

Changes in Hospital Admissions for Facial Fractures During and After Covid 19 Pandemic: National Multicentric Epidemiological Analysis on 2,938 Patients.

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Abstract

Purpose: the purpose of this study was to retrospectively analyze the clinical records of patients admitted for maxillo-facial fracture to 18 Italian center, evaluating the epidemiological differences between the different phases of the SARS-CoV-2 pandemic.

Methods: This is a retrospective study on patients who underwent surgery for facial bone fractures in 18 maxillo-facial surgery departments in Italy, from February 23, 2020 to February 23, 2022. According to the date of admission, all the data were stratified in four chronological periods encompassing the four different moments in terms of restriction in Italy: pre-pandemic, first wave, partial restrictions and post-pandemic groups. Differences in epidemiological data between the groups were analysed.

Results: 2,938 patients were included. There was a statistically significant difference in the cause of hospitalization between pre-pandemic and first wave groups ($p=0.005$) and between pre-pandemic and partial restriction groups ($p=0.002$). The differences between the pre- and post-pandemic groups were instead not significant ($p=0.106$). Compared to the pre-pandemic period, the number of Black patients was significantly higher during the first wave and the post-pandemic period. Differences between the periods in terms of gender, age, type of fracture, treatment modality, and length of hospital stay were not found to be statistically significant.

Conclusions: during the COVID-19 pandemic there have been profound changes in the epidemiology of fractures influenced by the restrictive measures implemented by the government. At the end of the pandemic, the epidemiology of fractures returned to being the same as in the pre-pandemic period.**Purpose:** the purpose of this study was to retrospectively analyze the clinical records of patients admitted for maxillo-facial fracture to 18 Italian center, evaluating the epidemiological differences between the different phases of the SARS-CoV-2 pandemic.

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Conclusions: during the COVID-19 pandemic there have been profound changes in the epidemiology of fractures influenced by the restrictive measures implemented by the government. At the end of the pandemic, the epidemiology of fractures returned to being the same as in the pre-pandemic period.

INTRODUCTION

The SARS-CoV-2 pandemic originated in January 2020 and rapidly spread across the globe. To slow down the infection's spread, Italy, like the rest of the world, implemented a series of restrictive measures starting from March 2020. These measures, known as lockdown, limited personal contacts and people's movement. As infection cases decreased, restrictions were gradually eased, allowing a progressive return to normalcy.

Lockdown and subsequent restrictions significantly impacted people's lifestyle, and consequently, the epidemiology of maxillo-facial fractures in Italy and worldwide [2–7]. Some epidemiological studies have analysed the differences in frequency and etiology of facial fractures between the pandemic period and during the lockdown. However, these studies only included data from certain regions and did not provide a comprehensive picture of the situation in Italy. Furthermore, no studies have assessed the overall trend in facial trauma epidemiology throughout the various phases of the pandemic. Thus, it is not possible to determine whether significant differences in facial fracture epidemiology persist post-pandemic compared to the pre-pandemic era.

The purpose of this multicenter study was to retrospectively analyze the epidemiological characteristics of facial fractures in patients admitted to 18 Maxillofacial Surgery centers in Italy, evaluating the epidemiological differences between the different phases of the SARS-CoV-2 pandemic.

MATERIALS AND METHODS

This is a retrospective observational multicentric study, promoted by AUSL Bologna. Clinical records of patients admitted for craniofacial trauma from February 23, 2020 to February 23, 2022 in 18 Oral and Maxillo-Facial Units in Italy were reviewed: AUSL Bologna Bellaria-Maggiore Hospital (coordinator center), Torino University Hospital, Santi Paolo e Carlo Hospital of Milan, Maggiore Hospital of Parma, Santa Croce Carle Hospital of Cuneo, Riuniti Hospital of Ancona, University Hospital of Pisa, ASL Pescara Hospital, University Hospital of Perugia, University Hospital of Naples "Federico II", Magna Graecia University Hospital of Catanzaro, IRCCS "Casa Sollievo della Sofferenza" of San Giovanni Rotondo, Mazzini Hospital of Teramo, Ospedali Riuniti of Lanciano, Sassari University Hospital, Brotzu Hospital of Cagliari, Messina University Hospital, Palermo Civic Hospital. Patients managed with conservative treatment were excluded from the study.

According to the date of admission, all the data were stratified in four chronological periods encompassing the four different moments in terms of restriction in Italy:

1. Pre-pandemic group: from June 23, 2019 to February 23, 2020.
2. First wave group: from February 23, 2020 to October 23, 2020 corresponding to the lockdown and immediate post-lockdown period.
3. Partial restriction period group: from October 23, 2020 to June 23, 2021 corresponding to a period in which the Italian Ministry of Health stratified the different areas of concern with different levels of restrictions (ranging from bars and clubs' closure, social distancing, obligation to wear a mask in closed places, smart working, closure of leisure and sport clubs)

4. Post-pandemic group: from June 23, 2021 to February 23, 2022 corresponding to a period in which all restrictions have been lifted.

For each patients, epidemiological and demographic data were considered (age, gender, date of admission, ethnic group, cause of admission, in-hospital stay); the authors also stratified the groups by aethiology, dividing the types of fractures in high impact (injuries caused by a force 50 times and more the force of gravity) and low impact (all the fractures caused by force lower than 50 times the for of gravity) as described by Pappachan & Alexander [8]. High impact fractures included mandible, orbit and fronto-glabbellar fractures while zygomatic and nasal fractures were included in the low impact group.

Data were extracted from the electronic clinical records by two independent researchers. The study was approved by the CEAVEC Ethical Committee Board (n.192-2022-OSS-AUSLBO).

Statistical analysis

Statistical analysis was conducted with Statistical Package for Social Sciences (IBM, Chicago, Illinois, US) version 26.0. Continuous variables were expressed as median and interquartile range [IQR], while categorical variables were presented as frequencies and percentages. Comparisons between continuous variables were performed with the Mann-Whitney U test while the Chi-square test with Yates's correction for continuity were used for categorical variables. Bonferroni correction for multiple comparisons was performed [9]. Tests were 2-sided and a $p < 0.05$ was considered significant.

RESULTS

The data of 2938 patients who meet the inclusion criteria were included and analysed. Table 1 reports the data regarding the cause of admission subdivided for ethnicity, gender, pandemic period, treatment and type of fracture [Table 1].

Table 1
Descriptive analysis according to the causes of admission

Cause of admission								
Factor	Group	Aggression	Domestic	Sport	Suicidal Attempted	Traffic	Work	p value
N	2938	615	878	338	13	956	138	
Ethnic Group	Asian 17 (0.6)	5 (29.4)	2 (11.8)	3 (17.6)	0 (0.0)	6 (35.3)	1 (5.9)	< 0.001
N (%)								
	African 241 (8.2)	116 (48.1)	47 (19.5)	17 (7.0)	1 (0.4)	51 (21.2)	9 (3.7)	
	Caucasian 2680 (91.2)	494 (18.4)	829 (30.9)	318 (11.9)	12 (0.4)	899 (33.5)	128 (4.8)	
Gender	Female 701 (23.9)	58 (8.3)	374 (53.3)	50 (7.1)	5 (0.7)	203 (28.9)	11 (1.6)	< 0.001
N (%)								
	Male 2237 (76.1)	557 (24.9)	504 (22.5)	288 (12.9)	8 (0.4)	753 (33.7)	127 (5.7)	
Period	Pre-pandemic 854 (29.1)	175 (20.5)	238 (27.9)	129 (15.1)	6 (0.7)	265 (31.0)	41 (4.8)	0.001
N (%)								
	First wave 651 (22.2)	140 (21.5)	202 (31.0)	58 (8.9)	1 (0.1)	210 (32.3)	40 (6.1)	
	Partial restrictions 558 (19.0)	94 (16.8)	192 (34.4)	50 (9.0)	3 (0.5)	192 (34.6)	26 (4.7)	
	Post-pandemic 875 (29.8)	205 (23.4)	246 (28.1)	101 (11.5)	3 (0.3)	289 (33.0)	31 (3.5)	
Treatment	Closed 726 (24.7)	144 (19.8)	262 (36.1)	123 (16.9)	0 (0.0)	180 (24.8)	17 (2.3)	< 0.001
N (%)								
	Open 2212 (75.3)	471 (21.3)	615 (27.8)	215 (9.7)	13 (0.6)	777 (35.1)	121 (5.5)	
Type of fracture	high energy 1370 (46.6)	344 (25.1)	61 (4.4)	119 (8.7)	13 (0.9)	772 (56.3)	61 (4.4)	< 0.001
N (%)								
	low energy 1568 (53.4)	271 (17.3)	816 (52.0)	219 (14.0)	0 (0.0)	185 (11.8)	77 (4.9)	

Cause of admission							
Age at admission	29.00	52.00	22.00	54.00	32.00	45.50	< 0.001
(Median [IQR])	[22.00, 42.00]	[28.00, 70.00]	[16.00, 33.00]	[21.00, 70.00]	[21.00, 48.00]	[37.00, 56.00]	
Discharge time	4.00	4.00	3.00	10.00	7.00	6.00	< 0.001
(Median [IQR])	[3.00, 7.00]	[3.00, 7.00]	[3.00, 5.00]	[9.00, 15.00]	[4.00, 11.00]	[4.00, 9.75]	

Among the included patients, 615 were admitted for aggression and interpersonal violence, 878 for domestic accidents, 338 for sport accidents, 13 for suicidal attempt, 957 for traffic road collision and 138 for work accidents. 701 patients were female (23.9%) and 2237 males (76.1%). 17 patients were asians (0.6%), 241 black (8.2%) and 2681 caucasian (91.2%). Road traffic accidents (33.5%) and aggressions (24.9%) were the most frequent causes of admission in male, while domestic (53.3%) road traffic accidents (28.9%) were the most frequent etiologies in female.

There was a statistically significant difference in the cause of hospitalization between pre-pandemic and first wave groups ($p = 0.005$) and between pre-pandemic and partial restriction groups ($p = 0.002$). The differences between the pre- and post-pandemic groups were instead not significant ($p = 0.106$) [Table 2].

Table 2
Comparative analysis of the causes of admission between the pre-pandemic and the other groups.

Period				
Factor	Group	Pre-pandemic	First wave	p value
N		854	652	
Cause of admission N (%)	Aggression	175 (20.5)	141 (21.6)	0.005
	Domestic	238 (27.9)	202 (31.0)	
	Sport	129 (15.1)	58 (8.9)	
	Suicidal Attempt	6 (0.7)	1 (0.2)	
	Traffic	265 (31.0)	210 (32.2)	
	Work	41 (4.8)	40 (6.1)	
Factor	Group	Pre-pandemic	Partial restriction	p value
N		854	558	
Cause of admission N (%)	Aggression	175 (20.5)	94 (16.8)	0.002
	Domestic	238 (27.9)	192 (34.4)	
	Sport	129 (15.1)	50 (9.0)	
	Suicidal Attempt	6 (0.7)	3 (0.5)	
	Traffic	265 (31.0)	193 (34.6)	
	Work	41 (4.8)	26 (4.7)	
Factor	Group	Pre-pandemic	Post-pandemic	p value
N		854	875	
Cause of admission N (%)	Aggression	175 (20.5)	205 (23.4)	0.106
	Domestic	238 (27.9)	246 (28.1)	
	Sport	129 (15.1)	101 (11.5)	
	Suicidal Attempt	6 (0.7)	3 (0.3)	
	Traffic	265 (31.0)	289 (33.0)	
	Work	41 (4.8)	31 (3.5)	

Given a statistically significant difference between cause of admission and the period of the data collected, a post-hoc analysis was conducted to investigate the most significant associations. In Table 3 are reported standardized residuals (the difference between observed and theoretic values) and cells with the highest absolute standardized residuals which contribute the most to the total Chi-square score [Table 3]. The sign of the standardized residuals reveals the direction of association. Residuals are shown in Fig. 1 [Figure 1].

Table 3
Standardized residuals

Period	Cause of admission					
	<i>Aggression</i>	<i>Domestic</i>	<i>Sport</i>	<i>Suicidal Attempted</i>	<i>Traffic</i>	<i>Work</i>
Pre-pandemic	-0,37	-1,52	3,92	1,36	-1,13	0,17
First wave	0,50	0,70	-2,36	-1,26	-0,22	1,97
Partial restriction	-2,63	2,60	-2,09	0,38	1,14	-0,05
Post-pandemic	2,17	-1,36	0,05	-0,53	0,35	-1,92

Table 3 shows how sport admission is strongly associate with period, followed by aggression and domestic admission while there is no evidence for suicidal attemptd, traffic and work. A strong association was noted between sport-related trauma admissions and the pre-pandemic period (24.303% versus 9.688% during the first wave period, 7.688% in the partial restriction period, and 0.003% in the post-pandemic period). Furthermore, an association was detected between aggressions (prepandemic 0.193%, first wave 0.385%, partial restriction period 11.117%, post-pandemic 6.598%) and domestic accidents (prepandemic 2.895%, first wave 0.674%, partial restriction 9.673%, postpandemic 0.003%) and the partial restriction period [Table 4] [Figure 2].

Table 4
The contribution (in %) of a given period respect to cause of admission

Period	Cause of admission					
	<i>Aggression</i>	<i>Domestic</i>	<i>Sport</i>	<i>Suicidal Attempted</i>	<i>Traffic</i>	<i>Work</i>
Pre-pandemic	0.193	2.895	24.303	3.293	1.550	0.051
First wave	0.385	0.674	9.688	3.100	0.063	7.247
Partial restrictions	11.177	9.673	7.883	0.289	1.771	0.004
Post-pandemic	6.598	2.285	0.003	0.493	0.147	6.235

Compared to the pre-pandemic period, the number of Black patients was significantly higher during the first wave and the post-pandemic period [Supplementary tables]. Differences between the periods in terms of gender, age, type of fracture, treatment modality, and length of hospital stay were not found to be statistically significant [Supplementary tables].

DISCUSSION

The epidemiology of facial fractures is significantly influenced from cultural and socio-economics [1, 10–16]. The COVID-19 pandemic and associated public health restrictions have had a substantial impact on nearly every aspect of daily life, including the epidemiology of facial fractures. Changes in patterns of human activity such as reduced traffic due to lockdown measures may influence the incidence and types of facial fractures. For instance, with fewer vehicles on the road, we might expect a decrease in traffic-related facial injuries.

However, pandemic-related restrictions may also have indirect effects. For instance, with many recreational facilities and public spaces closed, people may be engaging in different types of activities at home, potentially leading to a shift in the causes of facial fractures. Similarly, the increase in work from home arrangements could potentially lead to a decrease in work-related injuries, including facial fractures [17–19]. This shift in epidemiology is clearly illustrated in the results of our study. We observed a dramatic change in the etiology of facial fractures during the first wave and the partial restriction period of the pandemic. As public health restrictions tightened, limiting certain activities and behaviors, the causes of facial fractures shifted correspondingly.

This shift in the etiology of facial fractures was particularly evident in the case of sports-related injuries, which significantly decreased during the pandemic due to the closure of sports facilities and the suspension of most organized sports activities. Conversely, the number of home-related injuries increased significantly, likely reflecting the fact that people were spending more time at home due to lockdowns and other restrictions.

Interestingly, contrary to what might be expected given the reductions in many forms of travel, the number of facial fractures associated with road traffic accidents did not significantly decrease during the pandemic. This finding may seem counterintuitive, as one might expect fewer traffic-related injuries due to reduced traffic volume during lockdowns.

However, there could be several explanations for this observation. Firstly, despite an overall reduction in traffic, there may have been an increase in risky behaviors such as speeding due to less congested roads, leading to accidents that are equally or more severe [20–22]. Secondly, changes in transportation patterns, such as increased cycling or walking due to concerns about virus transmission in public transit, could potentially lead to an increase in certain types of traffic accidents [23, 24].

Among all the factors analyzed, it's interesting to note that neither the type of treatment nor the duration of hospital stay significantly varied across different phases of the pandemic. Although the pandemic had a profound and negative impact on the capacity of healthcare systems to meet the demand for a wide array of health conditions [25–27], this finding testifies to the resilience of the healthcare sector in providing regular care for patients with facial fractures, maintaining pre-pandemic standards.

Another interesting finding was the significant difference in the ethnicity of patients between the pre-pandemic period and the first wave of the pandemic. There was a marked increase in the number of Black individuals subjected to trauma. This trend was detected even in the post-pandemic period.

There could be multiple explanations for this observation. It is possible that the economic and social effects of the pandemic during the lockdown disproportionately affected certain ethnic communities, leading to an increase in risk factors associated with trauma. For example, the pandemic has resulted in heightened levels of unemployment and economic insecurity, factors known to correlate with increased risk of injury. Furthermore, the increasing trend of fractures among Black individuals mirrors the increased migration flows observed post-pandemic in Italy [28]. It's plausible that the demographic changes due to these migration patterns may have contributed to the observed increase in trauma cases among this population.

This study stands out for its analysis of a temporal series encompassing all phases of the pandemic, extending into the post-pandemic era. In this regard, based on the data analyzed, it appears that the epidemiology of facial fractures has reverted back to its pre-pandemic state, with no significant differences observed. Our findings suggest that the effects of the pandemic and associated societal changes on the incidence and causes of facial fractures may have been transient rather than lasting.

The primary limitation of this study lies in its retrospective nature. While this design allowed us to gather data from a broad period and from various locations, it inherently limits the depth of information we can extract, particularly regarding individual patient characteristics and circumstances leading to the facial fractures.

Furthermore, although our study includes hospitals from all over Italy and thus provides a reliable picture of the situation in this country, it is important to note that our findings may not be generalizable to other countries. The restrictions in place during the pandemic and the socioeconomic characteristics of the population can significantly vary between different nations, potentially influencing the epidemiology of facial fractures.

CONCLUSIONS

During the COVID-19 pandemic there have been profound changes in the epidemiology of fractures influenced by the restrictive measures implemented by the government. At the end of the pandemic, the epidemiology of fractures returned to being the same as in the pre-pandemic period.

Declarations

Ethics approval

The study was approved by the CEAVEC Ethical Committee Board (n.192-2022-OSS-AUSLBO)

and was carried out in accordance with the ethical principles of the Declaration of Helsinki.

Competing interests

The authors declare no conflict of interest

Authors' contributions

Marzia Petrocelli: study conception, methodology, writing the original draft, reviewing the final draft, final approval.

Federica Ruggiero: study conception, methodology, reviewing the final draft, final approval.

Davide Allegri: statistical analysis, writing the original draft, reviewing the final draft, final approval.

Sebastiano Cutrupi: statistical analysis, writing the original draft, reviewing the final draft, final approval.

Anna Maria Baietti: supervision, reviewing the final draft, final approval.

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Giacomo De Riu, Luigi Califano: supervision, reviewing the final draft, final approval.

Luigi Angelo Vaira: supervision, literature review, writing the original draft, reviewing the final draft, final approval.

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Availability of data

Marzia Petrocelli has full access to data included in this manuscript

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Figures

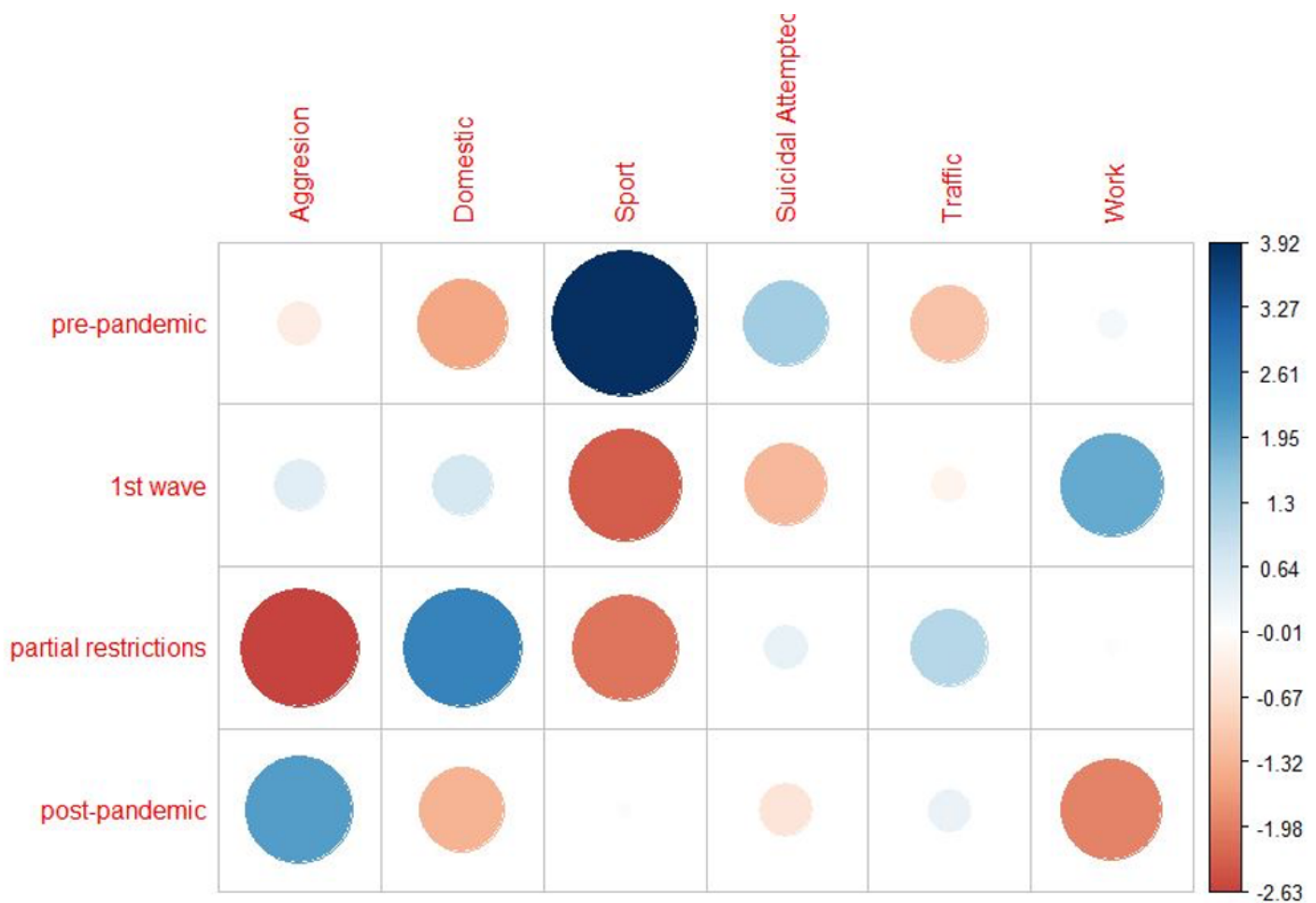


Figure 1

Positive association between the corresponding row and column variables are in blue (meaning a greater observed value respect theoretical value), otherwise the points are in red.

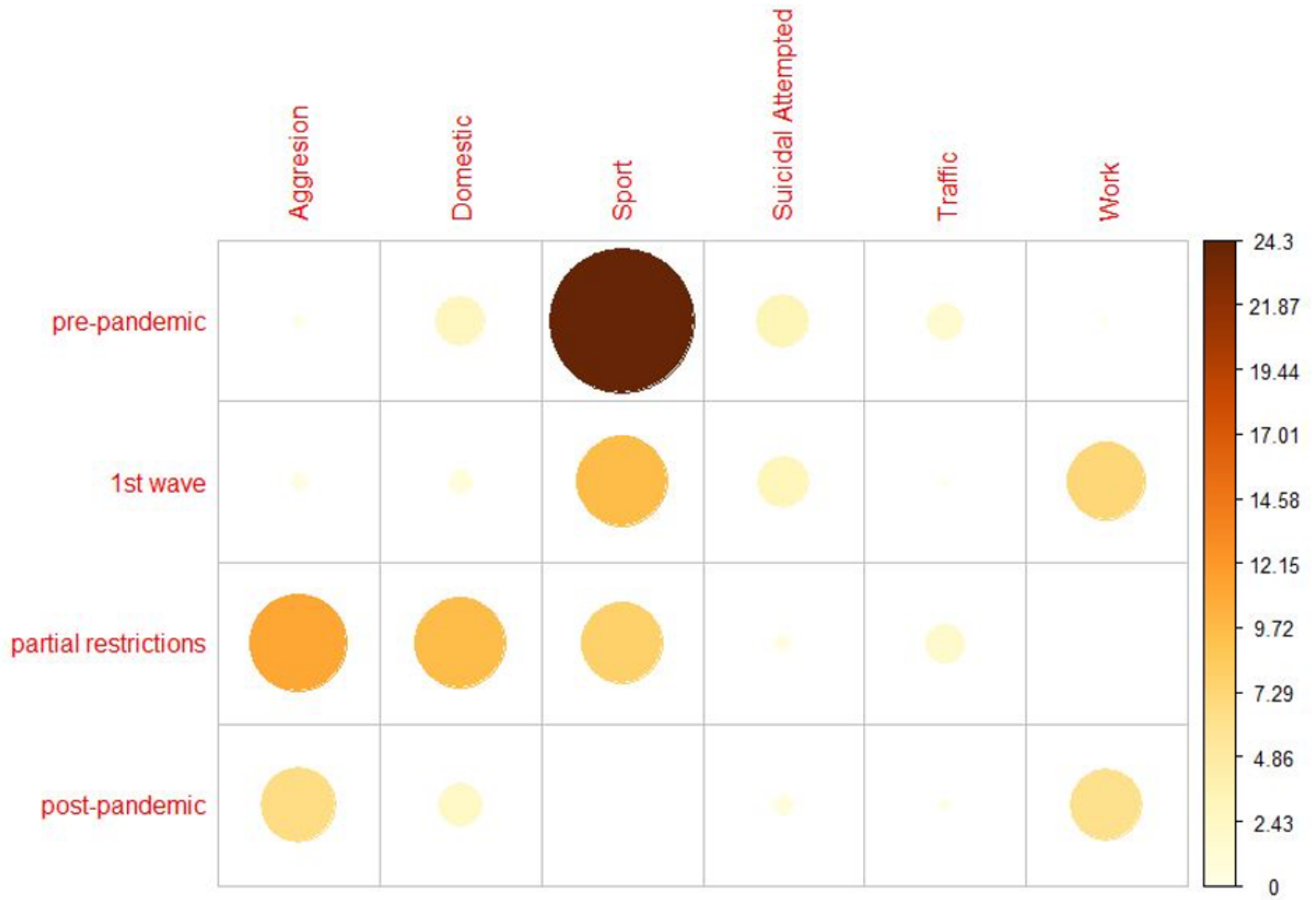


Figure 2

The contribution (in %) of a given period respect to cause of admission, a greater point correspond a major contribution

Supplementary Files

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- [Supplementarytables.docx](#)