



LITHUANIAN UNIVERSITY  
OF HEALTH SCIENCES

## Seasonality of Pediatric Trauma during COVID-19

Department of Orthopedic and Traumatology. Faculty of Medicine. Lithuanian University of Health Sciences, Kaunas. Hospital of LSMU “Kauno klinikos”. Eiveniu str. 2, LT-50161 Kaunas. Department of Orthopedic and Traumatology. 2022-2023

**Author:** Ali Mohamed Abdelhady Ali Radwan, Medical Faculty, 6<sup>th</sup> year

**Supervisor:** Prof. Emilis Čekanauskas, Department of Orthopedic and Traumatology

## **Table of contents**

1. TITLE PAGE.....	1
2. ABSTRACT.....	3
3. ABBREVIATIONS.....	5
4. ETHICS COMMITTEE APPROVAL.....	6
5. INTRODUCTION.....	7
6. OBJECTIVES.....	10
7. METHOD.....	10
8. RESULTS.....	18
9. DISCUSSION .....	24
10. CONCLUSION.....	27
11. CONFLICT OF INTERESTS.....	28
12. REFERENCES.....	29

# **Abstract**

## **Title**

Seasonality of Pediatric Trauma during COVID-19

## **Objectives**

Variations in the type and level of physical activity among children due to seasonal changes can influence patterns of injuries. Yet, there is scant data concerning how injuries are dispersed over the span of a year. This study aims to detail and scrutinize the effects of the COVID-19 pandemic on pediatric trauma.

Aim: to investigate pediatric trauma seasonality affected by COVID-19

Objectives:

- Collect pediatric trauma data prior to COVID-19 lockdown (2015.05/2019.05)
- Collect pediatric trauma data during COVID-19 lockdown (2020.05/2021.05)
- Collect pediatric trauma data after lockdown (2021.05/2022.05)

## **Methodology and Approach**

We undertook a retrospective, cross-sectional study from 2015 to 2022, analyzing children between the ages of 1 and 18 who were treated at the Klinikos trauma center and included in the Klinikos trauma registry. We categorized the time periods into pre-pandemic (January 2015 - February 2019), pandemic (March 2020 - July 2021), and post-pandemic (August 2021 - July 2022). The main focus was on pediatric trauma activations. We scrutinized demographic and clinical details, along with the nature and frequency of injuries. Bivariate analyses of injury trends across the designated time periods were conducted without any correction. To compare trauma activation rates pre, during, and post-pandemic, we employed segmented linear regression models.

## **Statistical Analysis**

We used the SPSS system for our statistical analysis. Continuous variables were displayed as mean and standard deviation, while categorical variables were represented as frequencies and percentages. We applied Chi-squared tests and independent t-tests to determine differences between groups for categorical and continuous variables, respectively. A p-value less than 0.05 was considered significant.

## **Results**

Our study encompassed a total of 14,270 pediatric patients aged between 0 and 18 years. Before the lockdown, the average number of admissions from May of each year, from 2015 to 2019, was 1,947 pediatric patients. However, during the lockdown in May 2020, this number dropped to 1,105 patients, marking a reduction of approximately 43.246%. Once the lockdown measures were lifted, the average number of admissions rose again, with 1,715 pediatric patients admitted, showing a 55.2036% surge in admissions post-lockdown. When comparing the pre-COVID averages from 2015-2019 with the averages from 2021-2022, there's an 11.915% increase in the post-COVID period. This notable rise in patient numbers post-COVID prompts many questions regarding the cause of this surge

## **Conclusion**

To sum up, the COVID-19 outbreak and subsequent lockdown resulted in a decrease in pediatric admissions and surgeries for trauma at our center. Over the past eight years, a clear correlation has been observed between the reduction in school days during lockdown periods and a significant decrease in the number of acute trauma hospitalizations and surgeries performed. With the reopening of schools, playgrounds, and sporting events nationwide, an increase in pediatric trauma admissions is anticipated. Recognizing the patterns of pediatric trauma during the current and potential future pandemics can help institutions to better allocate their resources and staff. These insights will be valuable for the authorities responsible for the phased reopening of schools, sports activities, and wider society.

## Abbreviations

1. **COVID-19** - Coronavirus Disease of 2019
2. **CT** - Computer Tomography
3. **FMT** - Final Master Thesis
4. **LSMU** - Lithuanian University of Health sciences
5. **MERS-CoV** - Middle East Respiratory Syndrome Coronavirus
6. **RNA** - Ribonucleic Acid
7. **SARS-CoV-1** - Severe Acute Respiratory Syndrome Coronavirus 1
8. **SARS-CoV-2** - Severe Acute Respiratory Syndrome Coronavirus 2
9. **WHO** - World Health Organization
10. **NAI** - Non-Accidental injuries.

## **ETHICS COMMITTEE APPROVAL**

Permission to conduct the research was obtained from Lithuanian University of Health Sciences, Bioethics Center, No. BEC-MF-408.

## Introduction

On January 30, 2020, the World Health Organization (WHO) declared the outbreak of COVID-19. This respiratory illness is caused by the SARS-CoV-2 coronavirus and is primarily spread through droplets of saliva or nasal discharge when a person carrying the virus coughs or sneezes [1,2].

The COVID-19 virus, first identified in Wuhan, China, is now recognized as a significant global threat [3]. The virus has since spread globally, leading to an escalating number of cases.

The order of Nidovirales comprises an important collection of viruses known as coronaviruses (CoVs), which include families such as Arteriviridae, Coronaviridae, Mesoniviridae, and Roniviridae. Further subdivisions of the Coronaviridae family include the Coronavirinae and Torovirinae families. All Nidovirales viruses can be categorized as enveloped, non-segmented positive-sense RNA viruses with large RNA genomes. Among them, the Coronavirinae is believed to possess the largest RNA genomes, reaching sizes of up to 33.5 kilobases (kb) [4].

Two significant public health issues in the past that contributed to global epidemics were caused by the Coronavirinae family. The first, known as SARS-CoV (Severe Acute Respiratory Syndrome Coronavirus), was discovered in the Chinese province of Guangdong in 2002–2003.

Before it was controlled, this virus afflicted 8422 persons, had a 11% mortality rate, and resulted in 916 fatalities [5]. Middle East Respiratory Syndrome Coronavirus (MERS-CoV), which was discovered almost ten years later in 2012, infected 2494 people, had a 34% fatality rate, and killed 858 people [6].

The Coronavirinae family can lead to moderate to serious respiratory conditions in humans, as well as causing upper respiratory infections [7].

The clinical characteristics of COVID-19 predominantly manifest as mild upper respiratory tract infections and more severe lower respiratory tract infections. These can range from non-life-threatening pneumonia to life-threatening pneumonia accompanied by acute respiratory distress syndrome. The virus is indiscriminate, affecting all age demographics from infants to the elderly [8]. The mortality rate for SARS-Cov-2 is estimated to be around 2%, with a majority of deaths occurring among specific groups [9].

As per the World Health Organization, most individuals infected with the COVID-19 virus are likely to experience mild to severe respiratory infections, such as fever, dry cough, and fatigue, and can recover without needing specialized treatment. However, some individuals are more prone to severe complications and may ultimately succumb to conditions like pneumonia and acute respiratory failure. These at-risk groups often include older adults with pre-existing conditions like cardiovascular disease, chronic respiratory diseases, diabetes, cancer, or those with compromised immune systems [1].

Although the recorded instances of pediatric COVID hospitalizations have been relatively low [10], there has been a noticeable uptick in the rate of pediatric injuries [11]. Specifically, a marked decrease in pediatric hospital admissions (ranging between 48% to 67% worldwide) has been observed, which has correspondingly led to a surge in severity [12,13]. While total lockdown contributed to a decline in pediatric traumas, a number of fractures still occurred domestically, either inside the home or while engaged in activities in the yard. Factors contributing to childhood injuries encompass increased social isolation, financial stress, and loss of support networks.

Various types of injuries sustained by children at home, such as burns, fractures, contusions, and traumatic injuries, are frequently reported in medical literature. Trauma stands as the primary factor in causes of pediatric morbidity and mortality [14]. According to international studies, pediatric trauma and injury patterns have undergone changes globally [14].

In terms of system preparedness, it is crucial to produce a comprehensive account of pediatric traumas during the lockdown to gain a better grasp of its implications on the pediatric healthcare system. National health data are of interest to a global audience due to the diverse approaches to emergency management reported across different countries. Moreover, offering national statistics and linking them with strategies of other countries can prove beneficial in addressing challenges during a global health crisis.

While there has been a consistent global decrease in pediatric trauma services, trauma continues to be a significant cause of death and health complications among children (Tuason et al. 2009[24]). Recent demographic studies have shown that the rate of fractures in children varies between 76 and 137 per 10,000 person-years (Orton et al. 2014 [23], Moon et al. 2016 [22]). Even as adult elective care is entirely halted, pediatric care that is semi-elective or urgently elective is still deemed essential during the pandemic. The COVID-19 outbreak enforced lockdowns starting in



March, leading to the closure of schools and daycare centers. Consequently, children, like adults, had to adjust to staying at home.

The aim of our research was to ascertain the incidence of pediatric emergencies during the COVID-19 pandemic at university centers in Kaunas. Based on previous studies, we expected a decrease in trauma cases this year compared to previous years. Additionally, we aimed to assess the different types of injuries associated with the trauma and anticipated that injuries related to outdoor activities would show the most significant drop. While we expected potential delays in receiving care, we hypothesized that COVID-19 would not significantly affect the number of emergency patients not related to trauma.

This study sought to determine whether there had been any changes in the patterns of pediatric trauma among patients admitted to the pediatric emergency department of a COVID-19 hospital during the entire lockdown period.

## Objectives

Aim: to investigate pediatric trauma seasonality affected by COVID-19

Objectives:

- Collect pediatric trauma data prior to COVID-19 lockdown (2015.05/2019.05)
- Collect pediatric trauma data during COVID-19 lockdown (2020.05/2021.05)
- Collect pediatric trauma data after lockdown (2021.05/2022.05)

## Material and method

In our study, we conducted a retrospective cross-sectional analysis of children between the ages of 1 and 18 years who were examined and registered in the Klinikos trauma registry at the Klinikos trauma center between 2015 and 2022. The pre-pandemic period was defined as January 2015 to February 2019, the pandemic period as March 2020 to July 2021, and the post-pandemic period as August 2021 to July 2022. Our primary outcome was pediatric trauma activations. We examined demographic and clinical data as well as the frequency and types of injuries sustained. We conducted uncorrected bivariate analyses to identify trends in injuries across time periods and used segmented linear regression models to compare rates of trauma activation before, during, and after the pandemic.

## Statistical Analysis

The mean and standard deviation were used to report continuous variables, while frequencies and percentages were used for categorical variables. To compare differences between groups for categorical and continuous variables, chi-squared tests and independent t-tests were used, respectively. A p-value less than 0.05 was considered significant.

## Patients and methods

We utilized the hospital's digital medical system, along with data from the statistics department, to access all urgent referrals, inpatient medical records, and discharge summaries. This approach ensured a uniform method for data collection.

## **Inclusion criteria**

The research encompassed all cases of acute orthopedic trauma that were initially presented to the emergency department and subsequently referred either for fracture clinic treatments at the orthopedic trauma department or to the acute referral team. All these patients were considered in our analysis.

## **Exclusion criteria**

We excluded all patients above the age of 18 from our study. The impact of social distancing measures on trauma caseloads would not have been accurately assessed if we had included non-urgent semi-elective procedures in our analysis. Given this, routine elective orthopedic cases, which were suspended during this period, were also left out of our study.

## **Results**

Our study encompassed a total of 14,270 pediatric patients aged between 0 and 18 years. In the period leading up to the lockdown, the average number of admissions for every May from 2015 to 2019 was 1947 pediatric patients. However, during the lockdown in May 2020, this figure dropped to 1105 patients, marking a roughly 43.246% decrease. Following the lifting of lockdown restrictions, the average admission rate once again rose, reaching 1715 pediatric patients, which indicates a surge of around 55.2036%. When comparing the average number of patients from 2015–2019 (pre-COVID) with the average from 2021–2022 (post-COVID), we notice an increase of 11.915%, prompting further investigation into the reasons for this uptick.

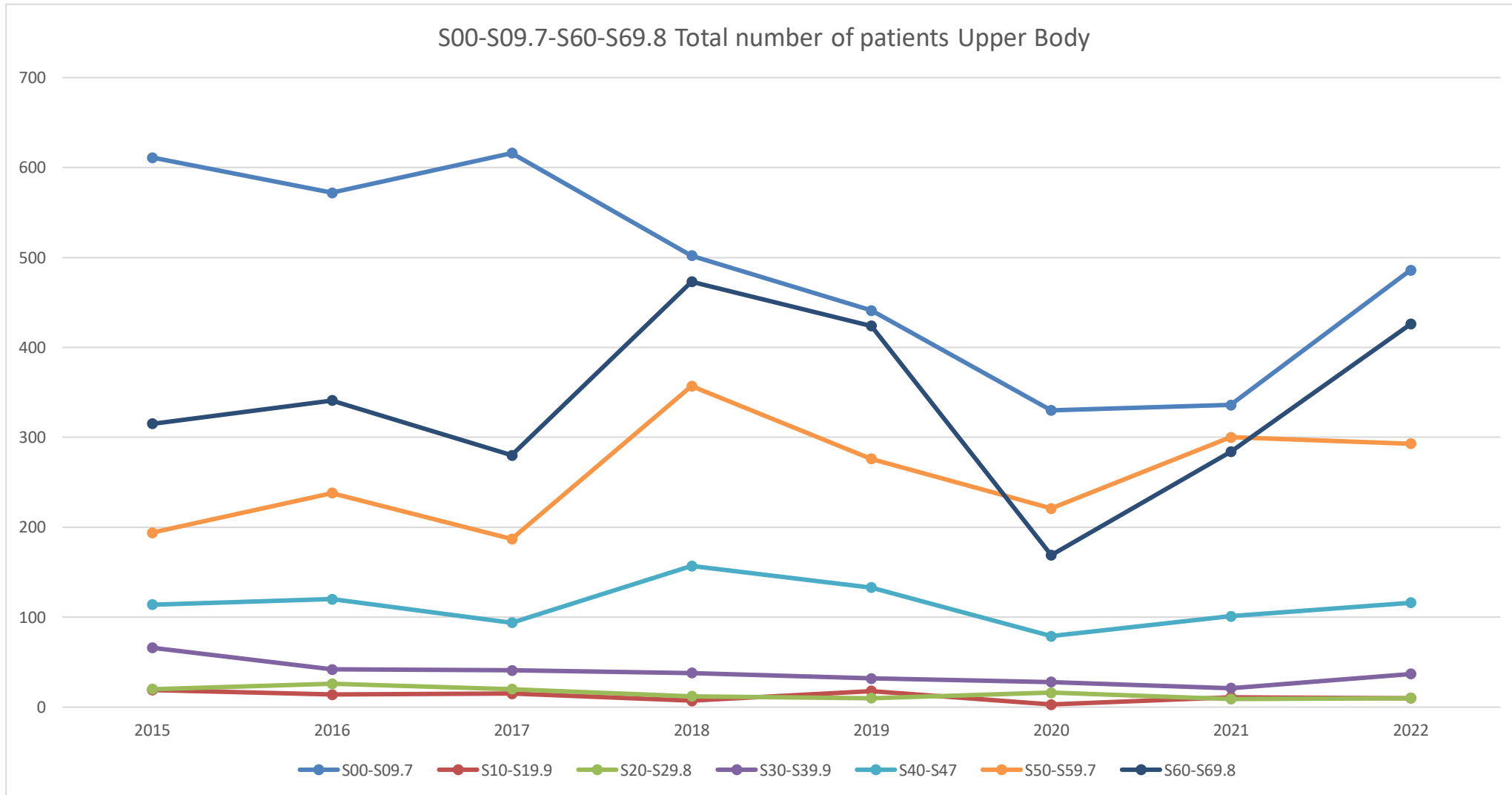
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
<b>2015</b>	53	31	34	77	91	51	56	79	52	48	104	82	76	57	53	38	48	58	51	61	60	64	53	66	71	73	57	58	65	45	49
<b>2016</b>	27	73	80	60	78	58	44	47	75	82	59	94	59	38	39	67	62	65	64	64	57	60	75	62	87	80	63	61	67	85	68
<b>2017</b>	50	58	48	64	57	44	39	68	59	50	62	61	62	65	56	52	59	60	80	54	60	81	62	53	75	45	52	62	83	65	59
<b>2018</b>	69	91	82	76	54	79	107	63	95	66	65	42	88	99	63	78	74	75	60	69	82	86	79	63	69	53	68	98	79	49	50
<b>2019</b>	61	65	60	43	45	92	75	55	100	50	61	47	76	61	63	81	59	56	47	76	96	62	85	54	69	39	82	81	61	67	50
<b>2020</b>	25	13	32	56	34	36	41	35	55	39	40	27	23	37	27	31	12	31	27	33	56	38	29	29	32	41	53	84	51	19	36
<b>2021</b>	40	41	37	44	59	53	38	23	38	56	59	61	52	34	53	71	85	62	54	38	70	33	44	60	40	47	43	33	32	45	66
<b>2022</b>	51	68	68	72	83	71	58	38	82	74	50	72	67	31	67	78	72	52	80	62	40	48	91	65	67	48	66	53	47	59	56

**Table 1: MAY NUMBER OF PATIENTS PER DAY**

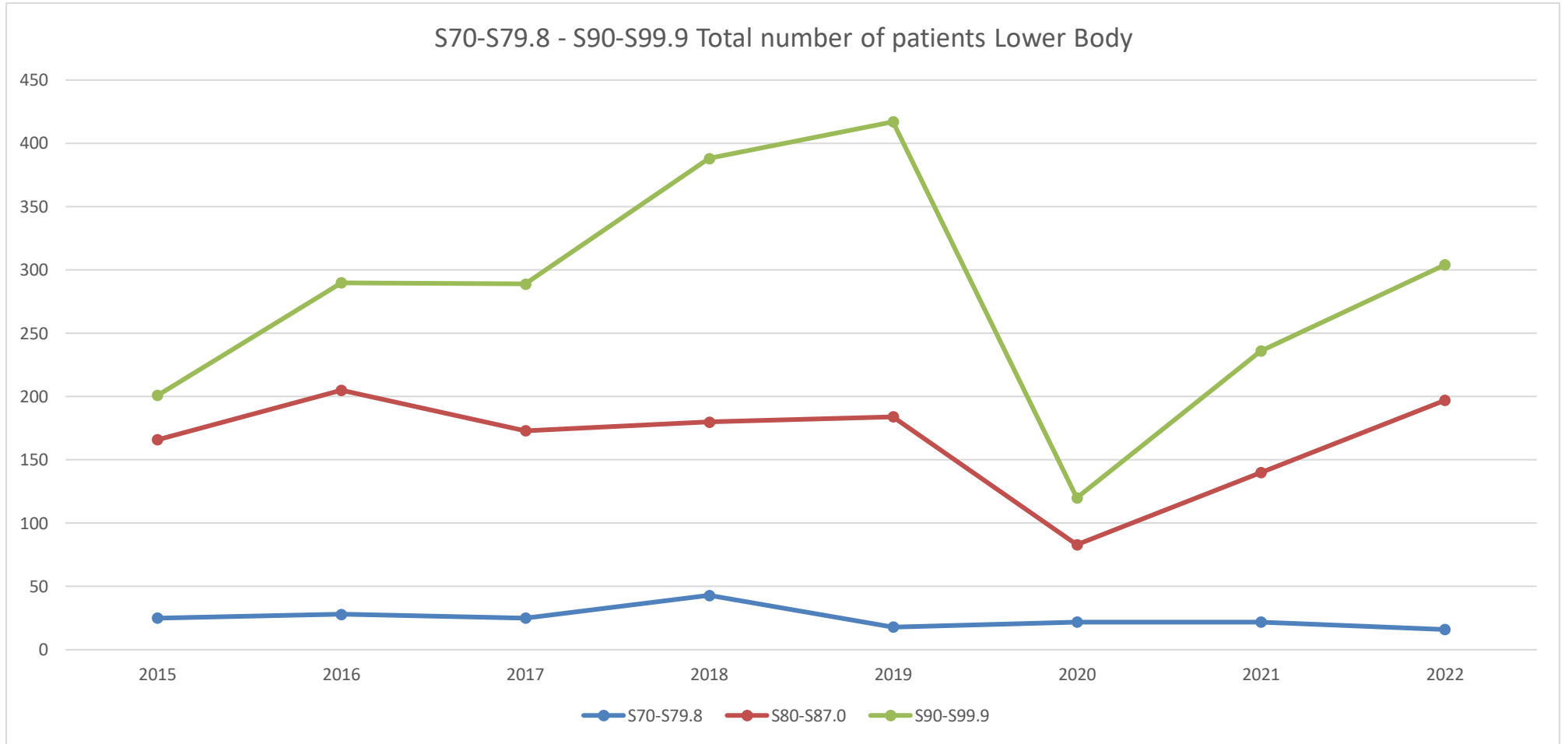
**Table 2: TYPE OF TRAUMA PER MONTH (MAY)**

	<b>S00- S09.7</b>	<b>S10- S19.9</b>	<b>S20- S29.8</b>	<b>S30- S39.9</b>	<b>S40-S47</b>	<b>S50- S59.7</b>	<b>S60- S69.8</b>	<b>S70- S79.8</b>	<b>S80- S87.0</b>	<b>S90- S99.9</b>	<b>T00- T07</b>	<b>T20.0- T31.1</b>	<b>Total</b>
<b>2015</b>	611	19	20	66	114	194	315	25	166	201	19	39	1789
<b>2016</b>	572	14	26	42	120	238	341	28	205	290	26	33	1935
<b>2017</b>	616	15	20	41	94	187	280	25	173	289	7	57	1804
<b>2018</b>	502	7	12	38	157	357	473	43	180	388	15	34	2206
<b>2019</b>	441	18	10	32	133	276	424	18	184	417	19	29	2001
<b>2020</b>	330	3	16	28	79	221	169	22	83	120	6	28	1105
<b>2021</b>	336	11	9	21	101	300	284	22	140	236	9	37	1506
<b>2022</b>	486	10	10	37	116	293	426	16	197	304	7	22	1924

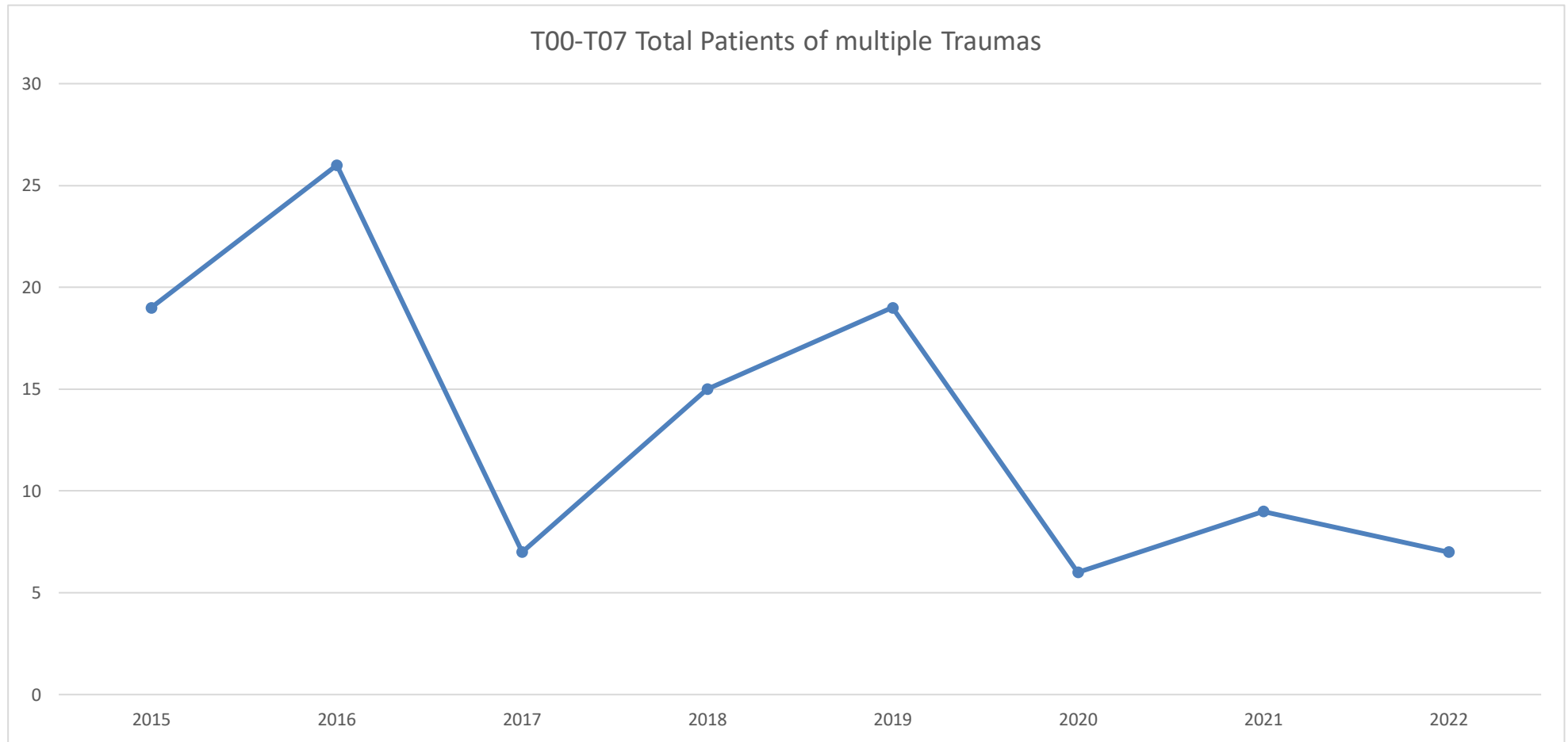
**Fig. 1.** S00-S09.7-S60-S69.8 Total number of patients Upper Body



**Fig. 2.** S70-S79.8 - S90-S99.9 Total number of patients Lower Body

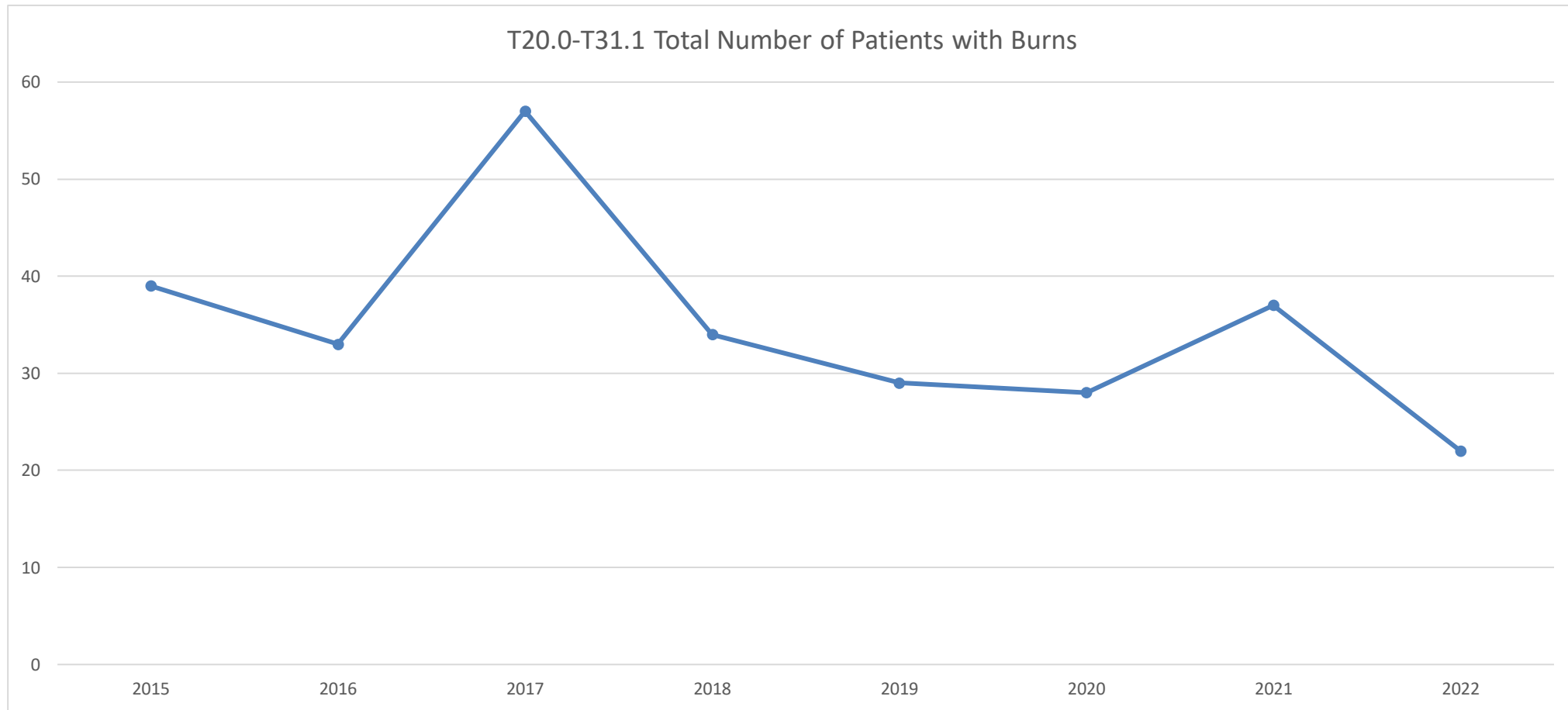


**Fig. 3.** T00-T07 Total Patients of multiple Traumas





**Fig. 4.** T20.0-T31.1 Total Number of Patients with Burns



## Results

We analyzed 14270 pediatric patients ranging in age from 0 to 18. Among the 14270 admissions, 9735 were before Covid from May 2015 to 2019, 1105 were admitted during the May 2020 lockdown, and 3430 were admitted after the lockdown. Taking the averages of pre covid which is 1947 patients and post covid with 1715 patients and comparing them shows us that there is a decrease of number of admissions by 11.915%.

When compared to prior years, the number of patients with head traumas (S00-S09.7) decreased by 39.781% in May of 2020, and following the lockdown in 2021–2022, the number of patients increased by 24.54% ( $r(6)=0.600$ ,  $p=0.116$ ). The average number of patients with head injuries decreased by 25.05% between pre and post covid, according to the comparison. In May 2020, neck injuries S10-S19.9 dropped by 79.45%; however, after lockdown, neck injuries increased by 250% ( $r(6)=0.439$ ,  $p=0.26$ ). As comparison to pre-COVID, there was an overall decrease in neck trauma patients of 28.08% after COVID.

For thoracic traumas S20-S29.8 during Covid compared to prior years, there was a 9.09% decline in admissions during May 2020, when limits were implemented, there was a 40.625% decrease in admissions, and there was a decrease in patient volume for thoracic trauma post-Covid by 46.02% compared to pre-Covid times,  $r(6)=-0.019$   $p=0.965$ .

Pediatric admissions decreased by 36.07% in May 2020 in terms of S30-S39.9 abdominal and pelvic traumas, while these injuries rose by 3.57% in pediatric patients following the harsh lockdown ( $r(6)=0.345$ ,  $p=0.404$ ). When comparing the years 2021–2022, there was a 33.789% drop in patients with abdominal and pelvic traumas.

After restrictions were eased, admissions for patients with shoulder and upper arm traumas, coded as S40-S47, increased by 37.34% throughout the course of 2021–2022, with  $r(6)=0.426$  and  $p=0.293$ . These injuries experienced a 36.08% drop during the lockdown in May 2020. A decrease of 12.216% in patients is observed between pre- and post-covid patients in 2021–2022, compared to 2015–2019.

And for elbow and forearm S50-S59.7 traumas, lockdown resulted in an 11.74% drop in pediatric trauma admissions, but following lockdown in 2021 and 2022, there was a 34.16% rise in

patients with (S50-S59.7 traumas),  $r(6)=0.426$   $p=0.293$ . As for elbow and forearm traumas we found out something different compared to rest of the results we managed to get. For S50-S59.7 patients there was an increase of 18.41% of admissions during the 2021-2022 period compared to 2015-2019 which raises some question, maybe during the 2015-2019 period there was something that affected the number of patient admissions.

In May 2020, wrist, hand, and finger traumas with codes S60–S69.8 dropped by 53.901%; however, after lockdown, there was a significant increase of 110.06%;  $r(6)=0.921$ ;  $p0.001$ . By comparing the post-covid and pre-covid periods, we detect a significant rise in wrist, hand, and finger traumas compared to lockdown time 2020, but only a slight decrease of 3.164% in patients with S60-S69.8 injuries.

Hip and thigh traumas are coded as S70-S79.8, and during the initial lockdown in May 2020, pediatric hospital admissions for these traumas decreased by 20.86%. Even when the limits were relaxed in 2021–2022, there was still a decrease in hip and thigh traumas of 13.63%,  $r(6)=0.413$ ,  $p=0.309$ . When we analyze the data from 2015 to 2019 and compare it to the years 2021 to 2022, we find that the number of patients in the post-COVID period has increased by 31.6 percent.

Knee and lower leg traumas with codes ranging from S80-S87.0 had a significant decrease of 54.295%, which is a significant difference, and after lockdown during the years 2021 and 2022, there was a huge increase of 103.01% of pediatric patients admitted to hospital for knee and lower leg traumas,  $r(6)=0.905$   $p=0.002$ . there was a 7.2136% decrease in patients comparing pre covid period with post covid period.

Traumas coded as S90-S99.9 are Ankle, Foot, and Toes traumas, which had a significant decrease of 62.145% of admissions during the May 2020 lockdown, and a massive increase of 125% of patients admissions during the 2021-2022 period, which is very significant when compared to other types of traumas,  $r(6)=0.877$   $p=0.004$ . For ankle, foot, and toe traumas, the difference between pre- and post-COVID periods shows that there was a 14.8265% decrease in patients.

In terms of patients with multiple traumas T00-T07, there was a 65.116% drop in admissions for pediatric traumas during the 2020 May period, and an increase in 33.333% of T00-T07 trauma admissions after COVID lockout and limits,  $r(6)=0.517$   $p=0.190$ . During the post-Coivid 2021–2022 period, there was a 53.488% decrease in patients seeking treatment for multiple traumas, which was more than the pre–Covid period.

Patients with burns are coded T20-T31.1, and compared to the previous years' average of 2015-2019, there was a decrease of 27.083% in admissions due to burns during May of 2020, and after the lockdown period, there was a minor increase of 5.35%, not very significant compared to leg traumas and how that was affected, Patients admissions post covid for burns decreased by 23.177% compared to the pre covid times,  $r(6)=0.033$   $p=0.939$ .(Table 2)

While analyzing the data, we discovered a very troubling change. For the elbow and forearm trauma coded S50-S59.7, we discovered that between May of 2015 and May of 2017, there was a decrease in elbow and forearm traumas. In May of 2015, there were 194 patients admitted to the hospital for S50-S59.7 type traumas; in May of 2016, there were 238 patients, and things returned to normal with 187 patients in May of 2017. 357 patients were admitted later in May 2018 and 276 patients arrived in May 2019. and during COVID lockdown 2020 there were 221 pediatric patients admitted. This caught us off guard and was intriguing because it didn't make sense to us because all types of injuries admitted during lockdown normally decreased except for elbow and forearm traumas. So we ask how and why was the a decrease during the May of 2015 and May of 2017; was it affected by the weather factor or was it affected by an event that occurred during these times that caused the decrease?

Then, we examined all the activities that occurred between May 2015 and May 2017. The International Labor Day was observed on May 1, 2015, in Kaunas and around Lithuania. On May 9, 2015, Kaunas had a military parade to commemorate Victory Day, a Russian national holiday. The Kaunas Jazz Festival, which took place from May 15–17 2015, featured performances by numerous jazz musicians from around the world. The Kaunas Half Marathon took place on May 16 and 17, 2015, with thousands of runners. The Lithuanian Basketball League Finals were held in Kaunas on May 23, 2015, and Žalgiris Kaunas won the title. Also, may marks the end of the academic year for many Lithuanian schools and institutions. Graduation ceremonies, thesis defenses, and other academic events so celebrated May 2015.

The average temperature in May 2015 was 13.84 degrees Celsius, which is not particularly warm. The total amount of precipitation for the month of May 2015 was 117.5 mm (4.63 in), and the snow depth was approximately 0.0 mm (0.0 in). As for the wind, it was a fairly windy month with an average wind speed of 12.45 km/h and an average gust wind speed of 18.97 km/h. Children these days prefer to stay inside because their devices can make up for it and take from their time indoors, which made the kids stay inside because of the unsteady weather and caused a decrease in the number of admissions during May 2015. We also saw numerous windy days during that month, which could have

caused schools and parents to keep the kids from going outside and reduce the risk of traumas. On May 1, 2017, Kaunas marked International Workers' Day with rallies and marches. These activities took place in May of 2017. Moreover, the Kaunas Jazz Festival, which included jazz musicians from all over the world, was held on May 6 and 7, 2017. The 2017 Kaunas Marathon took place from May 12–14 with competitors from Lithuania and other nations. The Lithuanian national basketball team and the Latvian national basketball team squared off in a friendly matchup on May 15, 2017, in Kaunas. The Kaunas City Day was commemorated on May 20, 2017, with a number of cultural activities, performances, and exhibitions. The International Contemporary Dance Festival "New Baltic Dance" took place in Kaunas from May 25–27, 2017, and it featured performances from contemporary dance companies from all over the world.

About the weather in May of 2017, we can observe that the average high was 14.84 degrees Celsius, the total amount of precipitation was 41.4 millimeters (1.63 inches), and the total amount of snowfall was 2.599 millimeters (0.1 inches). In terms of the wind, the average wind speed was 11.0 km/h for light winds, and 17.16 km/h for strong winds. Furthermore, as we previously indicated, these variables can cause children to stay inside on chilly and windy days, which lowers their risk of suffering most accidents.

We collected the weather data for each May from 2015 to 2019 to see if weather had an effect on the unexplained decrease in elbow and forearm trauma coded S50-S59.7 during May of 2015 and May of 2017. This was done after analyzing the results and researching the weather conditions since they could be one of the reasons for the decrease in elbow and forearm trauma coded S50-S59.7 during May of 2015 and May 2017. Accordingly, the average temperature in May from 2015 to 2017 was 13.84 degrees Celsius, the average temperature in May 2016 was 16.74 degrees Celsius, the average temperature in May 2017 was 14.84 degrees Celsius, the average temperature in May 2018 was 18.77 degrees Celsius, and the average temperature in May 2019 was 14.74 degrees Celsius. This could explain why there were fewer admissions in 2019 since it was the second-coldest month overall. These data show that May was virtually always the coldest month, with a low of 13.84 degrees Celsius in 2015. This could be the cause of the decline. As we saw in 2017, there wasn't much warmth, with an average temperature of 14.84 degrees Celsius through May 2017. As a result, it's possible that the temperature had anything to do with the anomaly we saw in S50-S59.7 (Table2).

Now that we have compared the precipitation totals through May for each year from 2015 to 2019, we can see that in 2015 there was a total of 117.5mm of precipitation and 0.0mm of snow depth. 2016 saw 138.0mm of total precipitation and 0.0mm of snow depth; 2017 saw 41.4mm of total

precipitation and 2.599mm of snow depth; 2018 saw 77.9mm of total precipitation and 0.0mm of snow depth; and 2019 saw 99.7mm of total precipitation and 0.0mm of snow depth. After analyzing the data, we found that there wasn't enough evidence to say that rain had an impact because, as we can see, there was 77.9mm of rain in 2018 but 357 pediatric children still made up the majority of trauma admissions between 2015 and 2019. While it's not certain that rain had the greatest impact, it did undoubtedly have some impact on the decline in the number of S50-S59.7 admissions between May of 2015 and May of 2017, when we saw 117.5mm of rain in 2015 and 41.4mm with a snow depth of 2.599mm.

Considering the wind speed averages that would have affected the S50–S59.7 admissions in May 2015 and 2017. In 2015, the average wind speed was 12.45 km/h, with gusts as high as 18.97 km/h. In 2016, the average wind speed was 10.39 km/h, with gusts as high as 16.9 km/h. 2017 had wind gusts an average of 17.16 km/h and an average wind speed of 11.0 km/h. In 2018, the average wind speed was 10.9 km/h, while average gusts were 17.23 km/h. In 2019, the average wind speed was 14.32 km/h, while average gusts were 21.68 km/h. We can't say with certainty that the wind alone had an impact, but if we combine the wind, temperature, and precipitation, we might get a month with unpredictably bad weather that might encourage youngsters to stay inside. For instance, in May 2015, the low temperature was 13.84 degrees Celsius, the total amount of precipitation was 117.5 mm, and the wind speed was roughly 12.45 km/h. As compared to other years, May 2015 was colder and wetter, which may have contributed to the decline in admissions. As for 2017, it was also chilly, with an average temperature of 14.84 degrees Celsius, 41.4 millimeters of precipitation overall, 2.599 millimeters of snowfall, and winds averaging 11.0 kilometers per hour. By comparing the months, we can see that the weather does indeed have an impact and may be one of the causes of the anomaly in S50-S59.7 in 2017. (Table 2)

There is no specific research available that has evaluated the incidence of multiple traumas for pediatric patients during the COVID-19 lockdown at the moment. As a result, providing a precise answer as to why there may have been a decline in numerous traumas during this time is challenging. Some of the factors that may have contributed to the general decrease in traumatic injuries among pediatric patients during lockdown, including those with multiple injuries, include, Physical activities and outdoor play have been reduced. Due to the closure of many schools and parks during the lockdown, children may have had fewer opportunities to engage in physical activity and outdoor play, potentially lowering their chance of experiencing catastrophic injuries. Less travel and fewer accidents While many families stayed at home during the lockdown, fewer car accidents and other types of incidents that might result in devastating injuries may have occurred. Parental supervision has been

increased. Because parents worked from home and spent more time with their children during the lockdown, there may have been better supervision and awareness of possible hazards that could result in traumatic injuries. Medical care is being delayed. It is also possible that some children were injured during the lockdown but did not seek medical attention owing to fears about COVID-19 exposure in hospital settings.

## Discussion

This investigation aimed to scrutinize the effects of the COVID-19 crisis on child-related trauma, focusing on a trauma center located in Kaunas, Lithuania. The six-year period from 2015 to 2020, divided into eight 4-week intervals, revealed that the year 2020's lockdown period had the least incidences of trauma admissions and surgeries involving children.

We underline a few potential limitations of this research. Firstly, the potential delay in disease presentation could be attributed to the fears and concerns of parents and patients about hospital visits amidst the COVID-19 outbreak. Nevertheless, a recent study by Bram et al. involving 14,270 pediatric patients, comparing a one-month lockdown period to a similar timeframe in the preceding year, reported no such delays [15]. Another constraint is our inability to assess the influence of activities such as sports, playground engagements, and other behavioral factors on the frequency of emergency trauma admissions and surgical interventions.

The initial lockdown phase that we studied, spanning four weeks, was relatively short. However, the strength of our investigation is significantly enhanced by the inclusion of data collected over an eight-year span. With regards to Non-Accidental Injury (NAI), the time children spend at home with potentially abusive parents has surged alongside rising unemployment rates. It is anticipated that such incidents may continue to rise. Consequently, it is of utmost importance that we remain vigilant in protecting children from possible life-threatening injuries when they arrive at our trauma centers.

Christey et al. also revealed a comparable pattern, showing a 48% drop in pediatric admissions during the lockdown in contrast to the fortnight before the lockdown began [16]. We observed a pattern akin to this. Nonetheless, as the lockdown prolongs and the likelihood of injuries escalates due to heightened tension in numerous homes, there remains a pressing need for more rigorous surveillance.

Several factors contribute to understanding our observations, with the environment being one key aspect. Atherton et al. examined the influence of temperature, daylight duration, and weekdays on pediatric trauma admissions [17]. Our study established a connection between increased daylight hours and a rise in emergency trauma admissions, while an inverse correlation was found between rainfall and acute trauma admissions. Similar results were reported by Masterson et al. during a three-year



span in 1993 [18]. The environmental factor's relevance is reasonable, as children tend to participate in activities that may cause trauma more frequently during extended sunshine hours and less so during increased rainfall. Despite the pandemic, children were permitted to spend time outdoors, provided they adhered to social distancing guidelines, even though schools were closed and playgrounds were off-limits.

The most significant finding of our study, which could have considerable future implications, was the marked correlation between the count of school days and pediatric trauma admissions ( $p = 0.03$ ). We found that an increase in school days within a specific timeframe corresponded to an increase in trauma procedures. For instance, during a four-week period, we estimated 23 school days in 2018, the highest in the eight-year span, which coincided with 2,206 admissions. 2021, following 2020, had the second-lowest admission figures and rate. During the lockdown in 2020, we recorded the fewest school days ( $n = 0$ ) and admissions ( $n = 2,206$ ). The influence of an increased number of school days on the rise in acute trauma treatments remained evident in a multivariate regression analysis, even after adjusting for all known seasonal predictive factors ( $p = 0.015$ ).

We posit that during the pandemic, children are not utilizing local playgrounds or climbing structures, nor are they partaking in potentially risky sports activities either at school or elsewhere. This may account for the pattern of serious injuries we have observed at our institution over the past eight years. Ordinarily, school-going children interact more with their peers, use potentially harmful equipment, and partake in various school sports activities. Corroborating this, Segal et al. recently showed a decrease in daily fracture rates from 6.62 to 4.45 when comparing a typical school day to a summer vacation day ( $p 0.01$ ) [19].

The implications for both trauma centers and regulatory bodies are such that there's a substantial decrease in pediatric trauma volumes during the pandemic. This situation allows for potential changes in staffing and resource distribution in healthcare facilities to better cater to children affected by COVID-19, without significantly impacting the quality of trauma care provided to the younger population. Several guidelines for managing pediatric orthopedic patients are already available [20]. We acknowledge that trauma centers have had to drastically adjust their usual services to accommodate an increasing number of patients with COVID-19-related respiratory issues [21]. These insights could be instrumental in formulating future guidelines. Specifically, it may be advisable to initially contemplate redeploying healthcare professionals from pediatric trauma to other respiratory services that could be overwhelmed due to the influx of COVID-19 cases.

Additionally, the decision to recommence school operations, including their related recreational and sporting activities, should be thoughtfully deliberated by all stakeholders. As schools reopen, it's foreseeable that there will be a surge in staffing and resources needed to manage an escalating count of pediatric trauma patients. The choices made within the context of COVID-19 should be balanced and thoroughly contemplated. Our research aids in outlining the potential trends of pediatric trauma that a level-I trauma center may expect in the upcoming weeks and months, and the reasons behind this change in trends.

## Conclusion

In the wake of the COVID-19 pandemic and ensuing lockdown, our trauma center experienced a decline in pediatric patient numbers and a reduction in pediatric trauma surgeries. Over an eight-year span, there was a significant decrease in the rate of emergency trauma hospitalizations and procedures, which corresponded with an increase in lockdown days for a given duration. As the country gradually reopens sports activities, parks, and schools, we anticipate a rise in trauma admissions for children. A deeper understanding of the patterns of pediatric trauma during the current and possible future pandemics can assist institutions in making more informed decisions regarding staffing and resource allocation, and in applying trauma prevention strategies. These findings will be beneficial to regulatory bodies responsible for the reopening of schools, sporting events, and broader society. Despite the pandemic crisis, children in Kaunas have managed to maintain their physical activities while adhering to social distancing measures. Team sports have been temporarily discontinued, yet typical physical activities seem to remain prevalent. This shift towards recreational activities with higher trauma risks was perceived to be partially responsible. While pediatric surgical traumas were initially lower during the study period, they quickly returned to their usual levels. Given that children are invariably active, we must always be prepared with adequate resources to manage any potential trauma scenarios.

**CONFLICT OF INTEREST**

No conflict of interest

## References

1. World Health Organization. Coronavirus disease (COVID-19). [Cited 19 Nov. 2021]. Available from: [https://www.who.int/health-topics/coronavirus#tab=tab\\_1](https://www.who.int/health-topics/coronavirus#tab=tab_1)
2. World Health Organization. Achieved: WHO Timeline - COVID-19. [Cited 20 Nov. 2020]. Available from: <https://www.who.int/news/item/27-04-2020-who-timeline---covid-19>
3. Akhtar H, Patel C, Abuelgasim E, Harky A. COVID-19 (SARS-CoV-2) Infection in Pregnancy: A Systematic Review. *Gynecol Obstet Invest.* 2020;85(4):295-306.
4. Fehr AR, Perlman S. Coronaviruses: An overview of their replication and pathogenesis. *Methods Mol Biol.* 2015;1282:1-23.
5. Chan-Yeung M, Xu RH. SARS: epidemiology. *Respirology.* 2003 Nov;8 Suppl (Suppl1): S9-14.
6. World Health Organization. Middle East respiratory syndrome coronavirus (MERS-CoV).[Cited 20 Nov. 2021]. Available from:<https://www.who.int/emergencies/mers-cov/en/>
7. Hasöksüz M, Kiliç S, Saraç F. Coronaviruses and SARS-COV-2. *Turk J Med Sci.* 2020 Apr21;50(SI-1):549-556.
8. Liu H, Wang LL, Zhao SJ, Kwak-Kim J, Mor G, Liao AH. Why are pregnant women susceptible to COVID-19? An immunological viewpoint. *J Reprod Immunol.* 2020 Jun; 139:103122.
9. Schwartz DA, Graham AL. Potential Maternal and Infant Outcomes from (Wuhan) Coronavirus 2019-nCoV Infecting Pregnant Women: Lessons
10. Gilmartin, S.; Barrett, M.; Bennett, M.; Begley, C.; Chroinin, C.N.; O'Toole, P.; Blackburn, C. The Effect of National Public Health Measures on the Characteristics of Trauma Presentations to a Busy Paediatric Emergency Service in Ireland: A Longitudinal

Observational Study. *Ir. J. Med. Sci.* 2021.

11. Isba, R.; Edge, R.; Jenner, R.; Broughton, E.; Francis, N.; Butler, J. Where Have All the Children Gone? Decreases in Paediatric Emergency Department Attendances at the Start of the COVID-19 Pandemic of 2020. *Arch. Dis. Child.* 2020, 105, 704.

12. Christey, G.; Amey, J.; Campbell, A.; Smith, A. Variation in Volumes and Characteristics of Trauma Patients Admitted to a Level One Trauma Centre during National Level 4 Lockdown for COVID-19 in New Zealand. *N. Z. Med. J.* 2020, 133, 81–88.

13. Sokoloff, W.C.; Krief, W.I.; Giusto, K.A.; Mohaimin, T.; Murphy-Hockett, C.; Rocker, J.; Williamson, K.A. Pediatric Emergency Department Utilization during the COVID-19 Pandemic in New York City. *Am. J. Emerg. Med.* 2021, 45, 100–104.

14. Sanford, E.L.; Zagory, J.; Blackwell, J.-M.; Szmuk, P.; Ryan, M.; Ambardekar, A. Changes in Pediatric Trauma during COVID-19 Stay-at-Home Epoch at a Tertiary Pediatric Hospital. *J. Pediatr. Surg.* 2021.

15. Bram JT, Johnson MA, Magee LC, et al. Where have all the fractures gone? The epidemiology of pediatric fractures during the COVID-19 pandemic. *J Pediatr Orthop.* 2020;40(8):373-379.

16. Christey G, Amey J, Campbell A, Smith A. Variation in volumes and characteristics of trauma patients admitted to a level one trauma centre during national level 4 lockdown for COVID-19 in New Zealand. *N Z Med J.* 2020;133(1513):81-88.

17. Atherton WG, Harper WM, Abrams KR. A year's trauma admissions and the effect of the weather. *Injury.* 2005;36(1):40-46.

18. Masterson E, Borton D, O'Brien T. Victims of our climate. *Injury.* 1993;24(4):247-248.

19. Segal D, Slevin O, Aliev E, et al. Trends in the seasonal variation of paediatric fractures. *J Child Orthop*. 2018;12(6):614-621.
20. Farrell S, Schaeffer EK, Mulpuri K. Recommendations for the care of pediatric orthopaedic patients during the COVID-19 pandemic. *J Am Acad Orthop Surg*. 2020;28(11):e477-e486.
21. Konda SR, Dankert JF, Merkow D, et al. COVID-19 Response in the global epicenter: converting a New York City Level 1 orthopedic trauma service into a hybrid orthopedic and medicine COVID-19 management team. *J Orthop Trauma*. 2020;34(8):411-417.
22. Moon R J, Harvey N C, Curtis E M, de Vries F, van Staa T, Cooper C. Ethnic and geographic variations in the epidemiology of childhood fractures in the United Kingdom. *Bone* 2016; 85: 9-14.
23. Orton E, Kendrick D, West J, Tata L J. Persistence of health inequalities in childhood injury in the UK: a population-based cohort study of children under 5. *PLoS One* 2014; 9(10): e111631.
24. Tuason D, Hohl J B, Levicoff E, Ward W T. Urban pediatric orthopaedic surgical practice audit: implications for the future of this subspecialty. *J Bone Joint Surg Am* 2009; 91(12): 2992-8.



## LIETUVOS SVEIKATOS MOKSLŲ UNIVERSITETAS

### BIOETIKOS CENTRAS

Kodas 302536989, Tilžės g. 18, LT- 47181, Kaunas, tel.: (8 37) 327233, [www.lsmuni.lt](http://www.lsmuni.lt), el.p.: [bec.registracija@lsmuni.lt](mailto:bec.registracija@lsmuni.lt)

Medicinos akademijos (MA)  
Vientisųjų studijų programa – Medicina  
V k. studentui Ali Mohamed Abdelhady Ali  
Radwan  
Darbo vadovas prof. Emilis Čekanauskas  
LSMUL KK Ortopedijos traumatologijos  
klinika

2022.04.21 Nr. BEC-MF-408

#### DĖL PRITARIMO TYRIMUI

LSMU Bioetikos centras, įvertinęs Ali Mohamed Abdelhady Ali Radwan pateiktus dokumentus, studento tiriamajam darbui tema „Seasonality of Pediatric Trauma during COVID-19“ pritaria\*.

dr. Eimantas Peičius

\* Pastaba: šis pritarimas neatleidžia tiriamąjį mokslinį darbą vykdančių asmenų nuo prievolės laikytis Bendrojo duomenų apsaugos reglamento nuostatų ir nuo atsakomybės gauti nacionalinio arba regioninio bioetikos komiteto leidimą, jei toks leidimas būtinas pagal LR Biomedicininų tyrimų etikos įstatyme numatytus reikalavimus.