

Effect of Shelter-In-Place on Orthopedic Trauma Volumes in Italy During the COVID-19 Pandemic

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Abstract. *Background:* The COVID-19 outbreak heavily attacked Italy, putting a strain for an extended time on the National healthcare system. Hospitals fastly rearranged the activity to cope with the crisis. This retrospective comparative study intended to investigate the impact of the lockdown imposed in Italy, in two different periods, during the COVID-19 outbreak on acute orthopedic trauma, in order to identify significant issues for improvement and future preparation. *Materials and methods:* We obtained data on total trauma access to a single University hospital DEA (Department of Emergency and Acceptance) in Rome during two periods of the COVID-19 pandemic lockdown in Italy: from March 9th, 2020 to May 4th, 2020(Phase 1), from May 10th, 2020 to June 30th, 2020(Phase 2) and then comparing them with the analogous period in 2019. We recorded demographic data; the characteristics of the lesion, including the anatomical area, fracture, sprain, dislocation, contusion, laceration, whether the lesion site was exposed or closed, where the trauma occurred and polytrauma. We also reported the waiting time in the emergency room and the mode of transport. *Result:* The study sample was composed of 1655 patients, 894 (54%) males and 761 (46%) females. The overall number of admissions in 2019 (pre-COVID-19 period) was 995; then it was 204 during Phase 1 and increased again to 456 during Phase 2. The average age of the Phase 1 group was 51.9 ± 24.8 years, significantly higher than that of the 2019 group (41.4 ± 25.7) and Phase 2 group (42.2 ± 22.5 years) ($p < 0.0001$). In particular, elderly patients (≥ 65 years) were the most commonly involved in the Phase 1 group, while in the pre-COVID-19 period and in Phase 2 they were middle-aged adults (15-44 years) ($p < 0.0001$). The injury occurred at home in 66.2% of cases in the Phase 1 group, in 32.3% of cases in the Phase 2 group and in 32.3% of patients in the 2019 group. Concerning the injury type, in all groups, the most frequent injury was a fracture (45.1% in 2019; 62.7% in Phase 1; 50% Phase 2) ($p < 0.0001$). The most injured anatomical section during Phase 1 was the upper limb (43.1%), while in the pre-COVID-19 group and in Phase 2 group the most frequent injury location was the lower limb (48.3% and 40.8% respectively). *Conclusion:* Despite the decrease of overall acute trauma referral rates during the COVID-19 outbreak in Italy, the incidence of fractures in elderly people remained constant, indicating that not all trauma presentations would inevitably decrease during such circumstances. (www.actabiomedica.it)

Key words: COVID-19, SARS-CoV-2, Epidemiology, Orthopedic, Trauma, Fracture.

Introduction

The very first Coronavirus disease (COVID-19) cases diagnosed in Europe were detected in Rome, on January 20th, when a Chinese couple spending holidays in the city resulted affected, and then in Codogno, a

little town in Lombardy, on February 21st. During the following weeks, COVID-19 spread around the world, then, on March the 11th, the World Health Organization declared the pandemic (1-4).

Since COVID-19 outbreak, Italy has been one of the first and most affected countries in the world.

On March 9th, the Italian Government imposed the so called “Phase One”: a series of restrictive measures to reduce transmission rate and, therefore, reduce the number of accesses to the Emergency Room (ER), unless for strictly necessary reasons. Non-urgent procedures such as elective surgery and clinical office activity were postponed or canceled, reducing the need for postoperative care, leaving empty rooms for COVID-19 patients and maximizing the available hospital resources.

In order to reduce as much as possible population movements, public places, schools and all non-essential businesses were closed, and public transportation was restricted.

People’s behaviors deeply changed and subsequently the demographic and epidemiological characteristics of traumatic injuries significantly changed as well (5-9). The “lockdown” resulted in a drastic and progressive reduction of traumas related to sport and work activities (10).

The so called “Phase Two” began on May 18th, when COVID-19 transmission rate decreased, restrictions were reduced and many businesses re-opened, “smart working” was maintained whenever possible.

Several authors studied the incidence and prevalence of injuries during the lockdown, (8,9,11-13) but there is still the need to investigate how the epidemiology of traumatic injuries changed.

Aim of the study was to evaluate the impact of the lockdown’s rules imposed in Italy during the so-called “Phase One” and “Phase Two” on acute orthopedic trauma referral caseload in order to recognize and highlight potential critical areas in order to better cope with possible new outbreaks.

Materials and methods

This is an observational epidemiological study performed at a first level DEA, in the Sant’Andrea Hospital a referral trauma center located in Rome, , within the Italian National Health System. The hospital’s Ethical Review Board approved the study protocol and it was conducted following principles of the Declaration of Helsinki.

The study analyzed three periods: the first Italian COVID-19 lockdown period (Phase 1), from March

9th, 2020 to May 4th, 2020. Then we analyzed the subsequent post-lockdown period (called Phase 2, considering 56 days as well as those in phase 1, from May 10th, 2020 to June 30th, 2020. Those two periods were compared with the same interval of the first lockdown (March 9th to May 4th) but in 2019. Using the hospital’s electronic medical system, we collected all the trauma-related accesses to the DEA, the triage notes, the inpatient medical records, and discharge summaries.

The study included all orthopedic traumas with the exception of pathological fractures and infectious complications following previous orthopedic surgery. This choice had the objective of carrying out a more reliable evaluation of the impact of restrictive measures in trauma workloads in the emergency room.

Demographic data, including age and gender, were recorded. Characteristics of the injury, including the anatomical location, location of trauma, type of fracture, sprain, dislocation, contusion, laceration, whether the injury site was exposed or closed and the anatomical position of the fracture were recorded and classified for all patients. Polytraumas was assessed as a patient with more than one injury on multiple anatomical locations; instead, those who had more than one injury on the same anatomical site were counted, as single injury.

Other recorded data included the waiting time in the ER and mode of transportation.

Statistical analysis

Statistical analyses were performed using SataMP 15 Software. After ascertaining the skewed distribution of all data with the Shapiro-Wilk test, the Wilcoxon rank-sum test was used to compare continuous variables, while proportional differences were assessed using the chi-square test. A p-value of <0.05 was considered significant.

Results

During the considered periods, there was a total of 1655 admissions; the average age was 42.9 ± 24.9 years (range, 1 to 97). The study sample was composed by 894 (54%) males and 761 (46%) females. Mean age of males was 39.7 ± 23.9 years, significantly lower than the female’s one (46.6 ± 25.6 years) ($p < 0.0001$). Com-

paring the three time frames we considered, the overall number of admissions decreased from 995 in 2019 to 204 during Phase 1 (-79.4%) and increased again to 456 during Phase 2 (Figure 1).

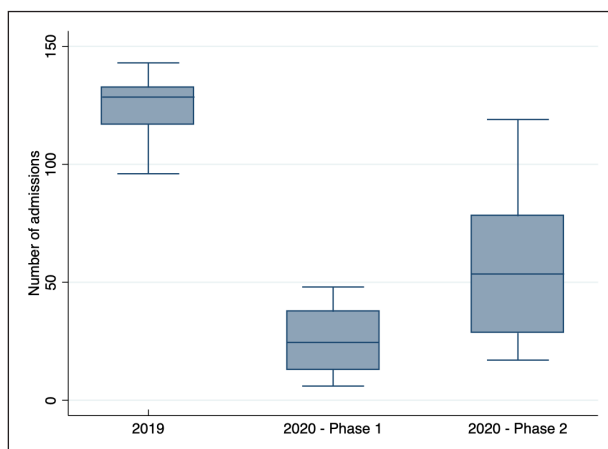


Figure 1. Mean value of weekly admissions in Phase 1 2020, Phase 2 2020 and 2019.

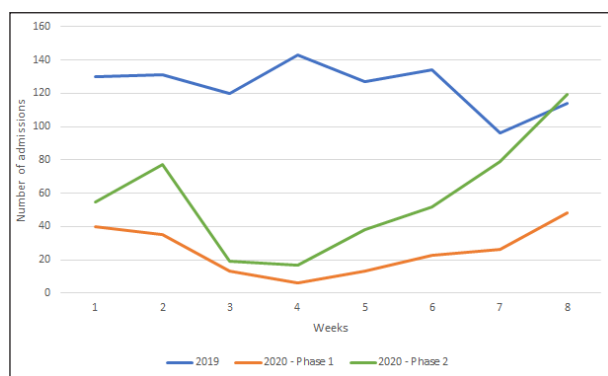


Figure 2. Overall admissions from March 9th to May 4th, 2020 compared with the same period in 2019 and from May 5 to June 20, 2020.

Consequently, also the mean value of total admissions per week in the 8 observed weeks decreased in 2020 compared to 2019, as shown in Figure 2.

The gender distribution did not change significantly ($p=0.212$): in 2019, there were 520 (52.3%) males and 475 (47.7%) females; in Phase 1, there were 116 (56.9%) males and 88 (43.1%) females; in Phase 2, there were 258 (56.6%) males and 198 (43.3%) females. The average age of the Phase 1 group was 51.9 ± 24.8 years, significantly higher than the 2019 group one (41.4 ± 25.7 years) and of Phase 2 (42.2 ± 22.5 years) ($p<0.0001$). In particular, age distribution showed that the most involved age group during the Phase 1 of the lockdown was elderly patients ($>=65$ years), while it was middle-aged adults (15-44 years) for the pre-COVID-19 group and Phase 2 (Table 1), with a statistically significant difference ($p<0.0001$).

There was a significant difference regarding the place where the injury occurred ($p<0.0001$); in all groups, the majority of patients suffered a domestic injury (2019 group: 36.3%; Phase 1 group: 66.2%; Phase 2 group: 55.3%) (Table 2).

Concerning the distribution of the injury characteristics, in all groups the most frequent type of in-

Table 1. Frequency distribution of age groups of patients between groups.

Age group	2019	2020 - Phase 1	2020 - Phase 2	p-value
<15	202	18	55	<0.001
15-44	349	52	195	<0.001
45-64	224	63	122	0.020
≥ 65	220	71	84	<0.001
Total	995	204	456	

Table 2. Characteristics of patients between two groups. Mann-Whitney U Test for continuous variables, Pearson chi-squared test for categorical variables.

	2019	2020 - Phase 1	2020 - Phase 2	p-value
Age in years (mean \pm SD)	41.4 \pm 25.7	51.9 \pm 24.8	42.2 \pm 25.7	$p<0.0001$
Gender, male (%)	523 (52.6)	116 (56.9)	258 (56.6)	0.946
Type of access, ambulance (%)	123 (12.4)	52 (25.5)	94 (20.6)	0.163
Length of stay (mean \pm SD)	8.6 \pm 18.4	7.5 \pm 11.3	7.9 \pm 15.5	0.6937
Setting				
Domestic, n (%)	361 (32.3)	135(66.2)	252 (55.3)	0.009
Drive, n (%)	315 (31.7)	45 (22.1)	138 (30.2)	0.030
Sport, n (%)	227 (22.8)	9 (4.4)	22 (4.8)	0.817
Work, n (%)	92 (9.2)	15 (7.3)	44 (9.7)	0.339

jury was the fracture: 128 (62.7%) in Phase 1 group; 228 (50%) in Phase 2; 448 (45%) in the 2019 group ($p < 0.0001$). Other injury types are represented in Table 3.

In the 2019 group, among 995 injuries, the top-three were as follows: 481 (48.3%) lower limb; 260 (26.1%) upper limb; and 229 polytraumas (22.8%). Among 204 injuries in Phase 1 group, the top-three of most frequent injury sites were upper limb (88; 43.1%); lower limb (71; 34.8%); and head-neck (26; 12.7%). Considering Phase 2 group, the top-three injury sites were: lower limb (186; 40.8%), upper limb (162; 35.5%) and polytrauma (64; 14%). There was a significant difference in the anatomical location of the injuries between the three groups ($p < 0.0001$). Anatomical location data are summarized in Table 4. Regarding the time spent in the ER, there were no statistically significant differences between 2019 and phase 1 in 2020 (8.6 vs 7.5 hours, $p = 0.1675$) and between phase 1 and phase 2 in 2020 (7.5 vs 7.9 hours, $p = 0.6937$). Instead, regarding the mode of transport, in Phase 1 we observed 54 ambulance admissions (26.5%) compared to 123 (12.4%) during 2019 and 94 (20.6%) during Phase 2, and this difference was statistically significant ($p < 0.0001$).

Discussion

Restrictive measures varied significantly by country during COVID-19 pandemic, and translated into varying degrees of lockdowns in 82 countries (14).

Whereas a significant change has been observed in the orthopedic departments' capacity during COVID-19 scenario, orthopedic surgeons continued to serve patients requiring acute and urgent care.

The overall reduction in acute caseload was mainly due to national lockdown policies, vehicular transport and mobility restrictions imposed by the Italian Government and the fear to get infected by COVID-19. Although easing lockdowns could lead to a partial resurgence of traumas; the persistence of social distancing and travel restrictions led to a constant lowered demand for emergency orthopedic care throughout the pandemic.

Since industries not related to food, medicines or strategic needs stopped their productions, sport and outdoor activities and non-essential transportation were suspended, the risk of fracture for the younger population considerably decreased.

One of the most important findings of the study is the reduction of acute trauma cases registered in the ER, between the time intervals pre- and post-lockdown and during the lockdown in a University Hos-

Table 3. The distribution of characteristics of injuries in 2019 and 2020.

	2019	2020 - phase 1	2020 - phase 2	p-value
Fracture	449 (45.1%)	128 (62.7%)	228 (50%)	<0.0001
Dislocation	118 (11.9%)	15 (7.4%)	49 (10.7%)	<0.0001
Laceration	66 (6.6%)	12 (5.8%)	137 (30.1%)	<0.0001
Sprain	20 (2%)	15 (7.4%)	11 (2.4%)	<0.0001
Contusion	342 (34.4%)	34 (16.6%)	31 (6.8%)	<0.0001
Total	995	204	456	

Table 4. Distribution of injury sites in each group.

	2019	2020 - phase 1	2020 - phase 2	p-value
Polytrauma	229 (22.8%)	17 (8.3%)	64 (14%)	<0.0001
Head-neck	23 (2.3%)	26 (12.7%)	43 (9.4%)	<0.0001
Upper limb	260 (26.1%)	88 (43.1%)	162 (35.5%)	<0.0001
Lower limb	481 (48.3%)	71 (34.8%)	186 (40.8%)	<0.0001
Torso	4 (0.4%)	2 (1%)	1 (0.2%)	0.374
Total	995	204	456	

pital in Rome. Moreover, the most frequently group involved was the elderly one (> 65 years) during the lockdown period, while we observed that both pre-lockdown and post-lockdown periods showed opposite trends in terms of age involvement, as shown in Table 1.

The age distribution difference between pre- and post-lockdown groups and the lockdown group is probably related to the change in lifestyle and in daily activities, with restrictions in sports and the introduction of smart working that reduced injuries on the way.

The present study, according to recent literature, found an overall increase in incidence rates of traumas in the elderly age group due to the predominance of domestic falls, which commonly occur in the geriatric population (15).

Overall admissions decreased as well (Figs. 1-2), as procedures were performed on an outpatient basis whenever possible.

Compared to the non-lockdown period, epidemiological characteristics and injury mechanisms of traumatic fractures changed significantly in Italy (9,11,12,16), which is consistent with the deep changes observed in other countries (5,7,8,13).

Italy, Spain, and France were among the most affected European countries by COVID-19 (17). Hence, the great concern of European countries about healthcare systems capacity to respond to COVID-19 epidemic.

In Italy, because of the severe COVID-19 outbreak, addressed by a lockdown that gradually increased in terms of intensity, time and space, we assisted to a progressive reduction of vehicle accidents (up to a reduction of 94%)(9); consequently we observed that polytrauma caseload nearly disappeared (-92.5%) (Table 3).

However, there was some controversy regarding the number of polytrauma patients; in fact, Donovan et al. (18) found no significant difference in the volume of polytrauma patients between April 2019 and April 2020. However, it should be noted that their findings include a very small study population (only 5 polytrauma on a total of 106 patients) and this small group may result in an underpower of the study.

Other recent observational studies (7,13,19,20)

found significant reductions in accesses to the ER, workplace accidents, traffic accidents and hospital admissions. Nonetheless, geriatric patients continued to suffer from low-energy falls, despite social isolation within their homes (8).

At the time of the pandemic, fractures occurring at home accounted for 66.2% during Phase 1 and 55.3% during Phase 2, compared to 36.3% registered during the non-epidemic period. These findings are coherent with the rigorous anti-epidemic measures imposed by the Italian Government, which led to a significant reduction in acute referrals due to sporting and “on the way” injuries.

The distribution of fractured site was also influenced by the state of emergency and in particular upper limb fractures (43.1%) was the most typical location during the lockdown in comparison to other anatomical sites. This is in line with findings of a recent study (21) showing that elderly individuals continued to be exposed to shoulder and elbow trauma as consequence of domestic falls.

Gender distribution did not seem to be affected by the effect of shelter-in-place. In fact, Authors (22,23,24) observed more injuries in males as compared to females during both periods.

Indeed, as observed in this analysis, gender comparison between lockdown and non-lockdown periods did not significantly change, as we show in Table 1.

Furthermore, the reorganization of the hospital (including the creation of a selected COVID-19 track with separated ER) led to a natural decrease in the amount of time spent inside ER area (25). This confirms that in such a scenario, a comprehensive strategy is vital, as well as a well-functioning local network able to deliver better primary healthcare services.

This study had several limitations. The main one is its single-centered nature, which may not be representative of the national profile as well as its retrospective nature, but it would not have been possible to expect such an unpredictable emergency. On the other hand, it could be helpful in future studies to perform multilevel analysis to assess the role of age, gender and location.

The major strength of this study is that it investigated the full Italian lockdown period, in three completely different situations (pre-lockdown, lockdown

and post-lockdown), analyzing various quantitative and qualitative data, from a level-I trauma center.

Further research is required to analyze the different trends in acute orthopedic referrals and orthopedic trauma caseload as a consequence of the structural changes due to COVID-19. Finally, more attention should be paid to the changes linked to the evolving pandemic in order to be prepared for any further pandemics or lockdowns.

Conclusion

This observational study provided a snapshot of how the characteristics and the management of traumas changed during the COVID-19 pandemic in Italy.

Overall acute trauma referral rates have fallen; however, fractures in elderly individuals remain stable in incidence during such times, accompanied by a rise in incidents occurring at home. Healthcare professionals and Governments should use available data and learnings from this period to create strategies that improve trauma care at a national level.

Conflict of Interest: Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article.

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