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ORIGINAL ARTICLE

Characteristics and age-related injury patterns of maxillofacial fractures in children and adolescents: A multicentric and prospective study

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Abstract

Background/Aims: Paediatric maxillofacial trauma accounts for 15% of all maxillofacial trauma but remains a leading cause of mortality. The aim of this prospective, multicentric epidemiological study was to analyse the characteristics of maxillofacial fractures in paediatric patients managed in 14 maxillofacial surgery departments on five continents over a 1-year period.

Methods: The following data were collected: age (preschool [0–6 years], school age [7–12 years], and adolescent [13–18 years]), cause and mechanism of the maxillofacial

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fracture, alcohol and/or drug abuse at the time of trauma, fracture site, Facial Injury Severity Scale score, associated injuries, day of the maxillofacial trauma, timing and type of treatment, and length of hospitalization. Statistical analyses were performed using SPSS software.

Results: Between 30 September 2019 and 4 October 2020, 322 patients (male:female ratio, 2.3:1) aged 0–18 years (median age, 15 years) were hospitalized with maxillofacial trauma. The most frequent causes of the trauma were road traffic accidents (36%; median age, 15 years), followed by falls (24%; median age, 8 years) and sports (21%; median age, 14 years). Alcohol and/or drug abuse was significantly associated with males ($p < .001$) and older age ($p < .001$). Overall, 474 fractures were observed (1.47 per capita). The most affected site was the mandibular condyle in children <13 years old and the nose in adolescents. The proportion of patients who underwent open reduction and internal fixation increased with age ($p < .001$).

Conclusion: The main cause of paediatric maxillofacial fractures was road traffic accidents, with the highest rates seen in African and Asian centres, and the frequency of such fractures increased with age. Falls showed an inverse association with age and were the leading cause of trauma in children 0–6 years of age. The choice of treatment varies with age, reflecting anatomical and etiological changes towards patterns more similar to those seen in adulthood.

KEYWORDS
adolescent, children, epidemiology, maxillofacial fractures, multicentric, prospective

1 | INTRODUCTION

Maxillofacial fractures in children and adolescents account for less than 15% of all facial fractures.[1–4] Despite their relatively low incidence, facial trauma remains one of the leading causes of morbidity and mortality,[5] with large costs for national healthcare systems because they often necessitate intensive care unit stays as a result of polytrauma.[6,7] Several studies have reported wide variability in estimates of facial trauma age and gender distribution, cause, and pattern of injuries.[2,7–9] Imahara et al[2] reported that nasal/maxillary fractures and mandibular/nasal fractures were the most common fractures in children and adolescents, respectively, while Costa et al[10] reported alveolar fractures and mandibular fractures in the same groups. Grunwaldt et al[7] reported orbital fractures as the most common site across all age groups. In addition, characteristics of facial injuries in children and adolescents also vary among countries due to demographic, socioeconomic and environmental differences. Articles on the epidemiology of maxillofacial fractures in children and adolescents, which have often been monocentric and retrospective, have reported road traffic accidents (RTAs) as the most common cause in Africa,[11–13] Oceania[14,15] and America,[16–19] while falls were the most common in Europe[6,20,21] and Asia.[22–25] The aim of this epidemiological and prospective study was to analyse the characteristics of oro-maxillofacial trauma in children and adolescent populations hospitalized in 14 worldwide oral–maxillofacial surgery departments in the World Oral Maxillofacial Trauma (WORMAT) project during a 1-year period.

2 | MATERIALS AND METHODS

This study collected data on patients aged from 0 to ≤18 years old with oral–maxillofacial trauma who had been hospitalized between Monday 30 September 2019 and Sunday 4 October 2020 in the following 14 maxillofacial surgery departments:

- 5 in Europe (Department of Oral and Maxillofacial Surgery, Paracelsus Medical University Salzburg, Austria; Department of Oral and Maxillofacial Surgery, Hippocratio General Hospital, Athens, Greece; Division of Maxillofacial Surgery, University of Turin, Italy; Department of Oral and Maxillofacial Surgery, Hospital Universitario Vall d'Hebron, Barcelona, Spain; Department of Oral and Maxillofacial Surgery, University of Dundee, United Kingdom).
- 4 in Asia (Department of Oral and Maxillofacial Surgery, Aligarh Muslim University, India; Oral and Maxillofacial Disease Research Centre, Mashhad University of Medical Sciences, Iran; Department of Oral and Maxillofacial Surgery, Gazi Alhariri Hospital, Medical City, Baghdad, Iraq; Department of Oral and Maxillofacial Surgery, Dharan, Nepal).

- 2 in Africa (Maxillofacial Surgery Unit, Department of General Surgery, Faculty of Medicine, Sohag University, Egypt; Department of Oral and Maxillofacial Surgery, College of Medicine, University of Ibadan, Nigeria).
- 2 in South America (Department of Diagnosis and Surgery, Division of Oral and Maxillofacial Surgery, Araraquara Dental School, UNESP, São Paulo State University; Department of Diagnosis and Surgery, Division of Oral and Maxillofacial Surgery, Araçatuba, UNESP, São Paulo State University).
- 1 in Australia (Department of Plastic, Reconstructive, and Maxillofacial Surgery, Nepean Hospital, Sydney).

The following data were collected: age (preschool age [0–6 years], school age [7–12 years], and adolescent [13–18 years]), gender, cause of the trauma (fall, RTA, assault, accident at work, sports injury, other), mechanism of fracture (Table 1), alcohol and/or drug abuse at the time of trauma, maxillofacial fracture site, Facial Injury Severity Scale (FISS) score,[26] associated injuries (orthopaedic, neurological, spinal, ocular, thoracic and/or abdominal), day and month of the trauma, time of treatment (within or after 24 h of admission), type of treatment (observational, closed reduction, or open reduction with internal fixation [ORIF]) and length of hospital stay.

All statistical analyses were performed using SPSS software (version 27.0, IBM Corporation). Quantitative data analyses were performed using the chi-square test for categorical variables and the Mann–Whitney *U* test or Kruskal–Wallis test for categorical and continuous variables, as appropriate. Kendall's tau was used to investigate the correlation between non-normally distributed variables. All statistical tests were two-tailed, and $p < .05$ was deemed statistically significant.

This study was approved by the relevant institutional review boards. All relevant guidelines of the Declaration of Helsinki were followed.

3 | RESULTS

Between 30 September 2019 and 4 October 2020, 2387 patients were hospitalized with maxillofacial trauma. Of these, 322 patients, 226 males and 96 females (male:female ratio [M:F], 2.3:1), were between 0 and 18 years of age (median [interquartile range, IQR] age, 14 [8] years). Male patients were significantly older (median [IQR] age, 15 [6] years) than females (median [IQR] age, 10.5 [8] years) ($p < .001$).

The most frequent cause of the maxillofacial trauma was RTAs (117 patients [36%]; median [IQR] age, 15 [7] years), with the highest frequencies in Asian (50%) and African (47%) departments (Figure 1). The M:F ratio of these patients was 2.2:1 (80 males, 37 females). Forty-seven patients (31 drivers and 16 pillions) were involved in motorcycle accidents (83% were not wearing helmets), 41 were cyclists (80% falls to the ground), and 16 were pedestrians hit by a car or motorcycle. The remaining 14 patients (2 drivers and 12 passengers) were involved in car accidents (79% had not worn seat belts) (Table 1). When considering car and motorcycle accidents, 82% of the patients were not wearing safety devices (seatbelts or helmets) and this rate was high both in surgery departments where RTAs were the main cause of fracture (African and Asian units, 88%) and in the remaining surgery departments (58%).

The second most frequent cause of maxillofacial trauma was falls (77 patients [24%]; median [IQR] age, 8 [8] years). The M:F ratio of these patients was 1.1:1 (41 males, 36 females). In the overall study population, falls were a significantly more frequent cause of injury in females (38% of all causes) than in males (18%) ($p < .001$). The mechanisms of the falls included slipping, tripping, or stumbling (27 patients), falling from a height of ≤3 m (19 patients), falling from stairs (15 patients), falling from a height of ≥3 m (14 patients) and falling due to a loss of consciousness (2 patients) (Table 1).

Sports injuries were the third most frequent cause of trauma (67 patients [21%]; median [IQR] age, 14 [5] years) everywhere except Austrian and Italian surgery departments, where they were the number one cause (Table 2). The M:F ratio of these patients was 3.8:1. Overall, sports injuries were a more common cause of injury in males (24% of all causes) than in females (15%), but the difference was not statistically significant ($p > .05$). Most cases ($n = 42$) were due to team ball/stick and racquet sports, particularly soccer (Table 1). The most frequent mechanism of injury was impact with the ground (33 patients), followed by impact with a player/opponent (24 patients) and impact with equipment (10).

The fourth most common cause of injury was assault (53 patients [16%]; median [IQR] age, 14 [5] years), which ranked first in the Australian and Spanish units (Table 2). Punching and/or kicking were responsible for 88% of these injuries (Table 1). The M:F ratio was 6.6:1 (46 males and 7 females). Assaults were a significantly more common cause of trauma in males (20% of all causes) than in females (7% of all causes) ($p = .004$).

Only two male patients (mean age, 17 years) suffered work-related maxillofacial fractures.

Alcohol/drug abuse at the time of trauma was recorded in 31 patients (median [IQR] age, 17 [1] year), all of whom were adolescents (9.6%) and males, except for one female patient. The association with male gender was statistically significant ($p < .001$). In addition, patients who abused alcohol or drugs were significantly older (median [IQR] age, 13 [8] years) ($p < .001$). Sixteen cases were associated with RTA, 14 with assaults and 1 with a fall.

The 322 patients in this study sustained 474 fractures (1.47 fractures per patient), half of which (53%) involved the lower third of the face, followed by the middle third (45%) and upper third (2%). As summarized in Table 3, the mandibular condyle was the most frequently affected site, followed by the nose.

The median [IQR] FISS score was 2 [2] points. The FISS score was not significantly different between males (median [IQR], 2 [2]) and females (median [IQR], 1.5 [2]). Eighty concomitant injuries were reported in 63 (28%) patients, with orthopaedic (39%) and encephalic (35%) injuries being the most frequently observed, followed by abdominal (11%), thoracic (6%), ocular (5%) and spinal injuries (4%). The presence of at least one concomitant injury was associated with a

TABLE 1 Distribution of causes and mechanisms of maxillofacial fractures by age group

	Cause of fracture	Preschool	School Age	Adolescent	TOTAL
ASSAULT	Fist	0	4	33	37
	Blunt Force Trauma	0	1	5	6
	Fist & Kick	0	1	5	6
	Kick	0	0	4	4
	TOTAL	0	6	47	53 (16.5%)
FALLS	Slipping+Tripping+Stumbling	12	11	4	27
	Fall from height < 3 m	4	5	10	19
	Fall from stairs	7	7	1	15
	Fall from height > 3 m	3	6	5	14
	Loss of consciousness	0	0	2	2
	TOTAL	26	29	22	77 (23.9%)
RTA	Bicycle falls with impact on the ground	1	11	21	33
	Bicycle collides against car or motorcycle	0	1	7	8
	Car with seatbelts driver	0	0	1	1
	Car without seatbelts driver	0	0	1	1
	Car with seatbelts passenger	1	0	1	2
	Car without seatbelts passengers	1	2	6	10
	Motorcycle with helmet driver	0	0	5	5
	Motorcycle with helmet pillion	0	1	2	3
	Motorcycle without helmet driver	1	1	24	26
	Motorcycle without helmet pillion	2	6	5	13
	Pedestrian hit by car or motorcycle	3	7	6	16
	TOTAL	9	29	79	117 (36.3%)
SPORT	team ball/stick and racquet sports	1	12	29	42
	wheeled non-motor sports	3	5	3	11
	athletic activities and individual water sports	0	2	6	8
	Ice or snow sports	0	0	3	3
	Equestrian activities	0	0	2	2
	Wheeled motor sports	1	0	0	1
	TOTAL	5	19	43	67 (20.8%)
WORK	Farm and forestry workers	0	0	2	2 (0.6%)
OTHER	Recreational activities	4	1	0	5
	Iatrogenic	0	0	1	1
	TOTAL	4	1	1	6 (1.9%)

Abbreviations: RTA, road traffic accident.

significantly higher FISS score (median [IQR], 2 [3] vs. 2 [1] points) ($p < .001$) and a longer hospitalization stay (mean ± standard deviation [SD], 4.7 ± 4.2 vs. 2.0 ± 1.8 days) compared with maxillofacial fractures alone ($p < .001$). Associated injuries were significantly more common in patients with trauma from RTA (39% of patients) than from other causes ($p < .001$).

The incidence of facial trauma did not differ according to the day of the week or the month in which the trauma occurred, but a decrease in incidence was reported from February to May in the European and African surgery departments.

A total of 110 patients (44%) were treated within 24 h. Of all patients, 117 (36%) underwent ORIF (median [IQR] age, 16 [4] years), 118 (37%) underwent closed reduction (median [IQR] age, 12 [7] years), and 87 (27%) did not receive surgical treatment (median [IQR] age, 13 [11] years) (Table 4). A positive correlation was found between the FISS score and hospitalization stay (Kendall's tau, 0.331; $p < .001$, $n = 322$).

According to age, the preschool group consisted of 44 patients (14%), comprising 26 males and 18 females (M:F, 1.4:1), whose fractures were caused mainly by falls (59%) (Table 1). The

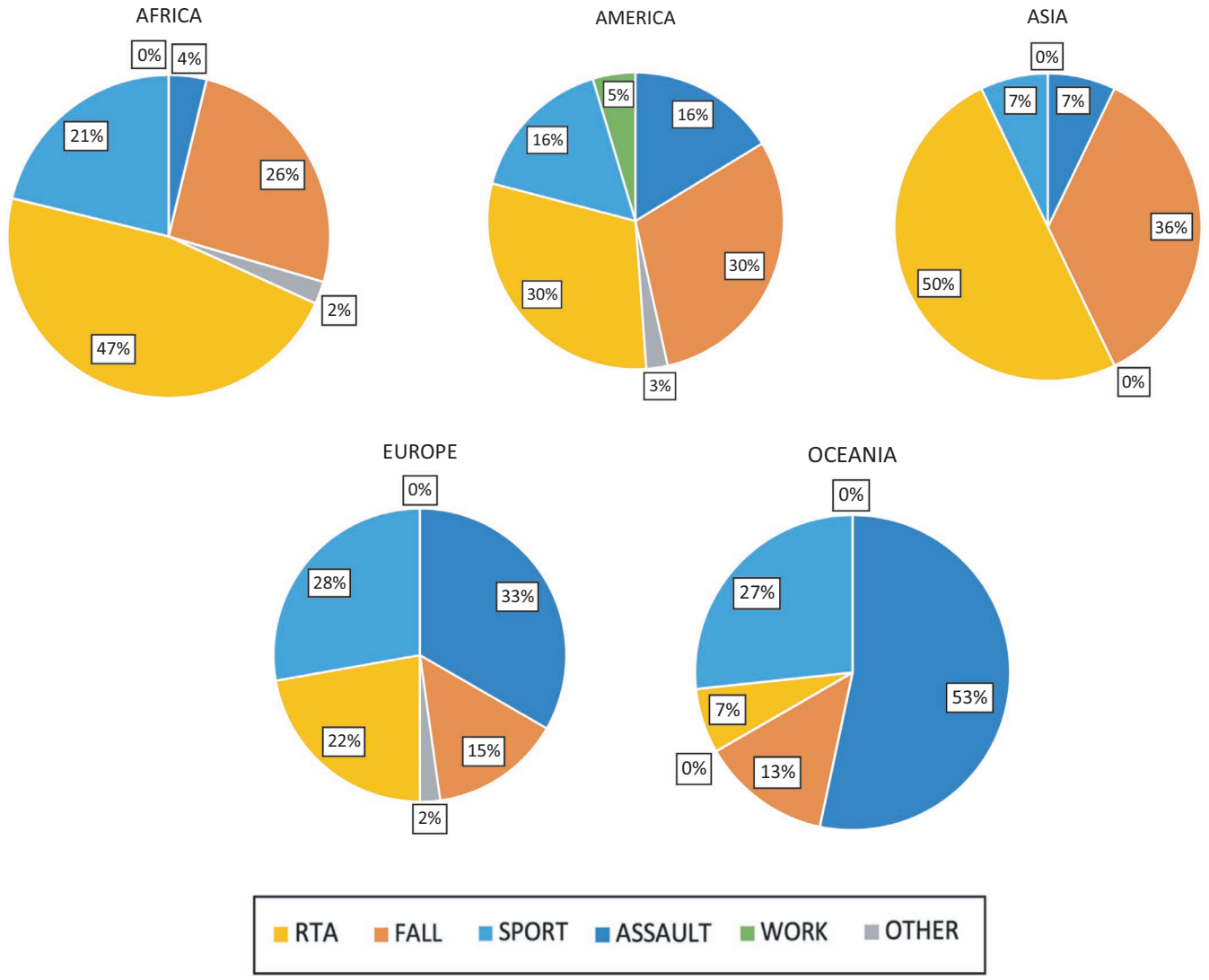

FIGURE 1 Distribution of the causes of the maxillofacial fractures by continent

lower third of the face was the most affected, particularly the mandibular condyle, followed by the orbito–maxillo–zygomatic complex in the middle third of the face (Table 5). The median (IQR) FISS score was 1 (1) point. Eight patients reported concomitant injuries (18%). Of the 44 patients, 9 were treated within 24 h (20%). In the preschool group, 24 patients did not undergo surgical treatment, 17 underwent closed reduction, and 3 underwent ORIF (Table 4). The mean (SD) hospitalization stay was 1.8 (2.9) days.

The school age group consisted of 84 patients (26%), comprising 43 males and 41 females (M:F, 1:1), with fractures caused mainly by falls (35%) and RTAs (35%) (Table 1). The most frequently affected site was the lower third of the face, particularly the mandibular condyle (Table 5). The median (IQR) FISS score was 2 (2) points. Eighteen patients (21%) reported 23 concomitant injuries. Thirty-three were treated within 24 h (39%). In this group, 45 patients underwent closed reduction followed by ORIF (20) and no treatment (19) (Table 4). The mean ± SD hospitalization stay was 2.2 ± 2.4 days.

Finally, in the adolescent group, 194 patients (60%), comprising 157 males and 37 females (M:F, 4.2:1), suffered facial trauma due to RTAs (40%) and assaults (24%) (Table 1). The lower third of the face was the most affected area, while the nose was the main affected site (Table 5). The median (IQR) FISS score was 2 (2) points. Thirty-seven patients (19%) reported 49 concomitant injuries. Sixty-eight patients (35%) underwent surgery within 24 h of trauma. In this group, 94 patients underwent ORIF, followed by closed reduction (56) and no treatment (44) (Table 4). The mean ± SD hospitalization stay was 2.8 (2.9) days.

Overall, the proportion of patients who underwent ORIF increased with age ($p < .001$). The FISS score did not differ significantly according to age group but showed an increasing trend with age. The hospitalization stay significantly increased with age ($p = .014$).

4 | DISCUSSION

The aim of this prospective study of maxillofacial trauma in children and adolescents was to show the characteristics and patterns of

TABLE 2 Summary of maxillofacial fracture characteristics in children and adolescent populations across the WORMAT centres

Continent	Country	N° of patients	M:F ratio	Median age (IQR)	Main cause of injury	Main site of fracture	Median FISS score (IQR)	Mean hospital stay in days (SD)
Africa	Egypt	119	2.8:1	13 (9)	RTA (45%)	Mandibular Condyle	2 (1)	2.4 (3.1)
	Nigeria	13	1.6:1	12 (12)	RTA (69%)	OMZc	1 (1)	5.0 (5.0)
Asia	India	12	5:1	13 (5)	RTA (58%)	Parasymphysis	2 (1)	4.3 (1.5)
	Iran	7	1.3:1	12 (10)	RTA (43%)	Nose	2 (2)	1.3 (0.5)
	Iraq	6	2:1	15 (8)	RTA (50%)	OMZc	1.5 (1)	2.0 (1.1)
	Nepal	17	1.4:1	16 (7)	RTA (47%)	OMZc	2 (1)	2.9 (3.0)
Europe	Austria	10	4:1	16 (2)	Sport (50%)	Orbital floor	2 (3)	4.6 (1.4)
	Greece	7	7:0	16 (1)	RTA (43%)	Mandibular body	2 (1)	5.7 (3.5)
	Italy	14	13:1	16 (3)	Sport (36%)	Mandibular Condyle	1.5 (3)	3.9 (1.5)
	Spain	45	1.25:1	15 (5)	Assault (40%)	Nose	1 (1)	1.7 (1.4)
	UK	14	2.5:1	13.5 (4)	RTA (36%)	Orbital floor	1 (0)	1.9 (2.7)
America	Brazil 1	27	2:1	8 (11)	RTA (33%) & Falls (33%)	Nose	1 (0)	1.7 (1.6)
	Brazil 2	16	1:1	12 (9)	RTA (25%), Falls (25%) and Assault (25%)	Nose	1 (1.5)	1.9 (1.2)
Oceania	Australia	15	6.5:1	17 (4)	Assault (53%)	Nose	1 (2)	1.3 (0.5)

Abbreviations: IQR, interquartile range; OMZc, orbito–maxillo–zygomatic complex; SD, standard deviation.

fractures among three distinct groups of patients admitted to different centres around the world.

In agreement with previous studies, this study found that maxillofacial injuries are rare before the age of 5 years, with their incidence progressively increasing from the beginning of school to adolescence.[27–29] In addition to anatomical changes associated with facial skeletal growth that make them more susceptible to fractures, the increase in maxillofacial injuries with age is attributed to children at school being engaged in more recreational and sports activities, together with a general decrease in parental supervision.[28,29] Subsequently, adolescents become more independent and develop more adult-like lifestyles, resulting from an increase in participation in social activities with a higher risk of assaults and motorcycle accidents.[3,28]

The male predominance (M:F, 2.3:1) in this study is also in agreement with several recent studies.[2,27,30–34] This ratio progressively increased with age, from 1.4:1 in the preschool group to 4.2:1 in the adolescent group, with males being significantly more represented in the 13–18-year age group ($p < .001$). This male preponderance is explained by behavioural differences between the two genders, in particular by more intense and hazardous physical activity along with an increase in motorcycle accidents and interpersonal violence among males.[28] Injuries due to RTA, sports and assaults showed an increasing trend with age, with the highest rate in the adolescent group, in which there was a strong male predominance (4:1, 4:1 and 11:1 respectively).

According to several authors, RTA is the main cause of oro-maxillofacial fractures.[18,23,27,35] Patients suffering trauma from RTA had the highest median age among the causes of trauma, with 68% of all RTA-related fractures in the adolescent group (Table 1). In addition, RTA was the main cause of maxillofacial paediatric fractures in all African and Asian centres, ranging from 42% to 69% (Table 2), in agreement with several studies.[11,13,27,36–38] As reported previously, a reason for the high rate of this type of injury in developing countries may be the widespread use of motorcycles and badly maintained roads, but most importantly the lack of enforcement and implementation of road rules and policies.[37] In contrast, lower incidences of RTA-related fractures in developed countries are related to the strict application of safety policies, including the mandatory use of seatbelts, motorcycle helmets and child restraints.[6,21,39,40] The current study showed that most patients (82%) involved in car or motorcycle accidents did not wear protection. This is a relevant problem not only in African and Asian centres, where RTA represents the main cause of fracture, but also in the remaining centres, suggesting that further informative and educational measures for both parents and children should be implemented to encourage the use of road safety devices. RTA-related injuries affected the middle and lower third of the face almost equally, with the orbito–maxillo–zygomatic complex and mandibular condyle being the most affected sites respectively (Table 3). In addition, they were characterized by more complex injuries, as reflected by the FISS score, and a significant association with concomitant

TABLE 3 Distribution of the sites and subsites of the fractures by cause of the trauma

Site of fracture	RTA	Falls	Sport	Assault	Work	Others	Total
Upper third of the face (11)							
Anterior wall	5	3	1	0	0	0	9
Anterior and posterior wall	2	0	0	0	0	0	2
Total	7	3	1	0	0	0	11 (2%)
Middle third of the face (212)							
Dentoalveolar	22	10	6	0	0	1	39
Palatal bone	0	0	0	0	0	1	1
Le Fort I	3	0	0	0	0	1	4
Le Fort II	2	0	0	0	0	1	3
Le Fort III	2	0	0	0	0	0	2
OMZc	28	6	3	9	1	2	48
NOE	7	1	0	0	0	0	8
Nose	17	13	17	24	1	1	73
Orbital floor	5	3	6	4	0	1	19
Orbital medial wall	1	3	1	1	0	0	6
Orbital lateral wall	2	1	0	0	0	0	3
Orbital roof	4	2	0	0	0	0	6
Total	93	39	33	37	2	8	212 (45%)
Lower third of the face (251)							
Angle	8	2	3	11	0	0	24
Ascending ramus	3	1	0	3	0	0	7
Body	12	13	6	3	0	0	34
Condyle	27	27	25	3	0	0	82
Coronoid	0	0	0	0	0	0	0
Dentoalveolar	9	4	2	0	0	1	16
Parasymphysis	23	18	17	8	0	0	66
Symphysis	8	6	7	1	0	0	22
Total	90	71	60	29	0	1	251 (53%)

Abbreviations: OMZc, orbito–maxillo–zygomatic complex.

TABLE 4 Distribution of the type of treatment by age group

Treatment	Preschool n (%)	School Age *n* (%)	Adolescent *n* (%)	Total *n* (%)
ORIF	3 (7%)	20 (24%)	94 (48%)	117 (36%)
Closed treatment	17 (39%)	45 (53%)	56 (29%)	118 (37%)
No treatment	24 (54%)	19 (23%)	44 (23%)	87 (27%)

injuries ($p < .001$), confirming the severity of these injuries and accounting for the longer hospital stays.

Falls were the second most common cause of fracture in this study, and they were associated with the lowest median age among the other causes of injury and significantly associated with females. They were the main cause of maxillofacial fractures in the preschool group, consistent with other studies that have reported this age group to be prone to sustaining injuries from low-velocity forces (in almost half of the patients due to slipping, tripping, or stumbling).[24,27,41] This may be attributable to greater uncertainty in movement and poor coordination in children in this age group as they become more mobile and learn to walk and run.[41,42] In addition, the head-to-face ratio of 8:1 at birth, greater than the 2.5:1 in adults, explains the greater exposure to trauma in the upper third of the face, as reported by other studies.[22,27,28] In this study, 55% of upper-third facial fractures were sustained by preschool children (Table 5). On the contrary, adolescents were more likely to be exposed to high-velocity forces, as shown by the finding that 68% of falls in the adolescent group were due to a

TABLE 5 Distribution of the sites and sub-sites of the fractures by age group

Third	Site of fracture	Preschool	School Age	Adolescent	Total
Upper Third of the face (11)	Anterior wall	6	2	1	9
	Anterior and posterior wall	0	0	2	2
	Total	6	2	3	11 (2%)
Middle third of the face (212)	Dentoalveolar	4	13	22	39
	Palatal bone	0	0	1	1
	Le Fort I	1	1	2	4
	Le Fort II	0	0	3	3
	Le Fort II	0	0	2	2
	OMZc	5	7	36	48
	NOE	0	3	5	8
	Nose	3	21	49	73
	Orbital floor	2	4	13	19
	Orbital medial wall	2	2	2	6
	Orbital lateral wall	1	1	1	3
	Orbital roof	2	4	0	6
	Total	20	56	137	212 (45%)
Lower Third of the face (243)	Angle	2	0	22	24
	Ascending ramus	0	1	6	7
	Body	5	8	21	34
	Condyle	12	29	41	82
	Coronoid	0	0	0	0
	Dentoalveolar	4	2	10	16
	Parasymphysis	6	23	37	66
	Symphysis	3	7	12	22
	Total	32	70	149	251 (53%)

Abbreviations: OMZc, orbito–maxillo–zygomatic complex.

fall from a height, compared with only 27% in the preschool group (Table 1).[6,30] Fall-related injuries mainly affected the lower third of the face, with the condyle being the most affected site, in line with several other studies.[24,42] In order to reduce the incidence of fall-related facial trauma, it is important to advise parents, especially those with young children, to intensify their supervision during recreational activities inside and outside the home.

With a slightly lower rate than falls, sport-related maxillofacial injuries were the third most common cause of maxillofacial fractures in this sample population, but remarkably the first cause in the Austrian and Italian centres (Table 2). As shown in Table 1, sport-related fractures increased with age, and this was attributed to progressively more unsupervised and more aggressive physical activity, especially among males.[21,30,39] Team ball/stick and racquet sports were the major contributors to fractures, particularly soccer, which is the most popular sport in schools and amongst adolescents worldwide. Sports-related injuries caused fractures mainly in the lower third of the face (64%), with the condyle and parasymphysis being the most affected subsites, in contrast to that reported in the literature.[43–45]

Assault was the fourth most common cause of trauma, but the first in the Australian and Spanish centres (Table 2). In accordance with the literature, assault was an uncommon cause in the preschool group and occurred more frequently in male adolescents, with rates and patterns similar to those in adults (Table 1).[1,46,47] Likewise, the fracture sites were similar, namely, the middle third of the face and particularly the nose.

The nose and condyle were the most common fracture sites, showing an opposite trend with age, with one (condyle) decreasing and the other (nose) increasing with age, which is consistent with other reports.[11,16,30,41,48] This is attributable to the peculiar paediatric anatomical features of these two sites. The highly vascularized condyle and its thin neck are susceptible to low-velocity trauma such as falls.[24,28,49] On the contrary, the nasal bones are the most susceptible in the facial skeleton, a factor that is associated with their relative prominence on the face, rendering this site more prone to injury with older age.[30,31]

Because of problems associated with interference with the growth and development of the facial skeleton, as well as with normal dental development, a minimalist approach (no treatment or closed reduction) is often the preferred management for maxillofacial fractures, especially of the mandibular condyle, in preschool and school age children.[24,28,35,50] On the contrary, as patients age,

the craniofacial skeleton approaches adult maturity, and ORIF is performed more frequently.[24,35,50] This was confirmed in this study, as only 7% of preschool children underwent ORIF, but this increased to almost 50% in the adolescent group, indicating a significant correlation with age.

5 | CONCLUSION

Although a complete global picture of this issue cannot be obtained from 14 centres, the results of this prospective epidemiological study on maxillofacial trauma in children and adolescents showed a male predominance and an increase in the incidence of maxillofacial fractures with advancing age. As age increased, there was a change in the causes of fracture, which became similar to those reported in the literature in adults, with RTA being the leading cause followed by falls. Although in this study, sample RTA-related injuries were observed mainly in developing countries, a lack of use of safety devices (helmets, seatbelts) was reported, albeit at different rates, in all of the centres participating in the WOMART project. Finally, although primarily epidemiological, this study showed a preference for conservative treatment and significant positive correlation between surgical treatment of maxillofacial fractures and age.

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CONFLICT OF INTEREST

The authors confirm that they have no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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