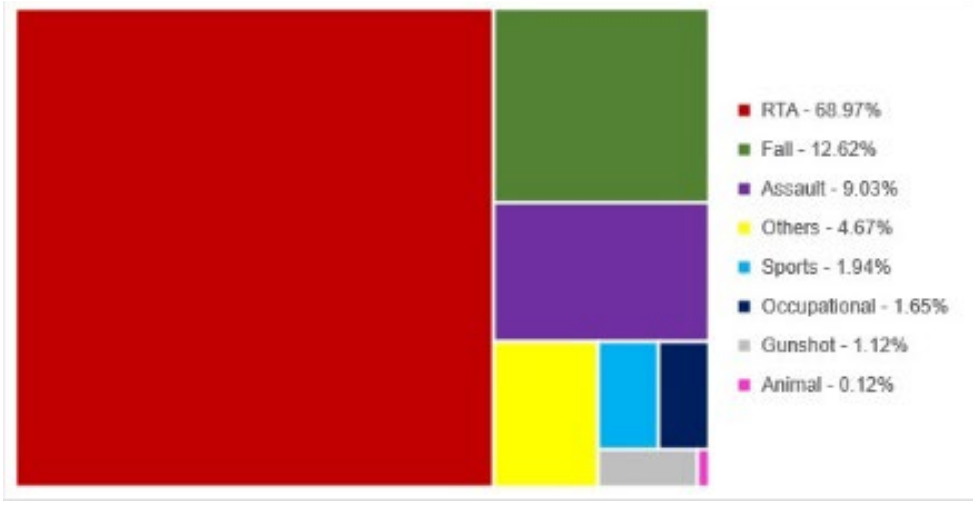


Figure 3: Comparison of more usual etiologies in order of incidence Legend: Road Traffic Accident (RTA)

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in a higher proportion than cars and pedestrian accidents[12,16,24,27,38,41,44]. Data on etiology were not normally distributed (w=0.57892, *P*=8.996e-05).
Mandible was the most usual are affected (54.63%). Incidence of mandible fractures was higher than facial middle third (1:1.58), exclusive orbit (1:6.12) and frontal bone (1:27.98). Mandibular body and condyle were the most affected regions in the lower jaw (Figure 4), while nose and zygomatic arch were the most affected areas in the facial middle third (Figure 5).
Surrounding tissue complications were reported in a low proportion in comparison to bone fractures (n=531, 2.66%). Table 3 summarizes incidence of these complications.
Other relevant data were available in few articles what makes inviable to discuss it, bringing high level evidence. Type of treatment, educational level of injured patients, Glasgow scale on admission, hospitalization stay, domestic violence as etiology and incidence among the months of the year[12,13,22,23,26–28,44] are amongst these data.

Risk of bias

The risk of bias across studies is expressed in Figure 6. No additional analyses were pre-specified and made. According to prespecified protocol, included studies could be considered in low risk of bias (p=0.7875). The biggest flaws related to some risks of bias were found in the quality of the data and the lack of additional information. Half of the articles needed to present clearer data, especially regarding age groups. Ideally, the same age group standards (0-10, 11-20, 21-30, etc.) should be used routinely in order to allow for comparison. The use of additional data and comparisons between different groups are also relevant in preventing some types of traumas such as age or sex and etiology.

DISCUSSION

Maxillofacial fractures are a significant public health concern worldwide, and their causes and prevalence have been the subject of numerous studies. This comprehensive systematic review aimed to explore the causes and prevalence of maxillofacial fractures in Iran, based on data from 32 articles.
We found that the most affected age group was between 21-30 years. This is consistent with other studies reported a higher incidence of maxillofacial fractures in young adults[2,9,12]. One of the main reasons for this could be the higher use of motor

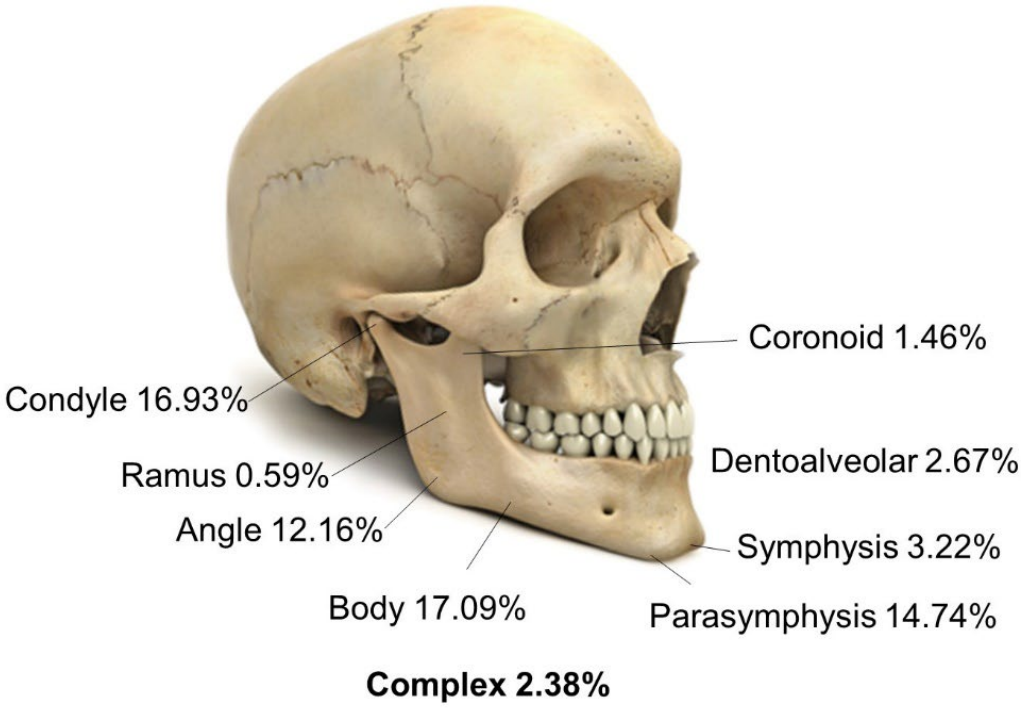


Figure 4: Affected regions of the mandible

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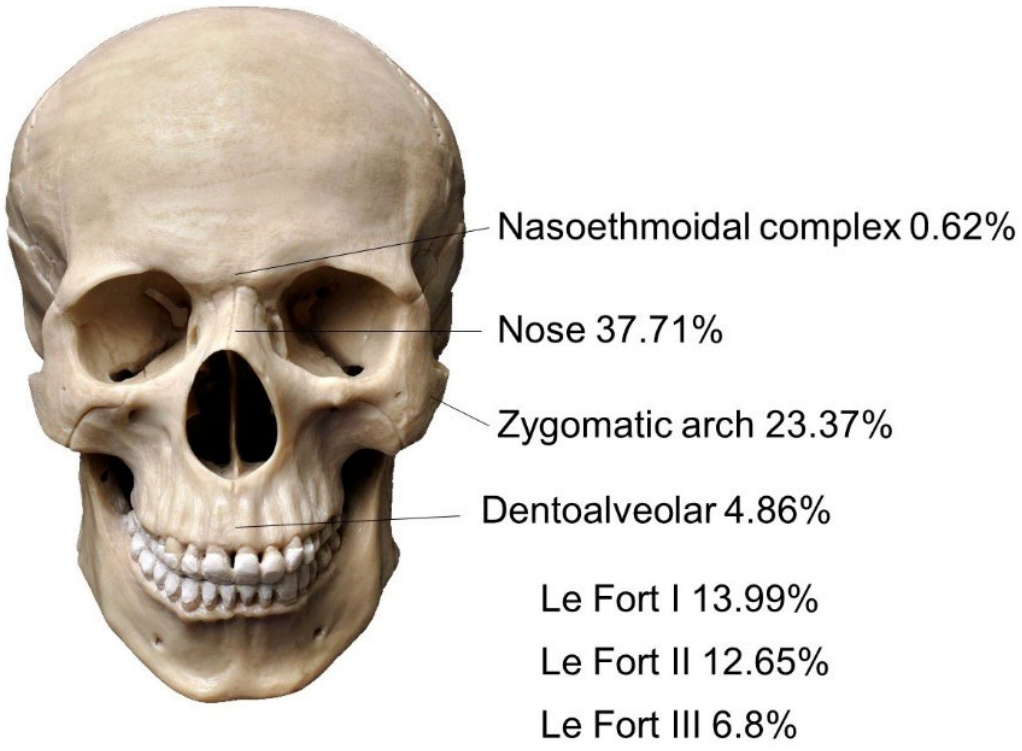


Figure 5: Affected regions of the midface

Table 3: Surrounding tissues complications related to bone maxillofacial fractures.

Tissue	Incidence (%)
Orbital soft tissue	33.90
Palpebral injuries	3.20
Nasal soft tissue	54.61
Lip injuries	1.32
Ears injuries	3.58
Lacrimal system injuries	0.38
Facial nerve	2.26
Trigeminal nerve	0.75

vehicles by this age group. Several studies have shown that motor vehicle accidents are the leading cause of maxillofacial fractures in young adults [46,47]. This age group is also more likely to engage in physical altercations, which can result in maxillofacial trauma[48].

In Iran, this age group is particularly prone to maxillofacial fractures due to the low age of retirement. Older people in Iran tend to be less active and involved in fewer physical activities than their younger counterparts[49]. This difference is more pronounced in Iran compared to other countries, where older people may still participate in physical activities such as sports and exercise[50–53].

In all the articles we reviewed, male patients suffered more maxillofacial trauma than female patients, with a margin of four to one. This finding is consistent with other studies that have reported a higher incidence of maxillofacial fractures in males[2]. In Iran, cultural factors may contribute to this difference. Men in Iran are often the primary breadwinners and perform the main activities of the household, including driving and manual labor. These activities put them at a higher risk of accidents and trauma.

Comparing our findings to other studies conducted

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in different countries, cultural factors also seem to play a role in the differences between fractures of men and women. For example, in the United States, men are more likely to be involved in high-risk activities such as extreme sports or physical altercations, which may result in maxillofacial trauma[54,55]. In India, cultural factors such as gender-based violence and road safety issues have also been reported as significant contributors to maxillofacial fractures in both men and women[56].

Also, in our review the mandible was the most common bone affected by maxillofacial fractures in Iran, with an incidence of 54.63%. This is consistent with other studies that have reported a higher incidence of mandibular fractures compared to other facial bones[57]. One of the main reasons for this may be the high incidence of motor vehicle accidents (MVA) in Iran, which are a leading cause of maxillofacial fractures. In MVAs, the mandible is the main affected bone due to the position of the mandible in relation to the rest of the facial bones[58]. The mandible is also a relatively thin bone compared to the other facial bones, making it more vulnerable to fractures in high-impact accidents[59].

Additionally, our review found that the mandibular body and condyle were the most commonly affected regions in mandibular fractures. This again supports the argument that MVAs are the primary cause of mandibular fractures in Iran, as these accidents typically result in high-impact forces that affect the mandibular body and condyle[60]. In contrast, physical assaults typically result in fractures of the zygomatic arch or orbital bones, as these areas are more exposed and vulnerable to direct impact[48].

Comparing our findings to studies conducted in other countries, the incidence of mandibular fractures in Iran appears to be higher than in some other countries. For example, a study in India found that the mandible was affected in only 34% of maxillofacial fractures, while the zygomatic bone was the most affected[61]. In the United States, the mandible was the most affected bone in pediatric maxillofacial fractures, with a lower incidence in adult patients[5]. These differences may be attributed to variations in the prevalence of risk factors, such as MVA, in different countries.

Another potential explanation for the differences between our study and studies conducted in other countries regarding the incidence of maxillofacial fractures could be related to cultural and social factors. For example, in Iran, alcohol consumption is strictly prohibited in public and private, while in many other countries, alcohol is more widely available and consumed. Alcohol consumption is a well-established risk factor for traumatic injury, including maxillofacial fractures[62,63].

Therefore, the differences in incidence of maxillofacial fractures in Iran compared to other countries may be partially attributed to the lack of public alcohol consumption. A study from Australia, for example, found that alcohol was involved in 18% of maxillofacial fractures[62]. Similarly, a study from South Africa reported that alcohol was involved in a significant amount of maxillofacial fractures and was a significant risk factor for injury severity[64].

However, it is worth noting that while public alcohol consumption is prohibited in Iran, it is still possible for individuals to consume alcohol privately, which may still contribute to the incidence of maxillofacial fractures[65]. Additionally, there may be other cultural and social factors that contribute to the differences between our study and studies from other countries. For example, differences in the prevalence of high-risk activities such as sports or occupational hazards may also play a role.

While the incidence of maxillofacial fractures in Iran may be different compared to other countries, the reasons for this are likely multifactorial and include a combination of cultural, social, and environmental factors. The lack of public alcohol consumption may be one contributing factor, although it is important to consider other potential explanations as well. Further research is needed to better understand the underlying reasons for the differences in the incidence of maxillofacial fractures between Iran and other countries, and to develop targeted interventions aimed at reducing the incidence of these injuries.

This systematic review provides valuable insights into the causes and prevalence of maxillofacial fractures in Iran. The data suggest that young adults, particularly males, are at a higher risk of maxillofacial trauma due to their engagement in high-risk activities such as motor vehicle use and physical altercations. Cultural factors also appear to play a role in the differences between maxillofacial fractures in men and women. These findings can inform targeted public health interventions aimed at reducing the incidence of maxillofacial fractures in Iran and other countries with similar cultural

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backgrounds, such as improving road safety measures and promoting safe driving practices.

CONCLUSION

This comprehensive systematic review of 32 articles provides valuable insights into the patterns and trends of maxillofacial fractures in Iran. Motor vehicle accidents and physical altercations are the most common causes of these injuries in Iran, with the mandible being the most affected bone. The high incidence of maxillofacial fractures in the 21-30-year-old age group highlights the need for targeted interventions, such as public education campaigns and improvements in road infrastructure and enforcement of traffic laws. Our study underscores the importance of further research into the cultural and social factors that contribute to the incidence of maxillofacial fractures in Iran. Overall, our study provides a valuable resource for healthcare providers, policy makers, and researchers working to address the burden of maxillofacial fractures in Iran.

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COMPETING INTERESTS

Authors declare that they have no conflicts of interest to disclose.

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