

The epidemiological analysis of maxillofacial fractures in Italy: The experience of a single tertiary center with 1720 patients



Paola Bonavolontà^a, Giovanni Dell'aversana Orabona^a, Vincenzo Abbate^a,
Luigi Angelo Vaira^{a,*}, Carmelo Lo Faro^a, Marzia Petrocelli^a, Federica Attanasi^b,
Giacomo De Riu^c, Giorgio Iaconetta^d, Luigi Califano^a

^a Maxillofacial Surgery Operative Unit (Head: Prof. Luigi Califano), University Hospital of Naples "Federico II", Via Pansini 5, 80131 Naples, Italy

^b Actuarial Science, University of Rome "La Sapienza", Rome, Italy

^c Maxillofacial Surgery Operative Unit (Head: Dott. Giacomo De Riu), University Hospital of Sassari, Viale San Pietro 43B, 07100 Sassari, Italy

^d Neurosurgery Operative Unit (Head: Prof. Giorgio Iaconetta), University Hospital of Salerno, Via Allende, 84081 Baronissi, Salerno, Italy

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ABSTRACT

Purpose: Maxillofacial fractures represent a serious public health problem. Their epidemiology is extremely variable, and its analysis is crucial to establish effective treatment and prevention of these injuries. However only two works have been published about maxillofacial fracture epidemiology in Italy. **Materials and methods:** The records of 1720 patients diagnosed with maxillofacial fractures in a 15-years period (2001–2015) in our department were retrospectively reviewed.

Results: A total of 1108 male and 612 female patients were included in the study. The most frequent aetiology of fracture was road traffic injuries (57.1%), followed by assault (21.7%), falls (14.2%), work accidents (3.5%), sport accidents (3.3%) and other causes (0.2%). Significant variations of aetiology were detected between males and females and between Italians and individuals from other countries. The most frequently observed fracture involved the mandible (861 cases, 36%), followed by zygoma (489 cases, 20.4%), orbital walls (386 cases, 16.1%) and maxilla (282 cases, 11.8%).

Conclusion: Road traffic legislation enforcement and continuous public education regarding the use of security devices remain an ongoing problem in our region and should be encouraged. In the same way, as migration flows influence and change the epidemiology of facial traumas, it is crucial to establish social support programs that avoid these disadvantaged categories of victims of violence and crime.

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1. Introduction

Maxillofacial fractures are one of the most frequent pathologies treated in a maxillofacial surgery department, representing a serious public health and economic problem. The epidemiology is extremely variable, depending on several factors such as the geographical area, cultural and lifestyle differences and socio-economic trends (Boffano et al., 2014, 2015).

Epidemiological analysis of maxillofacial fractures is crucial to identify the trauma burden and to help in developing a more

efficient system to plan resource allocation and to deliver care and preventive measures establishing clinical and research priorities for effective treatment and prevention of these injuries (Arangio et al., 2014; Boffano et al., 2015).

The incidence of maxillofacial fractures varies widely among different countries, and a large number of studies have been done regarding their epidemiology (Afzelius and Rosèn, 1980; Hogg et al., 2000; Iida et al., 2001; Hackl et al., 2001; Gassner et al., 2003; Laski et al., 2004; Brasileiro and Passeri, 2006; Eggenesperger et al., 2007; Erdmann et al., 2008; Chrcanovic, 2012; Lee, 2012; Arangio et al., 2014; Boffano et al., 2014; Mijiti et al., 2014; Zhou et al., 2015; Boffano et al., 2015; Rocca et al., 2016). However, a review of the international literature showed that only two works have been published about the epidemiology in Italy (Arangio et al., 2014; Rocca et al., 2016).

* Corresponding author. Via Pietro Canalas 12, 07100, Sassari, Italy. Fax: +39 079229002.

E-mail address: luigi.vaira@gmail.com (L.A. Vaira).

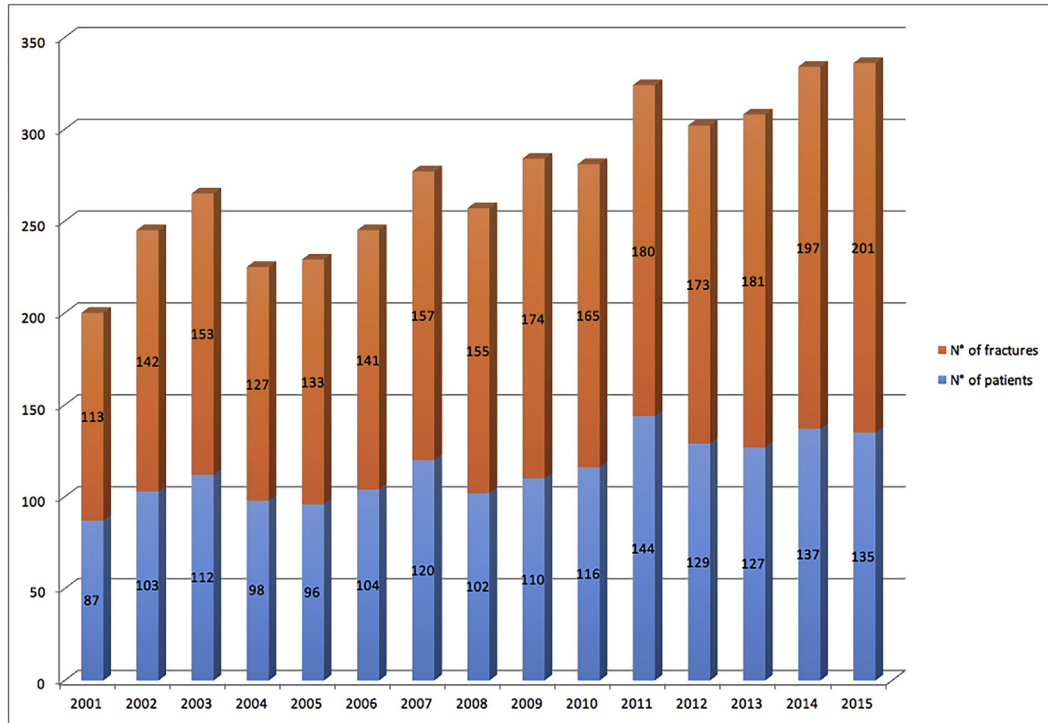


Fig. 1. Number of patients per year.

The purpose of our work is to analyse the series of patients admitted for fractures of the facial skeleton (both surgical and not surgical), over the last 15 years, at the maxillofacial surgery department of the University of Naples “Federico II” as the tertiary referral center for trauma care in Campania since 2011.

2. Materials and methods

The records of 1720 patients diagnosed with maxillofacial fractures in a 15-year period (2001–2015) in our Department were retrospectively reviewed extracting the following data: gender, age,

Time trend of Male-Female Ratio

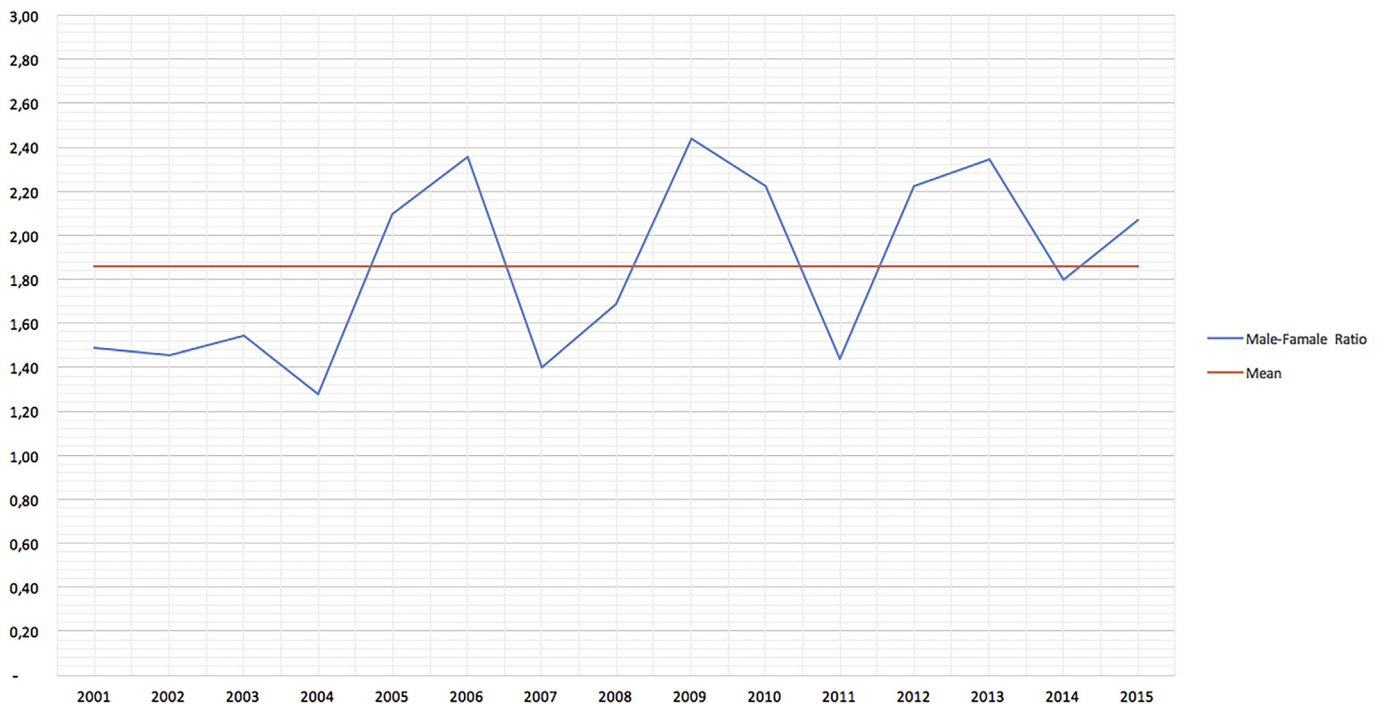


Fig. 2. Male/female ratio trend during the observation period.

Table 1
Numbers and mean ages of male and female patients.

Year	No. of males	No. of females	Mean age of males (yr)	Mean age of females (yr)
2001	52	35	45.3	58.4
2002	61	42	43.3	61.2
2003	68	44	44	57.3
2004	55	43	41.2	58
2005	65	31	45.1	61.4
2006	73	31	46	57.9
2007	70	50	43	62.5
2008	64	38	44	61.3
2009	78	32	45	57.3
2010	80	36	45	64.3
2011	85	59	46	55.6
2012	89	40	47	59.7
2013	89	38	46	60.5
2014	88	49	45	58.7
2015	91	44	44	59.4

nationality, date of accident, aetiology, aetiology subtype, and site of facial fractures (Fig. 1).

Fractures were diagnosed with radiological examinations and classified according to AO-CMF criteria: mandibular (dento-alveolar, symphysis/parasymphysis, body, angle/ramus, coronoid process, condylar process), maxilla (palate-alveolar, Le Fort 1, Le Fort 2, Le Fort 3), nasal, nose-orbital-ethmoidal (NOE), orbital (floor, medial wall, roof, lateral wall, combined), zygomatic (zygomatic complex, isolated arch fracture), and frontal sinus (Cornelius et al., 2014).

The following categories of injury cause were considered: falls, road traffic accidents (RTAs), assaults, sport injuries, work injuries, and other causes. Sport injuries were analysed and divided according to the type of sport. RTAs were classified on the basis of the accident dynamic: car accident, motorbike accident, pedestrian, bicycle accident, unknown/other. Work injuries were divided according to the type of work: construction workers, factory workers, farm and forestry workers, office workers, other (Boffano et al., 2015).

The analysis did not include length of hospitalization, time of intervention, type of surgical treatment, or trauma outcomes.

Data were aggregate and analysed with a Microsoft Excel (Microsoft Corporation, Redmond, WA, USA) spread sheet.

This study respects the principles of the Declaration of Helsinki and was approved by the University of Naples Ethical Committee.

3. Results

Of the 1720 patients with maxillofacial injuries admitted in the study, 1108 were male (64.4%) and 612 were female (35.6%), with a male-to-female ratio of 1.8:1 (Fig. 2). The mean age of females (59.5 years) was significantly higher than that of the males (44.6 years) (Table 1). During the analysed period, 358 (20.8%) foreign patients have been treated in our Department. This percentage has remarkably increased over the years, from 13.8% in 2001 to 30.5% in 2015 (Fig. 3). The most represented nationality was Nigeria (97 patients), followed by Romania (38 patients), Ukraine (33 patients), Russia (28 patients), and Senegal (25 patients) (Table 2).

The most frequent aetiology of fracture was road traffic injuries (57.1%), followed by assault (21.7%), falls (14.2%), work accidents (3.5%), sport accidents (3.3%), and others causes (0.2%) (Fig. 4). Concerning road traffic accidents (RTAs), motorbike accidents were responsible for the trauma in 430 cases (43.8%); other RTA aetiological factors were car accidents (221 cases, 22.5%), bicycle accidents (76 cases, 7.7%) and pedestrian-versus-car accidents (252 cases, 25.7%).

In the group of patients with sport-related injuries, soccer was the most frequently responsible for maxillofacial fractures (32 cases, 56.1%), followed by basketball (11 cases, 19.3%), contact sports (8 cases, 14%) and others (6 cases, 10.5%).

The most frequently involved work category was construction work (22 cases, 36.1%). Other categories involved were factory work (20 cases, 32.8%), farm work (12 cases, 19.7%) and office work (3 cases, 4.9%).

Significant variations of aetiology were detected between males/females and Italians/foreign patients. The most common cause of accidents in male was RTAs (552 cases, 49.8%) followed by assaults (335 cases, 32%), falls (97 cases, 8.8%), sport-related accidents (53 cases, 4.8%) and work-related accidents (33 cases, 3%). Otherwise, in females, RTAs were responsible of 70.3% of traumas

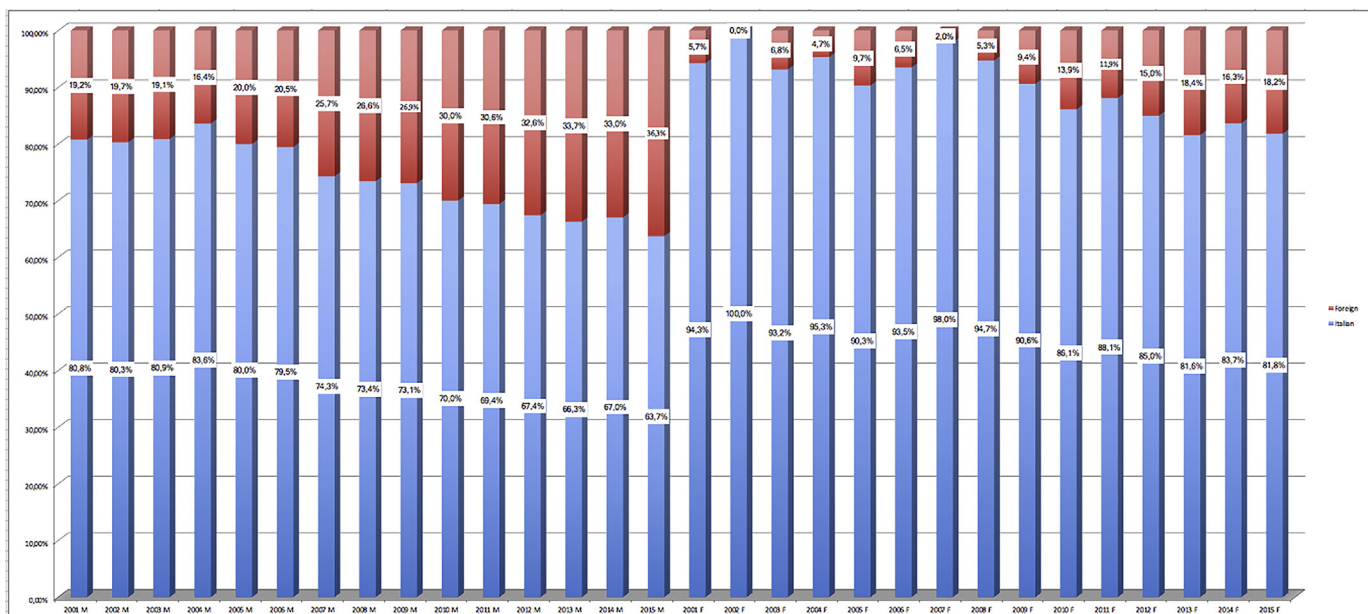


Fig. 3. Italian/foreigner ratio trend during the observation period.

Table 2
Foreign patient nationalities.

Nationality	No. of patients
Nigeria	97
Romania	38
Ukraine	33
Russia	28
Senegal	25
Albania	21
Serbia	18
Tunisia	17
Bulgaria	17
Germany	9
USA	6
Turkey	6
China	6
UK	5
France	5
Sweden	3
Japan	2
Other	22

(430 cases), followed by falls (147 cases, 24%), assaults (18 cases, 2.9%), work-related accidents (11 cases, 1.8%) and sport-related accidents (4 cases, 0.7%) (Fig. 5).

RTAs accidents were responsible for 63.4% of the fractures in Italian patients and 23.7% in foreigners. In the latter group, assaults were the most frequent cause of fracture (35.8%, considering only foreign males 59.2%), while in Italians this percentage dropped to 14.2% (Fig. 6).

The cohort of 1720 patients of this study presented with a total of 2392 fractures (Table 3). In all, 1187 patients reported 1 fracture, 412 patients had 2 fractures, 98 patients 3 fractures, and 23 patients 4 or more fractures. The most frequently observed fracture involved the mandible (861 cases, 36%), followed by the zygoma (489 cases, 20.4%), orbital walls (386 cases, 16.1%), maxilla (282 cases, 11.8%),

nasal bones (259 cases, 10.8%), nose-orbital-ethmoidal complex (72 cases, 3%) and frontal sinus (42 cases, 1.8%) (Fig. 7).

Within the group with mandible fractures, the condyle was involved in 271, representing the most frequent mandibular fracture and accounting for 31.5%; this was followed by angle/ramus fractures (179 cases, 20.8%), symphysis/parasymphysis (151 cases, 17.5%), body (142 cases, 16.5%), dento-alveolar process (95 cases, 11%) and coronoid process (23 cases, 2.7%).

4. Discussion

National Healthcare Expenditures Accounts data from 2014 shows that Italy spends €111 billion per year on health care, €1867 per person, and is projected to continue to increase, reaching €118 billion in 2019. The effect of the incidence of maxillofacial injuries on this cost it is calculated to be around €160 million (Ministry of Health, 2014). Most patients with such injuries undergo hospitalization and subsequent rehabilitation, and considerable resources are needed for treatment, thus placing an enormous burden on the health care system.

A long-term data collection on maxillofacial fractures is important because it provides information about the dynamics of accidents and how social behaviour influences this type of trauma, allowing the development and evaluation of preventive measures (Hogg et al., 2000).

Through this analysis, it is possible to validate operative protocols regarding the management of patients with maxillofacial trauma to achieve optimal management (Arangio et al., 2014).

In this retrospective study, the occurrence and distribution of maxillofacial fractures in Campania, during a 15-year period, were evaluated and compared.

We mainly found that male patients are significantly more affected than female patients (1.8:1). This is a common finding in many studies (Afzelius and Rosèn, 1980; Iida et al., 2001; Laski et al.,

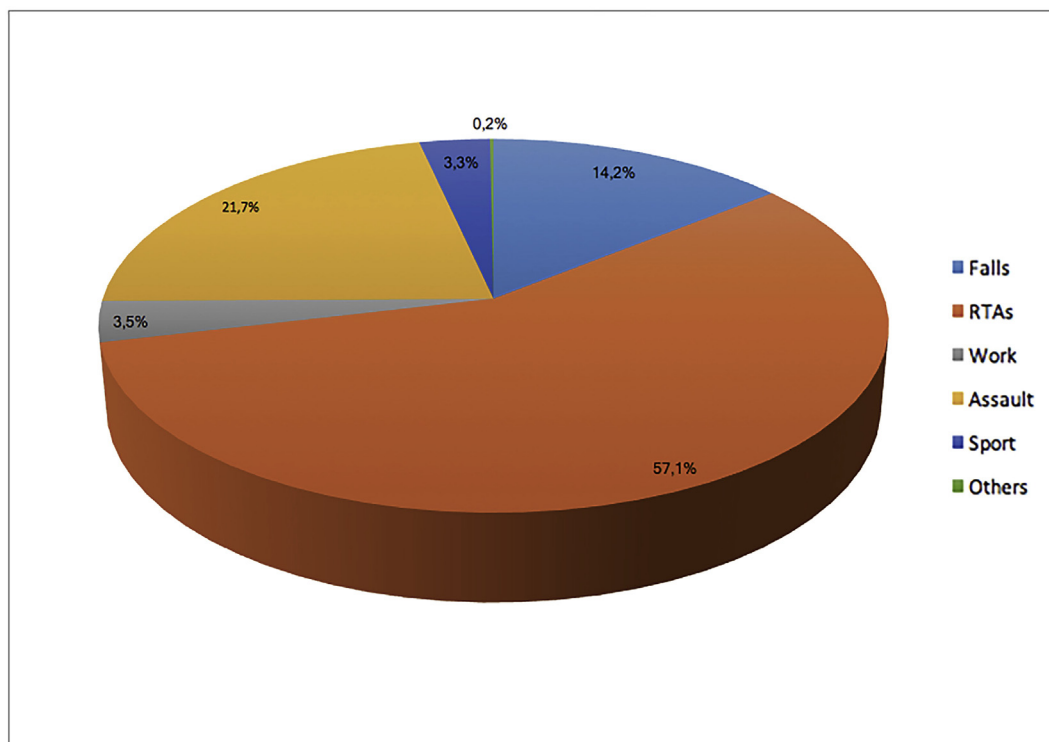


Fig. 4. Aetiology of the fractures.

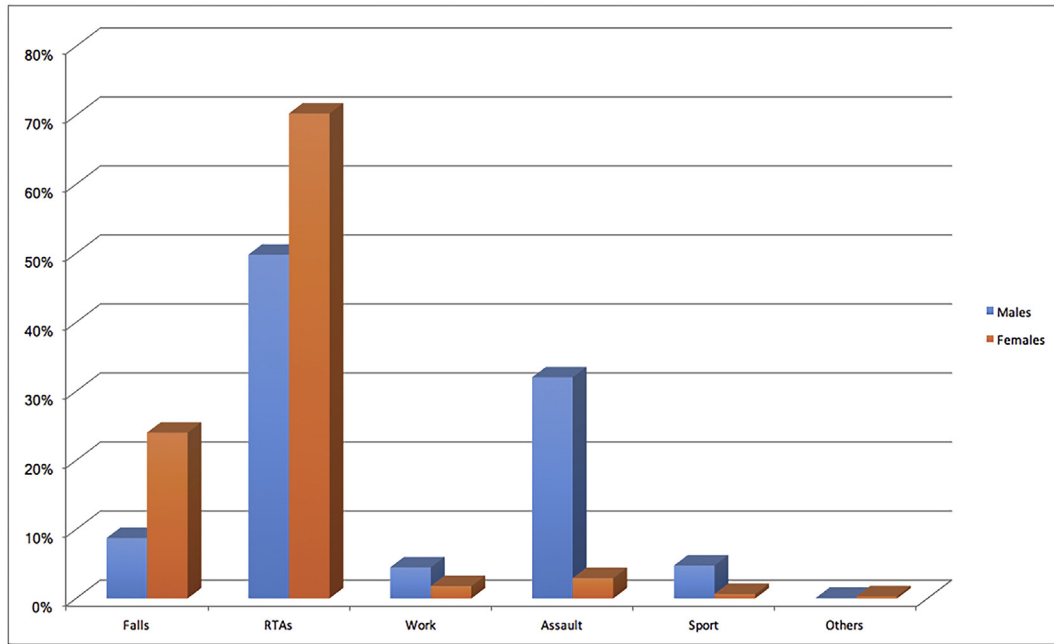


Fig. 5. Aetiology in male and female patients.

2004; Brasileiro and Passeri, 2006; Zhou et al., 2015; Boffano et al., 2015), as male patients have intense social interaction and an high rate of mobility, are more likely to take part in dangerous exercise practices, unsafe driving and interpersonal violence. Despite the fact that, in recent years, a gradual levelling of this gender difference was detected, probably due to a more active lifestyle among women, in our study, no significant variations of the gender ratio or trend during the 15-year period of observation were detected.

Similarly to other previous works (Gassner et al., 2003; Boffano et al., 2015), the female average age is remarkably higher than the

male (59.5 vs 44.6 years). After 70 years of age, facial injuries predominated in women.

During the observation period, a significant increase in the percentage of foreign patients treated has been reported as mainly affecting those nationalities most involved in large-scale migration in recent years, according to data provided by the Italian National Institute of Statistic (ISTAT, 2015) (Table 4).

The aetiology of facial trauma directly affects the incidence, clinical presentation and treatment modalities of facial fractures; therefore it is a crucial aspect to investigate in epidemiological

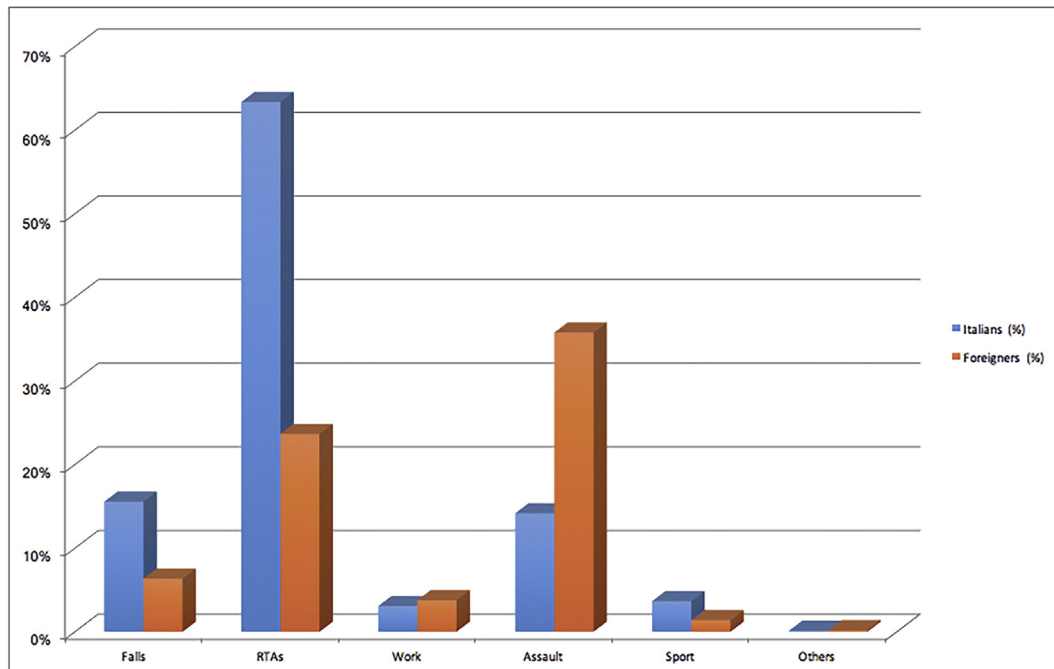


Fig. 6. Aetiology in Italian and foreign patients.

Table 3
Fracture site frequency.

Fracture site	No. of patients	% of patients
Mandibula	861	36.0%
Dento-alveolar	95	11.0%
Symphysis/parasymphysis	151	17.5%
Body	142	16.5%
Angle/ramus	179	20.8%
Coronoid process	23	2.7%
Condylar process	271	31.5%
Maxilla	283	11.8%
Palate-alveolar	53	18.7%
Le Fort 1	112	39.6%
Le Fort 2	82	29.0%
Le Fort 3	36	12.7%
Nose	259	10.8%
Nose-orbital-ethmoidal	72	3.0%
Orbit	386	16.1%
Floor	187	48.4%
Medial wall	62	16.1%
Lateral wall	12	3.1%
Roof	24	6.2%
Combined	101	26.2%
Zygoma	489	20.4%
Zygomatic complex	398	81.4%
Isolated arch	91	18.6%
Frontal sinus	42	1.8%

Table 4
Foreigners resident in Campania (2015).

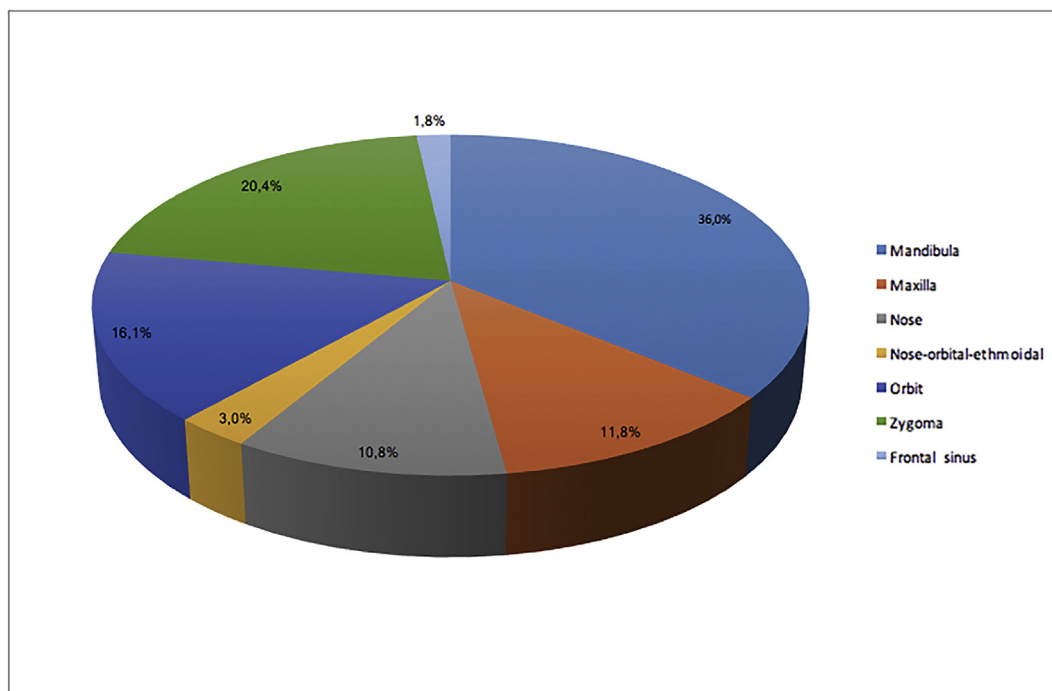
	Nationality	No.	Males (%)	Trend compared to 2013
1	Ukraine	42,474	24.0%	3.0%
2	Romania	37,905	41.8%	6.2%
3	Morocco	18,987	70.0%	10.6%
4	Sri Lanka	14,219	54.4%	7.0%
5	China	12,843	55.6%	18.8%
6	Poland	9,739	23.8%	-1.3%
7	Albania	6,843	57.4%	0.9%
8	Bulgaria	6,669	27.5%	5.4%
9	India	6,115	70.8%	22.0%
10	Bangladesh	5,427	85.9%	40.6%
11	Russia	4,091	13.8%	3.6%
12	Filippines	3,912	37.7%	5.0%
13	Pakistan	3,664	88.5%	41.3%
14	Nigeria	3,592	47.5%	10.5%
15	Algeria	3,559	79.6%	12.4%

interpersonal violence, which was the cause of facial injury in 59.2% of foreign males (Fig. 8). These patients often live in socially disadvantaged conditions with a higher probability of being involved in criminal or violent situations. The increasingly aggressive behaviour in urban centres of developed countries has been observed also by other authors, who reported assaults as the leading cause of maxillofacial trauma (Iida et al., 2001; Hackl et al., 2001; Eggenperger et al., 2007; Erdmann et al., 2008; Chrcanovic, 2012; Lee, 2012).

According to the literature (Afzelius and Rosèn, 1980; Hogg et al., 2000; Iida et al., 2001; Gassner et al., 2003; Laski et al., 2004; Brasileiro and Passeri, 2006; Erdmann et al., 2008; Arangio et al., 2014; Mijiti et al., 2014; Zhou et al., 2015; Boffano et al., 2015; Rocca et al., 2016), we confirm that maxillofacial fractures were prevalently represented by mandibular fractures (36.3%). This is the most frequent fracture site reported in RTAs, with a predominance of condylar involvement, whereas in interpersonal violence accidents the zygomatic complex, orbit and nose are the most common bones involved (Fig. 9). In this trauma category, the left side of the

studies (Mijiti et al., 2014). Even though traffic rules and regulations have been enforced, seat belts and helmet use imposed, and passive safety devices have been introduced in motor vehicles, RTAs remained the most important cause of maxillofacial fractures in Italian patients. A widespread violation of these rules, in our region, is the basis of a continuing high incidence and is supported by the fact that the 65.4% of the patients who had facial fractures due to car or motorbike accidents were not using seat belts or helmets.

RTAs are responsible for only 23.7% of fractures in foreign patients. In this group, the most common etiological factor was

**Fig. 7.** Fracture site frequency.

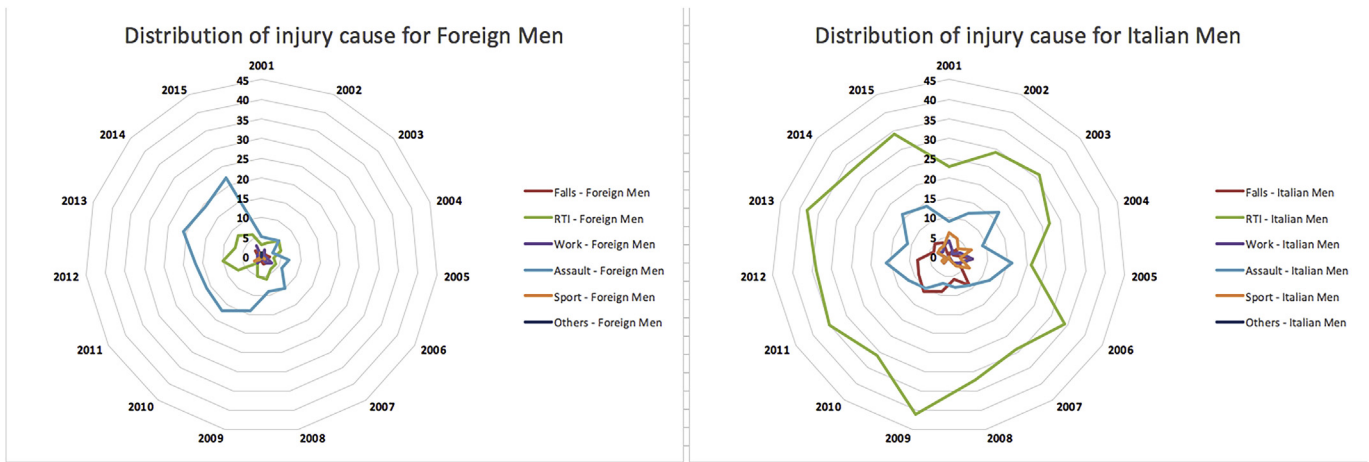


Fig. 8. Aetiologic difference between Italian and foreign males.

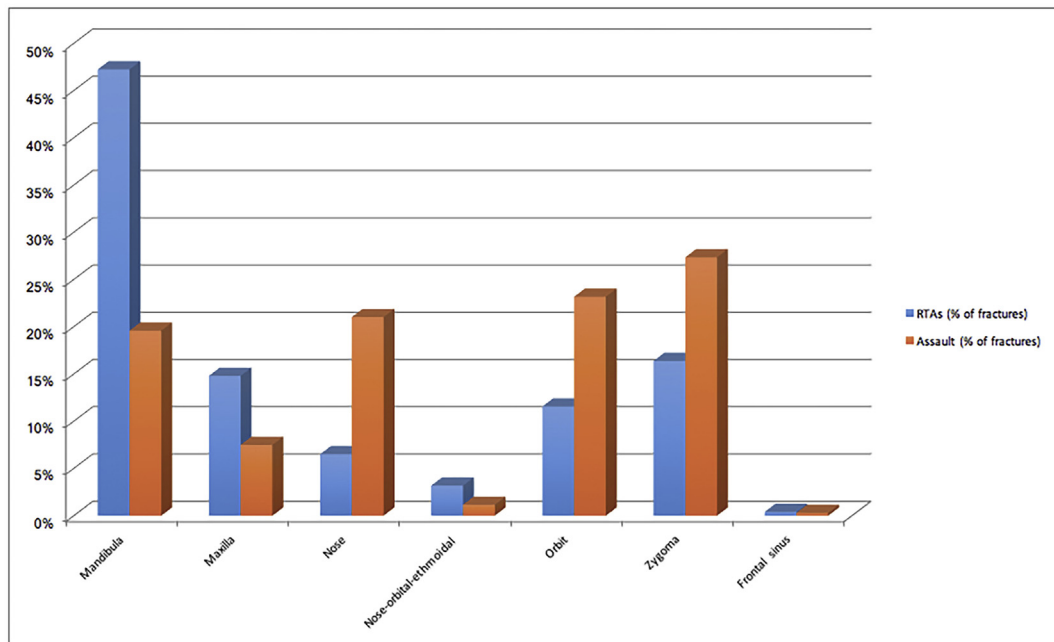


Fig. 9. Fracture site frequency in road traffic accidents (RTAs) and assaults.

face was affected in 78.3% of the cases, as 95% of all persons are right-handed (Zhou et al., 2015).

5. Conclusions

The present study supports that regular epidemiologic data collection regarding maxillofacial fractures is crucial. For this reason it is appropriate to create multicenter databases that allow a comparative analysis providing important support for clinical and research priorities.

Road traffic legislation enforcement and continuous public education regarding the use of security devices remain ongoing problems in our region and should be encouraged. In the same way, as migration flows influence and change the epidemiology of facial traumas, it is crucial to establish social support programs that help prevent these traumas, particularly among disadvantaged individuals who are victims of violence and crime.

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Conflict of interest

The authors declare that they have no conflict of interest.

References

Afzelius L, Rosén C: Facial fractures. A review of 368 cases. *Int J Oral Surg* 9: 25–32, 1980
 Arangio P, Vellone V, Torre U, Calafati V, Capriotti M, Cascone P: Maxillofacial fractures in the province of Latina, Lazio, Italy: review of 400 injuries and 83 cases. *J Craniomaxillofac Surg* 42: 583–587, 2014
 Boffano P, Kommers SC, Karagozoglou KH, Forouzanfar T: Aetiology of maxillofacial fractures: a review of published studies during the last 30 years. *Br J Oral Maxillofac Surg* 52: 901–906, 2014
 Boffano P, Rocca F, Zavattero E, Dedioli E, Uglesic V, Kovacic Z, et al: European Maxillofacial Trauma (EURMAT) project: a multicenter and prospective study. *J Craniomaxillofac Surg* 43: 62–70, 2015

- Brasileiro BF, Passeri LA: Epidemiological analysis of maxillofacial fractures in Brazil: a 5-year prospective study. *Oral Surg Oral Med Oral Pathol Radiol Endod* 102: 28–34, 2006
- Chrcanovic BR: Factors influencing the incidence of maxillofacial fractures. *Oral Maxillofac Surg* 16: 3–17, 2012
- Cornelius CP, Kunz C, Neff A, Kellman RM, Prein J, Audigè L: The comprehensive AOCMF Classification System: fracture case collection, diagnostic imaging work up, AOCMIAC iconography and coding. *Cranio-maxillofac Trauma Reconstr* 7: S131–S135, 2014
- Eggensperger N, Smolka K, Scheiddegger B, Zimmermann H, Hzuka T: A 3-year survey of assault-related maxillofacial fractures in central Switzerland. *J Craniomaxillofac Surg* 35: 161–167, 2007
- Erdmann D, Follmar KE, Debruijn M, Bruno AD, Jung SH, Edelman D, et al: A retrospective analysis of facial fracture etiologies. *Ann Plast Surg* 60: 398–403, 2008
- Gassner R, Tuli T, Hachi O, Rudisch A, Ulmer H: Cranio-maxillofacial trauma: a 10 year review of 9543 cases with 21067 injuries. *J Craniomaxillofac Surg* 31: 51–61, 2003
- Hackl W, Hausberger K, Sailer R, Ulmer H, Gassner R: Prevalence of cervical spine injuries in patients with facial trauma. *J Trauma* 50: 41–45, 2001
- Hogg NJ, Stewart TC, Armstrong JE, Girotti MJ: Epidemiology of maxillofacial injuries at trauma hospitals in Ontario, Canada, between 1992 and 1997. *J Trauma* 49: 425–432, 2000
- Iida S, Kogo M, Sugiura T, Mima T, Matsuya T: Retrospective analysis of 1502 patients with facial fractures. *Int J Oral Maxillofac Surg* 30: 286–290, 2001
- ISTAT: Cittadini stranieri 2015 – Campania. Available at: <http://www.tuttitalia.it/campania/statistiche/cittadini-stranieri-2015/>.
- Laski R, Ziccardi VB, Broder H, Janal M: Facial trauma: a recurrent disease? The potential role of disease prevention. *J Oral Maxillofac Surg* 62: 685–688, 2004
- Lee K: Global trends in maxillofacial fractures. *Cranio-maxillofac Trauma Reconstr* 5: 213–222, 2012
- Mijiti A, Ling W, Tuerdi M, Maimaiti A, Tuerxun J, Tao YZ, et al: Epidemiological analysis of maxillofacial fractures treated at a university hospital, Xinjiang, China: a 5-year retrospective study. *J Craniomaxillofac Surg* 42: 227–233, 2014
- Ministry of Health: Rapporto SDO. Available at: http://www.salute.gov.it/imgs/C_17_pubblicazioni_2396_allegato.pdf; 2014
- Roccia F, Savoini M, Ramieri G, Zavattero E: An analysis of 711 victims of interpersonal violence to the face, Turin, Italy. *J Craniomaxillofac Surg* 44: 1025–1028, 2016
- Zhou HH, Liu Q, Yang RT, Li Z, Li ZB: Maxillofacial fractures in women and men: a 10 years retrospective study. *J Oral Maxillofac Surg* 73: 2181–2188, 2015