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## Original article

# Cycling injuries requiring orthopaedic intervention during the first COVID-19 lockdown period: A multi-centre Scottish Orthopaedic Research collaborativE (SCORE) study



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## ABSTRACT

**Introduction:** The COVID-19 lockdown resulted in decreased vehicle use and an increased uptake in cycling. This study investigated the trends in cycling-related injuries requiring orthopaedic intervention during the COVID-19 lockdown period compared with similar time periods in 2018 and 2019.

**Methods:** Data were collected prospectively for patients in 2020 and collected retrospectively for 2019 and 2018, from hospitals within four NHS Scotland Health Boards encompassing three major trauma centres. All patients who sustained an injury as a result of cycling requiring orthopaedic intervention were included. Patient age, sex, mechanism of injury, diagnosis and treatment outcome from electronic patient records.

**Results:** Number of injuries requiring surgery 2020: 77 (mean age/years – 42.7); 2019: 47 (mean age/years – 42.7); 2018: 32 (mean age/years – 31.3). Overall incidence of cycling injuries 2020: 6.7%; 2019: 3.0%; 2018: 2.1%. Commonest mechanism of injury: fall from bike 2020 n = 54 (70.1%); 2019 n = 41 (65.1%); 2018 n = 25 (67.6%). Commonest injury type: fracture 2020 n = 68 (79.1%); 2019 n = 33 (70.2%); 2018 n = 20 (62.5%). Commonest areas affected: Upper extremity: 2020 n = 45 (58.5%); 2019 n = 25 (53.2%); 2018 n = 25 (78.1%). Lower extremity: 2020 n = 23 (29.9%); 2019 n = 14 (29.7%); 2018 n = 7 (21.8%).

**Conclusion:** A significant increase in the number of cycling related injuries requiring orthopaedic intervention, a greater proportion of female cyclists and an older mean age of patients affected was observed during the COVID-19 lockdown period compared with previous years. The most common types of injury were fractures followed by lacerations and fracture-dislocations. The upper extremity was the commonest area affected.

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## Introduction

The SARS-CoV-2 (COVID-19) pandemic declared by the World Health Organisation (WHO) resulted in many countries across

the world implementing widespread lockdown measures. The United Kingdom (UK) implemented its first nationwide lockdown measures on the 23rd March 2020.<sup>1,2</sup> This meant that travel was restricted for essential purposes only to buy food, seek medical care, exercise for 1 hour once a day and for those to travel to work who could not work from home.<sup>2</sup> Furthermore, social distancing measures restricting contact to two metres apart between individuals were also implemented. As

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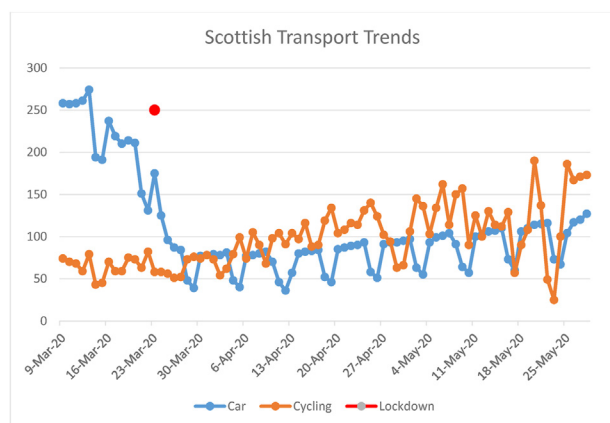
as a result, public transport and car use declined which was accompanied by an increased uptake in cycling<sup>3,4</sup> (see Fig. 1) and demand for bicycles from retailers.<sup>5</sup> In Scotland, several towns including Dunfermline, Newton Mearns, Dundee and Livingston reported a significant rise in cyclists on the roads during lockdown compared with the same time period in 2019.<sup>6</sup> Decisions relating to easing lockdown measures were made by the devolved governments in Scotland, Wales and Northern Ireland and the Westminster government for England. The Scottish Government began easing the first lockdown on Friday 29th May 2020.

The benefits of increased cycle use as an alternative to motor vehicles includes a reduction in congestion, noise pollution, improving health and cutting exhaust emissions.<sup>7</sup> The overall increase in demand resulted in many new and possibly inexperienced cyclists hitting the roads.

Despite the many benefits cycling affords, it is also widely recognised that it can contribute to serious injury including head injury, fracture and polytrauma.<sup>8</sup> Between 2008 and 2018 the number of cyclists killed or seriously injured in Great Britain rose by 21%.<sup>9</sup> We wanted to investigate and compare the incidence and demographics of injuries due to cycling requiring orthopaedic intervention during the COVID-19 lockdown period compared with previous years across Scotland to inform future planning and service provision.

## Methods

Data were collected from hospitals within three Health Boards in Scotland with major trauma capabilities: NHS Greater Glasgow and Clyde (Queen Elizabeth University Hospital and Glasgow Royal Infirmary), NHS Grampian (Aberdeen Royal Infirmary), and NHS Tayside (Ninewells Hospital and Perth Royal Infirmary) and collected during the time period of the 17th March until the 28th May for the years 2020, 2019 and 2018.



**Fig. 1 – Graph created using figures from Transport Scotland Scottish transport trends 2020. Figures are compared against a baseline index taken on 18th to 24th May (Baseline = 100).<sup>10</sup>**

All patients who sustained an acute injury, defined as presenting to a healthcare professional within seven days of the injury occurring, requiring orthopaedic intervention during the time period were included with injuries specific to cycling recorded. Data were collected prospectively for patients in 2020 and retrospectively for 2019 and 2018. Demographic data collected included age and sex. In addition, mechanism of injury, injury severity score (ISS), diagnosis and orthopaedic interventions were also recorded. Orthopaedic interventions were defined as treatment requiring operative intervention performed by a Trauma and Orthopaedic Surgeon out with the Emergency Department (ED). Electronic patient records and radiographs were utilised to source this information. Patients were excluded if they did not sustain an injury due to cycling or if the injury occurred more than seven days prior to presentation.

Injuries sustained were classified as per the Brukner and Kahn classification of acute sports injuries [Appendix 2](#)<sup>11</sup> and further subdivided into anatomical regions. Multiply injured patients were defined as those with an injury affecting two or more anatomical regions.

Statistical analysis was performed using SPSS v. 25.0 (IBM, Armonk, New York). The chi-square test was utilised when comparing between categorical variables. The Mann Whitney U test was used to compare independent variables in non-parametric continuous data. The Kruskal Wallis test was used to compare multiple independent variables of non-parametric continuous data. Confidence intervals were set at <0.05.

Ethical approval was not required for this study. The data collection was carried out in accordance with General Medical Council (GMC) guidance on good clinical practice. All records were anonymised and no patient identifiable data was collected. The study was completed without funding.

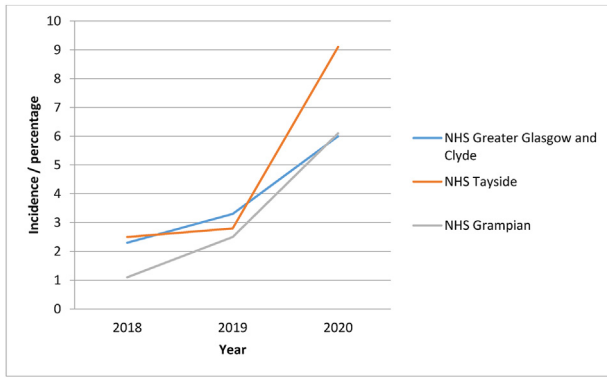
## Results

Overall, 156 patients with cycling related injuries required orthopaedic intervention between 17th March and 28th May between 2018 and 2020. No. of operative interventions: 77 in 2020, 47 in 2019 and 32 in 2018. A statistically significant increase in admissions occurred between 2018 and 2020  $p < .05$  and 2018 and 2019  $p < .05$ .

### Patient demographics

Patient demographics are summarised in [Table 1](#). Incidence of cycling injuries requiring operative intervention by region is summarised in [Table 2a](#). Overall incidence is summarised in [Table 2b](#) and [Fig. 2](#).

A statistically significant increase in males requiring orthopaedic intervention than females was observed  $p < .05$  overall. More females required orthopaedic intervention in 2020 compared with 2019  $p < .05$  and 2018  $p < .05$ . No difference was observed in females requiring intervention between 2018 and 2019  $p = .08$ . A statistically significant difference in age between 2018 and 2020  $p < .05$  was observed in all patients however no difference was observed in age between 2019 and



**Fig. 2 – Graph demonstrating the incidence of cycling injuries across all three health boards between 17th March until the 28th May 2018–2020.**

2020  $p = .78$ . Yearly incidence in cycling injuries was observed to be increasing between 2018 and 2020.

**Mechanism of injury**

Mechanism of injury per year is summarised in Table 3. Breakdown of injury types is summarised in Table 4. A statistically significant difference was observed in fall from bike injuries in 2020 compared with 2019  $p < .05$  and 2020 and 2018  $p < .05$ . An observed reduction in frequency was noted in cyclist vs. car injuries in 2020 compared with previous years. No difference was observed in median ISS across all years.

**Injury body site affected**

Injury body site affected is summarised in Table 5. Orthopaedic interventions are summarised in Appendix 1. A greater proportion of upper extremity injuries occurred across the years compared with lower extremity injuries. No significant difference was observed between upper and lower extremity injuries across the years  $p = .39$ . Lower extremity injuries were proportionally higher in 2020 compared with previous years.

**Table 1 – Patient demographics and Injury Severity Score per year. IQR – interquartile range.**

Year	n	Mean age/years	Sex M:F	Ratio M:F	Median ISS	ISS IQR
2020	77	42.7 (SD 19.48)	52:25	1 : 0.5	4.00	28
2019	47	42.7 (SD 19.98)	40:7	1 : 0.2	4.00	35
2018	32	31.3 (SD 14.92)	25:7	1 : 0.3	4.00	12

**Table 2a – Incidence of cycling injuries compared with total number of presentations requiring orthopaedic intervention.**

	NHS Greater Glasgow and Clyde			NHS Tayside			NHS Grampian		
	2018	2019	2020	2018	2019	2020	2018	2019	2020
n	895	879	687	324	352	253	281	319	212
Cycling frequency	21	29	41	8	10	23	3	8	13
Incidence/percentage	2.3	3.3	6.0	2.5	2.8	9.1	1.1	2.5	6.1

**Table 2b – Overall incidence of cycling injuries across all three health boards.**

	Year		
	2018	2019	2020
n	1500	1550	1152
Cycling	32	47	77
Incidence/percentage	2.1	3.0	6.7

**Table 3 – Mechanism of injury per year.**

Mechanism	2018		2019		2020	
	n	%	n	%	n	%
Cyclist vs. stationary obstacle	1	3.1	3	6.4	8	10.4
Cyclist vs. animal			2	4.3	1	1.3
Cyclist vs. car	5	15.6	7	14.9	1	1.3
Cyclist vs. van					3	3.9
Cyclist vs. lorry	1	3.1				
Cyclist vs. cyclist	2	6.3	1	2.1	3	3.9
Fall from bike at speed	20	62.5	33	70.2	54	70.1
Other	3	9.4	1	2.1	7	9.1

**Discussion**

This study demonstrated that there was a significant increase in the number of cycling related injuries requiring orthopaedic intervention during the COVID-19 lockdown period in 2020 compared with 2018. Furthermore the incidence of cycling related injuries increased between 2018 and 2020. The most common types of injury observed in 2020 were fractures followed by lacerations, and fracture-dislocations. The upper extremity was the most common affected area which is consistent with the literature<sup>12–14</sup> however, the proportion of lower extremity injuries was still significantly more in 2020 compared with previous years. A larger proportion of females sustained injuries requiring operative intervention in 2020 compared with previous years. Furthermore, there was a reduction in cyclist versus car injuries in 2020 compared with the same time period in 2019.

There was a significant increase in the number of admissions requiring orthopaedic intervention due to cycling injuries in all health boards during lockdown compared with previous years and several factors may account for this. As the Scottish Government encouraged increased uptake in cycling, this has not been reflected in the changes in infrastructure required to optimise safety. Furthermore the increase in less experienced cycling on the roads may have led to increased numbers of injury. Amoros et al. stated that the “type of cyclist” was a better predictor of injury than helmet use alone.

**Table 4 – Injury type adapted from Bruckner and Kahn classification of acute sports injury.**

	2018		2019		2020	
	n	Percent	n	Percent	n	Percent
Abrasion (infection)	1	3.1				
Dislocation	1	3.1	1	2.1		
Fracture	28	87.5	36	76.6	64	83.1
Fracture + compartment syndrome					2	2.6
Fracture-dislocation	1	3.1	1	2.1	2	2.6
Laceration	1	3.1	2	4.3	2	2.6
Ligament tear			1	2.1		
Multiple injuries			6	12.8	6	7.8
Tendon tear					1	1.3

**Table 5 – Injury body site affected per year.**

	2018		2019		2020	
	n	Percent	n	Percent	n	Percent
<b>Upper Extremity</b>						
Shoulder	4	12.5	5	10.6	8	10.4
Elbow	4	12.5	3	6.4	10	13
Forearm	12	37.5	13	27.7	24	31.2
Wrist			1	2.1		
Hand	2	6.3	2	4.3	2	2.6
Finger	3	9.3	1	2.1	1	1.3
Total	25	78.1	25	53.2	45	58.5
Pelvis			2	4.3	2	2.6
Spine					1	1.3
<b>Lower Extremity</b>						
Hip	1	3.1	9	19.1	6	7.8
Thigh	1	3.1	2	4.3	2	2.6
Knee	1	3.1	1	2.1	3	3.9
Leg	1	3.1	1	2.1	4	5.2
Ankle	2	6.3	1	2.1	8	10.4
Foot	1	3.1				
Total	7	21.8	14	29.7	23	29.9
Multiple			6	12.8	6	7.8

Teenagers and adults who were injured “outside town” or in more rural environments conferred higher rates of hospitalisation and serious injury and that females were more likely to be injured as children.<sup>13</sup> It is important to recognise that guidance issued by the British Orthopaedic Association (BOA) to trauma units during the first wave of the COVID-19 pandemic in the UK emphasised the role of conservative management and the importance of minimising unnecessary hospital visits.<sup>15</sup> Additionally, Macdonald et al. demonstrated that for a similar time period, the overall number of patients undergoing surgery for musculoskeletal trauma in Scotland decreased during the first lockdown.<sup>16</sup> An overall reduction in musculoskeletal injuries requiring operative intervention during lockdown was also observed in France,<sup>17</sup> and Norway<sup>18</sup> during this time period. Therefore, the increase in hospital admissions from cycling injuries likely reflects the higher numbers of patients requiring operative strategies for their injuries over conservative management.

The variation in presentation among the three different Scottish health boards is interesting due to the range of population densities and geography in these regions. For example

NHS Greater Glasgow and Clyde predominantly comprises of a population living in “large urban” and “other urban areas” compared with NHS Tayside and NHS Grampian which have a mixed picture of “large urban” and “accessible rural” areas as defined by the Scottish Government.<sup>19</sup>

Overall, more males compared with females sustained cycling injuries which has been consistently reported in the literature.<sup>12–14</sup> This is most likely due to greater cycling uptake and trip frequency made by males compared with females.<sup>20</sup> Additionally females account for only one-third of cyclists in the UK,<sup>21</sup> which are due to a number of reasons. Female cyclists are more likely to experience verbal or sexual harassment compared with male cyclists and are more likely to be blamed for accidents.<sup>20</sup> Furthermore female cyclists experience a 50% higher incidence rate of “problematic close passes” by vehicles despite reduced average cycle speeds and distances travelled compared with males.<sup>20,22</sup> Interestingly, the proportion of female cyclists requiring operative treatment increased during the lockdown period compared with previous years. It has been postulated that a reduction in street traffic has anecdotally resulted in a reduction in verbal and sexual harassment experienced by female cyclists<sup>23</sup> contributing to this increased uptake in cycling among females during this time period.

The mean age of cycling in 2020 was also higher compared with previous years suggesting increased cycling participation in older people. This is an important finding as Ekman et al. stated that the risk of dying due to cycling related injury was 3.5 times greater in the elderly and the risk of being severely injured was 7.5 times higher.<sup>24</sup>

Overall there was an observed reduction in number of cyclist versus car collisions in 2020 compared with the similar time periods in 2019 and 2018 which supports previous findings.<sup>25</sup> Scott et al. investigated the injuries present in Edinburgh however that study examined a much smaller time period and study population pre- and during lockdown. It has been reported that cyclist versus vehicle collisions are more likely to cause polytrauma, lower limb injury<sup>12</sup> and death.<sup>26</sup> There was a lower proportion multiply injured patients in 2020 compared with 2019 which may reflect the reduction in overall traffic on the roads during this period.

In other parts of the world, there are variable reports on cycling injuries during lockdown. In Auckland, New Zealand, and in several cities across China it was observed that there was no change in the number of cycling injuries before or during lockdown<sup>27,28</sup>. The time period observed in those studies were characterised by the autumn-winter months in the Southern and Northern hemispheres respectively which is associated with a reduction in cycling uptake.<sup>29</sup>

To our knowledge this is the first paper to analyse trends in cycling injuries requiring orthopaedic intervention during the entire COVID lockdown period on a national level compared with similar time periods in 2019 and 2018. The overall size and scope of this paper encompassing multiple health boards and a catchment area of 2.1 million people across Scotland, including both urban and rural areas, is a strength compared with studies focusing on individual cities and more limited time periods.

There are a number of limitations to this study. Data collection from multiple health boards with varying information technology (IT) systems to capture injuries may have resulted in incomplete data. Furthermore this study covers the first of a

series of nationwide lockdowns in Scotland which emerged out of lockdown at a different rate compared with other UK constituent countries.<sup>30</sup> Capturing injuries out with trauma and orthopaedics was challenging due to the fact that head injuries and abdominal injuries aren't referred to orthopaedics. It was difficult to ascertain from the records whether cycling was due to commuting or recreational use as it has been noted that commuting is often associated with a higher risk of injury<sup>31</sup> most likely due to cycling during periods of rush hour when there is an increased number of vehicle users on the road.

This study demonstrates there was a significant increase in the number of injuries requiring operative fixation, and fractures across Scotland during the first COVID-19 lockdown compared to similar time periods in 2019 and 2018. The incidence of these injuries appeared to increase during this time period from 2018 to 2020. Furthermore, there was an increased number in female cycling participants injured when compared with previous years. Although the benefits of cycling are well established, there needs to be considerable infrastructure changes to improve overall safety and minimise the risk of

#### Appendix 1 – Orthopaedic interventions.

	2018		2019		2020	
	n	%	n	%	n	%
<b>Soft tissue procedures</b>						
Incision and drainage of abscess	1	3.1				
Wound washout, debridement ± primary closure	3	9.4	3	6.4	2	2.6
Ligament repair			1	2.1		
Tendon repair					1	1.3
<b>Fixation procedures</b>						
Intramedullary nail (femur)	1	3.1	2	4.2		
Kirschner wire (K-wire) fixation			4	8.5	4	5.2
Compression Hip Screw (CHS)	1	3.1	4	8.5	2	2.6
External fixation of fracture			2	4.3	1	1.3
Tension band wire of fracture					3	3.9
Open reduction internal fixation (ORIF) of fracture	21	65.6	22	46.8	51	66.2
Open reduction and stabilisation (acromioclavicular joint)			1	2.1		
Intramedullary nail (humerus)					1	1.3
Radial head excision					1	1.3
Open reduction (shoulder)						
Spinal fusion					1	1.3
<b>Multiple procedures</b>						
ORIF of fracture, leg fasciotomy, delayed closure and split skin graft					1	1.3
CHS, Thigh Fasciotomy, Delayed primary closure					1	1.3
Application of external fixation and delayed ORIF of fracture					1	1.3
<b>Arthroplasty</b>						
Primary total elbow replacement			1	2.1		
Revision total hip replacement			1	2.1		
Hemiarthroplasty (Hip)					2	2.6
Total hip replacement					1	1.3
Radial head replacement					1	1.3
<b>Manipulation procedures</b>						
Closed Reduction (elbow)						
Manipulation under anaesthesia (MUA) of fracture and application of cast	1	3.1	4	8.5	3	3.9
Closed reduction (shoulder)						

#### Appendix 2 – Brukner and Kahn Classification of Sports Injuries.<sup>11</sup>

Site	Acute Injuries	Overuse Injuries
Bone	Fracture Periosteal contusion	Stress fracture Bone strain Stress reaction Osteitis Periostitis Apophysitis
Articular cartilage	Osteochondral/ chondral fracture Minor osteochondral injury/lesion	Chondropathy (e.g. chondromalacia)
Joint	Dislocation Subluxation	Synovitis Osteoarthritis
Ligament	Sprain/tear (grades I–III)	Inflammation
Muscle	Strain/tear (grades I–III) Contusion Cramp Compartment syndrome (acute)	Compartment syndrome (chronic) Delayed onset muscle soreness (DOMS) Focal tissue thickening/fibrosis
Tendon	Tear (complete or partial)	Tendinopathy
Bursa	Traumatic bursitis	Bursitis
Nerve	Neuropraxia	Nerve entrapment Minor nerve injury/irritation Adverse neural tension
Skin	Laceration Abrasion Puncture wound	Blister Callus

future injury. As social distancing continues and countries slowly emerge from lockdown, it's possible that cycling participation may continue to rise and these injuries may make up a higher proportion of the Trauma and Orthopaedic workload.

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