



The hidden dangers of staying home: a London trauma unit experience of lockdown during the COVID-19 virus pandemic

L Oliver-Welsh, C Richardson, DA Ward

Department of Trauma and Orthopaedics, Kingston Hospital Foundation Trust, Kingston upon Thames, UK

ABSTRACT

Introduction The COVID-19 pandemic resulted in reconfiguration of the NHS. Elective services were stopped and trauma services focused on decreasing patient–clinician interactions and managing injuries nonoperatively wherever possible. The everyday life of the general public changed dramatically with the introduction of a national lockdown to prevent the spread of COVID-19. This paper looks at the experience of a South West London trauma unit.

Materials and methods All patients reviewed in fracture clinic and by the orthopaedic on-call team between 23 March to 23 April 2020 were included. Data on the mechanism of injury and whether this was a usual activity, the injury sustained and its management were collected.

Results A total of 167 trauma injuries were seen, compared with 735 new patients with injuries in the previous month. The number of trauma operations completed decreased by 38%; 55% of injuries occurred inside the home and 44% outside the home during daily exercise. Some 31% of injuries were secondary to a new activity taken up during lockdown. Three open fractures and two polytrauma cases were seen that would have normally been managed at the local major trauma centre.

Conclusion Overall, both the number of injuries seen and trauma operations completed during the enforced lockdown decreased. This is probably due to a change in the way the general public are living their lives, and the reconfigurations within the NHS in response to the COVID-19 pandemic. This is an interesting time within trauma and orthopaedic departments, as they continue to adapt to the changing injuries and working environment.

KEYWORDS

Trauma – Accidental injury – COVID-19 – Lockdown – Injuries

Accepted 20 July 2020

CORRESPONDENCE TO

Lucy Oliver-Welsh, E: Lucy.oliverwelsh@nhs.net

Introduction

At 8pm on the evening of Monday the 23 March 2020, strict lockdown measures were introduced across the UK as a response to the COVID-19 pandemic. These lockdown measures, introduced with a view to reduce the spread of coronavirus, meant that the British public would only be able to leave their homes for essential reasons or daily exercise (Box 1). All shops selling

non-essential goods were closed and all social gatherings except funerals were banned.¹

The NHS responded to the COVID-19 pandemic by increasing both hospital bed and workforce capacity. All but essential services, including all elective orthopaedic work, were stopped. Doctors, nurses and healthcare professionals were largely redeployed to different clinical areas.

The British Orthopaedic Association (BOA) released guidance on injury management during the pandemic. Trauma and orthopaedic departments were advised to restructure their services to minimise patient–clinician interactions and to provide senior-led decision making at a patient's first presentation. It was advised that more injuries should be managed nonoperatively because of the unquantified risk to surgeons and patients and to decrease the burden on the remainder of the health service.²

London hospitals were the worst affected by the pandemic, most likely due to London's high population density. The Office for National Statistics reported that London had almost double the death rate from COVID-19

Box 1 Limited reasons for which the UK public could leave their homes during the UK's first national lockdown

- Shopping for basic necessities, as infrequently as possible.
- One form of exercise a day (eg a run, walk, or cycle) alone or with members of your household.
- Any medical need.
- To provide care or to help a vulnerable person.
- Travelling to and from work, but only where this is absolutely necessary and work cannot be done from home.

compared with the next worst affected region (West Midlands) in the UK.⁵

The London major trauma system issued a response to COVID-19 in March 2020 predicting a 40% reduction in major trauma cases during the pandemic. To relieve pressure from major trauma centres with high intensive care capacities and to reduce patient transfer, the trauma network was reconfigured. Trauma units in the South West London and Surrey trauma network would manage injuries locally, with video conference support to discuss the management of complex or polytrauma remotely where required.

With dramatic changes to both the general public's everyday life and the management of injuries within the NHS, the work of the trauma unit was expected to change. We examine the experience of a South West London trauma and orthopaedic department in a busy district general hospital during the COVID-19 pandemic.

Materials and methods

All patients presenting to the orthopaedic trauma service during a one-month (31-day) period starting from the implementation of lockdown were identified, including children. The data collection period was 8pm Monday 23 March to 8pm Thursday 23 April 2020. Patients who were seen in this period but whose injuries had been sustained prior to lockdown were excluded. Patients who were seen for non-traumatic presentations, for example joint swellings and atraumatic back pain, were also excluded.

Owing to a service redesign in response to COVID-19, all acute injuries seen by the accident and emergency department and the urgent treatment centre were directly referred either to the orthopaedic on-call team or to a walk-in fracture clinic service. All patients with injuries were identified.

For each patient, demographics including age, sex and usual occupation were collected. The mechanism of injury and whether this was a usual or new activity was recorded, as well as where the injury was sustained (inside or outside the home). Whether the injury was managed operatively or nonoperatively was also recorded. Data for all patients seen in fracture clinic were collected prospectively. Data for patients presenting to the on-call trauma service were collected retrospectively using patient record electronic databases. Electronic databases were also used to obtain data from the 31-day period prior to the study period (8pm 20 February to 8pm 22 March 2020), to provide comparative data where available.

Results

A total of 167 patients were included in this observational study. This included 25 children (1–16 years) and 142 adults (17–97 years). The average age was 51 years, and 63 patients (38%) were aged 65 years and over; 102

patients were female (61%) and 65 were male (39%). For the purpose of this study, polytrauma has been labelled as one injury. There were therefore 167 injuries within these 167 patients. In the 31-day period prior to lockdown, the orthopaedic trauma service saw 735 patients with new injuries; 61 trauma operations were completed during the study period, compared with 99 trauma operations in the previous month.

Some 92 injuries (55%) were sustained within the home (including gardens) and 74 injuries (44%) were sustained during daily exercise outside the home. Only one injury was sustained in a person's normal workplace; this was by a nurse while at work. Breakdown of injury by occupation (the patient's normal occupation prior to any changes to their job as a result of the COVID-19 pandemic) is shown in [Tables 1 and 2](#).

Mechanisms of injury and whether it was a new or usual activity for the patient is shown in [Table 3](#). All injuries sustained for each mechanism are shown in [Table 4](#). [Table 5](#) details mechanisms included under 'other' as a mechanism of injury. The most common mechanism of injury was a fall from standing, followed by a mechanism involving a bicycle. Bicycle injuries were mostly falls from the bicycle while cycling; three were collisions with a car and two were while attempting to perform jumps or stunts. Running was responsible for five presentations and two of these injuries (40%) related to people who admitted they would not usually run and had started in lockdown for exercise. No contact sports injuries were seen.

The most common injury was a distal radius fracture (30 injuries), which accounted for 18% of all injuries; nine of these required surgical fixation (30%). In the month prior to the study period, 34 distal radius fractures were seen by the on-call team, although the total number of distal radius fractures will be higher as this does not capture the distal radius fractures referred by accident and emergency directly to the fracture clinic bypassing the orthopaedic on-call service (as was possible prior to the service redesign during the COVID-19 pandemic). A total of 25 distal radius fractures were managed operatively in the month prior to the study period.

Nineteen neck of femur fractures were seen during the study period, 74% of which resulted from a fall from standing, and all were managed operatively. During the month prior to the study period, the orthopaedic service managed 33 neck of femur fractures, of which 31 were managed operatively. This is a 42% decrease in the number of neck of femur fractures seen. A total of 51 injuries resulted from the patient participating in a new exercise or activity; 16% of these injuries required urgent trauma surgery.

In the home, 50% of DIY injuries involved the use of angle grinders for cutting concrete slabs and 50% involved ladders. Three of the four in this group were retired, and one usually uses an angle grinder in his manual job. Twenty people (age range 4–80 years) injured themselves in a park (falling from trees or logs, dog walking, running, roller skating, skateboarding and

Table 1 Occupation and place of injury

Occupation	Patients (n)	Place of injury		Type of activity or exercise	
		Inside the home	Outside	Usual	New
Desk based	36	16	20	19	17
Manual	7	2	5	4	3
Services	11	1	10 ^a	6	5
Retail	5	0	5	2	3
Creative	5	1	4	2	3
Stay at home parent	9	4	5	6	3
Unemployed	6	4	2	6	0
Retired	57	48	9	48	9
Student	22	8	14	16	6
Infants (1–4 years)	9	7	2	8	1
Total	167	91 (55%)	76 (45%)	117 (70%)	50 (30%)

^a One at work.

Table 2 Jobs included in each occupation

Occupation	Jobs included
Desk based	Accountants, engineers, stockbrokers, editors, human resources professionals, project managers and company owners
Manual	Builders, tilers, plumbers, delivery drivers, warehouse workers and other jobs that required heavy lifting
Services	Firefighters, paramedics, nurses, cleaners, teachers and those providing care or childcare services
Retail	Shopworkers, hairdressers, restaurant and café staff
Creative	Jewellery designer, art therapist, cello maker, professional musician
Student	School age children (5–16 years), further education (A-levels) and those studying at university
Stay at home parent	Also included maternity/paternity leave
Unemployed	Current unemployment (those furloughed due to COVID-19 were grouped according to their normal occupation)
Infants	Pre-school age children (1–4 years)
Retired	Includes those aged 60 years and above where continuing employment was not documented

Table 3 Mechanisms of injury

Mechanism of injury	Patients (n)	Type of activity or exercise	
		Usual	New
Bicycle	23	15	8
Running	5	3	2
Dog walking	3	3	0
DIY	4	2	2
Housework	5	4	1 ^a
Stairs	9	6	3 ^b
Fall from standing	32	32	0
Garden	14	8	6
Roller skate/skateboard	8	2	6
Trampoline	9	7	2
Road traffic accident	6	4	2
Social distancing activities	5	0	5
Altercations	6	5	1
Tree/log	4	0	4
Other	34	27	7
Total	167	116 (69%)	51 (31%)

^aOffice worker
^bWorking from home

one altercation with another park user). Five people (aged 39–93 years) sustained injuries while delivering food to neighbours or vulnerable people, volunteering and trying

to maintain social distance. These were classed as ‘social distancing activities’. Retired individuals made up 34% of those injured (57 patients) and only two of these were

Table 4 Mechanisms and injuries

Mechanism	Injuries sustained	(n)
	Type	
Bicycle		23
	Distal radius fracture	7
	Bilateral distal radius fracture	1
	Radial head fracture	2
	Olecranon fracture	1
	Scaphoid fracture	1
	Proximal humerus fracture	1
	Acromioclavicular joint dislocation	2
	Clavicle fracture	1
	*Polytrauma (sternoclavicular joint dislocation, rib fractures, ankle sprain)	1
	Shoulder dislocation	2
	Elbow soft tissue injury	1
Running		5
	First metatarsal fracture	1
	Ankle fracture	1
	Olecranon fracture	1
	Scaphoid fracture	1
	Proximal humerus fracture	1
Dog walking		3
	Ankle fracture	1
	Radial head fracture	1
	Acetabular fracture	1
DIY		4
	*Open fracture first metatarsal	1
	Calcaneus fracture	2
	Extensor hallucis longus rupture	1
Housework (5 injuries)		5
	Distal radius fracture	1
	Bilateral ankle fractures	1
	Proximal humerus fracture	1
	Shoulder dislocation	1
	Calcaneus fracture	1
Stairs		9
	Ankle fracture	2
	5th metatarsal fracture	1
	2nd metatarsal fracture	1
	Calcaneus fracture	1
	*Polytrauma (clavicle, scapula, rib fractures)	1
	Thoracic spine fracture	1
	Proximal tibia and fibula fracture	1
	Distal radius fracture	1

(Continued)

Table 4 Continued

Mechanism	Injuries sustained	(n)
	Type	
Fall from standing		32
	Neck of femur fracture	14
	Pubic rami fracture	4
	Distal radius fracture	3
	Ankle fracture	2
	Proximal humerus fracture	2
	Sacrum fracture	1
	Distal femur fracture	2
	Lumbar spinal fracture	2
	Thoracic spinal fracture	1
	Tibial plateau fracture	1
Garden		14
	Ankle fracture	2
	Ankle sprain	1
	Neck of femur fracture	1
	Tibial laceration	1
	Tibial shaft fracture	1
	Ulna shaft fracture	1
	Proximal humerus fracture	2
	Distal radius fracture	1
	Mallet finger	1
	Biceps rupture	1
	Olecranon bursitis	1
	Metatarsal fracture	1
Roller skate/skateboard		8
	*Open distal radius fracture	1
	Distal radius fracture	2
	Distal tibia fracture	1
	Radial head fracture	1
	Scaphoid fracture	1
	Soft-tissue knee injury	1
	Shoulder dislocation	1
Trampoline		9
	Soft-tissue knee injury	2
	Ankle fracture	1
	*Open ankle dislocation	1
	Supracondylar fracture	1
	Lateral condyle elbow fracture	1
	Radius and ulna fracture	1
	Radial shaft fracture	1
	Ankle sprain	1

(Continued)

Table 4 Continued

Injuries sustained		
Mechanism	Type	(n)
Road traffic accident		6
	Distal radius fracture	2
	Acromioclavicular joint dislocation	1
	Clavicle fracture	1
	Cervical spine fracture	1
	5th metacarpal fracture	1
Social distancing activities		5
	Neck of femur fracture	1
	Laceration to knee	1
	Distal radius fracture	1
	Ankle sprain	1
Altercations		6
	Distal radius fracture	3
	Forearm laceration	1
	Dog bite	1
	5th metacarpal fracture	1
Tree/log		
	Distal radius fracture	1
	Radial head fracture	2
Other		34
	Distal radius fracture	7
	Neck of femur fracture	3
	Dislocated total hip replacement	2
	Soft-tissue knee injury	3
	Supracondylar fracture	3
	Ankle fracture	2
	Proximal humerus fracture	2
	Talus fracture	1
	Humeral shaft fracture	1
	Periprosthetic distal humerus fracture	1
	Radial head fracture	1
	Radial shaft fracture	1
	Tibial fracture	1
	Thoracic spinal fracture	1
	Scaphoid fracture	1
	Clavicle fracture	1
	Phalanx fracture	1
	5th metacarpal fracture	1
	Laceration wrist wound	1

Table 5 Other mechanisms of injury

Mechanism	Detail
Other falls	Fall from slide, chair, hammock, bunk bed, table, bed, shower. Running inside
Walking	Tripped over toy, extension cable, flip flops, slippers, on treadmill
Working from home	Kicked desk, punched wardrobe
Other indoor activities	Opening window; bending to do up sandal; twisting at work on hospital ward

performing a new activity for exercise (1 cycling and 1 exercise walking); 84% of these (48 patients) were participating in their usual activities and 53 (93%) fell from standing height or lower.

Discussion

The trauma and orthopaedic department at Kingston Hospital Foundation Trust responded to the COVID-19 pandemic and BOA guidelines⁵ with a redesign of the orthopaedic trauma service. With all elective services stopped and junior doctors redeployed to support the general medical teams, the service was consultant led. All injuries requiring orthopaedic input were referred directly to a walk-in fracture clinic or the orthopaedic on-call team on the day of injury. This was instead of normal practice of referring to a virtual trauma triage service, followed by a face to face fracture clinic appointment if required. This allowed a definitive orthopaedic management plan to be put in place by a senior decision maker on the patient's first presentation to hospital. Routine fracture clinic follow-up decreased significantly, with a walk-in fracture clinic service offered daily if patients had continuing concerns. Removable splints were used in place of fibreglass casts more readily to decrease the need to return for cast removal. All these measures decreased the number of clinician-patient interactions, increasing both efficiency and safety with regards to the potential risk of exposure to the COVID-19 virus. There was also a move towards managing more injuries nonoperatively where possible, as per the BOA guidelines.⁵ This is seen in the number of distal radius fractures managed operatively: there was a 64% decrease during the study period compared with the previous month. Long-term data will be required to evaluate the long-term effect of this change in approach to the management of orthopaedic injuries. Overall, the department staff have found the experience of running the department in this way positive and plan to continue the senior-led decision making and a walk-in fracture clinic service post pandemic.

In the month immediately prior to the study period, Kingston Hospital Foundation Trust orthopaedic service

performed a total of 99 trauma operations. During the study period, this fell to 61 trauma operations. The majority of these were performed under regional anaesthesia wherever possible. This was to reduce the risk of intubation with concurrent COVID-19 infection, especially when the infection may be present but not yet clinically apparent. In elective surgeries in Wuhan, China, between 1 January and 5 February 2020, 34 patients were studied who all developed COVID-19 pneumonia following intubation, with an associated 20.5% mortality.⁴ The reason for this 38% decrease in trauma operating is likely to be two-fold: fewer injuries were seen (167 compared with 735 the previous month) and more identified injuries were managed nonoperatively compared with normal practice. Our practice during this pandemic time is therefore in line with BOA guidelines.⁵

The redesign of the South West London and Surrey Trauma Network meant that the nature of the injuries presenting to a trauma unit was expected to change. Injuries that would have previously been managed in a major trauma centre included three open injuries that went to theatre for surgical management and two polytrauma cases that were conservatively managed. All were managed without the need for transfer. The Kingston trauma unit had the capacity to manage these injuries because of the overall decrease in the numbers of patients presenting with injuries and requiring operative management.

There was a 77% decrease in the total number of new patients with injuries seen during the study period, compared with the previous month. Breaking this down further, there was a 38% decrease in the total number of trauma operations and an 83% decrease in the numbers of new patients seen in fracture clinics with injuries not requiring operative management for their injury. The London Major Trauma Network had predicted a 40% decrease in major trauma cases. From this study based in a trauma unit, we are unable to comment on major trauma within the network overall, but the 38% reduction in trauma operations (making an assumption that it is the more significant trauma that requires operative management) falls roughly in line with the network prediction.

Road traffic accidents were only responsible for 4% of the injuries seen during the study period; nationally, 30% of major trauma injuries resulted from road traffic accidents according to the UK national database.⁵ With the lockdown in place, road traffic reduced by 73% to levels not seen in the UK since 1955.⁶ Additionally, many manual labourers were not working during the study period due to the lockdown restrictions. With both manual labourers⁷⁻⁹ and road traffic accidents^{10,11} being a source of major trauma, these factors may partially explain the decrease in number of injuries seen.

As a result of social distancing measures, no contact sports injuries were seen. Only six soft-tissue knee injuries were seen, when normally our orthopaedic service runs an acute soft-tissue knee injury clinic once a

week. Sporting activities are a common mechanism of injury in our population, and studies have shown that sports injuries are responsible for 10–19% of all acute injuries seen by emergency departments.¹² The ban on all recreational sports is likely to be partly responsible for the decrease in the numbers of injuries. However, as lockdown eases and these changes are reversed, major trauma and injuries normally seen by trauma units are likely to increase. Trauma units may need to continue to adapt to accommodate this workload, especially as hospital resources will continue to be required to manage COVID-19 while this increase occurs.

All places of work are safety checked, with preventative and protective measures put in place to keep workers safe.¹³ Regulations, legislation and inspections all contribute to the prevention of occupational accidents.¹⁴ The same is true of public spaces such as schools. The unusual situation of lockdown meant that many people were not in their normal workplaces. During this observed month, 99.4% of injuries occurred at home or outside during daily exercise. Only one injury occurred in the workplace. Another 36 injuries occurred in desk-based workers who were now working from home, of which 44% occurred in the home. It is possible that some of these injuries would not have occurred if the patients were in their normal place of work rather than at home. The same is true of manual labourers; when heavy machinery and ladders are used in the workplace there is a process of risk and hazard assessment, and safety measures are put in place to protect staff.^{15,16} However, when carrying out DIY tasks at home, this level of protection is not routine. Four patients injured themselves undertaking DIY activities at home, with two of these patients using unfamiliar equipment or machinery, only undertaking this new activity due to the lockdown and limitations to their normal life.

Overall, new activities accounted for 31% of injuries (51 patients). New dangerous activities, which included trampolining, cycling, tree climbing, roller skating and skateboarding, were responsible for 20 injuries (12% of all injuries). With exercise as the only permitted activity outside the home, people were exploring new forms of exercise which posed a risk of injury. The UK government suggested that daily exercise could be 'a run, walk or cycle' and these were three of the most common modes of injury. The most common mechanism of injury in our study was a fall from standing, and this was the most common mechanism of injury in patients aged 65 years and above. These data remain in line with the 2017 Trauma Audit and Research Network report, which found a fall from standing to be the most common mechanism of injury in the national database and also the most common mechanism of injury in patients aged 65 years and older.¹⁷

The second most common mechanism of injury was an injury sustained while cycling, with a total of 23 injuries sustained. Cycling is a common mechanism of injury. The majority of injuries occur without the involvement of another party,¹⁸ and it is thus unsurprising that cycling

injuries continued to occur despite the decrease in road traffic during this period. The three most common injuries seen were distal radius fractures (18%), hip fractures (11%) and ankle fractures (8%). Distal radius fractures are estimated to account for 16% of all fractures,¹⁹ and these three injuries are the most common fractures to result in a hospital admission.²⁰ The next most common injuries were hand fractures (7%; 6 scaphoid fractures, 3 metacarpal fractures, 1 phalanx fracture, 1 mallet finger injury) and foot fractures (6%; 1 talus fracture, 4 calcaneus fractures, 5 metatarsal fractures). This is comparable to epidemiological data on fractures, which show that fractures of the hip, foot, ankle, radius and ulna and carpus are the fractures with the highest incidence in the UK.²¹ The overall trend of individual fractures seen has therefore not changed as a result of the government-enforced lockdown, despite the changes seen in mechanisms and the overall number of injuries.

The number of neck of femur fractures seen during the study period decreased by 42%. Hip fractures normally make up a significant part of a trauma unit's on-call work and operating theatre capacity; 66,313 patients across England, Wales and Northern Ireland presented with a hip fracture in 2018, across 175 different trauma units.²² During the study period, neck of femur fractures comprised 29% of all the trauma operations that took place compared with 31% in the previous month. With hip fractures requiring significant resources from an orthopaedic department, understanding that the total number of hip fractures decreased but with a constant proportional requirement for theatre capacity can help to guide future workforce planning.

During the COVID-19 pandemic, there has been concern regarding the overall reduction in hospital attendances for non-COVID related presentations across the breadth of the NHS. It is possible that more injuries have occurred in our local population and that patients have chosen not to attend accident and emergency due to fears of exposure to the virus and overloading the healthcare service.

Conclusion

A London trauma unit has successfully responded to the COVID-19 pandemic to continue to provide an orthopaedic trauma service, while minimising patient-clinician interactions where possible. Long-term data will be required to evaluate the impact that these changes will have on outcomes. Overall, both the number of injuries and the number of trauma operations seen at the Kingston trauma unit decreased as a result of the government lockdown. Although the most common mechanism of injury remained a fall from standing, 31% of injuries seen were a result of a novel activity taken up in response to the lockdown. The theatre capacity

required for neck of femur fractures remained constant, despite the overall decrease in trauma operations. Polytrauma cases and open fractures normally managed by the local major trauma centre were managed at the trauma unit successfully. These data can aid future workforce planning if similar situations were to occur again. The service reconfiguration that has had to occur poses an interesting and unique opportunity to instigate long-term changes in the way that orthopaedic trauma services are run.

References

1. BBC News. Coronavirus: strict new curbs on life in UK announced by PM. <https://www.bbc.co.uk/news/uk-52012432> (cited December 2020).
2. British Orthopaedic Association. BOAST – Management of patients with urgent orthopaedic conditions and trauma during the coronavirus pandemic. <https://www.boa.ac.uk/resources/covid-19-boasts-combined.html> (cited December 2020).
3. Office for National Statistics. Deaths involving COVID-19 by local area and socioeconomic deprivation. <https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/bulletins/deathsinvolvingcovid19bylocalareasanddeprivation/deathsoccurringbetween1marchand17april> (cited December 2020).
4. Lei S, Jiang F, Su W et al. Clinical characteristics and outcomes of patients undergoing surgeries during the incubation period of COVID-19 infection. *EClinicalMedicine* 2020; **21**.
5. Kehoe A, Smith JE, Edwards A et al. The changing face of major trauma in the UK. *Emerg Med J* 2015; **32**: 911–915.
6. Carrington D. UK road travel falls to 1955 levels as Covid-19 lockdown takes hold. *Guardian* 3 April 2020. <https://www.theguardian.com/uk-news/2020/apr/03/uk-road-travel-falls-to-1955-levels-as-covid-19-lockdown-takes-hold-coronavirus-traffic> (cited December 2020).
7. Sabongi RG, Erazo JP, de Moraes VY et al. Circular saw misuse is related to upper limb injuries: a cross-sectional study. *Clinics* 2019; **74**: e1076.
8. Pfortmueller CA, Kradolfer D, Kunz M et al. Injuries in agriculture: injury severity and mortality. *Swiss Med Wkly* 2013; **143**: w13846.
9. Koroma ET, Kangbai JB. Agro-industrial accidents linked to length of service, operation site and confidence in employer adherence to safety rules. *BMC Publ Health* 2020; **20**: 591.
10. Weijermars W, Bos N, Filtness A et al. Burden of injury of serious road injuries in six EU countries. *Accid Anal Prev* 2018; **111**: 184–192.
11. Charters KE, Gabbe BJ, Mitra B. Population incidence of pedestrian traffic injury in high-income countries: a systematic review. *Injury* 2017; **48**: 1331–1338.
12. Bahr R, Krosshaug T. Understanding injury mechanisms: a key component of preventing injuries in sport. *Br J Sports Med* 2005; **39**: 324–329.
13. Watterson A. Occupational safety and related impacts on health and the environment. *Int J Environ Res Public Health* 2016; **13**: 988.
14. Teufer B, Ebenberger A, Affengruber L et al. Evidence-based occupational health and safety interventions: a comprehensive overview of reviews. *BMJ Open* 2019; **9**: e032528.
15. van der Molen HF, Basnet P, Hoonakker PLT et al. Interventions to prevent injuries in construction workers. *Cochrane Database Syst Rev* 2018; **2**: CD006251.
16. Mischke C, Verbeek JH, Job J et al. Occupational safety and health enforcement tools for preventing occupational diseases and injuries. *Cochrane Database of Syst Rev* 2013; **8**: CD010183.
17. Trauma Audit and Research Network. *Major Trauma in Older People: England and Wales*. Salford: University of Manchester; 2017.
18. Virtanen K. Cyclist injuries. *Duodecim* 2016; **132**: 1352–1356.
19. Goldie BS. Distal radius fractures in adults. 2018; **84-B**(Suppl 3): 358.
20. Jennison T, Brinsden M. Fracture admission trends in England over a ten-year period. *Ann R Coll Surg Engl* 2019; **101**: 208–214.
21. Curtis EM, van der Velde R, Moon RJ et al. Epidemiology of fractures in the United Kingdom 1988–2012: variation with age, sex, geography, ethnicity and socioeconomic status. *Bone* 2016; **87**: 19–26.
22. Royal College of Physicians. *National Hip Fracture Database (NHFD) Annual Report 2019: Data from January to December 2018*. London: RCP; 2019.