The Influence of Socioeconomic Factors on the Epidemiology of Maxillofacial Fractures in Southern Italy

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Abstract: 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. The aim of this multicentric retrospective study was to analyze causes, demographics, incidence, characteristics of 987 patients diagnosed with maxillofacial trauma between 2011 and 2015 at Complex Operative Unit of Maxillofacial Surgery of Federico II University of Naples and Magna Graecia University of Catanzaro, Italy; 657 male and 310 female patients were admitted in the study. The most frequently observed fracture involved the mandible (399 patients, 35.4%), followed by zygomatic complex (337 patients, 29.9%), orbital walls (160 patients, 14.2%), and nasal bones (129 patients, 11.4%). The most frequent cause of fracture was assaults (30.4%), followed by road traffic injuries (27.2%), falls (23.2%), sport accidents (15.4%), and others causes (2.6%). Significant variations of etiology have been detected between the 2 hospitals in relationship with different migration flow trends and cultural and socioeconomic features. 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.

Key Words: Maxillofacial fractures, maxillofacial fractures epidemiology, maxillofacial injuries

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Maxillofacial fractures represent an important public health problem worldwide. They are often associated with severe morbidity, loss of function, disfigurement, and significant financial cost[1–3] (Fig. 1). Their epidemiology is extremely variable, depending on several factors such as the geographical area, cultural and lifestyle differences, and socioeconomic trends.[4,5] The most common causes are represented by road traffic accidents, interpersonal violence, falls, sports, and work injuries.[6] Injuries physiopathologic mechanisms can change based on the kind of accident, the gender, and the age of patients. 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.[7–9] Moreover, understanding of mechanism-based factors resulting in various patterns of injury is valuable to the surgeon in the management of facial fractures. Identifying such patterns can provide surgeons with the ability to better predict, and subsequently manage most of these injuries.[10]

FIGURE 1. Multiple facial fractures following road traffic accident.

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However, from a deep analysis of the literature only 3 works have been published about the epidemiology of maxillofacial fractures in Italy.[4,7,11] The aim of this multicentric retrospective study was to analyze causes, demographics, incidence, characteristics of maxillofacial trauma over a 5-year period (between 2011 and 2015) at Complex Operative Unit of Maxillofacial Surgery of Federico II University of Naples (UNINA) and at Maxillofacial Surgery Department of Magna Graecia University of Catanzaro (UNICZ). It was also evaluated whether and how socioeconomic trends and personal behavior influenced fracture epidemiology in the 2 centers.

MATERIALS AND METHODS

A retrospective analysis of all patients with maxillofacial fractures presenting at UNINA and at UNICZ from January 2011 to December 2015. The source data were found in both analog and digital archived patients' data. A specific database was created including sex, age, nationality, cause of injury, site of fracture, place where the accident occurred, and yearly distribution. The causes of injuries were divided into 5 main categories: road traffic accidents, which included accidents involving cars, motorcycles, bicycles, and pedestrian accidents; assault, which included interpersonal violence and attacks with weapons; falls; sports injuries; and other causes, which included occupational accidents, domestic accidents, suicide attempts, accidents with animals, and iatrogenic fractures.

Fractures were diagnosed with clinical and radiologic examinations and classified according to Association Ostheosynthesis–Cranio-Maxillo-Facial criteria: orbital-zygomatic-maxillary complex, mandibular (symphysis, body, angle, ramus, coronoid, condyle), isolated orbital walls, maxilla (according to Le Fort classification), frontal sinus anterior table, nasal, and fractures naso-orbital-ethmoid (NOE).[12] In patient with panfacial trauma, each fracture was considered separately. Patients with isolated dentoalveolar or posterior table frontal sinus fractures were excluded from the study. The management of all surgical patients recruited consisted in closed reduction with arch bars, intermaxillary fixation, percutaneous wire reduction or open reduction, and fixation of bone segments with internal rigid fixation through plates, miniplates, and screws, as appropriate.[13–17]

Statistical Analysis

A statistical analysis was performed to identify the dependence between the considered variables identified for the study of the main maxillofacial trauma causes at UNINA and UNICZ. Comparisons were performed with chi-squared test using the Statistic Software R 3.3.0. These were followed by logistic regression analysis for the injury types in order to determine the impact of the 2 main causes of cranio-maxillofacial injuries (road traffic accidents and assault) in relation to the place of hospitalization. This regression analysis used the method of maximum likelihood through the Newton–Raphson algorithm.

This study respects Helsinki Declaration principles and has been approved by University of Naples Ethical Committee.

RESULTS

The study population consisted of 967 patients, 414 patients (43%) were treated at the UNINA while 553 (57%) at the UNICZ; 657 patients were males (67.9%) while 310 were females (32.1%), with a male to female ratio of 2.1:1 (Table 1).

The patients were divided into 8 groups according to their age (Table 2). The highest fracture incidence has been reported in the age group between 30 and 40 years old (24.6%) (Fig. 2). The mean patient age was 38 years for men and 45 for women. Furthermore, the observed mean age was different in the 2 study populations: UNINA presented a mean age that was included in the range age of 30 to 40 (102 patients, 24.6%) while UNICZ in the range age of 0 to 25 (148 patients, 26.2%).

TABLE 1. Percentage of Facial Trauma Occurred in Relation to Gender

Sex	Naples		Catanzaro		Total	
M	299	30.9%	358	37.0%	657	68%
F	115	11.9%	195	20.2%	310	32%
Total	414	42.8%	553	57.2%	967	100.0%

In both hospitals, significant difference in age groups for male and female patients has been founded (Table 3). At UNINA, men were most affected between 30 and 40 years (26.4%), while women presented the same incidence between 0 and 25 and 31 and 40 years (20%). At UNICZ, men presented a higher incidence of facial trauma than women in the first 25 years (31.3%) of their life, while women had a higher likelihood of facial injury after 70 years (24.7%).

The majority of 967 patients examined were Italians (762; 78.58%), followed by Polish (69; 7.1%), North Africans (55; 5.7%), Romanian (53; 5.5%), Asian (17; 1.8%), and British (11; 1.1%) (Fig. 3). The percentage of foreign patients was significantly higher in UNICZ (25.7% vs. 15.2%) (Table 4).

The cohort of 967 patients of this study presented with a total of 1128 fractures (Table 5). The mandible was the most frequently interested bone in both hospitals (399 patients, 35.4%), followed by orbito-maxillo-zygomatic complex (337 patients, 29.9%), orbital walls (160 patients, 14.2%), nasal bones (129 patients, 11.4%), maxilla fractures (48 patients, 4.3%), NOE (33 patients, 2.9%), and frontal sinus fractures (22 patients, 2%). Within the group with mandible fractures, the condyle has been the most involved segment with 114 patients (10.1%) followed by the body (102 patients, 9%).

The most frequent cause of facial injury on a sample of 967 patients was assault, with 294 patients (30.4%), followed by road traffic accident with 263 patients (27.2%), falls with 224 patients (23.2%), sport accidents with 149 patients (15.4%), and other traumatic events with 37 patients (2.6%) (Table 6).

A significant difference in the causes of fractures has been observed between Italian and foreigner patients. Road traffic accidents are responsible for 51.3% of the fractures in Italian patients and only 11.6% in foreigners. On the contrary, in foreigners, assaults are the most frequent cause of fracture (42.9%, considering only foreign males 65.3%) while in Italians this percentage drops to 27.7%. In UNINA sample, the most frequent cause of facial injury was road traffic accidents (138 patients, 14.3%); out of these 50 (36.2%) were involved in motorcycle accidents, 46 (33.3%) in car accidents, 22 (15.9%) in bicycle accidents, 20 (14.5%) in pedestrian accidents, facial injuries caused by assaults were 116 (15.9%), in

TABLE 2. Percentage of Facial Trauma Occurred in Relation to Age Groups

Age	Naples		Catanzaro		Total	
0–25	82	19.8%	148	26.8%	230	23.8%
26–30	46	11.1%	63	11.4%	109	11.3%
31–40	102	24.6%	136	24.6%	238	24.6%
41–50	75	18.2%	46	8.3%	121	12.5%
51–60	54	13%	25	4.6%	79	8.2%
61–70	38	9.2%	40	7.2%	78	8.1%
71–80	15	3.6%	86	15.5%	101	10.4%
81–100	2	0.5%	9	1.6%	11	1.1%
Total	414		553		967	

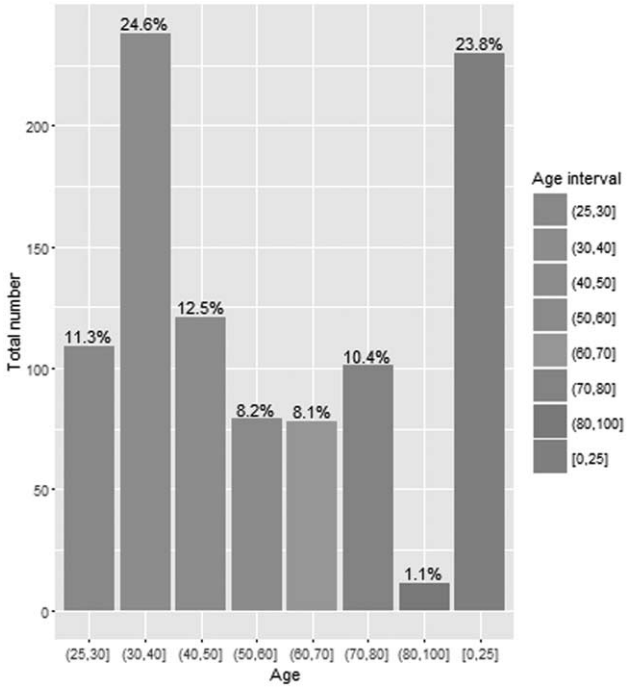

FIGURE 2. Total age distribution.

particular 114 (28%) were due to interpersonal violence and 2 (0.1%) due to gunshot attacks. Assaults were instead responsible for 116 facial traumas (28%). On contrary, the most frequent causes of facial traumas in UNICZ sample were assaults with 178 patients (32.2%); out of these, 152 fractures (85.4%) for interpersonal violence and 26 (14.6%) for gunshot attacks. In this center, falls were the second most frequent cause (137 patients, 24.8%) while road traffic accidents account for 22.6% of the patients (125 patients).

The chi-squared test results report a statistic dependence of 2 qualitative variables considered: ''place of the trauma'' and ''cause of the trauma'' ($P = 0.004$); however, their dependence is not so strong: Cramer value = 0.18.

The results of the chi-squared test, comparing the variables place of trauma and road accidents, as cause of the facial trauma, reported a statistic dependence ($P = 0.0002$) (Cramer V = 0.11); while there is no statistic dependence in the variables place of trauma and assaults as cause of facial trauma ($P = 0.18$). The results of the

TABLE 3. Distribution of Patients in the 2 Hospital According to Gender and Age

	Sex					Sex				
Age	F		M		Total Naples	F		M		Total Catanzaro
0–25	23	20%	59	19.7%	82	36	18.5%	112	31.3%	148
26–30	11	9.6%	35	11.7%	46	14	7.2%	49	13.7%	63
31–40	23	20%	79	26.4%	102	49	25.1%	87	24.3%	136
41–50	20	17.4%	55	18.4%	75	17	8.7%	29	8.1%	46
51–60	17	14.8%	37	12.4%	54	4	2%	21	5.9%	25
61–70	13	11.3%	25	8.4%	38	27	13.8%	13	3.6%	40
71–80	7	6.1%	8	2.7%	15	43	22.1%	43	12%	86
81–100	1	0.8%	1	0.3%	2	5	2.6%	4	1.1%	9
Total	115		299		414	195	35.3%	358	64.7%	553

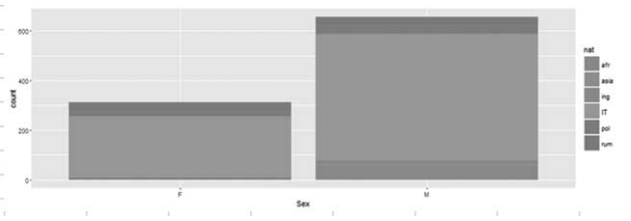

FIGURE 3. Geographical origin and gender distribution.

regression analysis report that the likelihood to have a facial trauma caused by a road accident in Catanzaro is 32%, while the likelihood to have a facial trauma caused by a road accident in Naples is 39%. The odds ratio reports that the probability to have a facial trauma caused by a road accident in UNINA is 1.38 times higher than in UNICZ.

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 incidence of maxillofacial injuries on this cost it is calculated to be around €160 million.[18] This study analyzed maxillofacial fracture epidemiology during a 5-year period, between January 2011 and December 2015, in 2 different cities of 2 Italian regions: Naples, a metropolitan city in Campania region, that covers a population of 3,107,009 inhabitants and Catanzaro, in Calabria region, that covers a population of 362,343.[19]

This study analyzes a total population of 967 patients with 1128 facial fractures. According to other studies,[7,11,20–22] the mandible was the most common fracture site detected (35.4%), followed by zygomatic complex (29.9%).

According to literature data,[3,4–7,11,13,21–23] maxillofacial fractures occurred most frequently in people aged between 19 and 39 years and male patients are significantly more affected than female (2.1:1) as young male patients have intense social interaction and a high rate of mobility taking part more likely in dangerous exercises, unsafe driving, and interpersonal violence.

Several studies report that the most common causes of facial bone fractures are represented by assaults, falls, road traffic, sport, and work-related accidents.[20] The incidence and the causes of facial injuries may be influenced by socio-demographic factors, cultural substrate, and environmental and economic factors. The analysis of this factors is crucial in order to validate operative protocols regarding the management of patients with maxillofacial trauma in order to obtain an optimal management.[7,11,24–27]

The main cause was represented by assaults (294 patients), followed by road traffic accidents (263 patients), accidental falls (224 patients), and sport accidents (149 patients). These data are in accordance with other European epidemiological studies that report interpersonal violence as the major cause of facial fractures in developed countries.[4,5] It is interesting to note that the major cause of facial injuries at UNINA appears to be road traffic accidents. Furthermore, with respect to road accidents, it is more common to find facial fractures caused by cyclists and motorcyclists at UNINA

TABLE 4. Patient's Nationality in the Two Centers

	UNINA	UNICZ	TOTAL
Italian	351 (84.8%)	411 (74.3%)	762 (78.8%)
Foreigners	63 (15.2%)	142 (25.7%)	205 (21.2%)
TOTAL	414	553	967

TABLE 5. Fracture Site Frequencies

Fracture	Catanzaro		Naples		Total	
OZM	191	29.3%	146	30.1%	337	29.9%
Mandibular	260	40%	139	29.1%	399	35.4%
Angle	41	6.3%	19	4%	60	5.3%
Condyle	71	10.1%	43	9%	114	10.1%
Coronoid process	5	0.8%	0	0%	5	0.4%
Body	53	8.1%	49	10.2%	102	9.0%
Sinfisis	34	5.2%	24	5%	58	5.1%
Ramus	56	8.6%	4	0.8%	60	5.3%
Maxilla	30	4.6%	18	3.7%	48	4.3%
Le Fort I	17	2.6%	10	2.1%	27	2.4%
Le Fort II	10	1.5%	5	1%	15	1.3%
Le Fort III	3	0.5%	3	0.6%	6	0.5%
NOE	29	4.5%	4	0.8%	33	2.9%
Nose	63	9.7%	66	13.8%	129	11.4%
Orbital	66	10.1%	94	19.7%	160	14.2%
Frontal sinus	11	1.7%	11	2.3%	22	2.0%
Total	650	57.6%	478	42.4%	1128	100.0%

NOE, naso-orbital-ethmoid; OZM, orbital-zygomatic-maxillary complex.

than at UNICZ, where it is more frequent to find facial injuries caused by car accidents. The Italian legislature attempted, over the years, to promote a national plan for road safety (Law 144 of 17.7.1999) and subsequent regional implementation plans (declaration of 21.12.2007). These laws gave more relevance to the actuation of a road safety program, adjusting speed limits, introducing new seat belts, helmet laws, personal protecting equipment, and car seats for children. A diffuse violation of these laws in Campania contributed, in our sample at the UNINA, toward a higher percentage (31.62%) of facial injuries caused by traffic accidents. On the other hand, at UNICZ, the major cause of facial injuries appears to be assaults (178 patients), followed by falls (137 patients). It is interesting to note that aggressive behavior due to socioeconomic inequalities and uncontrolled immigration are likely to have caused such a remarkable increase of accidents by interpersonal violence. The highest rate of aggression-related facial fractures that had occurred in the last 2 years, in correspondence of illegal landings on the coasts of Sicily and Calabria, involved mainly men of African nationality. Another important point is that the study was conducted in 2 trauma centers that accept all types of facial traumas. Although in Naples there are other trauma centers treating facial fractures, Catanzaro UNICZ hospital is the only facial trauma center in Calabria region. Therefore, it is questionable whether the results of the present study can be extensible to the whole Naples population.

TABLE 6. Etiology of the Fractures

Cause	Hospital				Total	
	Catanzaro		Naples			
Assaults	178	32.2%	116	28%	294	30.4%
Interpersonal violence	152	27.5%	114	27.5%	266	27.5%
Gunshot	26	4.7%	2	0.5%	28	2.9%
Falls	137	24.8%	87	21%	224	23.2%
Domestic	86	15.6%	67	16.2%		
Work-related	51	9.2%	20	4.8%	71	7.3%
Sport	79	14.3%	70	16.9%	149	15.4%
Road	125	22.6%	138	33.3%	263	27.2%
Car	61	11%	46	11.1%	107	11.1%
Bicycle	35	6.3%	22	5.3%	57	5.9%
Motorcycle	12	2.2%	50	12.1%	62	6.4%
Pedestrian	17	3.1%	20	4.8%	37	2.6%
Other	34	6.1%	3	0.7%	37	2.6%
Total	553	57.2%	414	42.8%	967	

Percentages of causes of maxillofacial trauma.

CONCLUSION

This study, that evaluated maxillofacial injuries occurred in 2 different Italian regions, confirms the correlation between the incidence and etiology of facial fractures and the geographical, cultural, and socioeconomic features of a population. Moreover, it shall give a message on prevention measures aimed to reduce facial injuries caused by road accidents and for the allocation of healthcare resources. This could be an important topic of discussion to design future regional plans of stricter rules for road safety. 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 are victims of violence and crime.

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