Original Clinical Article

JOURNAL OF CHILDREN'S ORTHOPAEDICS

The increase in paediatric orthopaedic trauma injuries following the end of the curfew during the COVID-19 period

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Abstract

Purpose: The aim of this study was to compare the injury patterns of orthopaedic trauma patients in the paediatric age group who presented to our hospital during and after lifting the curfew due to the pandemic, with the patients of the same age group who presented to our institution during the same time period last year.

Methods: Patients, aged 0 years to 18 years, who presented to our clinic between 21 March 2020 and 31 May 2020 (during curfew) (Group A1, n = 111), between 01 June 2020 and 31 August 2020 (Group A2, n = 214) and during the same periods in 2019 Group B1 (n = 220) and Group B2 (n = 211) were included. Patients with pathological fractures, traumas occurring earlier than the aforementioned date range and those consulted while being hospitalized in another department were excluded from study. Patients' demographics, the department they presented to, the anatomical region affected by trauma, trauma mechanism, the location of trauma, the treatment applied and the length of hospital stay were recorded.

Results: The prevalence of outdoor traumas (72.9% *versus* 61.1%), high-energy traumas (40.1% *versus* 26.5%), the rate of the patients treated with surgery (28% *versus* 17.1%) and the rate of admission to the emergency department (90.2% *versus* 58.3%) were significantly higher in Group A2 when compared with Group B2 ($p < 0.05$).

Conclusion: The significant increase was observed in the number of outdoor injuries, high-energy traumas and fracture patterns that require surgical treatment during the first three months following the lift of the curfew, in comparison with the corresponding dates from last year. We think that children's lower extremity muscle strength and neuromuscular control was decreased due to staying home for a prolonged period of time.

Level of Evidence: Level III, Case-control study.

Cite this article: Kalem M, Özbek EA, Kocaoğ lu H, Merter A, Karaca MO, Şahin E, Başarir K. The increase in paediatric orthopaedic trauma injuries following the end of the curfew during the COVID-19 period. *J Child Orthop* 2021;15:409-414. DOI: 10.1302/1863-2548.15.210071

Keywords: COVID-19; SARS-CoV-2; trauma; curfew; paediatrics; pandemic

Introduction

The first COVID-19 case emerged in Wuhan, China on 01 December 2019 and started spreading across the Asian continent, followed by other continents.[1] A day after the first COVID-19 case was discovered in Turkey on 10 March 2020, the disease was declared a pandemic by the World Health Organization.[2] After Europe was reported to be the epicentre of the pandemic on 13 March 2020, measures including the closure of schools and restaurants and curfews were imposed as of 21 March 2020 in Turkey as well as in other countries around the globe.[3] Along with the curfew, individuals over the age of 65 years and under the age of 20 years were completely prohibited from leaving their homes. In our quaternary university hospital, an increase in orthopaedic trauma cases was observed, as expected, after the curfew was lifted on 01 June 2020.[4] However, during this period, it was observed that hospital admissions due to orthopaedic trauma in the paediatric population (0 years to 18 years) increased more in comparison with the adult population.

Sports injuries around the knee, which are common in the paediatric age group, are treated surgically to prevent secondary injuries that may occur in the future.[5] It has been reported that 90% of the paediatric age group can return to sports with postoperative rehabilitation and in

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a shorter time than adults.[6] This is explained by the fact that the paediatric age group is less afraid of the risk of re-injury and has a better neuromuscular structure than adults.[6] However, the risk of anterior cruciate ligament (ACL) re-rupture in the operated knee and an ACL rupture in the contralateral knee in the paediatric age group following return to sports is reported as 16%; two to three times higher than in the adult age group.[5,6] Poor aerobic fitness, fatigue and the increased risk of falling due to the decreased strength and neuromuscular control in the quadriceps and hamstring muscles, which occur during the rehabilitation and recovery period when the person falls short of performing activities have been reported to be the reason for this situation.[5,6] A dynamic functional test and reactive agility test, which evaluate the neuromuscular control prior to active exercises, especially in children with lower extremity injuries have been predicted to reduce recurrent injuries.[7,8]

The aim of this study was to compare the injury patterns of orthopaedic trauma patients in the paediatric age group who presented to our hospital during and after lifting of the curfew due to the pandemic with the patients of the same age group who presented to our institution during the same time period last year. In this study, we hypothesized that orthopaedic trauma due to falls would be more frequently encountered in the paediatric age group who lived in crowded and urban area and returned to sports and social life following the lifting of the curfew, since their lower extremity muscle strength and neuromuscular control would have been decreased as a result of staying home for a prolonged period of time.

Patients and methods

This study was performed with the approval of the local ethics committee and according to the principles of the Declaration of Helsinki. In this single-centre study, patient data from those who were admitted to our quaternary university hospital between 21 March 2020 and 31 August 2020, were collected prospectively, as well as the data from those who were admitted during the same period in 2019. Patients between the ages of 0 years and 18 years who applied to the orthopaedic outpatient department or emergency department due to orthopaedic trauma were included in the study, while patients with pathological fractures, traumas occurring earlier than the aforementioned date range and those consulted while being hospitalized in another department were excluded.

Data files including the demographic information and radiographs of the patients were evaluated by four orthopaedic specialists (EAÖ, HK, AM, MOK). In case of a conflict or uncertainty, the files were also evaluated by MOK. The patients' age and sex, date of trauma, the department the patients presented to (orthopaedics department, emergency department), the anatomical region affected by trauma (upper extremity (supracondylar humerus, distal radius), lower extremity, axial skeleton), trauma mechanism (low-energy trauma (fall), high-energy trauma (falling off a bicycle, falling from height, traffic accident)), the location of trauma (indoor, outdoor), the type of post-trauma treatment (conservative, surgical treatment) and the length of hospital stay were recorded.

Of the total number of 3772 patients who presented to the orthopaedic outpatient department or emergency department due to orthopaedic trauma between the aforementioned dates, 756 patients who met the inclusion criteria were identified. These patients were divided into two groups as those who presented in 2020 (Group A, n = 325) and those who presented in 2019 (Group B, n = 431). These groups were further categorized as those who presented between 21 March 2020 and 31 May 2020 (Group A1, n = 111), between 01 June 2020 and 31 August 2020 (Group A2, n = 214), 21 March 2019 and 31 May 2019 (Group B1, n = 220) and between 01 June 2019 and 31 August 2019 (Group B2, n = 211).

Statistical analysis

StataMP13 (StataCorp, Stata Statistical Software: Release 13, StataCorp LLP ,College Station, TX, USA) was used for descriptive and inferential analysis. The Shapiro-Wilk test was used to assess normality. Mean with SD was used to analyze the metric data. The chi-square and Fisher exact tests were used for categorical outcomes. The Kruskal Wallis test, followed by *post hoc* analysis with Bonferroni correction, was used to compare the four groups, as metric data were nonparametric. The Mann Whitney U test was used to analyze the non-parametric data between two groups. Required sample size was calculated via G*Power 3.1 (GPower Statistical Power Analyses; Düsseldorf, Germany). With alpha 0.05, power 0.95 and effect size 0.05, a total number of 76 participants are required. The statistical significance level was 0.05.

Results

There was no statistically significant difference between Group A and Group B in terms of age, sex, length of hospital stay, trauma mechanism and the anatomical regions affected by trauma ($p > 0.05$). The mean age of the patients in Group B (median 9 years (1 to 17)) was significantly higher than the mean age of the patients in Group A (median 8 years (1 to 17)) ($p < 0.05$). While the percentage of patients treated with surgery in Group A (27.7%) was significantly higher than the percentage of patients treated with surgery in Group B (18.3%), the percentage of patients admitted to the emergency department from

Group A (83.4%) was significantly higher than the percentage of patients from Group B (62.9%) ($p < 0.05$), as shown in Table 1.

There was no statistically significant difference between Group A1 (n = 111) and Group A2 (n = 214) in terms of age, sex, the treatment method, length of hospital stay and the anatomical region affected by trauma ($p > 0.05$). The percentage of patients who first presented to the emergency department in Group A2 (90.2%) was found to be significantly higher than the percentage of patients who presented to the emergency department in Group A1 (70.3%) ($p < 0.05$). Group A1 also had a significantly higher percentage of patients who had indoor injuries (71.2%) when compared with Group A2 (27.1%) ($p < 0.05$). On the other hand, the percentage of patients injured due to a high-energy trauma in Group A2 (40.1%) was significantly higher than the percentage of patients injured with the same type of trauma in Group A1 (10.8%) ($p < 0.01$).

There was no statistically significant difference between Group B1 (n = 220) and Group B2 (n = 211) in terms of sex, the department the patient presented to, the treatment method, length of hospital stay and the anatomical region affected by trauma ($p > 0.05$). The mean age of the patients in Group B1 (median 11 years (2 to 17)) was significantly higher than the mean age of the patients in Group B2 (median 7 years (1 to 17)) ($p < 0.05$). In Group B2, the percentage of patients that encountered an indoor injury (38.9%) was found significantly lower than the percentage of patients in Group B1 (52.7%) ($p < 0.05$). In addition, the percentage of patients injured due to a high-energy trauma in Group B1 (75.5%) was significantly higher than the percentage of patients injured with the same type of energy in Group B2 (26.5%), as shown in Table 2 ($p < 0.01$).

There was no statistically significant difference between Group A1 (33.5%) and Group B1 (66.5%) in terms of sex, the department the patient presented to, the treatment method and the anatomical region affected by trauma. The mean age of the patients in Group B1 was significantly higher than the mean of the patients in Group A1 (median 7 years (1 to 17)) ($p < 0.05$). In addition, the percentage of patients with indoor injuries in Group A1 (71.2%) was found to be significantly higher than the percentage of patients with indoor injuries in Group B1 (52.7%) ($p < 0.05$). On the other hand, the percentage of patients injured due to a high-energy trauma in Group B1 (75.5%) was significantly higher than the percentage of patients injured with the same mechanism in Group A1 (10.8%) ($p < 0.01$).

No statistically significant difference was detected between Group A2 (50.4%) and Group B2 (49.6%) in terms of age, sex, length of hospital stay and the anatomical region affected by trauma ($p > 0.05$). The percentage of patients treated by surgery in Group A2 (28%) was significantly higher than the percentage of patients treated with surgery in Group B2 (17.1%) ($p < 0.05$). While 90.2% of the patients in Group A2 presented to the emergency department, this rate was 58.3% for Group B2, exhibiting a significant difference between the two groups ($p < 0.05$). Similarly, the percentage of patients with outdoor injuries in Group A2 (72.9%) was significantly higher than the percentage of patients with the same type of injury Group B2 (61.1%) ($p < 0.05$). In addition, the percentage of patients injured due to a high-energy trauma in Group A2 (40.1%) was also significantly higher than the percentage of patients injured due to a high-energy trauma in Group B2 (26.5%), as shown in Table 2 ($p<0.01$).

Discussion

Several studies have reported about the increased risk of falls and bone fractures with decreasing physical activ-

Table 1 Demographics data of patients.

		Group A	Group B	p-value
Patients, n (%)		325 (*43*)	431 (*57*)	
Median age (range)		8 (1 to 17)	9 (1 to 17)	**0.001**
Sex	Female, n (%)	113 (*34.8*)	164 (*38.1*)	0.354
	Male, n (%)	212 (*65.2*)	267 (*61.9*)	
Place trauma occurred	Home, n (%)	137 (*42.1*)	198 (*45.9*)	> 0.05
	Outdoor, n (%)	188 (*57.9*)	233 (*54.1*)	
Trauma mechanism	Low energy, n (%)	227 (*69.9*)	209 (*48.4*)	0.904
	High energy, n (%)	98 (*30.1*)	222 (*51.6*)	
Anatomic region	Upper extremity, n (%)	260 (*80*)	346 (*80*)	> 0.05
	Distal humerus, n (%)	44 (*13*)	46 (*10*)	
	Distal radius, n (%)	120 (*36*)	163 (*37*)	
	Lower extremity, n (%)	63 (*19*)	75 (*17*)	
Admittance (place)	Emergency service, n (%)	271 (*83.4*)	271 (*62.9*)	< **0.001**
	Inpatient, n (%)	54 (*16.6*)	160 (*37.1*)	
Treatment methods	Conservative, n (%)	235 (*72.3*)	352 (*81.7*)	< **0.001**
	Surgery, n (%)	90 (*27.7*)	79 (*18.3*)	
Hospitalization range		1 to 7	1 to 4	0.961

StataCorp. 2013. Stata Statistical Software: Release 13 was used for statical analysis. Bold p values are statically significant.

Table 2 The difference of demographic datas between sub-groups

		Group A1	Group B1	Group A2	Group B2	p-value (A1 *vs* B1)	p-value (A2 *vs* B2)	p-value (A1 *vs* A2)	p-value (B1 *vs* B2)
Patients, n (%)		111 (*14.7*)	220 (*29.1*)	214 (*28.3*)	211 (*27.9*)				
Median age (range)		7 (1 to 17)	11 (1 to 17)	8 (1 to 17)	7 (1 to 17)	< **0.001**	> 0.05	> 0.05	< **0.001**
Sex	**Female, n (%)**	40 (*36*)	76 (*34.5*)	73 (*34.1*)	88 (*41.7*)	> 0.05	> 0.05	> 0.05	> 0.05
	Male, n (%)	71 (*64*)	144 (*65.5*)	141 (*65.9*)	123 (*58.3*)				
Place trauma occurred	**Home, n (%)**	79 (*71.2*)	116 (*52.7*)	58 (*27.1*)	82 (*38.9*)	< **0.001**	< **0.05**	< **0.001**	< **0.001**
	Outdoor, n (%)	32 (*28.8*)	104 (*47.3*)	156 (*72.9*)	129 (*61.1*)				
Trauma mechanism	**Low energy, n (%)**	99 (*89.2*)	54 (*24.5*)	128 (*59.9*)	155 (*73.5*)	< **0.001**	< **0.001**	< **0.001**	< **0.001**
	High energy, n (%)	12 (*10.8*)	166 (*75.5*)	86 (*40.1*)	*56* (*26.5*)				
Anatomical region	**Upper extremity, n (%)**	89 (*81.7*)	167 (*78.8*)	171 (*79.9*)	179 (*85.6*)	> 0.05	> 0.05	> 0.05	> 0.05
	Distal humerus, n	20	20	*24*	*26*				
	Distal radius, n	35	80	85	83				
	Lower extremity, n (%)	20 (*18.3*)	45 (*21.2*)	43 (*20.1*)	30 (*14.4*)				
Admittance (place)	**Emergency service, n (%)**	78 (*70.3*)	148 (*67.3*)	193 (*90.2*)	123 (*58.3*)	> 0.05	< **0.001**	< **0.001**	> 0.05
	Inpatient, n (%)	33 (*29.7*)	*72* (*32.7*)	21 (*9.8*)	88 (*41.7*)				
Treatment methods	**Conservative, n (%)**	81 (*73*)	177 (*80.5*)	154 (*72*)	175 (*82.9*)	> 0.05	< **0.05**	> 0.05	> 0.05
	Surgery, n (%)	30 (*27*)	43 (*19.5*)	60 (*28*)	36 (*17.1*				
Hospitalization range, days		1 to 4	1 to 4	1 to 7	1 to 3	> 0.05	> 0.05	> 0.05	> 0.05

StataCorp. 2013. Stata Statistical Software: Release 13 was used for statical analysis. Bold p values are statically significant.

ity.[9-14] The reason behind this has been associated with the serious effects of muscle size and strength on neuromuscular control in adolescents.[9] In more specific studies, it has been reported that when the strength of the vastus medialis, the semimembranosus and the lateral gastrocnemius muscles decreases, a safe landing may not be possible after a jump, and this may result in a fall.[9] The most important result we reached in our study, which is in parallel to our hypothesis, is the statistically significant increase in the number of outdoor injuries, high-energy traumas and fracture patterns that require surgical treatment during the first three months following the lift of the curfew (Group A2), in comparison with the corresponding dates from last year ($p < 0.05$). In line with the literature, we believe that the reason for these results was a decrease in the muscle strength and the neuromuscular control of the patients during the curfew period. As a result, the paediatric age group, who returned to outdoors social and sports activities at the end of the curfew, experienced an increase in the number of falls, especially in high-energy traumas that needed surgical treatment such as falling off a bicycle or falling from height. To the best of our knowledge, no other study has been conducted in line with this hypothesis in the English literature.

Some studies reported a decrease in the number of hospital admissions due to orthopaedic trauma in the paediatric population with the restrictions imposed and school closures at the beginning of the COVID-19 pandemic.[15,16] Bram et al[15] reported that during the time of restrictions (15 March to 15 April 2020), the paediatric population admitted to the hospital due to orthopaedic trauma decreased 2.5-times compared with the average in 2019 and 2018.[15] In another study, Turgut et al[16] reported a decrease in the number of surgeries performed in this age group. The authors also reported that between 16 March 2020 and 22 May2020, when a curfew and other restrictions were imposed, there was a decrease in the number of traumas seen in the paediatric age group compared with 2019 and 2018, but an increase in the number of surgeries performed due to trauma.[16] However, according to the same study, during the period of restrictions, the number of outpatient clinic visits due to the concern of the parents regarding the risk of COVID-19 transmission was decreased, whereas the number of patients admitted to the emergency department was increased.[16] In our study, the number of patients treated with surgery and the number of admissions to the emergency department in Group A (21 March 2020 to 31 August 2020) was significantly higher than the patients in Group B (21 March 2019 to 31 August 2019) ($p < 0.05$). The reason behind the decrease in the number of presentations to the outpatient clinic following trauma and the increase in the number of admissions to the emergency department, in line with the literature, is presumably due to the fact that parents avoided presenting to the hospital for minor injuries because of their concern of the COVID-19 transmission, and instead directly applied to the emergency department in the cases of serious injuries. However, in contrast to Bram et al's study,[15] we believe that the reason for the increase in the number of patients that underwent surgery in 2020 was due to the fact that a long period of approximately three months, during which restrictions were applied, was included in our study. The prevalence of injuries due to outdoor and high-energy traumas were found to be statistically significantly higher in Group B1 patients when compared with the patients from Group A1 ($p < 0.05$). Nabian et al[17] reported that during the period when COVID-19 restrictions were applied, outdoor orthopaedic injuries decreased while indoor injuries increased in the paediatric age group.[17] Bram et al[15] reported that

indoor injuries increased by 25% during the restriction period, but in contrast to the results of our study, high-energy traumas such as falling off a bicycle also increased during the same period. We believe that this controversial situation is due to the scope of the restrictions imposed by the countries where the studies were carried out; while a full curfew was imposed for this age group in our country, only schools and parks were closed in the United States.

When admissions to hospitals due to paediatric orthopaedic injuries are examined, it is seen that these traumas increase during the spring season according to the demographic conditions of the countries.[18] Wang et al[19] reported that the 23.5% prevalence of paediatric orthopaedic trauma admissions in the spring season increased to 27.3% due to the closure of schools in the summer and due to this age group finding more time for sports and social activities. In our study, when groups A1 and B1 (21 March to 31 May) and A2 and B2 (01 June to 31 August) were compared, the prevalence of injury due to outdoor and high-energy traumas in Groups A2 and B2 were significantly higher than Group A1 and B1, respectively ($p < 0.05$); a finding in parallel to the literature. However, the number of patients admitted to the emergency department due to orthopaedic trauma in Group A1 was significantly higher than Group A2 ($p < 0.05$). According to our interpretation and in line with the literature, this was a result of the decrease in hospital admissions due to minor complaints and traumas during the restriction period.[16]

Our study had some limitations. This study was done in Turkey which has specific restrictions. However different restrictions, which were very different as outdoor activity was allowed to continue during the lockdowns, while schools were closed, were applied by other countries and this issue could cause different results.[20] Conducting our study in a single centre was one of these limitations, however, our hospital is the largest quaternary hospital in the second largest city (population of more than 5.5 million) in Turkey. Significant difference in numbers of two groups (group A (n = 325) and group B (n = 431)) should be kept in mind when interpreting the statistical analysis of percentages. Our study has no data about physical activity habits before and during lockdown or change in body mass index during lockdown, which could affect our hypothesis. Another limitation was the lack of an objective test that would investigate the decrease in the muscle strength and neuromuscular control of patients, which we mentioned in our hypothesis.

In line with the data obtained as a result of our study, after the curfew restrictions were terminated, an increase in high-energy fracture patterns such as falling off a bicycle or in the park, which require surgical treatment, was observed in comparison with last year. We are of the opinion that this increase in the paediatric age group is due to the decrease in the muscle strength and neuromuscular control of the patients during the restriction period. It has been reported that measures such as curfews for the paediatric age group and the closure of schools and parks may be brought to the table again during the expected second and even the third wave peaks of COVID-19.[21] This situation would also cause other factors which can affect the epidemiology of paediatric trauma such as: 1) vitamin D deficiency because of less exposure of sun; 2) increase body mass index because of less activity; and 3) deprivation of sleep.[22-24] We believe that a decrease in the number of paediatric orthopaedic traumas may be achieved in the future through home exercises in which muscle strength is increased and educational broadcasts aiming to achieve neuromuscular control can be held online or on national television channels during these possible restrictions, along with measures such as gradual removal of bans for the paediatric age group. There is a need for more comprehensive future studies, in which neuromuscular tests are used and muscle strengths are evaluated.

Received 30 March 2021, accepted after revision 13 June 2021

COMPLIANCE WITH ETHICAL STANDARDS

FUNDING STATEMENT

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

ETHICAL STATEMENT

Ethical Approval: This study was performed with the approval of the university ethics committee (**İ8-491-20**) and according to the principles of the Declaration of Helsinki.

Informed Consent: Informed consent form was not obtained from any patient or their family. Informed consent was not needed for this study due to its retrospective nature.

ICMJE CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflict of interest.

AUTHOR CONTRIBUTIONS

MK: Conceptualization/design, Methodology, Investigation, Supervision/oversight.
EAÖ: Conceptualization/design, Methodology, Data curation, Formal analysis.
HK: Methodology, Supervision/oversight.
AM: Supervision/oversight, Data curation, Formal analysis.
MOK: Methodology.
EŞ: Methodology.
KB: Conceptualization/design, Supervision/oversight.

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