Epidemiology of paediatric orthopaedic-related trauma injuries sustained across a lockdown period during the COVID-19 pandemic

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Abstract

Objectives: Lockdowns have been implemented by countries to slow down SARS-CoV-2 transmission. Singapore’s lockdown was enforced between 7 April 2020 and 1 June 2020. The objective of this study was to compare the epidemiology of paediatric orthopaedic trauma injuries during and immediately after the lockdown, with a non-pandemic period in 2019.

Methods: All paediatric outpatients and inpatients seen in our hospital following an orthopaedic-related traumatic injury from the 8-week lockdown and 8 weeks post-lockdown were evaluated. Cases for matched periods in 2019 were identified retrospectively for baseline comparison. Patient demographics, venue of injury, anatomic location of injury, caregiver supervision and location of procedures performed in the hospital were assessed.

Results: 968 and 2810 injuries were observed in 2020 and 2019, respectively. While the proportion of injuries sustained by pre-schoolers and toddlers increased, those sustained by primary and secondary school children decreased in 2020 (p < 0.001). Majority of the injuries during the lockdown were sustained at home compared to schools or public recreational facilities (p < 0.001). Hand (26.2%) and elbow (20.8%) injuries were the most common during the lockdown. The proportion of procedures performed in the Children’s Emergency during the lockdown was more than twice that of the same period in 2019 (p < 0.001).

Conclusion: Our study showed a 2.9-fold decrease in orthopaedic-related injuries seen during the peri-lockdown period compared to a non-pandemic period. Pre-schoolers seem to be most vulnerable to injuries during the lockdown. Hand and elbow injuries were most common.

Keywords
COVID-19, SARS-CoV-2, lockdown, epidemiology, paediatric, trauma

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Introduction

More than a year following the emergence of SARS-CoV-2, the pandemic continues to disrupt our lives and overwhelm healthcare systems worldwide. Many countries are encountering devastating second and third waves of the pandemic. Understanding the epidemiology of orthopaedic
injuries in the lockdown and post-lockdown periods will help us to plan better for the future as we maintain vigilance during this ongoing pandemic.

On 23 January 2020, Singapore’s Ministry of Health (MOH) confirmed the first imported case of COVID-19. Within 2 weeks, the MOH stepped up the risk assessment from Disease Outbreak Response System Condition (DORSCON) Yellow to DORSCON Orange on 7 February 2020. In the subsequent weeks, a trend of increasing local transmission of COVID-19 was observed. This prompted an initial 4-week lockdown termed ‘circuit breaker’ from 7 April 2020, with a subsequent 4-week extension to 1 June 2020. During this period, all pre-schools and kindergartens suspended their general services, while primary, secondary and pre-university students shifted to full home-based learning (HBL).

During this period of heightened alert, several changes were made in the approach to managing patients with orthopaedic injuries. Clinical care was provided based on three principles – (1) clinical urgency, (2) patient and healthcare worker protection and (3) conservation of healthcare worker numbers.

With a decrease in social interactions during the lockdown period and all children being home-bound, we hypothesised that the epidemiology of paediatric orthopaedic injuries, the injury pattern and their mechanisms, will significantly differ from a comparable historic period.

The primary aim of this study was to examine the epidemiology of orthopaedic trauma in paediatric patients below the age of 19 years during and after the lockdown period in Singapore and compare this with a similar time period in the preceding year. The secondary aim was to determine the number of operative cases and emergency consultations to serve as a baseline to plan for manpower deployments in future pandemic and lockdown scenarios.

Materials and methods

Study design and patients

Our hospital is an 830-bed tertiary hospital, and it has the largest paediatric trauma centre serving the central and eastern regions of Singapore. In 2019, there were more than 153,927 visits to the children’s emergency department and 533,251 paediatric outpatient visits. As a standard practice, all patients seen at the children’s emergency department with a diagnosis of an orthopaedic-related injury are referred to our department for review and continuation of treatment. Our department also takes referrals from primary health care physicians practicing in the central and eastern regions of Singapore.

This study was approved by the hospital’s institutional review board. All outpatients and inpatients that were seen at our hospital with an orthopaedic injury caused by an acute traumatic event within the specified time periods were identified. All patient data in 2020 were collected prospectively, while cases for matched periods in 2019 were identified retrospectively from the hospital’s electronic medical records system to act as baseline for comparison.

Data collected included patient demographics, diagnosis, date and venue of injury, types of caregiver supervision, whether the injury was witnessed, anatomical location of injury, mechanism of injury, hospital admission, as well as procedures performed.

Patients were excluded if there was no clear account of a traumatic event resulting in the hospital visit. Cases of isolated limb burns and head injuries were also excluded.

The time periods studied were as follows. Period 1, from 7 April to 1 June 2020, represented the entire 8-week duration of enforced lockdown, when only entities providing essential services were allowed to operate with the minimum staff needed on premises. All educational activities were conducted online by primary, secondary and pre-university schools. Only children whose parents were working in essential services and had no alternative childcare arrangements were allowed to go to childcare or school. Tourist attractions, theme parks, museums as well as sports and recreation facilities such as public swimming pools, country clubs, gymnasiums and fitness studios were not allowed to operate. Sporting events and religious services were also suspended. Period 2, from 2 June to 31 July 2020, represented the immediate 8-week post-lockdown period. In addition to the existing essential services that had been operating during the lockdown, businesses that operated in settings with low disease transmission risks were gradually allowed to open, although working from home remained as the default arrangement. Pre-schools were reopened fully while primary, secondary and pre-university schools adopted a hybrid arrangement alternating between HBL and returning to school for lessons. These two time periods represented distinctly different social environments during and after an enforced lockdown period.

Procedures performed were classified into four categories – nil (indicating no procedures were performed), and those who had procedures performed in the children’s emergency department (CE), operating theatre (OT) and both CE and OT.

Examples of procedures performed in the CE include toilet and suture, manipulation and reduction of fractures and dislocations, ring removal, wound exploration, nail avulsion, nail bed repair and removal of foreign bodies. Procedures in the CE are usually performed under local anaesthesia or ketamine sedation. In the OT, surgical procedures are usually performed under general anaesthesia, but may occasionally be performed under regional or local anaesthesia. Examples of patients that needed
procedures in both the CE and OT are lacerations that were explored in the CE and found to be too deep, necessitating further exploration in the OT. Patients that were offered treatment procedures but declined were also included.

**Statistical analysis**

Chi-square test or Fisher’s exact test was used to evaluate the effect of the lockdown on categorical variables. Statistical significance was set at $p < 0.05$.

**Results**

In 2019, there was a total of 2810 injuries (1770 in Period 1, and 1040 in Period 2). There was a 2.9-fold reduction in the number of injuries seen in 2020 with a total of 968 injuries (432 in Period 1, and 536 in Period 2).

**Age groups**

Patients were divided into seven age groups – neonate (<1-month-old), infant (1–<12-months-old), toddler (1–<3-years-old), pre-school (3–<7-years-old), primary school (7–<13-years-old), secondary school (13–<17-years-old) and post-secondary school (17 and 18-years-old).

Primary school students (45.8%) and secondary school students (27.6%) accounted for the majority of orthopaedic-related injuries that were seen in the two periods in 2019. During the lockdown period (Period 1 in 2020), the majority of orthopaedic-related trauma injuries occurred in the younger age groups, with an increased proportion of injuries observed in pre-schoolers (38.7%, $n = 167$) and toddlers (21.5%, $n = 93$) (Figure 1). The difference in the distribution of injuries amongst toddlers, pre-school children, primary and secondary school children during Period 1 in 2019 compared to 2020 was statistically significant ($p < 0.001$). The trend reverted to pre-pandemic levels in Period 2 with primary school children comprising most of the injuries while the proportion of pre-school children sustaining injuries decreased.

**Venue of injury**

The venue of injury was broadly classified into four categories – home, school, public recreational facilities (including playgrounds, parks and sports centres) and others.

In 2019, the majority of injuries were usually sustained in school. An exception to this was in Period 2, which coincided with the month-long June school holidays where the venues of injury were evenly distributed over various locations. During the lockdown period (Period 1 of 2020), most injuries as expected, occurred at home ($n = 351, 81.3\%$) (Figure 2). The same trend continued in the post-lockdown period, although to a lesser extent ($n = 235, 43.8\%$) (Figure 2). The difference in the injury venue for both Periods 1 and 2 of 2020 was statistically significant when compared to 2019 ($p < 0.001$).

The age demographics of the injuries that occurred at home were sub-analysed. Pre-school children and primary school children accounted for most of the injuries in 2019. There was a statistically significant increase in the proportion of injuries sustained amongst pre-school children at home ($n = 147, 41.9\%$) during the lockdown period, compared to the similar period in 2019 ($n = 103, 30.2\%$) (Figure 3).

Of the home injuries sustained during the lockdown in 2020, 58% ($n = 204$) were witnessed by caregivers. The majority of home injuries were sustained in the living room and bedroom (43.9% and 41.3% respectively) (Figure 4).

![Figure 1.](image-url) **Figure 1.** Epidemiological distribution of orthopaedic injuries according to age groups in 2019 and 2020.
Figure 2. Epidemiological distribution of injuries according to venue of injury in 2019 and 2020.

Figure 3. Epidemiological distribution of injuries sustained at home in 2019 and 2020.

Figure 4. Distribution of venue of injury for home injuries during Period 1 in 2020 (n = 351).
Anatomical location of injury

The proportion of hand injuries increased \(n = 113, 26.2\%\) during the lockdown period in 2020 when compared to 2019 \(n = 321, 18.1\%\) (Figure 5). Similarly, elbow injuries accounted for a higher proportion of injuries during the lockdown period \(n = 90, 20.8\%\) compared to 2019 \(n = 261, 14.7\%\) (Figure 5).

Knee and ankle injuries, especially the ligamentous injuries were noted to have a decreased incidence during the pandemic. Patients presenting with neck or back trauma was almost non-existent during the pandemic periods.

Location of procedures performed

The number of procedures performed in the CE was higher during the lockdown period \(n = 113, 26.2\%\) compared to post-lockdown period \(n = 102, 19.0\%\) \(p = 0.002\) (Table 1) and was slightly more than twice that of the same period in 2019 \(n = 217, 12.3\%\) \(p < 0.001\) (Table 1).

A higher percentage of patients needed procedures to be performed either in the CE or OT during the lockdown period \(n = 145, 33.6\%\) compared to 2019 \(n = 319, 18.0\%\) \(p < 0.0005\) (Table 1). A similar pattern was seen in Period 2 with 33.5\% \(n = 126\) of injuries needing procedures in 2020, as opposed to 21.3\% \(n = 222\) in 2019, but this did not approach statistical significance \(p = 0.33\) (Table 1).

Of the procedures conducted in the CE during the lockdown period, the largest proportion was from finger lacerations or fingertip injuries. This represents a 2.5-fold increase compared to the same period in 2019. The overall proportions of procedures performed in the OT in 2020 compared to 2019 remained largely the same with the largest contributors being fixations for elbow fractures.

The location of procedure performed for hand injuries was sub-analysed. The majority of hand injuries required...
procedures in the CE during the lockdown period (\(n = 54, 47.8\%\)) compared to the similar period in 2019 (\(n = 68, 21.2\%\)) (\(p < 0.001\)) (Table 2). Although more hand injuries required procedures to be performed, the number of hand injuries requiring admission dropped from 14 during Period 1 in 2019 to 4 during the lockdown period in 2020.

The study also presents the proportion of various types of caregiver supervision at the time of these home injuries. During the lockdown period, the majority were supervised by a parent at the time of injury (\(n = 277, 78.9\%\)) with the other caregivers being a grandparent (\(n = 26, 7.4\%\)), a domestic helper (\(n = 12, 3.4\%\)) or a sibling (\(n = 4, 1.1\%\)). The children were not supervised in 27 cases (7.7%). Subgroup analysis could not be reliably assessed due to small numbers in the other subgroups.

**Discussion**

The overall incidence of paediatric orthopaedic-related traumatic injuries decreased by 2.9-fold during the period lockdown period in 2020 compared to the same time period in 2019. This is comparable to the findings of other epidemiological studies during this pandemic period on paediatric fractures.\(^9,10\) The majority of injuries sustained during the lockdown involved pre-school children and toddlers. The proportion of toddlers sustaining injuries during the lockdown was triple that of a similar period in 2019. This corresponds to a reduction of the proportion of injuries sustained in the other age groups.

**Venue of injury**

With the majority of children having to stay at home during the lockdown period, it is unsurprising that most of the injuries were sustained at home. Notably, the most vulnerable group to sustain such injuries during the lockdown period were the pre-school children, despite having parents at home. This could be attributed to parents not being able to provide effective child supervision as many were occupied with work-from-home commitments, with only 58% of home injuries being witnessed by caregivers.

With pre-school children returning to school in Period 2, the proportion of injuries sustained by pre-schoolers returned to pre-lockdown levels. This could be due to more effective supervision by pre-school teachers compared to parents who are working-from-home. It is worthwhile exploring ways to better prepare parents of pre-school children in preventing home injuries. We agree with by Bram et al.\(^9\) that a greater emphasis must be placed on home safety.

**Anatomical location of injury and location of procedures performed**

The majority of the injuries sustained during the lockdown period were hand injuries. Most of these were sustained in the living room or bedroom due to fingers being caught in the hinge side of the door or being accidentally cut by a sharp object. This is in contrast with pre-pandemic periods when the majority of hand injuries were sustained during
sporting activities such as being hit by a ball or tripping over while running. It was expected that the incidence of common elbow injuries, such as supracondylar fractures of the humerus, would decrease during the lockdown period due to a decrease in outdoor time. However, the proportion of elbow injuries during the lockdown period was higher than the post-lockdown period. The mechanism of injury was mainly due to jumping off furniture (bed or sofa) and landing awkwardly on the elbow, resulting in lateral condyle or supracondylar fractures of the humerus. Most of such injuries were severe enough for the child to present to the hospital. The incidence of knee and ankle injuries also decreased and could have been due to a decreased level of organised sports.

The proportion of procedures performed in the CE during the lockdown period more than doubled compared to a similar period in 2019. Similarly, the number of CE procedures performed for hand injuries more than doubled, while admission to hospital for these injuries dropped by more than three-fold (14 injuries in 2019 vs. 4 injuries in 2020). This might be because most procedures were preferentially performed in the CE due to an aversion for hospital admissions during the pandemic for the fear of catching a SARS-CoV-2 infection. The 2.5-fold increase in finger lacerations or fingertip injuries during the lockdown could be managed in the CE and performed under intramuscular ketamine sedation or local anaesthetic blocks, depending on the patient’s age, choice and injury. The increase in CE procedures may also be reflective of the severity of orthopaedic-related trauma injuries that present to the hospital during this period. Children who are deemed to have less severe injuries are not brought to the hospital for assessment, when they usually would have been in a non-pandemic setting. A similar finding was made by Turgut et al.11 who found that the rate of operation encountered during the pandemic was twice that compared to other years.

Limitations

A limitation of this study was that the comparator data from 2019 were identified retrospectively based on existing patient records. The information collected for each case may not have been as robust as data collected prospectively in 2020. Additionally, the information on the type of procedures performed in the CE was not sufficiently captured to analyse the rate of operations encountered.

Secondly, not all types of musculoskeletal injuries were included, such as burns which in our hospital are managed by plastic surgeons, or head injuries which are managed by neurosurgeons.

Thirdly, due to the broad spectrum of musculoskeletal injuries, it was not feasible to compare the severity of injuries objectively such as size of wound, and scale of procedure required. Hence, the need for CE or OT procedures was chosen as a surrogate measure of the severity of injuries.

The data reflects the experience of a single tertiary paediatric referral centre and it may not be possible to extrapolate this to the actual incidence of orthopaedic-related trauma injuries in the population during the pandemic period. Future extensions of this research include a multi-centre study and setup of a nationwide trauma registry to better identify epidemiological trends.

Conclusion

The 8-week lockdown period resulted in a reduced number of paediatric orthopaedic trauma injuries that presented to the hospital, across all age groups. As a result of HBL and decreased outdoor activities, there was an increase in the proportion of home injuries, particularly amongst preschool children and toddlers. More work needs to be done to better equip parents with tools in future pandemic scenarios, particularly in preventing hand and elbow injuries. The general public should also be informed of such increased risk of injuries to these age groups when they are spending more time at home.

Hospitals should allocate more manpower resources in staffing emergency services during a lockdown. The number of resources for orthopaedic-related OT procedures and hospital admissions can be reduced. This allows hospitals to redesignate existing beds for pandemic purposes. We estimate an overall decrease of 2.9-fold of orthopaedic-related trauma injuries during and immediately after a pandemic lockdown period. With the knowledge that the volume of hand-related operative cases only marginally decreased, we recommend that hand surgery services should not be compromised during a lockdown period.

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