Are outdoor playgrounds the real culprit for elbow fractures in children? A lesson learned from COVID-19 sanitary measures

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Background: The association between elbow fractures and outdoor playgrounds has always been anecdotal. We sought to determine the impact of closing outdoor playgrounds and other play areas during the COVID-19 lockdown on elbow fractures in a pediatric population.

Methods: We conducted a retrospective cohort study of all elbow fractures from a single pediatric referral hospital between 2016 and 2020 for the months of April and May. The months chosen corresponded to the COVID-19 lockdown during which outdoor playgrounds were closed. Inclusion criteria were elbow fracture diagnosis based on radiography and age younger than 18 years. Fracture type, where the injury occurred and the mechanism of injury were recorded.

Results: A total of 370 fractures were reported, with an average of 83 (95% confidence interval [CI] 83–84) per year for 2016–19 and only 36 recorded in 2020. The average annual number of fractures before 2020 was 17 (95% CI 16–17) for schools, and 33 (95% CI 31–34) for outdoor playgrounds, including 22 (95% CI 21–24) falls from playground structures. No fracture was reported in schools in 2020, and only 3 were reported from outdoor playgrounds (including 1 associated with falling from playground structures).

Conclusion: We found an association between elbow fractures in a pediatric population and outdoor playground accessibility, but also with indoor public locations. Our findings emphasize the importance of safety measures in those facilities.

Contexte : Le lien entre les fractures du coude et la fréquentation des terrains de jeux extérieurs a toujours été anecdotique. Nous avons voulu mesurer l'impact de la fermeture des terrains de jeux extérieurs et autres aires de jeux durant le confinement dû à la COVID-19 sur les fractures du coude dans une population pédiatrique.

Méthodes : Nous avons procédé à une étude de cohorte rétrospective regroupant tous les cas de fracture du coude dans 1 seul centre pédiatrique de référence entre 2016 et 2020 pour les mois d'avril et de mai. Les mois choisis correspondent au confinement dû à la COVID-19 durant lesquels les terrains de jeux extérieurs étaient fermés. Les critères d'inclusion étaient un diagnostic de fracture du coude, radiographie à l'appui et un âge inférieur à 18 ans. On a également noté le type de fracture, le lieu de sa survenue et son mécanisme.

Résultats : En tout, 370 fractures ont été signalées, à raison d'une moyenne de 83 (intervalle de confiance [IC] de 95 % 83–84) par année pour 2016–2019, et de seulement 36 en 2020. Le nombre annuel moyen de fractures avant 2020 était de 17 (IC de 95 % 16–17) pour les écoles, et de 33 (IC de 95 % 31–34) pour les terrains de jeux extérieurs, incluant 22 (IC de 95 % 21–24) chutes des structures de terrains de jeu. Aucune fracture n'a été signalée dans les écoles en 2020, et seulement 3 ont été signalées dans des terrains de jeux extérieurs (dont 1 associée à une chute d'une structure de jeu).

Conclusion : Nous avons établi un lien entre les fractures du coude dans une population pédiatrique et l'accessibilité aux terrains de jeux extérieurs, mais aussi avec les aires de jeux intérieures publiques. Nos observations confirment l'importance des mesures de sécurité dans ces lieux.

Elbow fractures have a bimodal distribution, being more prevalent in the pediatric and elderly populations.[1] Among younger patients, elbow fractures represent approximately 20% of all fractures[2] and supracondylar fractures are the most common.[3] Typically, nonsurgical management is preferred in that population, with closed reduction as the second most common option.[4] Most epidemiological studies have reported a high prevalence (20%–40%) of elbow fractures in children taking place at outdoor playgrounds.[5,6]

The strong association between outdoor playgrounds and elbow fractures is largely anecdotal, although it has been widely accepted in clinical practice by orthopedic surgeons and pediatric emergency physicians. For example, a recent study by Barr and colleagues investigated the effect of school holidays on elbow fractures.[7] They reported that when children were not attending school, they probably spent more time playing at outdoor playgrounds, leading to a significant increase in supracondylar fractures. However, no studies have clearly demonstrated a direct correlation between access to outdoor playgrounds or playground structures and elbow fractures. Until the COVID-19 pandemic, it was very difficult to establish a direct association since it would have been unethical to forbid children to play at outdoor playgrounds. With many countries implementing a lockdown in the year 2020, it was possible to perform a quasi-experimental observational study on the direct and specific impact of playground closures on elbow fracture.

The main purpose of this study was to determine the impact that the closure of outdoor playgrounds and other locations during the lockdown period had on elbow fractures in a pediatric population. We hypothesized that closing children's outdoor playgrounds would be associated with a lower prevalence of elbow fractures.

Methods

We conducted a retrospective cohort study of all elbow fractures between April 1 and May 31 over 5 consecutive years (2016–2020) at a single pediatric referral centre. The setting was an urban, tertiary care, pediatric hospital in Montréal, Canada. Approximately 4800 patients are seen at the orthopedic clinic yearly, while the emergency department has an annual census of approximately 80 000 patient visits. This retrospective study was approved by the Research Ethics Board of the CHU Sainte-Justine.

All the records of patients seen at the outpatient orthopedic fracture clinic during the designated period were reviewed. We included all patients younger than 18 years of age with a radiological diagnosis of elbow fracture between April 1 and May 31. Only 1 radiograph was needed to prove elbow fracture. Therefore, if the initial radiograph was negative for elbow fracture, a subsequent positive radiograph was sufficient. To be considered positive, radiographs had to show bone or articular discontinuity, a visible fracture line, or signs of consolidation such as callus and periosteal reaction.[8,9] We excluded all patients with elbow fractures that happened outside the designated timeframe and/or without a positive radiograph.

The chosen timeframe corresponds to the COVID-19 lockdown period that took place in Montréal, between April 1 and May 31, 2020. During this lockdown period, all public areas that were considered nonessential were closed. This included most kindergartens, all schools and sports facilities and all outdoor playgrounds.

The demographic data recorded included sex, age at the time of injury, type of fracture, location where the injury took place and mechanism of injury. Fracture types were classified as follows: supracondylar fracture, lateral condyle fracture, epitrochlear fracture, radial head or neck fracture, olecranon fracture, elbow dislocation and "other." Location where the injury took place was categorized as follows: indoor private (household), indoor public (school, sports centre), outdoor private (garden, driveway), public outdoor unconfined during lockdown (sidewalk, roads) and outdoor public confined during lockdown (outdoor playgrounds, school yards). Finally, the mechanism of injury was categorized as follows: bicycle, trampoline, playground equipment, fall from a skateboard/scooter, fall from a height and "other" (the latter included a fall from the bed or the sofa, falling down stairs or a direct hit to the elbow).

Patient identification

Patients were identified using the computerized database of the orthopedic clinic. All children with an elbow fracture diagnosis were identified using this database. Among these, a researcher identified all children fulfilling the inclusion criteria by reading their medical charts.

Data collection

A standardized data collection form was created before data extraction and was used to collect all pertinent information. The medical records of every patient seen at the orthopedic fracture clinic between April and May for the years 2016–2020 were systematically reviewed. Different investigators collected the data, but they were all trained by the study's principal investigator. Unclear or abnormal data were highlighted and reviewed by the same principal investigator. To ensure interinvestigator data extraction reliability, random data collected from different investigators were reassessed by the principal investigator.

Statistical analysis

Statistical analysis was performed using SPSS 26.0 statistical analysis software. Descriptive analysis (mean,

median, minimum and maximum), χ^2 test and 95% confidence interval (CI) for means and for proportions were calculated.

The χ^2 analysis was undertaken in 2 steps for each of the 3 variables of interest (fracture type, location where the injury took place and mechanism of injury). First, χ^2 analysis was done for the years 2016–2019. If the result was not significant, there was no association between the studied variables, meaning that the years before the COVID-19 pandemic were comparable to one another. Second, the year 2020, which represented the COVID-19 lockdown component, was included in the analysis. If the result of the χ^2 analysis for the years 2016–2020 was not significant, there was no statistically significant association between the COVID-19 lockdown and the variable of interest; however, if the result was significant, it was possible to state that there was a statistically significant association between the COVID-19 lockdown and the variable of interest. Once a statistically significant association was found, 95% CIs were calculated for the different subcategories of the variable of interest.

Results

Among the 4833 patients who consulted the outpatient orthopedic fracture clinic during the study period, 370 elbow fractures were identified. The number of elbow fractures was stable during the first 4 years, with a median of 86 (range 74–88), while it decreased to 36 during the lockdown in 2020. With a 95% CI of 82.8–84.2 between 2016 and 2019, the smaller number of fractures in 2020 is considered statistically significant. Between 2016 and 2019, on average 44% of fractures happened in April and 56% in May, which was similar to what was found in 2020, with 42% in April and 58% in May ($\chi^2_4 = 2.15$, $p = 0.708$). Prior to the COVID-19 pandemic, boys accounted for 55% of patients, and the mean age was 7 ± 3.6 years (95% CI 6.6–7.4). This was similar during the lockdown, with boys representing 61% of patients and the mean age being 7.5 years for this specific year. Population characteristics are presented in Table 1.

Less than 10% of all the collected data for the variables of interest were missing. There were no missing data for fracture type, but the location where the injury occurred was not reported for 36 patients. Between 2016 and 2019 the data on where the injury took place were missing for 8 patients each year and unavailable for 4 patients in 2020. The mechanism of injury was not reported in only 2 cases, which were classified in the "other" category.

Between 2016 and 2019, supracondylar fractures were the most common fracture type (mean 59%, 95% CI 53%–64%), followed by radial neck/head fractures (mean 19%, 95% CI 15%–23%). The distribution for fracture types was the same in 2020 ($\chi^2_{24} = 25.27$, $p = 0.391$). Demographic and clinical characteristics are presented in Table 2.

Public outdoor and public indoor locations were where injuries most frequently occurred before the pandemic, with an average of 32 and 17 fractures per year, respectively, which was stable over the 4 years ($\chi^2_{15} = 18.77$, $p = 0.224$). However, in 2020, these proportions were significantly different: public outdoor and public indoor locations were the least common, with 3 (8%) and 0 fractures, respectively ($\chi^2_{20} = 56.36$, $p < 0.001$). The number of fractures for other locations was stable over the 5 years (Figure 1). Consequently, private indoor followed by unconfined public outdoor areas became the most common locations for elbow fracture during the lockdown (36% and 25%, respectively) (Figure 1).

Before the COVID-19 lockdown, a fall from a height was the most common mechanism of injury for elbow fractures, representing 31.7% compared with 19.4% in 2020 (95% CI 26.8%–37.0%). Falls from playground structures were the second most common mechanism of injury before the lockdown, representing 27% compared with 3% in 2020 (95% CI 32.0 –31.7%) (Figure 2).

Results of the χ^2 analysis for the 4 categorical variables between 2016 and 2019 were not significant (all $p > 0.05$), showing that the years within this timeframe were comparable to one another for the selected variables. The results for type of fracture between 2016 and 2020 during the designated months was not significant either ($p = 0.177$), showing that there was no significant association between the COVID-19 lockdown and the type of fracture. However, results of the χ^2 analysis for the location where the injury took place and the mechanism of injury between 2016 and 2020 were statistically significant ($p < 0.001$ and $p = 0.001$, respectively), indicating a statistically significant association between the COVID-19 lockdown and the location where the injury took place and with the mechanism of injury.

Regarding the mechanism of injury, the proportion of fractures secondary to falls from a bicycle or skateboard/scooter was significantly higher before the COVID-19 lockdown, whereas the proportion of falls from playground structures was significantly lower during the lockdown. Between 2016 and 2019, 7.5% (95% CI 4.9%–10.9%) of fractures were secondary to bicycle injuries and

Table 1. Population characteristics

Characteristic	2016–2020, *n**	Median (range) per year 2016–2019	2020, *n**
Fractures			
Total	370	86.0 (74–88)	36
April	162	36.5 (34–40)	15
May	208	47.5 (38–54)	21
Age, mean, yr	7.1	7.0 (6.7–7.5)	7.5
Sex			
Male	205	45.5 (38–54)	22
Female	165	38.0 (36–42)	14

*Unless indicated otherwise.

Table 2. Demographic and clinical characteristics of pediatric patients with elbow fractures before and during the COVID-19 pandemic lockdown

Characteristic	2016–2019		2020	
	Median (range) no. of fractures per year	Proportion of fractures per year, %	No. of fractures	Proportion of fractures, %
Type of elbow fracture				
Supracondylar	50.0 (46–51)	58.5	21	58.3
Radial neck/head	8.0 (6–10)	18.7	8	22.2
External condyle	3.0 (2–8)	9.5	4	11.1
Epitrochlear	15.0 (12–21)	4.7	1	2.8
Olecranon	3.0 (1–6)	3.9	1	2.8
Dislocation	3.5 (0–6)	3.9	1	2.8
Other	0.5 (0–2)	0.9	0	0.0
Total	87.0 (74–89)	100.0	36	100.0
Location where injury occurred*				
Private indoor	13.5 (9–19)	16.5	13	36.1
Public indoor	17.0 (12–20)	19.8	0	0.0
Private outdoor	5.5 (3–7)	6.3	7	19.4
Nonconfined public outdoor	7.5 (5–9)	8.7	9	25.0
Confined public outdoor	34.0 (22–41)	39.2	3	8.3
Unknown	9.5 (3–10)	9.6	4	11.1
Total	86.0 (74–88)	100.0	36	100.0
Mechanism of injury				
Bicycle	6.5 (2–10)	7.5	9	25.0
Trampoline	8.0 (2–13)	9.3	4	11.2
Playground structure	23.5 (16–26)	26.6	1	2.8
Skateboard/scooter	2.5 (2–5)	3.6	3	8.3
Fall from height	27.0 (23–29)	31.7	7	19.4
Other	18.0 (13–22)	21.3	12	33.4
Total	86.0 (74–88)	100.0	36	100.0

*Examples of locations described include the following: private indoor = household; public indoor = school, sports centre; private outdoor = garden, driveway; unconfined public outdoor = sidewalk, roads; confined public outdoor = outdoor playgrounds, school yards.

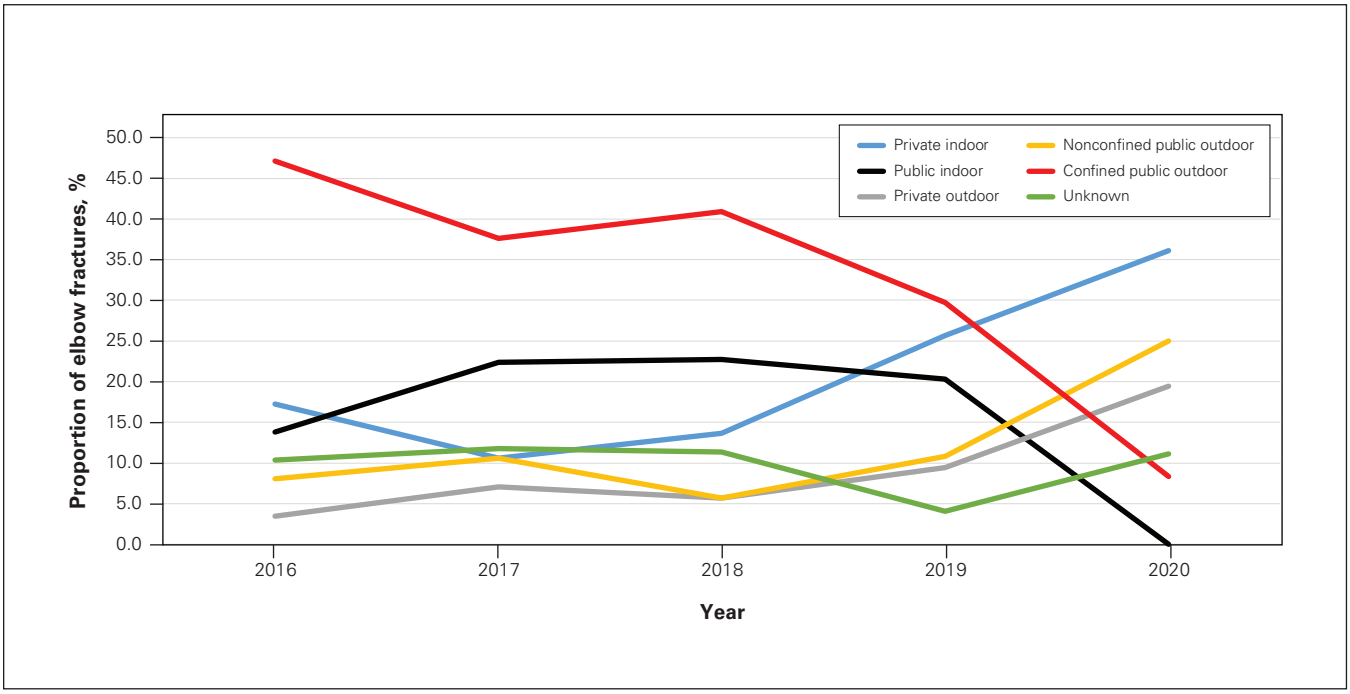

Fig. 1. Distribution of the location where the elbow fractures occurred. Examples of locations described include the following: private indoor = household; public indoor = school, sports centre; private outdoor = garden, driveway; unconfined public outdoor = sidewalk, roads; confined public outdoor = outdoor playgrounds, school yards.

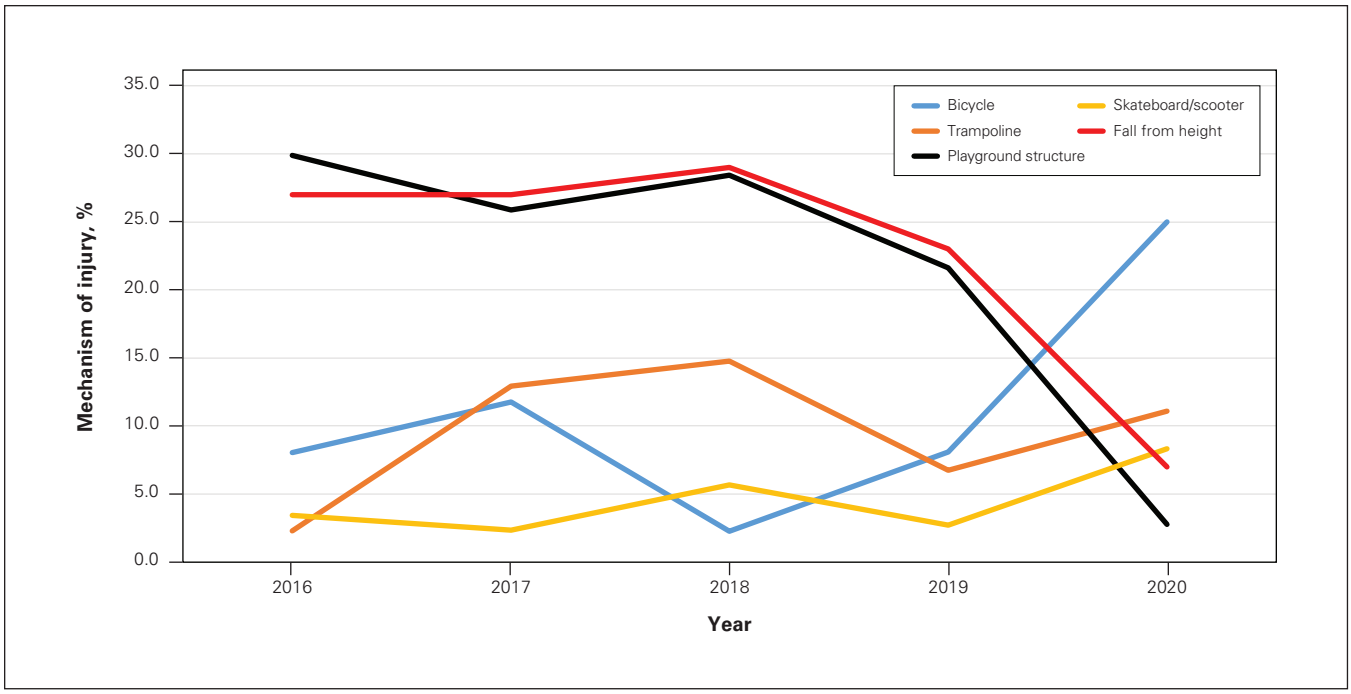

Fig. 2. Distribution of the mechanism of injury. The category "other" does not appear on the figure because of the heterogeneity of the category.

3.6% (95% CI 1.9%–6.2%) were secondary to skateboard/scooter injuries. However, these were the cause of fracture for 25.0% and 8.3%, respectively, in 2020. Between 2016 and 2019, 31.7% (95% CI 26.8%–37.0%) of fractures were secondary to a fall from a height and 26.6% (95% CI 22.0%–31.7%) to a fall from playground structures. Meanwhile, they represented 19.4% and 2.8%, respectively, of all causes of fracture in 2020. Furthermore, the number of fractures secondary to bicycle injuries was significantly higher in 2020, but that for falls from playground structures was significantly lower. Between 2016 and 2019, on average 6.3 (95% CI 5.0–7.6) fractures were attributed to falls from a bicycle, 26.5 (95% CI 26.0–27.0) to falls from a height and 22.3 (95% CI 21.4–23.2) to falls from playground structures; during the COVID-19 lockdown these numbers changed to 9, 7 and 1, respectively.

Discussion

Our study showed a strong reverse association between the closing of outdoor playgrounds and other play areas and elbow fractures in children. Indeed, when public areas were closed there were 57% fewer elbow fractures. However, this observation was solely for fractures that occurred in locations that were closed during the pandemic. To our knowledge, this is the first study evaluating the real impact of outdoor playgrounds on elbow fractures.

The primary objective of the present study was to determine the effect of outdoor playground closures on elbow fractures. With an average of 84 elbow fractures per year before the pandemic and only 36 reported in 2020, it is possible that the COVID-19 lockdown was responsible for a significant decrease in elbow fractures. It could be argued that the smaller number of fractures was due to confounding variables, such as a decrease in emergency or orthopedic consultations, rather than closures. However, this is very unlikely as elbow fractures, especially in a pediatric population, cannot be ignored or omitted. Moreover, the number of fractures in other locations (i.e., private indoor) was stable. A slight decrease in the number of elbow fractures was noted for the year before the COVID-19 lockdown, although the decrease was not statistically significant when compared with the data for 2016–2018. One of the factors that may explain this is the weather, since the data collection period was early spring, with temperatures and precipitation levels that can vary. This is why we included 4 years in the study period before 2020.

Our statistical analyses clearly showed a significantly lower number of fractures in 2020 as well as an association with the location where the injury took place and the mechanism of injury. Having the same amount of at-home elbow fractures during the COVID-19 pandemic strengthens the argument that there was indeed a strong association between activities taking place at outdoor playgrounds and schools or sports centres and the incidence of elbow fracture. Our results are in agreement with those of similar epidemiological studies, such as that of James and colleagues,[10] which stated that public areas were the most common locations at which to sustain an

injury. Barr[7] also estimated that children's use of play structures, such as climbing walls and monkey bars, was positively associated with elbow fractures. However, it seems that the risk associated with indoor public play areas was underestimated.[7,10,11]

Our results show the necessity for supervision, care and safety measures at outdoor playgrounds to prevent fractures and suggest that safety in schools and sports centres should not be underestimated. Previous studies have discussed the topic of safety measures at public playgrounds, stating that they were lacking,[12,13] and the present study highlights the issue. For example, Park and colleagues[12] suggested using a softer composite to cushion falls, while other studies recommended lowering the height of playground structures[14] or even separating playground sections by age.[15]

These results are also of interest as they show the global impact of COVID-19 and the lockdown on the overall behaviour of children. While a reduced rate of elbow fractures is positive, it also suggests that recreational activities, specifically physical activities, which are known to be essential for youth development, were much fewer during this period. The adverse effects of the COVID-19 restrictions on youth development have been reported in a systematic review by Araujo and colleagues[16] and in a study by Benner and Mistry.[17]

The lockdown also had a major effect on the mechanism of injury, with a significant decrease in elbow fractures associated with a fall from playground structures and falls from a height. Those results show that a fall from a playground structure is an important cause of elbow fracture. Once again, this confirms the risk of elbow fractures associated with outdoor playground activities in a pediatric population and the need for safety measures. The decrease in the number of fractures after falling from a height was less specific than outdoor playground injuries to confirm our initial hypothesis. However, it is common knowledge that a fall from a height happens mostly while children play together or practise physical activities.[18] Therefore, a reduction in this type of fracture can be expected in the year 2020, considering the important decrease in fractures that also took place at outdoor playgrounds, sports centres and schools.

Limitations

There are some limitations to this study, such as its retrospective chart review design. For example, data with regard to location where the injury took place were missing in cases when this information was not reported by the triage nurse or any doctor seeing the patient. However, missing data accounted for no more than 10% of the overall collected data. Moreover, the missing data were distributed similarly among the available data. Thus, on average, there were twice the number of fractures for the years before the pandemic than during the lockdown, and there were twice the missing data for the same period. Another limitation was that it could not be ascertained whether confounding factors, such as parents taking their children to the other pediatric hospital in Montréal or deciding to go to a private clinic rather than the hospital, were attributable to the COVID-19 pandemic. Nonetheless, the number of fractures remained similar for locations where the injury took place that were not affected by the lockdown (e.g., household, driveway). The strengths of this study are the large study sample as well as the data spanning 4 years for comparison with 2020. Furthermore, its main strength remains the fact that it is, to our knowledge, the only study conducted during which outdoor playgrounds and schools were officially closed.

Conclusion

Elbow fractures are common in the pediatric population. Our results clearly and directly show an association between outdoor playgrounds as well as schools and sports centres with elbow fractures. This highlights the importance of safety measures in those facilities.

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