JOINTS (Journal Orthopaedi and Traumatology Surabaya)
October 2023; 12(2): 59-65, DOI: 10.20473/joints.v12i2.2023.59-65
Received: 19 January 2023 / Revised: 01 August 2023
Accepted: 08 August 2023 / Published: 31 October 2023

*Original Article*

# Examining The Impact of The COVID-19 Pandemic On Pediatric Orthopedic Cases: A Systematic Review and Meta-Analysis

**Ahmadin Yusuf Rizal Susatyo[1,2], Nizar Al Rhaazi[1], Farhan Haidar Fazlur Rahman[1,2], Ismail Hadisoebroto Dilogo[3]**

[1]General Practitioner, Faculty of Medicine, Universitas Airlangga, Surabaya, Indonesia
[2]General Practitioner, Metropolitan Medical Center Hospital, South Jakarta, Indonesia
[3]Orthopedic and Traumatology Department, Cipto Mangunkusumo National Hospital, Central Jakarta, Indonesia

Correspondence should be addressed to Ahmadin Yusuf Rizal Susatyo, Faculty of Medicine, Universitas Airlangga, Mayjend Prof. Dr. Moestopo No. 47, Surabaya 60132, Indonesia. e-mail: ahmadinyusufrizalsusatyo@gmail.com

## ABSTRACT

**Background:** This study examines the adverse effects of COVID-19 pandemic on pediatric orthopedics globally, including decreased patient admissions. The adverse effects of pandemic on pediatric orthopedic patients and surgeries have not been determined. This study aims to conduct a comprehensive systematic review and meta-analysis to investigate the specific impact of COVID-19 pandemic on pediatric orthopedic admissions and surgical cases.
**Methods:** A thorough examination of published literature was performed by searching databases such as PubMed, ScienceDirect, and Cochrane Library, using PRISMA guidelines, and limiting the search to articles published up to January 2022. The primary focus of this review was to inspect the ratio of admission and surgical cases, expressed as a risk ratio (RR) with a 95% confidence level. The study also evaluated any variation among outcomes using the $I^2$ test and examined potential bias using the Egger test. The study findings were calculated using Review Manager 5.4.
**Results:** Fifteen studies were reviewed, revealing a 70% decrease in pediatric orthopedic admissions during the pandemic but no significant difference in admissions between the pandemic and pre-pandemic eras (RR 1.08, 95% CI 0.76-1.54, p=0.66). Furthermore, in the perspective of the pediatric orthopedic surgical case, the pooled analysis also did not show any significant difference between both periods (RR 1.05, 95% CI 0.95 to 1.17, p=0.35). Egger's test result showed no evidence of small-study effects (p = 0.22).
**Conclusion:** This study found that the number of children admitted for orthopedic surgeries and other orthopedic treatments was not greatly impacted during the COVID-19 pandemic.

**Keywords:** COVID-19; Orthopedic procedure; Trauma; Surgery; Human and medicine

## INTRODUCTION

The emergence of the 2019 novel coronavirus disease (COVID-19) outbreak has been a global endemic since December 2019. The etiology of the disease is caused by the SARS (Severe Acute Respiratory Syndrome) COV-2 virus. It is a highly contagious virus that can infect rapidly in various nations and territories, infecting many people, with a total of over 600 million confirmed cases worldwide.[1] The virus was first identified in Wuhan, China, and promptly became a global outbreak. Chinese local government took immediate action to prevent the virus from spreading, such as implementing social & work restrictions. Therefore, people tend to stay at home and eventually shift their habits.[2]

The growing number of infected individuals caused significant disruptions in global medical systems and public healthcare.[3] The government took several methods, namely establishing new hospitals for infected patients and square cabin hospitals to quarantine suspected patients. Community quarantine in urban areas is commonly adopted to monitor infected individuals' medical conditions closely.[3,4]

In response to the outbreak, most countries implemented lockdowns, which closed most businesses and advocated staying home to limit the spread of the virus.[5] Since the population's habits changed, overall reported accidents declined because road traffic accidents decreased, schools closed, and outdoor recreational areas were prohibited. However, there was an increase in domestic accidents and acts of violence. This behavior change globally impacted how injuries and traumas were reported, particularly in pediatric orthopedic cases requiring surgery.[6]

Many hospitals limited or canceled elective procedures to lower the number of people needing orthopedic surgery during the COVID-19 outbreak. Only emergency or urgent surgeries were performed to avoid a negative impact on patient outcomes.[7] Additionally, orthopedic professional societies developed guidelines and protocols for determining which surgeries should be prioritized and which should be delayed.[8,9] Regarding the emergency time due to the outbreak, many surgeons transferred to various units, including emergency rooms, specialized COVID-19 units, and critical care units.[9] This has led to a significant decrease in scheduled orthopedic surgeries in some areas. For example, Paris had 65% less activity in orthopedic surgeries during the last two weeks of March.[10]

The changes in disease control measures and the social behavior of citizens may have led to shifts in orthopedic admissions in both adults and children. While the pandemic's impact on adult populations has been extensively studied, there is a growing concern about the potential repercussions on pediatric health. Pediatric orthopedic cases represent a substantial portion of the healthcare needs of the pediatric population. Timely and appropriately managing these conditions is crucial for achieving optimal outcomes and preventing long-term complications. Hence, this study aims to conduct a comprehensive systematic review and meta-analysis to investigate the specific impact of the COVID-19 pandemic on pediatric orthopedic admissions and surgical cases.

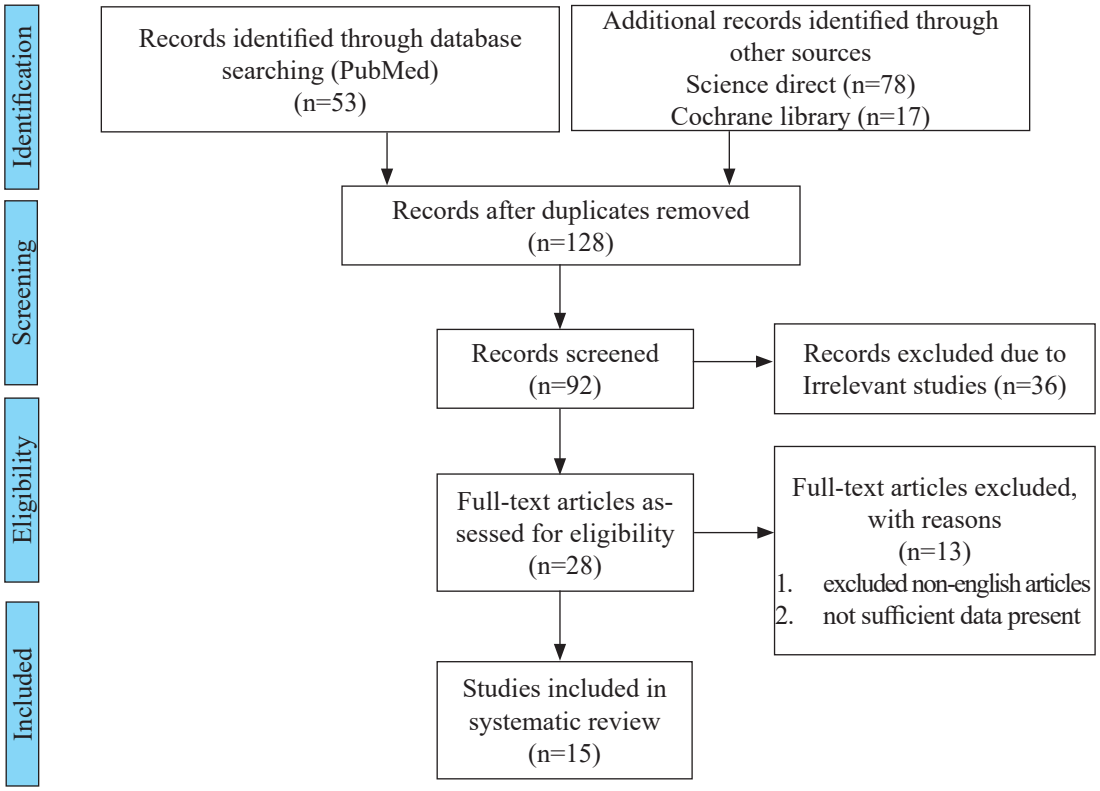


**Figure 1.** Flow diagram based on PRISMA Guideline

## MATERIAL AND METHODS

### Search Strategy

A systematic study was conducted in PubMed, ScienceDirect, and Cochrane Library published up to January 2022 following PRISMA guidelines. Pediatric orthopedic patients' admission and surgeries were assessed by comparing the pre-pandemic and pandemic eras. This study evaluates comprehensively a peer-reviewed manuscript that was written in English. The boolean keyword used in the literature search was "COVID-19," "Pediatric Trauma," and "Orthopedics."

We used PRISMA guidelines to determine the inclusion criteria. The formula diagram of PRISMA is shown in Figure 1. In this review, we include 15 studies for further analysis.

### Eligibility Criteria

The primary focus of this review was to inspect the ratio of admission and surgical cases, expressed as a risk ratio with a 95% confidence level. The study also evaluated any variation among outcomes using the $I^2$ test and examined potential bias in published results using the Egger test. The study findings were calculated using Review Manager 5.4.

Study inclusion criteria were as follows: all accessible retrospective studies were written in English. Studies that evaluated the impairment of COVID-19 in pediatric orthopedic trauma cases and studies published within the last three years. Studies excluded from the analysis were those with inaccessible full text and those that did not pertain to relevant outcomes. Evaluated outcomes included at least one of the following parameters: the number of pediatric orthopedic trauma patient admissions or the number of surgical cases, both measured as risk ratios with 95% confidence intervals.

The authors independently screened the retrieved reports and selected relevant studies, noting the reasons for excluding ineligible ones. Duplicate reports were removed using the EndNote application, ensuring each unique study was included in the review. In case of disagreements, a discussion is arranged to reach a consensus. The authors independently extracted the study characteristics from the included studies.

The Newcastle-Ottawa scale (NOS) was applied to gauge the quality of the included studies, and the $I^2$ test was utilized to evaluate the degree of heterogeneity among the studies. When the degree of variation exceeded 50%, a random-effect model was employed for the analysis. On the other hand, if the degree of variation was insignificant, a fixed-effect model was selected for the analysis. A quantitative analysis was considered statistically valid if the p-value was less than 0.05. The statistical analysis was performed using Review Manager 5.4, which is a software developed by Cochrane Collaboration located in Oxford, The United Kingdom.

## RESULTS

The PRISMA guidelines were used for the article selection process. After searching, 128 articles were found and processed using EndNote to remove duplicates, resulting in 92 studies that met the inclusion criteria. All authors manually assessed these studies, with 28 articles selected for further analysis. Ultimately, fifteen studies were chosen for both qualitative and quantitative analysis.

This study analyzed two outcomes: Pediatric orthopedic trauma admission and surgical cases, calculated as risk ratio since both were dichotomous data. Ninety-five percent of confidence intervals were used for calculations.

### 1. Pediatric Orthopaedic Admission Case

Fifteen studies met the inclusion criteria for the first pooled analysis of outcomes. The analysis reported initially that pediatric orthopedic patients in the pre-pandemic era were 1645 patients and experienced a decrease considerably to 491 patients during the pandemic era. In other

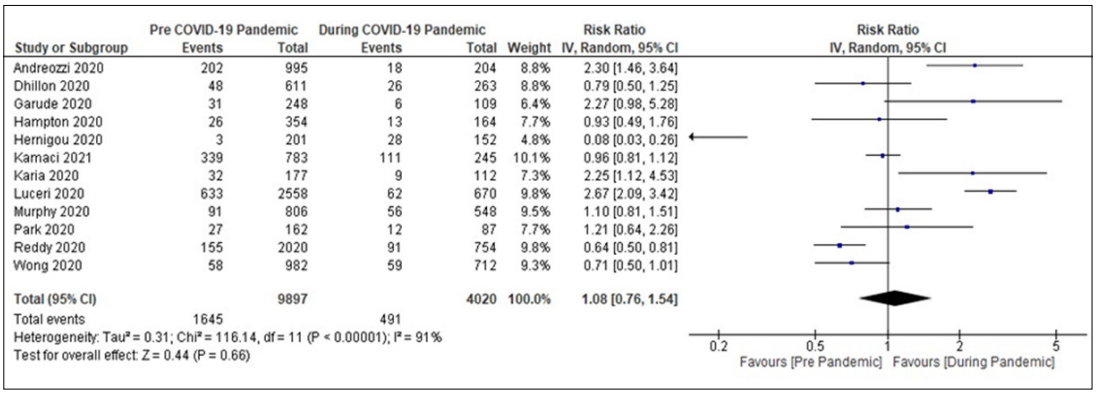


**Figure 2.** Forest plot of COVID-19 pandemic effect on pediatric orthopedic admission case

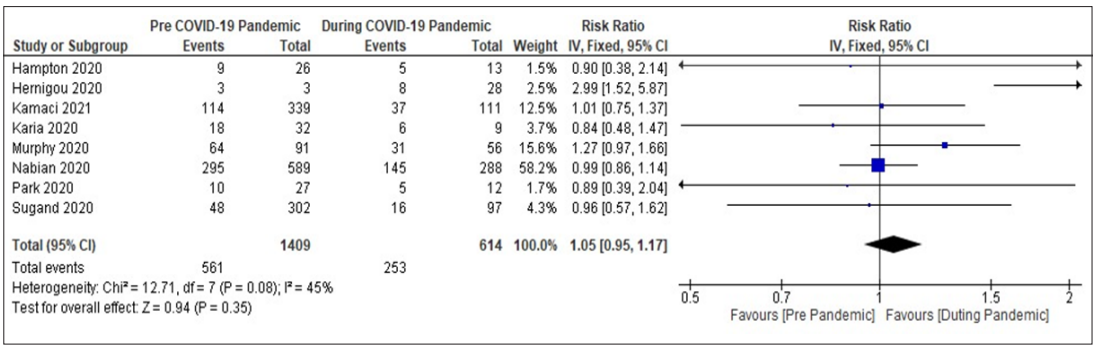


**Figure 3.** Forest plot of COVID-19 pandemic effect on pediatric orthopedic surgical case

words, overall, patients reduced by around 70% in pediatric orthopedic case admissions during the COVID-19 pandemic.

Pooled analysis showed a significant reduction in pediatric orthopedic admission cases between the pandemic era and before the pandemic era (RR 1.08, 95% CI 0.76 to 1.54, p=0.66). A random-effect analysis model was chosen because of significant heterogeneity in both groups ($I^2$=91%) (Figure 2).

### 2. Pediatric Orthopaedic Surgical Case

Eight studies were included in this study determining the pediatric orthopedic surgical case. We divided into two groups. Before the pandemic, the surgical case in pediatric orthopedics was 561 patients and showed a decrease in the pandemic era to 253 patients who underwent a surgical operation. But, in the perspective of the pediatric orthopedic surgical case, the pooled analysis did not show any significant difference between both periods (RR 1.05, 95% CI 0.95 to 1.17, p=0.35). A random effects design was chosen for the calculation due to significant heterogeneities between trials. ($I^2$=45%). Egger's test result showed no evidence of small-study effects (p=0.22) (Figure 3).

## DISCUSSION

Pediatric injury has contributed to a global health issue that needs greater attention. Approximately 950.000 death cases each year in children & youth below 18 years old are related to injury and violence.[11] Road traffic accident alone is one of the majority presented injury in children.[12] In this study, since the COVID-19 pandemic has taken place, the number of pediatric injuries dropped 70% in the pandemic era. The overall reduction in hospital admissions was because of the lockdown and stay-at-home policy imposed by the authorities, and also, people became afraid of getting infected by COVID-19. Reddy et al. stated there was a reduction in road traffic accidents, around 79,7% in India. Other studies from Italy, Spain, and the USA confirmed these findings with similar data.[13–15] The main contribution to the number of pediatric orthopedics is caused by road traffic accidents. Thus, reducing

such incidents would consequently lead to a decrease in the number of patients requiring admission to pediatric orthopedics.[16]

In addition, the limitation of any outdoor activities implies pediatric trauma admission.[17] Both the types and mechanisms of injury sustained have shown little variation over time, although the World Health Organization stated that falling also contributes to the number of children's injuries.[12] Several studies demonstrated that sport-related injuries decreased considerably during the pandemic.[7,18,19] As the Government limits any outdoor activities, this policy implies pediatric trauma admission as well.[17] Additionally, patients' fears of contracting COVID-19 may plague them, leading them to seek telemedicine consultations over ER visits to limit in-person contact.[20]

Another reason that led to reduced hospital admission was the enactment of various new regulations related to healthcare facilities. For example, due to the COVID-19 pandemic, all non-urgent elective orthopedic surgeries in the United Kingdom have been postponed indefinitely. In response to these extraordinary circumstances, the British Orthopaedic Association (BOA) and the NHS (National Health Service) have issued guidance regarding managing orthopedic trauma. The focus of this guidance is to promote non-operative management of fractures when suitable. The rationale behind this approach is to alleviate the strain on anesthetic services during the pandemic and to minimize patients' exposure to COVID-19 in a hospital environment. The decrease in surgical cases and admissions can be attributed partially to the growing preference for non-operative management of pediatric trauma.[18]

Other studies showed a decrease in surgical cases and around 57.2% in domestic accidents.[21] However, as reported by Andreozzi et al., during the epidemic period, there was a notable increase in fractures occurring at home, accounting for 66.2% of cases, compared to 36.3% during the non-epidemic period. These results align with the strict anti-epidemic measures implemented by the Italian Government, which resulted in a significant decrease in acute referrals related to sporting and "on the way" injuries.[22] Hernigou et al. found there was an increase in trauma among children. The number of pediatric orthopedic cases that had surgery in the pandemic increased by 166% compared to the prior year. Children were experiencing more trauma regularly since the family spent so much time at home together. This could contribute to increases in the chances of child neglect leading to bone fracture, and the availability of outside supervision may increase the risk of fracture.[23]

A 2019 study found that only 2.16% of affected patients were young and showed symptoms. Children may have mild or no symptoms when infected, but the virus can cause serious complications during surgery or anesthesia. To prevent harm to children, prompt treatment is required, and surgery should not be delayed when necessary.[22] Gaining insights into the patient flow patterns within a trauma hub emergency department is essential for improving the management of preventive isolation measures for every patient seeking health care.[24]

Although there was a noticeable decrease in pediatric orthopedic admissions, our study shows that the difference did not reach statistical significance (RR 1.08, 95% CI 0.76 to 1.54, p=0.66). Based on our findings, there is a slight decrease in surgical cases for pediatric orthopedic patients with no significant difference both statistically and clinically in the pre-pandemic and during the COVID-19 pandemic period.

This study requires further exploration due to the limited number of studies reporting pediatric trauma cases during the pandemic. Moreover, the lack of exclusion criteria and evidence of the included studies are other limitations of this study. Most included studies took place at the beginning of the first batch of the COVID-19 pandemic. Therefore, the result may not reflect the recent pandemic situation.

This study contains extensive literature that provides a comprehensive effect of the pandemic on pediatric orthopedic patients, which is a major strength of our study.

## CONCLUSION

This study found that the number of children admitted for orthopedic surgeries and other orthopedic treatments was decreased but not significantly impacted during the COVID-19 pandemic.

## ACKNOWLEDGEMENTS

None

## FUNDING

None

## REFERENCES

1. Johns Hopkins University. COVID-19 Dashboard by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University (JHU. Johns Hopkins University Corona Virus Resource Center; 2021 [cited 2023 Jan 16]. Available from: https://coronavirus.jhu.edu/.
2. Wang L, Wang Y, Ye D, Liu Q. Review of the 2019 novel coronavirus (SARS-CoV-2) based on current evidence. Int J Antimicrob Agents 2020; 55(6): 105948.
3. Li Q, Guan X, Wu P, Wang X, Zhou L, Tong Y, et al. Early Transmission Dynamics in Wuhan, China, of Novel Coronavirus–Infected Pneumonia. N Engl J Med 2020; 382(13):1199–207.
4. Vaughan A. Italy in lockdown. New Sci 2020; 245(3273):7.
5. Légifrance. Décret n° 2020-1310 du 29 octobre 2020 prescrivant les mesures générales nécessaires pour faire face à l'épidémie de covid-19 dans le cadrede l'état d'urgence sanitaire. Journal Officiel de la République Française; 2020 [cited 2023 Jan 01]. Available from: https://www.legifrance.gouv.fr/jorf/id/JORFTEXT000042475143.
6. Massey PA, McClary K, Zhang AS, Savoie FH, Barton RS. Orthopaedic Surgical Selection and Inpatient Paradigms during the Coronavirus (COVID-19) Pandemic. J Am Acad Orthop Surg 2020; 28(11):436-450.
7. Kamacı S, Göker B, Çağlar Ö, Atilla B, Mazhar Tokgözoğlu A. The Effect of the Covid-19 Pandemic on Orthopedic Surgeries in a Tertiary Referral Center. Jt Dis Relat Surg 2021;32(2):333–9.
8. Gregory TM, Bihel T, Guigui P, Pierrart J, Bouyer B, Magrino B, et al. Terrorist attacks in Paris: Surgical trauma experience in a referral center. Injury 2016;47(10):2122–6.
9. Ministère des Solidarités et de la Santé. Préparation à la phase épidémique de Covid-19. Établissements de santé Médecine de ville Établissements et services médico-sociaux. Guide Méthodologique Phase épidémique de Covid-19; 2020 [cited 2023 Jan 10]. Available from:https://sante.gouv.fr/IMG/pdf/guide-covid-19-phase-epidemique-v15-16032020.pdf.
10. Sarac NJ, Sarac BA, Schoenbrunner AR, Janis JE, Harrison RK, Phieffer LS, et al. A Review of State Guidelines for Elective Orthopaedic Procedures During the COVID-19 Outbreak. J Bone Joint Surg Am 2020;102(11):942-5.
11. Danseco ER, Miller TR, Spicer RS. Incidence and costs of 1987-1994 childhood injuries: demographic breakdowns. Pediatrics 2000;105(2):E27.
12. Peden M, Oyegbite K, Ozanne-Smith J, Hyder AA, Branche C, Rahman A, et al. World report on child injury prevention. Geneva: World Health Organization; 2008.
13. Lubbe RJ, Miller J, Roehr CA, Allenback G, Nelson KE, Bear J, et al. Effect of Statewide Social Distancing and Stay-at-home Directives on Orthopaedic Trauma at a Southwestern Level 1 Trauma Center during the COVID-19 Pandemic. J Orthop Trauma 2020;34(9):E343–8.
14. Nuñez JH, Sallent A, Lakhani K, Guerra-Farfan E, Vidal N, Ekhtiari S, et al. Impact of the COVID-19 Pandemic on an Emergency Traumatology Service: Experience at a Tertiary Trauma Centre in Spain. Injury 2020;51(7):1414–8.
15. Benazzo F, Marco S, Rossi P, Maniscalco P, Moretti B, Vaienti E, et al. The orthopaedic and traumatology scenario during Covid-19 outbreak in Italy: chronicles of a silent war. Int Orthop. 2020;44(8):1453-9.
16. Zhu W, Yang J, Xu L, Fang S. A plunge in the number of traumatic traffic injuries in an emergency center in Anhui province, China. Am J Emerg Med 2020; 38(10):2230-1.
17. Park C, Sugand K, Nathwani D, Bhattacharya R, Sarraf KM. Impact of the COVID-19

pandemic on orthopedic trauma workload in a London level 1 trauma center: the "golden month": The COVid Emergency Related Trauma and orthopaedics (COVERT) Collaborative. Acta Orthop 2020; 91(5):556–61.
18. Hampton M, Clark M, Baxter I, Stevens R, Flatt E, Murray J, et al. The effects of a UK lockdown on orthopaedic trauma admissions and surgical cases. 2020;1(5):137-43.
19. Tokumoto H, Akita S, Nakamura R, Yamamoto N, Kubota Y, Mitsukawa N. No flow pattern on indocyanine green lymphography in breast cancer patients undergoing taxane-based chemotherapy. J Plast Reconstr Aesthet Surg 2020; 73(8):1575-92.
20. Bram JT, Johnson MA, Magee LC, Mehta NN, Fazal FZ, Baldwin KD, et al. Where Have All the Fractures Gone? The Epidemiology of Pediatric Fractures during the COVID-19 Pandemic. J Pediatr Orthop 2020; 40(8):373–9.
21. Giuntoli M, Bonicoli E, Bugelli G, Valesini M, Manca M, Scaglione M. Lessons learnt from COVID 19: An Italian multicentric epidemiological study of orthopaedic and trauma services. J Clin Orthop Trauma 2020;11(4):721–7.
22. Andreozzi V, Marzilli F, Muselli M, Previ L, Cantagalli MR, Princi G, et al. The impact of COVID-19 on orthopaedic trauma: A retrospective comparative study from a single university hospital in Italy. Orthop Rev (Pavia) 2020; 12(4):210–3.
23. Hernigou J, Morel X, Callewier A, Bath O, Hernigou P. Staying home during "COVID-19" decreased fractures, but trauma did not quarantine in one hundred and twelve adults and twenty eight children and the "tsunami of recommendations" could not lockdown twelve elective operations. Int Orthop 2020;44(8):1473–80.
24. Luceri F, Morelli I, Accetta R, Mangiavini L, Maffulli N, Peretti GM. Italy and COVID-19: the changing patient flow in an orthopedic trauma center emergency department. J Orthop Surg Res 2020;15(1):323.