
Research Article

Pediatric Orthopaedic Trauma Volume Changes Associated with the Covid-19 Pandemic in Ohio

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Abstract

During the Covid-19 pandemic, our institution perceived a decrease in pediatric orthopaedic trauma volumes. We hypothesized this decrease was similarly the case for other institutions in Ohio. This study evaluates pediatric orthopaedic trauma volumes throughout the Covid-19 pandemic in Ohio. The 270-hospital Ohio Hospital Association (OHA) database was queried for ICD-codes of orthopedic surgical encounters for patients ages 0-18 between 2017-2021, utilizing March 2020 as the transition from pre- to post-Covid. Overall cases decreased only -3% during 2020 and increased +2% during 2021. However, the monthly patterns differed considerably. In 2020, the number of cases in April and May were -29% and -22% lower, which coincided with state stay-at-home order. Warm weather peaks were delayed to June and September. November and December saw increased volumes of +16% and +10%. In 2021, following cessation of stay-at-home order, volumes in March and April increased by +27% and +17%, but did not reach peak monthly summer volumes. 2021 saw increases in November (+6%) and December (+16%). Outpatient volumes decreased -0.3% in 2020 and increased +5.4% in 2021 with decreased volumes during lockdown and increased volumes in November and December. Inpatient volumes decreased -15% in 2020 and -14% in 2021, with decreased volumes most of the year. This is the first evaluation of the effect of the Covid-19 pandemic on pediatric orthopaedic trauma volumes throughout the state of Ohio. Annual trauma volume changes were not significant, despite large seasonal changes – relevant information for utilization in hospital budgeting, workforce planning, and resource allocation.

Keywords: Pediatric; Trauma; Trauma volumes; Covid-19

Introduction

Covid-19, caused by severe acute respiratory syndrome coronavirus 2 virus, was declared a worldwide pandemic by the World Health Organization in March of 2020, following its dissemination from the first reported case in China in December of 2019 [1]. Covid-19 was confirmed in the United States in January of 2020, and spread statewide [1,2]. Ohio declared a state of emergency in March of 2020 and then implemented the Stay at Home Order and its replacement, the Stay Safe Ohio Order, leading to school closures and the discontinuation of after-school activities [3,4]. Kindergarten through 12th grade students were transitioned to online schooling for the remainder of the academic year [5]. On June 18, 2020, the State of Emergency in Ohio was lifted. However, in the fall and spring, the school responses varied as many schools continued online learning through December, while others reopened [6,7].

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The Center for Disease Control and Prevention has reported a >70% decline in pediatric emergency department (ED) visits during the height of the Covid-19 pandemic [8]. Likewise, lower trauma volumes were perceived during the Covid-19 pandemic that seemingly continued through 2021. These trends have substantial impacts on budgeting, workforce planning, and resource allocation. As such, we sought to investigate the effect of the Covid-19 pandemic on pediatric orthopedic trauma volumes during the height of the Covid-19 pandemic and onward. We hypothesized that decreased trauma volumes occurred in 2020 and into 2021. With this information, hospitals can better interpret changes in volume/productivity, plan for workforce and resource allocation, and better prepare for future incidences, especially as Covid-19 has lingered into 2023.

Materials and Methods

The Ohio Hospital Association (OHA) data program was queried to include orthopedic encounters for patients ages 0-18 with an inpatient, observation, emergency department (ED), or outpatient visit between January 1, 2017 to December 31, 2021. March of 2020 was determined to be the transition from pre- to post-Covid. Patients were identified through electronic medical record query using injury ICD-10 codes for upper and lower extremity fractures treated during an orthopedic encounter.

Of note, The OHA database aggregates data from

participating institutions throughout Ohio, with any hospital having the opportunity to partake in the program. Over 270 hospitals throughout Ohio voluntarily contribute to the OHA data program, collecting data from inpatient, outpatient, ED and skilled nursing care facilities [9]. Data is collected quarterly and is processed and validated. All submitted data is required to have inpatient errors of <1% and outpatient errors of <10% [9].

The mean number of fractures treated during an orthopedic encounter for the pre-Covid years (2017-2019) was calculated for each month and compared with the monthly numbers of fractures for 2020 and 2021. Percent changes from the pre-Covid means were computed for both 2020 and 2021. Separate analyses were conducted for orthopedic fractures treated in an outpatient setting, inpatient setting, and total combined. The population of interest was fracture volumes in the state of Ohio over the given time. As such, the volumes reported are parameters of that population, not sample estimates. Therefore, significance testing of differences was not performed.

Results

When comparing pediatric fractures in Ohio during pre-Covid years (2017-2019), to those of 2020 and 2021 (Table 1, Figure 1), overall cases decreased -3% during 2020 and increased +2% during 2021. Although total year cases were similar, the monthly patterns varied substantially when comparing pre-Covid to post-Covid years.

Table 1: Upper and lower extremity fractures by month and year (2017 – 2021).

Month	Pre-COVID Mean Volume (2017 – 2019)	Post-COVID Volume -2020	Post-COVID Volume -2021	Difference from Pre-COVID -2020	Difference from Pre-COVID -2021
January	349	384	334	+10%	-4%
February	332	367	331	+11%	0%
March	377	358	480	-5%	+27%
April	532	378	624	-29%	+17%
May	671	524	622	-22%	-7%
June	610	697	605	+14%	-1%
July	601	607	608	+1%	+1%
August	704	620	611	-12%	-13%
September	681	681	695	0%	+2%
October	597	576	603	-4%	+1%
November	371	429	393	+16%	+6%
December	326	360	380	+10%	+16%
Total	6151	5981	6286	-3%	+2%

Prior to Covid-19, there were clear seasonal trends in Ohio, with relatively low trauma in the colder months (November-March), higher volumes in warmer months (April-October), with “spikes” in May and August (Table 1, Figure 1). In 2020, fracture volumes substantially decreased at the peak of Covid-19, including in March (-5%), April (-29%), and May (-22%), relative to the pre-Covid means for the same months. These changes aligned with implementation of Ohio’s Stay at Home and Stay Safe Ohio Orders [3,4]. There were delayed “spikes” in June and September 2020, as the seasonal patterns shifted to the right, with volumes in November (+16%) and December (+10%) of 2020 being higher than their respective pre-Covid means.

In 2021, the overall annualized fracture volume fully recovered to +2% of pre-Covid means; however, seasonal trends still differed from pre-Covid, as the spring spike occurred earlier in April, while the second spike occurred in September. March (+27%) and April (+17%) 2021 saw cases that were higher than pre-Covid years. As with 2020, there was higher volume in November (+6%) and December (+16%) than pre-Covid years in 2021.

When sub-dividing fracture visits into visit location, we identified similar trends as with the entire cohort. Outpatient visits decreased only -0.3% in 2020, with seasonal decreases occurring during the lockdown (-6% in March, -28% in April, and -20% in May) but increased in November (+17%) and

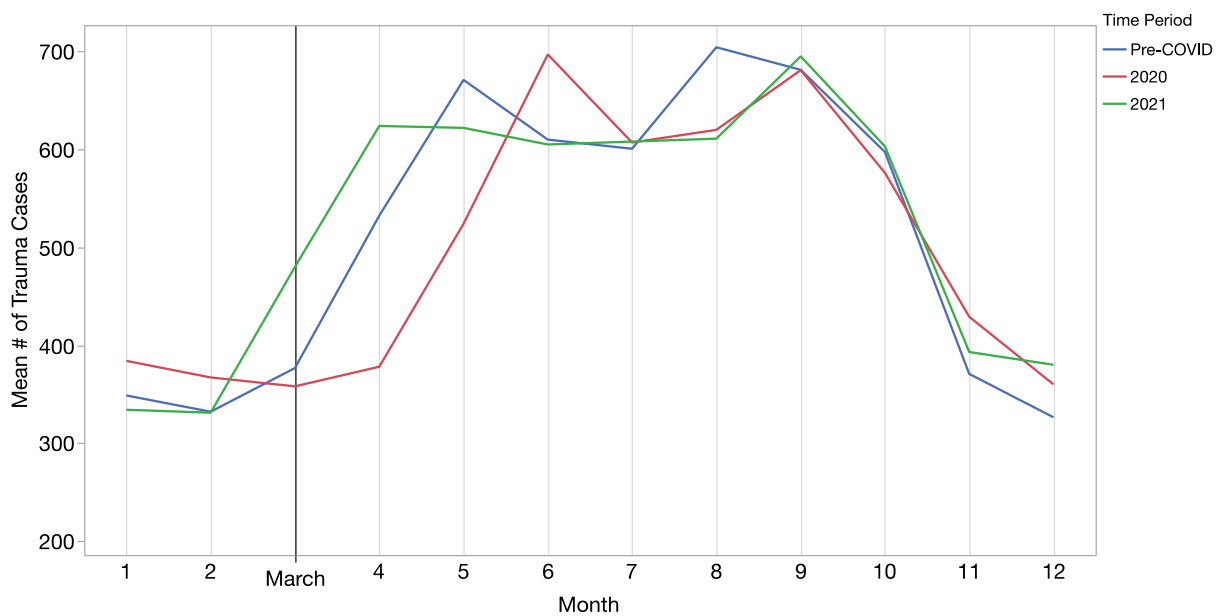


Figure 1: Mean Ohio pre-Covid (2017 – 2019), 2020 and 2021 monthly fracture volume.

Table 2: Outpatient fractures by month and year (2017 – 2021).

Month	Pre-COVID Mean Volume (2017 – 2019)	Post-COVID Volume -2020	Post-COVID Volume -2021	Difference from Pre-COVID -2020	Difference from Pre-COVID -2021
January	284	346	287	+22%	+1%
February	269	305	277	+13%	+3%
March	319	299	427	-6%	+34%
April	442	318	550	-28%	+24%
May	565	450	535	-20%	-5%
June	514	590	512	+15%	-0%
July	490	527	518	+8%	+6%
August	580	526	509	-9%	-12%
September	568	586	606	+3%	+7%
October	514	491	532	-4%	+4%
November	316	371	330	+17%	+4%
December	272	310	326	+14%	+20%
Total	5133	5119	5409	0%	+5%

December (+14%). In 2021, annualized outpatient visits rebounded with an overall increase +5.4% compared to pre-Covid mean outpatient visits (Table 2, Figure 2).

Fractures treated with an inpatient admission in 2020 decreased -15%, including decreases of -33% and -30% in April and May, respectively. These decreases continued throughout most of the year, including July, August, September, and December (Table 3, Figure 3). In 2021, inpatient admissions for fractures remained decreased from pre-Covid levels overall (-14%), and throughout most months of the year (Table 3, Figure 3).

Discussion

Hospital planning for global pandemics poses many challenges. This report is the first to address the impact of the Covid-19 pandemic on pediatric fracture volumes during and following the height of the Covid-19 pandemic. Though there was a perceived drop in pediatric fracture visits, OHA data shows only -3% decrease in the frequency of total pediatric visits in 2020 with a rebound +2% increase over pre-Covid frequency in 2021. While total annual pediatric fractures were similar from pre-Covid to post-Covid, there was significant seasonal variation from pre-pandemic trends, with -29%

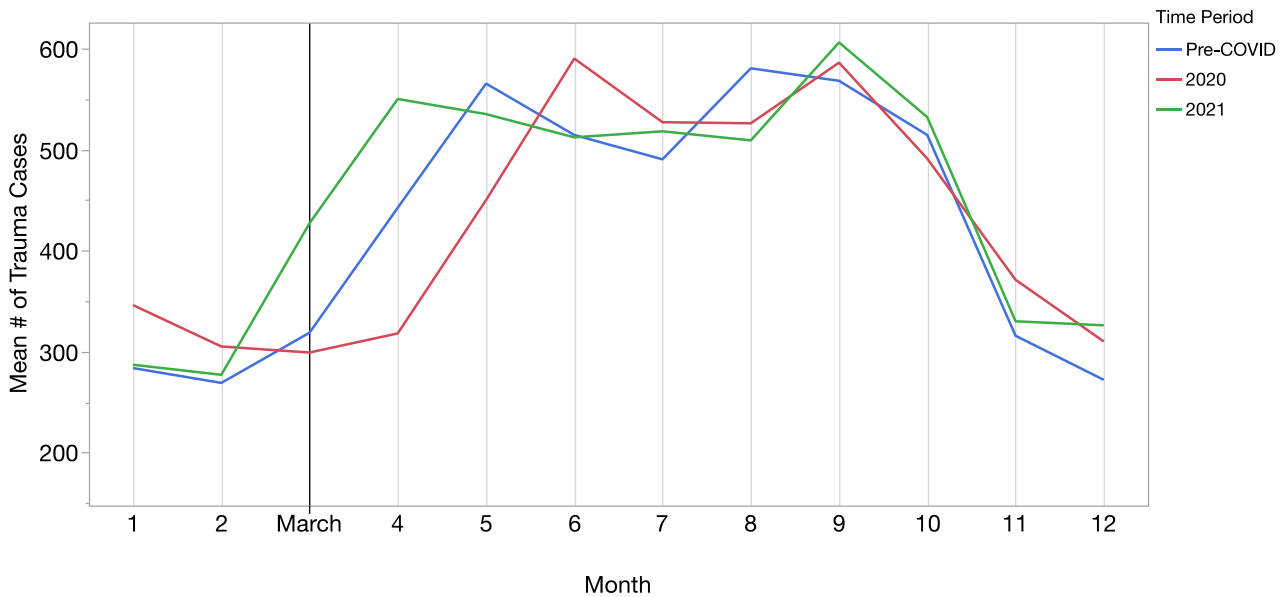


Figure 2: Mean Ohio pre-Covid (2017 – 2019), 2020 and 2021 monthly outpatient fracture volume.

Table 3: Inpatient fractures by month and year (2017 – 2021).

Month	Pre-COVID Mean Volume (2017 – 2019)	Post-COVID Volume -2020	Post-COVID Volume -2021	Difference from Pre-COVID -2020	Difference from Pre-COVID -2021
January	65	38	47	-42%	-28%
February	63	62	54	-2%	-14%
March	58	59	53	+2%	-9%
April	90	60	74	-33%	-18%
May	106	74	87	-30%	-18%
June	95	107	93	+13%	-2%
July	110	80	90	-27%	-18%
August	124	94	102	-24%	-18%
September	113	95	89	-16%	-21%
October	83	85	71	+2%	-14%
November	55	58	63	+5%	+15%
December	54	50	54	-7%	0%
Total	1016	862	877	-15%	-14%

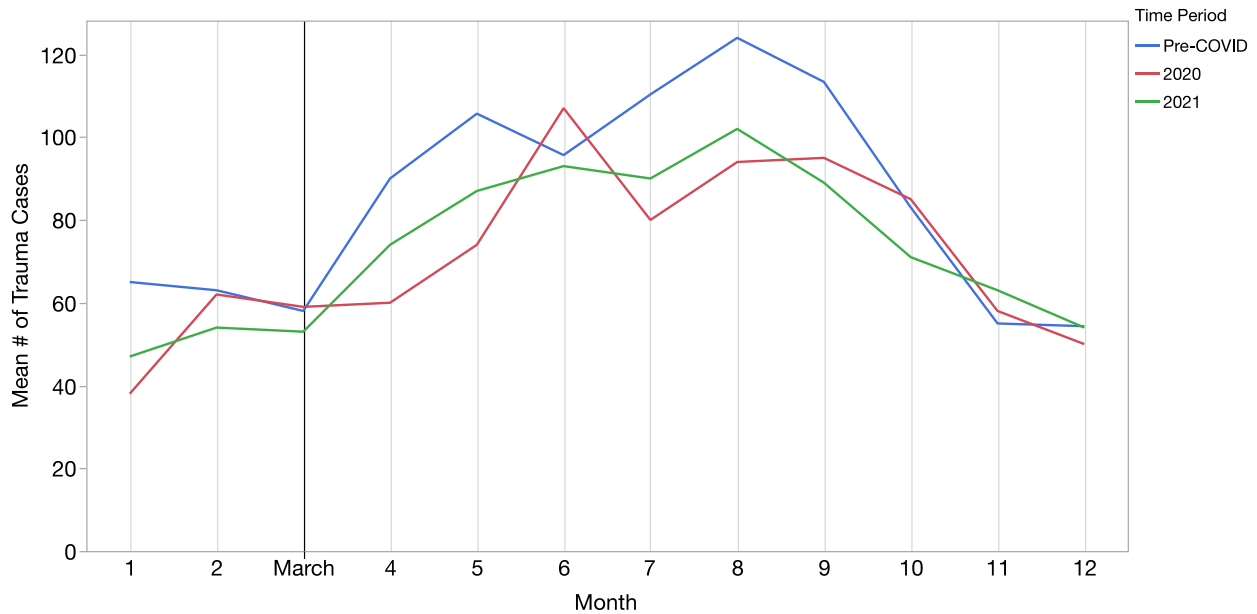


Figure 3: Mean Ohio pre-Covid (2017 – 2019), 2020 and 2021 monthly inpatient fracture volume.

and -22% fewer fractures April and May 2020, respectively, which recovered with a rightward shift and delayed spikes in the summer months. Additionally, fewer fractures were treated with inpatient admissions in both 2020 (-15%) and through 2021 (-14%) compared to pre-Covid patterns. These findings are not consistent with our original hypothesis of a significant decrease in overall trauma volume in 2020 and 2021, but are very helpful for hospital budgeting, resource allocation, and workforce planning.

The Center for Disease control and Prevention analyzed emergency room visits from March 29 - April 25 of 2020 and compared those to March 31 - April 27 of 2019 utilizing the National Syndromic Surveillance Program, which captures approximately 73% of all ED visits in 47 states [8]. The authors found that visits decreased amongst all age groups during the 2020 timeframe, with the largest declines occurring in patients ages ≤10 years by 72% and 11 to 14 years by 71%. Subsequent studies have evaluated the incidence of trauma center activations during the Covid-19 pandemic [10-13]. For instance, Bessoff et al. [10] found a 13% decrease in overall pediatric trauma volumes during 2020 at five institutions, with the lowest volumes occurring 16 days into the implementation of the shelter in place policies. Likewise, Sheridan et al. [11] evaluated pediatric trauma cases at a level 1 trauma center in Cork, Ireland, and found that the fewest cases occurred during first four weeks of lockdown compared to 11 years prior during same time frame. However, the etiology of ED visits and specific types of trauma activations were not reported in these studies, so it is unknown how orthopedic etiologies specifically affected these trends.

There are some reports looking specifically at pediatric orthopedic volumes during the height of the Covid-19 pandemic in the US and globally, but there is minimal data on how trauma volumes have subsequently recovered following the height of the pandemic. For instance, Bram et al. [14] found a 2.5 fold decrease in fracture cases at a Pennsylvania pediatric trauma center in during March 15 - April 15, 2020 compared to the same time frame in 2018 and 2019, but this study did not extend beyond the peak of the pandemic. Sugand et al. [15] found that acute pediatric orthopedic trauma referrals decreased by two-thirds during a 6-week lockdown period in London, England, while in Finland, Ratio et al. [16] found a 31% decrease in trauma operations and a 31% decrease in lower limb trauma procedures during March and April of 2020. In India, Maryada et al. [17] found a 43% decrease in the number of injuries in pediatric patients during the lockdown period of March 25 - April 25, 2020 compared to February 23 - March 24 2020 [17]. However, there is minimal data regarding how trauma volume subsequently recovered after the lockdown and through 2021.

Additional studies have evaluated other specific injury trends during the height of the pandemic. For instance, Bessoff et al. [10] found that injuries tended to be more severe during the pandemic lockdown, with an increase in gunshot wounds and non-motorized vehicle accidents. Additionally, more patients went directly to the operating room from the ED rather than discharging home first, there was a decrease in road traffic injuries and an increase in falls at home during the lockdown period [12,17]. There was no significant change in the incidence of nonaccidental trauma in pediatric patients [10,12].

Though these reports all align with our findings of decreased fracture volume during the height of the 2020 pandemic, we have been unable to find additional reports that describe subsequent trends of pediatric trauma volumes post lockdown throughout 2021. As such, to our knowledge, this is the first report of subsequent pediatric trauma trends following the height of the Covid-19 pandemic.

This study had limitations inherent to its study design of pooled data from multiple institutions. While the OHA does have quality measures in place for accuracy, we are limited to data that institutions self-report. Furthermore, we do not have access to specific patient information to verify accuracy of diagnostic codes or identify other trends specific to injury mechanism, type, and treatment. Additionally, this data is limited to the state of Ohio and therefore has questionable widespread applicability, but we hypothesize that these Ohio trends are predictive of trends elsewhere; we hope this report will generate interest in performing subsequent studies of other populations to better understand national and international trends.

During the stay-at-home order during the onset of the Covid-19 pandemic, fracture volume did drop substantially during the initial lockdown, but had delayed recovery with similar annualized volume (only -3% difference) as compared to pre-Covid. We found this to be an interesting finding, given the reduced participation in athletics and other recreational activities when patients were confined to the home [3-5,18]. Although we did not have access to mechanism of injury for this study, we suspect that many of these fractures sustained during the warmer summer months of 2020 occurred when pediatric patients may have been eager to leave the home and play outdoors, resulting in volume recovery with a delayed spike of fractures in the summer. We anticipate that future trends will continue to stabilize to pre-Covid trends, though it warrants continued investigation.

This is the first report to present the effect of the Covid-19 pandemic on pediatric orthopedic trauma volumes in the state of Ohio with inclusion of data pre-Covid, during the height of the pandemic, and the subsequent rebound through 2021. This is valuable information as it relates to human and financial resource allocation during continued recovery of the Covid-19 pandemic, especially in an era of widespread staff and supply chain shortages.

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We thank the Ohio Hospital Association for permission to share these data.

Conflict of Interest

The authors declare no relevant conflicts of interest.

References

- Centers for Disease Control and Prevention. CDC Museum COVID-19 Timeline. Updated August 16, 2022. Accessed August 30, 2022. <https://www.cdc.gov/museum/timeline/covid19.html>
- Health Policy Institute of Ohio. COVID-19 Pandemic in Ohio. Accessed August 30, 2022. <https://www.healthpolicyohio.org/coronavirus-covid-19-in-ohio/>
- DeWine M. Governor DeWine Announces 'Stay Safe Ohio Order'. Accessed October 18, 2022. <https://governor.ohio.gov/media/news-and-media/dewine-announced-stay-safe-ohio-order>
- DeWine M. Ohio Issues "Stay at Home" Order; New Restrictions Placed on Day Cares for Children. October 18, 2022. <https://governor.ohio.gov/media/news-and-media/ohio-issues-stay-at-home-order-and-new-restrictions-placed-on-day-cares-for-children>
- DeWine M. Governor DeWine Announces School Closures. Accessed October 18, 2022. <https://governor.ohio.gov/media/news-and-media/announces-school-closures>
- DeWine M. COVID-19 Update: State of Emergency to be Lifted, Vax-A-Million Winners. Accessed October 13, 2022. <https://governor.ohio.gov/media/news-and-media/covid19-update-state-of-emergency-to-be-lifted-vaxamillion-winners-06172021>
- DeWine M. COVID-19 Update: School Guidelines, Public Health Advisory System. Accessed October 13, 2022. <https://governor.ohio.gov/media/news-and-media/covid19-update-07022020>
- Hartnett KP, Kite-Powell A, DeVies J, et al. Impact of the COVID-19 Pandemic on Emergency Department Visits - United States, January 1, 2019-May 30, 2020. *MMWR Morb Mortal Wkly Rep* 69 (2020): 699-704.
- Ohio Hospital Association. Data Program Overview. Accessed October 18, 2022. https://www.youtube.com/watch?v=jBKMkU3JeCE&list=PLVrlZc17OWzU3vxNzcONwWbjmi-L648wK&index=5&t=2s&ab_channel=OhioHospitalAssociation
- Bessoff KE, Han RW, Cho M, et al. Epidemiology of pediatric trauma during the COVID-19 pandemic shelter in place. *Surgery Open Science* 6 (2021): 5-9.
- Sheridan GA, Nagle M, Russell S, et al. Pediatric Trauma and the COVID-19 Pandemic: A 12-Year Comparison in a Level-1 Trauma Center. *HSS Journal* 16 (2020): 92-96.
- Shi Y, Kvasnovsky C, Khan S, et al. Impact of the COVID-19 pandemic on trauma activations at a pediatric level 1 trauma center in New York. *Pediatr Surg Int* 37 (2021): 1409-1414.

13. Matthay ZA, Kornblith AE, Matthay EC, et al. The DISTANCE study: Determining the impact of social distancing on trauma epidemiology during the COVID-19 epidemic-An interrupted time-series analysis. *J Trauma Acute Care Surg* 90 (2021): 700-707.
14. Bram JT, Johnson MA, Magee LC, et al. Where Have All the Fractures Gone? The Epidemiology of Pediatric Fractures During the COVID-19 Pandemic. *Journal of Pediatric Orthopaedics* 40 (2020): 373-379.
15. Sugand K, Park C, Morgan C, et al. Impact of the COVID-19 pandemic on paediatric orthopaedic trauma workload in central London: a multi-centre longitudinal observational study over the “golden weeks”. *Acta Orthopaedica* 91 (2020): 633-638.
16. Raitio A, Ahonen M, Jääskelä M, et al. Reduced Number of Pediatric Orthopedic Trauma Requiring Operative Treatment during COVID-19 Restrictions: A Nationwide Cohort Study. *Scandinavian Journal of Surgery* 110 (2020): 254-257.
17. Maryada VR, Mulpur P, Guravareddy AV, et al. Impact of COVID-19 Pandemic on Orthopaedic Trauma Volumes: a Multi-Centre Perspective From the State of Telangana. *Indian Journal of Orthopaedics* 54 (2020): 368-373.
18. Dunton GF, Do B, Wang SD. Early effects of the COVID-19 pandemic on physical activity and sedentary behavior in children living in the U.S. *BMC Public Health* 20 (2020): 1351.