

Increased orthopaedic presentations as a result of COVID-19-related social restrictions in a regional setting, despite local and global trends

Elise Woo ,* Ariella Jessica Smith ,* Dominic Mah ,† Benjamin Francis Pfister* and Herwig Drobotz*

*Orthopaedic Department, Lismore Base Hospital, Lismore, New South Wales, 2480, Australia and

†School of Medicine, University of New South Wales, Kensington, New South Wales, 2052, Australia

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Correspondence

Dr Elise Woo, Orthopaedic Department, Lismore Base Hospital, Lennox Head, NSW, Australia.
Email: e_woo429@hotmail.com

E. Woo BSc, MBBS; **A. J. Smith** BMed, MD;
D. Mah BMed, MD; **B. F. Pfister** MBBS;
H. Drobotz PhD, FRACS.

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Abstract

Background: The coronavirus (COVID-19) pandemic has affected the utilisation of emergency department (ED) services worldwide. The aim of this study was to assess the impact of COVID-19-related public health measures on orthopaedic presentations to a regional Australian hospital.

Methods: A case-control study was performed at a regional trauma hospital in New South Wales (NSW), Australia. Data was collected prospectively from patients that required orthopaedic review in the period corresponding to a declaration of a global pandemic to the end of the NSW lockdown, and compared with retrospective data from the corresponding period in 2019. The five-year average of orthopaedic presentations to ED during the study period were obtained for comparison. The primary outcomes were overall number of presentations, mechanism and anatomical location of injuries, operative versus non-operative management and disposition.

Results: During the study period in 2020, presentations requiring orthopaedic review were significantly more frequent than 2019 (496 vs. 280, $p < 0.0001$), with more requiring admission in 2020 ($p < 0.0001$). The absolute number of patients managed operatively was higher ($p = 0.0002$) and significantly more patients were referred for community follow-up ($p < 0.0001$). There was a 20% increase of consults in 2020 compared to the average number of referrals during the same period in the previous five years.

Conclusions: Contrary to other published literature, lockdown conditions imposed during the COVID-19 pandemic resulted in a surprising 77% increase in orthopaedic presentations to this regional Australian hospital. These findings can be used to better direct resources, preparation and staff education in the current and for future pandemics.

Introduction

In December 2019, a novel coronavirus (COVID-19) was identified in Wuhan, China. COVID-19 was declared a global public health emergency by the World Health Organization on 30 January 2020.¹ By the end of March 2020, the Australian government introduced travel and social restrictions, border closures, cessation of non-essential activities including community sport and cancellation of elective surgeries.^{2,3} On 25 March, in accordance with New South Wales (NSW) health regulations, there was temporary suspension of all non-urgent elective surgeries at our regional hospital in Northern NSW, Australia. Outpatient clinics were mandated to use telehealth where possible, and patients were strongly advised to stay home unless absolutely essential to present for medical review.⁴ Most of the population worked or studied from home, and

only essential services remained open (Table 1).³ These restrictions began to ease after 15 May 2020, and allowed up to five visitors to a household and up to ten people at outdoor gatherings, cafes, restaurants, weddings and religious gatherings, up to 30 mourners for outdoor funerals and the ability to participate in outdoor sports and equipment with caution.⁵

The rapid spread of the virus, followed closely by implementation of government-led restrictions, lockdowns and cancellation of elective surgeries modified the trend and demographic of orthopaedic and trauma presentations to ED. There have been a number of studies worldwide demonstrating a reduction in rates of orthopaedic presentations as a result of social restrictions during the COVID-19 pandemic, predominantly in urban settings.⁶⁻¹³

Understanding the epidemiological transformations that took place during the acute period of COVID-19 is invaluable for the apt

Table 1 Timeline of COVID-19 pandemic public health measures and social restrictions in Australia

25 January	First case in Australia identified
30 January	WHO declared COVID-19 a global public health emergency
1 February	Arrivals from China blocked
27 February	Prime Minister Scott Morrison activates Government's emergency response plan
1 March	First Australian death from COVID-19
16 March	Ban on non-essential outdoor gatherings of more than 500 people and compulsory quarantine of 14 days for overseas travellers
18 March	Ban on non-essential outdoor gatherings of more than 100 people
19 March	2700 passengers from Ruby Princess cruise disembark in Sydney with three positive COVID-19 cases
25 March	Australians encouraged to work from home, non-essential businesses closed and interstate border control established
31 March	\$11 000 fine in NSW if found out of home for non-essential reason
10 April	Recoveries outnumber current cases
20 April	Tasmania overtakes NSW to become state with most confirmed cases per capita
22 April	20 deaths and 696 confirmed cases traced back to Ruby Princess
1 May	Two adults allowed to visit other households for social gatherings
15 May	Restrictions begin to ease in NSW

COVID-19, coronavirus disease 2019; NSW, New South Wales; WHO, World Health Organization.

preparation of medical services in future times of epidemic crisis. To the best of our knowledge this is the first study to investigate acute orthopaedic and trauma presentations to a regional hospital emergency department in Australia during the COVID-19 pandemic.

Methods

The study was performed in a monocentric observational cohort fashion at a Level 5 regional referral hospital in Northern NSW, Australia. The hospital has 260 beds, servicing a rural and regional population size of approximately 180 000 people. Smaller district hospitals assist in servicing the region, but none provide an orthopaedic service.

Data were collected prospectively for all patients who presented to ED and required orthopaedic review between 1 February and 17 May 2020 and compared to retrospectively collected data from the corresponding time period in 2019. These dates correspond to the declaration of a global pandemic (30 January 2020) and the first stage of lifting restrictions in NSW (15 May 2020)⁵ (Table 1). A report listing all completed orthopaedic consults from 2019 to 2020 was generated using the FirstNet electronic medical record (eMR) system (Cerner, USA). Information from both groups, such as type of pathology, mechanism of injury, location of injury, operation performed and disposition, was extracted from patient individual files on eMR by the authors and manually inserted into a

table. The available automated data includes standardised admission, discharge, outpatient and operation information for analysis. In addition to 2019 and 2020 data, the same FirstNet report generator was utilised to obtain the number of completed orthopaedic consults during the study period from 2015 to 2018 to calculate a five-year average (Fig. 1). Information from both groups, such as type of pathology, mechanism of injury, location of injury, operation performed and disposition, were manually extracted from electronic patient records and tabulated. Bony injuries included fractures and dislocations. Soft tissue pathology included degenerative, infective, inflammatory pathology and soft tissue trauma. Orthopaedic management was divided into operative and non-operative modalities. Patients primarily managed by a different specialty and or lost to follow-up were excluded.

In accordance with section 5.1.22 of the National Statement on Ethical Conduct in Human Research, the local health district research ethics committee determined this study to have negligible risk activity, which satisfied requirements for exemption from review by the Human Research Ethics Committee (reference number QA361).

Data was collected using Microsoft[®] Excel[®] (Version 16, the Microsoft Corporation) and transferred to PRISM GraphPad[®] Statistics (Version 9, GraphPad Software Inc.) for statistical analyses. Tests were two-sided and *p*-values of <0.05 with 95% confidence intervals were considered significant. Student's *t*-test and chi-square tests were used to compare results between groups. Mann-Whitney *U*-tests were performed for data that were not normally distributed. Bonferroni correction was performed for categories where multiple chi-square tests were performed.

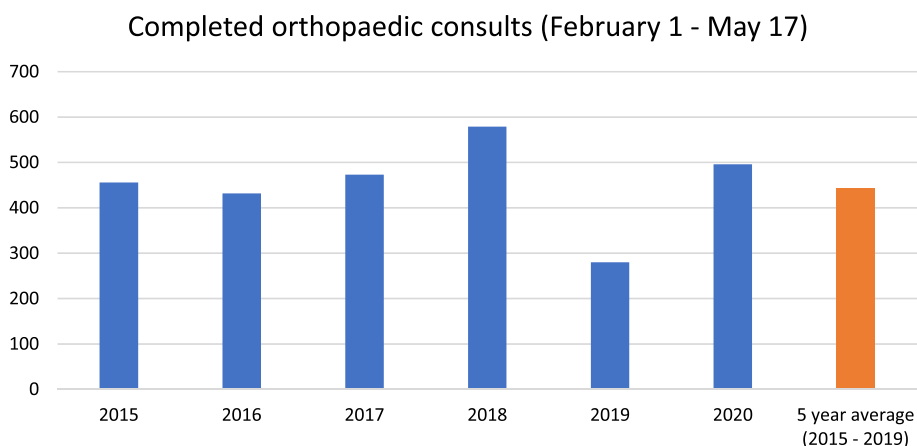
Results

There were 10 627 total presentations to the ED during the study period in 2020, and 11 091 in 2019. Of these, 496 presentations required orthopaedic review in 2020, compared with 280 in 2019 (*p* < 0.0001, odds ratio 1.89) (Table 2). The average number of orthopaedic referrals within the study period in the preceding 5 years amounted to 444, equating to 20% less referrals than in 2020 (Fig. 1).

Twenty patients were excluded from data analysis as they were lost to follow-up or were subsequently referred to other specialties (Fig. 2). One patient died in the ED.

The mean age and demographics including gender and Indigenous status were not significantly different amongst the two groups (Table 2). There was a higher proportion of children with orthopaedic presentations (*p* = 0.02) and a reduced rate of neck of femur fractures (NOFs) (*p* = 0.0099) in 2020.

The most common mechanism of injury during both time periods was falls, followed by sport or recreational activities (Table 2). There was no difference in the distribution of injury mechanisms between groups (*p* = 0.27). Bony injuries were more common than soft tissue in both time periods; however, there was no difference in distribution of types between groups (*p* = 0.09). The majority of injuries occurred to the hand or wrist and there was no difference in the location of injury between groups (*p* = 0.18).

Fig. 1. Emergency department orthopaedic referrals during the study period, five year comparison (2015 – 2020).**Table 2** Comparison of demographics, injury characteristics and disposition between orthopaedic referrals in the 2019 and 2020 groups.

	1 February–17 May 2019 (n, %)	1 February–17 May 2020 (n, %)	p (Bonferroni corrected)
Total orthopaedic presentations	280 (2.5)	496 (4.7)	<0.0001*
Demographics			
Mean age (years)	49.7	48.0	0.42
Children <18	36 (12.9)	94 (19.0)	0.02*
Gender			0.84
Male	168 (60.0)	300 (60.5)	0.79
Female	112 (40.0)	194 (39.1)	
Indigenous	25 (8.9)	42 (8.4)	
Mechanism of injury			0.27
Motor vehicle accident	7 (2.5)	5 (1.0)	
Motorbike accident	10 (3.6)	25 (5.05)	
Fall	97 (34.6)	145 (29.3)	
Sports/recreational	58 (20.7)	103 (20.8)	
Work related	35 (12.5)	67 (13.5)	
Punch/violence	12 (4.3)	20 (4.0)	
Horse	2 (0.7)	12 (2.4)	
Other	59 (21.1)	118 (23.8)	
Type of injury			0.09
Bony	162 (56.1)	253 (49.7)	
Soft tissue	127 (43.9)	256 (50.3)	
Both	9 (3.2)	14 (2.8)	
Location of injury			0.18
Wrist/hand	112 (38.0)	173 (34.9)	
Elbow/forearm	24 (8.1)	51 (10.3)	
Shoulder/humerus	17 (5.8)	28 (5.6)	
Pelvis	4 (1.36)	12 (2.4)	
Hip	54 (18.3)	74 (14.9)	
Femur/thigh	4 (1.36)	19 (3.8)	
Tibia/knee	36 (12.2)	89 (17.9)	
Foot/ankle	41 (13.9)	72 (14.5)	
Spine	3 (1.0)	7 (1.4)	
Neck of femur fracture	30 (10.7)	28 (5.7)	0.0099*
Orthopaedic management			0.0001*
Operative	193 (68.9)	271 (54.8)	
Non-operative	87 (31.1)	224 (45.2)	
Disposition			
Admit	205 (73.2)	289 (58.5)	0.0001*
Surgery at a later date	24 (8.6)	53 (10.6)	0.3
Fracture clinic follow-up	34 (12.1)	69 (13.9)	0.5
Telehealth follow-up	0 (0)	8 (1.6)	0.03
Community follow-up	18 (6.4)	77 (15.5)	0.0002*
Death	0 (0)	1 (0.2)	

* = statistically significant.

While the absolute number of orthopaedic emergency presentations requiring hospital admission was higher in 2020, this was proportionally less when compared to 2019 ($p < 0.0001$) (Table 2).

The proportion of patients managed non-operatively was higher in the 2020 cohort ($p = 0.0001$). Patients with injuries that required operative management but did not necessitate imminent admission

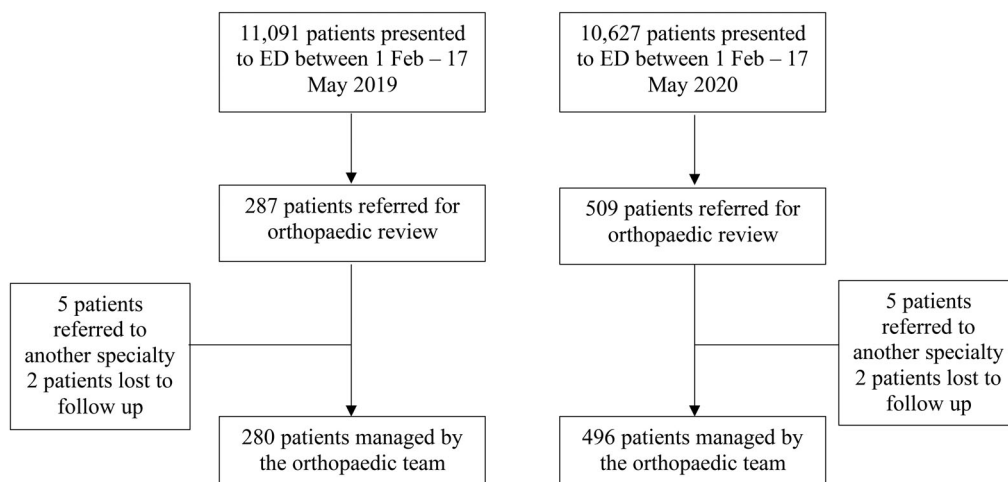


Fig. 2. Flow chart of patient inclusion and exclusion information.

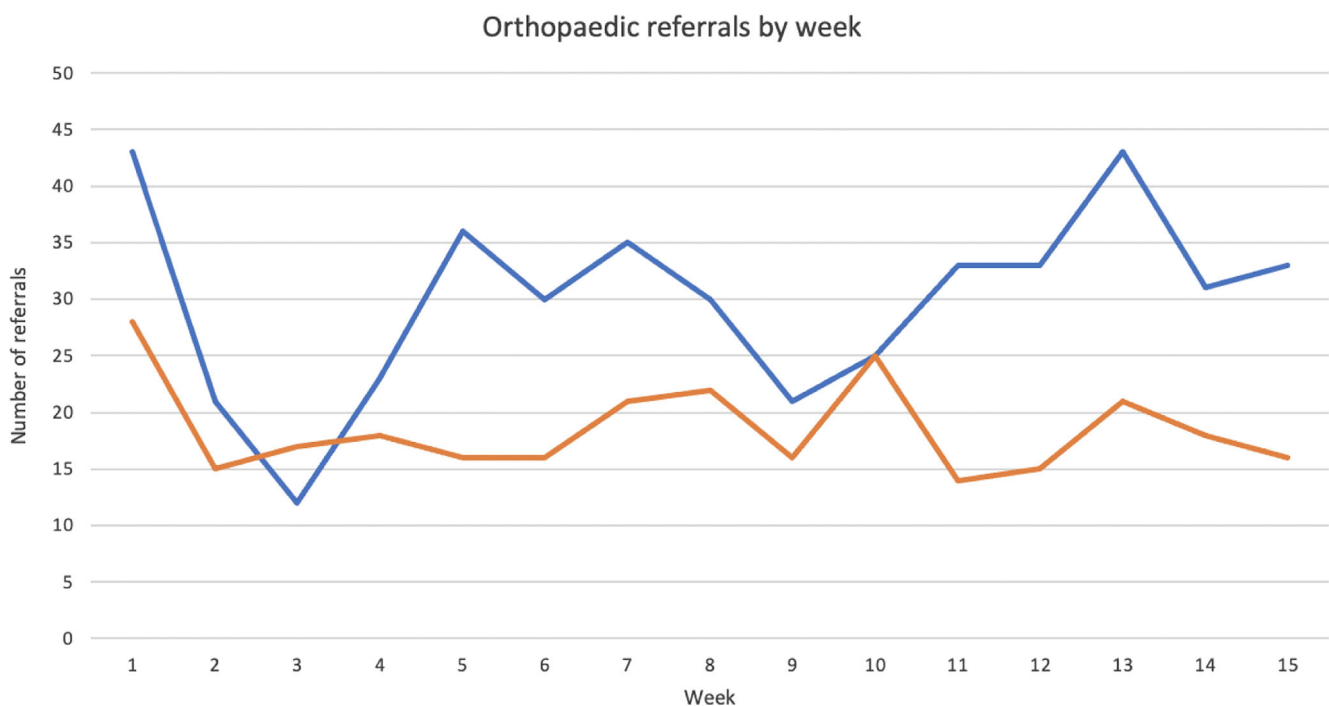


Fig. 3. Lismore Base emergency department orthopaedic referrals per week in 2019 (—) and 2020 (—).

or acute surgery were discharged with paperwork for surgery within 24–72 h and were categorised in our data as ‘surgery at a later date’. More patients in 2020 required surgery at a later date, however the proportion of these patients was not significantly different between the two groups ($p = 0.3$).

Significantly more patients were referred for community follow-up after discharge from the ED in 2020 ($p = 0.0002$).

Discussion

This study examined the impact of COVID-19 on the characteristics and frequency of emergency orthopaedic presentations

throughout the period of lockdown in Australia during early 2020. Prior research in infectious pandemics suggests that restrictions enforcing social isolation and quarantine reduce the frequency and alter the types of orthopaedic presentations.^{14–16} It would follow that lockdown laws and subsequent reduction of organised sporting activities, workplaces and traffic would reduce the risk of obtaining orthopaedic injuries, and therefore be paralleled by a reduction in orthopaedic presentations.

This is evidenced in a number of studies worldwide examining the impact of social restrictions during the COVID-19 pandemic on orthopaedic workload in both urban and regional settings.^{6–13,16} Contrary to our findings, these studies unanimously found a

reduction in the number of orthopaedic referrals. A London study by Park et al. noted that there was a reduction in orthopaedic trauma referrals during March 2020, as well as an 89% drop in acute sporting injury referrals, which is sharply contrasted to the doubling of our orthopaedic referrals.⁶ A more demographically comparable study looking at the orthopaedic presentations during COVID-19 in a rural and remote town in Scotland found a significant reduction in orthopaedic ED attendances compared to 2019.¹⁰

Contrastingly, we found a 77% increase in orthopaedic presentations to our ED in the 2020 cohort compared to 2019 and a 20% increase compared to the average number of completed orthopaedic consults in ED in the preceding 5 years despite a reduction in total ED presentations (Table 2, Fig. 1). This trend is reciprocal to the recently published trend in overall Australian ED presentations as outlined in the interim report for NSW Health by the Agency for Clinical Innovation (Fig. 3).¹⁷

The mechanism of injury for both the 2019 and 2020 groups showed a comparable distribution ($p = 0.27$). Falls remained the most common cause of injury, followed by sporting and recreational activities. Cases such as chronic degenerative joint pain, joint or wound infections and miscellaneous minor trauma predominantly accounted for 'other' causes of presentation requiring orthopaedic review. Similarly, there was no statistically significant difference in the proportion of bony and soft tissue cases between the 2019 and 2020 groups ($p = 0.09$). The distribution of injury location was comparable, with the majority of injuries occurring in the hand or wrist ($p = 0.18$).

These findings are likely reflective of a rural/regional Australian setting, where a lower population density, large properties and backyards with less need for shared public spaces facilitate easier social distancing and isolation compared to a metropolitan setting. This allows the community to remain in lockdown at home, yet continue to pursue outdoor activities, including exercise, horse riding, farm work, home or property renovations and use of motor vehicles and motorbikes, without breaching government regulations, therefore maintaining the burden of orthopaedic injury in our EDs.

The paradoxical increase in presentations in a rural or regional setting could further be explained by differences in risk-taking perceptions amongst this population. Chen et al. showed that residents living in rural areas were less likely to partake in COVID-19 preventative measures, and more likely to participate in risk-taking.¹⁸ Furthermore, lower health literacy in rural and regional areas compared to urban areas may contribute to less compliance with social restrictions imposed during the pandemic.¹⁹ During the peak of the pandemic in NSW, there remained low case numbers in our health district which may have led to a feeling of safety amongst residents and increased risk-taking behaviours.²⁰ However, Wong and Cheung⁸ in South Australia demonstrated a reduction in paediatric orthopaedic presentations at a major tertiary referral hospital despite also having low case numbers within the South Australian community at the time.⁹ This suggests that the Australian regional and rural population may demonstrate different behaviours to those in metropolitan areas.

Despite an increase in orthopaedic presentations, there were lower rates of orthopaedic hospital admissions during 2020 compared to the same time period in 2019 ($p < 0.0001$). Of note, the absolute

numbers for orthopaedic admission in 2020 remained higher than those of 2019 (289 and 205, respectively) (Table 2). Furthermore, there were more cases overall managed non-operatively in 2020 ($p = 0.0001$). This may reflect a tendency towards non-operative management for cases without an absolute indication for surgery, in which the decision to operate always involves weighing the risks and benefits.

In addition, there was a tendency towards performing minor procedures such as minor wound debridement, simple lacerations and nailed repairs in the ED to avoid prolonged exposure to the hospital environment. As a result, orthopaedic admission rates decreased as the necessity for admission was removed with immediate management in the ED. A study in rural Scotland found that minor operations formed a higher proportion of their admissions compared to a non-pandemic era and suggested the implementation of a minor operating theatre near ED as a means to reduce transmission risk during a pandemic.¹⁰

These trends mirror a global hesitancy to recommend admission to hospital and reduction in operative cases during the COVID-19 pandemic to avoid exposure of otherwise healthy patients to hospital-acquired COVID-19 infection.^{6-13,17} Limiting operative cases is also important for staff safety as a general anaesthetic potentially places theatre staff at increased risk of exposure to aerosolised COVID-19 particles during intubation.²¹

The number and rate of patients who underwent surgery at a later date were higher in 2020 than in 2019 (Table 2). This indicates that patients requiring surgery within 24–72 h were sent home whilst awaiting their procedure more often than usual practice, again presumably to avoid exposure to the hospital environment.

This concept of minimising exposure risk was also demonstrated by the significant increase in community follow-up following orthopaedic review in ED ($p = 0.0002$). In addition, a telehealth fracture clinic was implemented on an emergency basis and patients were followed up via mobile phone at home.⁴ This transition from face-to-face consultations to telehealth services is reflected in hospitals internationally and has provided the opportunity to confidently manage patients without necessitating hospital admission.

Wong et al. showed reduced paediatric presentations to a major paediatric tertiary hospital with a Level 1 paediatric trauma centre in South Australia, although admissions for children younger than 7 years were unchanged.¹¹ In contrast, our study found an increase in paediatric presentations in 2020, with 19% of presentations comprising patients younger than 18 years compared to 12.9% in 2019 ($p = 0.02$). Although in both locations children would spend more time at home due to the transition from classroom schooling to home video lessons, the difference in results could be explained by the ability for children in the vast landscape of regional Australia to engage in more outdoor activities and be left unsupervised whilst remaining compliant with social distancing.

On the other end of the age spectrum, there was a significant reduction in the rate of NOFs. In 2020, 5.7% of patients sustained an NOF compared to 10.7% in 2019 ($p = 0.0099$). The current literature has described varying effects of the COVID-19 restrictions in this group. A retrospective cohort study in Italy found that there was a significant decrease in the incidence of NOFs in the first 8 weeks of the pandemic.²² However, a retrospective, multicentre

cohort study in the UK found that in the 6 weeks from 17 March 2020, despite a 34% reduction in orthopaedic trauma referrals compared to 2019, the odds of sustaining a neck of femur fracture increased by more than 50%.¹²

This study is limited by some data being retrospectively collected, which requires reliance on accurate documentation. However, all patients had basic documentation, imaging and operative notes which covered all the required data. Some patients were lost to follow-up, predominantly due to follow-up in private rooms or transfer to another hospital; however, due to small numbers of exclusions this is unlikely to affect the overall trend. It is possible that some data may have been missed if patients avoided attending ED due to fear of COVID-19 exposure; however, if this was the case, the absolute number of presentations would have been even higher than reported and thereby further exaggerated the difference between the groups.

Lastly, it is unclear as to why the 579 completed orthopaedic consults in 2018 and 280 in 2019 both lie beyond one standard deviation from the mean value of 444 compared to the other years (Fig. 1). The pattern may potentially be attributed to the aftermath of the 2017 Lismore floods that required significant physical contribution towards a reconstruction effort,²³ therefore causing an increase in orthopaedic injuries. However, this may also have catalysed population movement to locations less prone to flooding and subsequently a reduction in orthopaedic presentations to ED.

This is the first study observing the effects of COVID-19 on orthopaedic presentations in a regional Australian hospital ED, with surprising outcomes. It is hoped that the findings will assist with resource allocation and departmental planning for orthopaedic services during lockdown phases of the ongoing international COVID-19 pandemic. In an Australian context, this can help inform how we distribute funding, staff and resources between urban and regional centres during the fluctuating social restrictions of the current pandemic.

Conflict of interest

None declared.

Author contributions

Elise Woo: Conceptualization; data curation; formal analysis; investigation; methodology; project administration; resources; software; validation; visualization; writing-original draft; writing-review & editing. **Ariella Smith:** Conceptualization; data curation; formal analysis; investigation; methodology; project administration; resources; software; validation; visualization; writing-original draft; writing-review & editing. **Dominic Mah:** Conceptualization; data curation; writing-review & editing. **Benjamin Pfister:** Conceptualization; data curation; writing-review & editing. **Herwig Drobotz:** Conceptualization; project administration; resources; supervision; writing-review & editing.

Data availability statement

The datasets generated and analysed during the current study are available from the corresponding author on reasonable request.

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