Impact of the COVID-19 pandemic on treatment of injuries during lockdown in Norway

Eyvind Ohm, Lars J. Hauge, Christian Madsen, Else K. Grøholt, Miriam Evensen & Anne Reneflot

Norwegian Institute of Public Health

Corresponding author:

Eyvind Ohm

Norwegian Institute of Public Health

PO Box 222 Skøyen, 0213 Oslo

Norway

Email: Eyvind.Ohm@fhi.no

ABSTRACT

Aims: To prevent a major outbreak of COVID-19 disease in Norway, a series of lockdown measures were announced on the 12th of March 2020. The aim of the present paper was to describe the impact of this lockdown on treatment of injuries. *Methods*: We collected hospital data on injury diagnoses from a national emergency preparedness register established during the pandemic. We identified the number of injured patients per day in the period January 1st – June 30th 2020, and analysed the change in patient volumes over two 3-week periods before and during the lockdown by gender, age, level of care, level of urgency, type of contact and type of injury. *Results*: Compared to pre-lockdown levels, there was an overall reduction of 43% in injured patients during the first three weeks of lockdown. The decrease in patient contacts did not differ by gender, but was most pronounced among young people. Substantial reductions were observed for both acute and elective treatment and across all levels of care and types of contact, with the exception of indirect patient contacts. The change in patient contacts varied considerably by injury type, with the largest reduction observed for dislocations/sprains/strains. The decrease was much lower for burns/corrosions and poisoning. ***Conclusions:*** **A substantial reduction in treatment of injury was observed during lockdown in Norway. Possible explanations for this finding include an overall decrease in injury risk, a redistribution of hospital resources and a higher threshold for seeking medical attention as a result of the pandemic.**

Keywords: Injuries, COVID-19 pandemic, emergency medical services, secondary care, international classification of diseases, registries, epidemiology.

Word count: 3,337

BACKGROUND (739 words)

As the world continues to combat the spread of a new and highly contagious virus, the final costs of the COVID-19 pandemic will not be known for years. From past pandemics and other disasters, we know that major crises can have profound consequences for public health and the provision of health care services in affected areas [1-3]. Such large-scale events have the potential to cause mass casualties and may quickly overwhelm emergency medical services with physical trauma, infectious diseases or other acute illness needs. In this initial phase, access to health care for patients with other medical conditions may be disrupted, posing potential health risks due to delays in assessment and treatment. Disasters may also have deleterious long-term consequences by increasing mortality and morbidity for a range of chronic diseases and mental health disorders [4-10], especially in vulnerable populations [3].

In response to an escalating number of SARS-CoV-2 (coronavirus) infections and the prospect of an uncontrolled outbreak of COVID-19 disease in Norway, a series of stringent control measures were announced on the 12th of March 2020 [11]. Childcare centres, schools and universities were closed, as were many businesses, restaurants and fitness centres. Cultural events, sporting events and organised sporting activities were all curtailed. These lockdown measures came on top of regulations already in place to contain the spread of infection, such as strict hygiene measures, quarantine/isolation rules and social distancing guidelines (including working from home and avoiding public transportation). Shortly after this lockdown, health care services were instructed to redistribute available resources in order to treat an anticipated mass influx of COVID-19 patients in need of intensive care and respirators [12]. As a result, hospitals postponed elective treatment and reduced other non-essential activity, reallocated hospital beds and redeployed manpower to intensive care units and other acute specialities vital in combatting the disease. Importantly, this redistribution of resources was to be done without compromising the capacity to provide urgent and critical care for patients with other serious conditions.

A few weeks after the implementation of the lockdown measures, the rate of transmission of the coronavirus in Norway began to plateau, and the number of COVID-19 patients decreased substantially from early April [13]. In late April, some of the restrictions were consequently lifted as Norway gradually re-opened. However, given the drastic nature of this combined effort to contain the spread of infection and the likely prospect of a long-lasting pandemic threat, there is an urgent need for more knowledge about the consequences of these types of measures for disease occurrence and health care utilisation in the population, both during periods of lockdown and in the time following the gradual re-opening of society.

In the current study, we investigate the impact of the COVID-19 pandemic in Norway for treatment of injuries following national lockdown in March 2020. Injuries constitute a major public health challenge, being a leading cause of death for young people worldwide and placing a substantial burden on health care services [14-18]. Given the newness of the situation, little is known about the consequences of the COVID-19 pandemic on the incidence and treatment of injuries. Intuitively, one would expect that the societal changes that were intended by these lockdown measures (more time spent at home, reduced leisure activity, less traffic etc.) have contributed to a general reduction in the risk of injury. Consistent with this hypothesis, a study from New Zealand found an overall reduction of 43% in injury-related admissions to a level 1 trauma centre during lockdown [19]. Similar findings have since been reported in studies from other countries [20-23]. These studies further suggest that the impact of the pandemic may vary both by sociodemographic characteristics and type of injury.

Previous studies documenting reductions in treatment of injury during lockdown were restricted to data either from a single hospital [19, 21-23] or from hospitals within one geographical region [20], with analyses frequently performed on relatively small numbers of cases. To our knowledge, no study has thus far explored the impact of the COVID-19 pandemic using nationwide data covering all injuries treated in secondary care. The aim of the present paper was therefore to quantify any changes in treatment of injuries in the wake of the lockdown measures implemented on the 12th of March 2020 in Norway, in total and as a function of level of care, level of urgency and type of contact. We also aimed to investigate whether these changes varied by age, gender and type of injury.

MATERIALS AND METHODS (608 words)

We used data from a new national emergency preparedness register (Norwegian acronym: BEREDT C19), which was established by the Norwegian Institute of Public Health (NIPH) in order to quickly provide policy-relevant knowledge about the COVID-19 situation in Norway [24]. This register, which is to be deleted when the pandemic is over and the measures implemented to combat the virus are evaluated, does not itself collect any new data, but instead compiles existing information routinely reported to various other data sources, including daily updated individual level data from the Norwegian Patient Registry (NPR). This data source is a nationwide health register that covers all in-patient, day patient and outpatient specialist health services in Norway. From this register, we identified all contacts during the first six months of 2020 for patients registered with an injury diagnosis (either principal or secondary), defined as codes S00-T98 (chapter XIX) in the tenth edition of the *International Statistical Classification of Diseases and Related Health Problems* (ICD-10). The following information was collected for these contacts: age and gender of patient, level of care (in-patient, day patient or outpatient) and level of urgency (acute or elective). For day patient care and outpatient consultations, information was also available for type of contact, categorised as either medical investigation (i.e., an examination of the patient with the use of various medical tests and diagnostic procedures), treatment, control or indirect patient contact (defined as consultations and other activities where the patient is not physically present). A subset of the injuries was further categorised into the following six types (ICD-10 codes in parentheses):

- Fractures (S02, S12, S22, S32, S42, S52, S62, S72, S82, S92, T02, T08, T10, T12, T14.2)

- Head injuries (S00-S09)
- Open wounds (S01, S11, S21, S31, S41, S51, S61, S71, S81, S91, T01, T09.1, T11.1, T13.1, T14.1)
- Dislocations/sprains/strains (S03, S13, S23, S33, S43, S53, S63, S73, S83, S93, T03, T09.2, T11.2, T13.2. T14.3)
- Burns/corrosions (T20-T32)
- Poisoning (T36-T65)

Note that these categories are not mutually exclusive, as some codes (e.g., S02 "Fracture of skull and facial bones") are included in more than one category.

Statistical analyses

We first identified the number of injured patients registered per day in the period January 1st – June 30th 2020. For episodes extending more than one day (i.e., in-patient treatment), patients were only counted on the date of admission. As patient volumes are much higher on weekdays than weekends and public holidays, we present the overall trend as the mean daily number of injured patients per week, from the first full week of 2020 (i.e., week 2) to the last full week in June (i.e., week 26). These overall data were compared with corresponding data from the same weeks in previous years, presented as the average for the period 2017-2019. To analyse the impact of the lockdown measures, we subsequently compared the number of patient contacts before and during lockdown in 2020 over two 3-week periods: February 21 – March 12 (pre-lockdown) and March 13 – April 2 (lockdown). We chose this observation period in order to keep the number of weekdays and weekend days the same in both periods, and to exclude Easter (week 15) from the lockdown period. We analysed the difference between these two periods for treatment of injuries overall and then separately by gender, age, level of care, level of urgency, type of contact and type of injury. We also estimated 95% confidence intervals (CI) for the change in injury contacts between the pre-lockdown and lockdown periods.

The Regional Committees for Medical and Health Research Ethics in Norway (REC) waived approval for this study. NIPH has conducted a Data Protection Impact Assessment (DPIA) of BEREDT C19, and the current study is covered by this DPIA.

RESULTS (483 words)

Figure 1 shows that the total number of injured patients in 2020 decreased substantially after the implementation of the lockdown measures in week 11 (March 9 – March 15). Prior to lockdown, roughly 2,000 injured patients were registered per day. In week 12 (March 16 – March 22), the first full week of lockdown, an average of 1,107 injured patients were registered daily. No such decrease was observed during the corresponding weeks in the period 2017-2019. As Norway gradually re-opened, the volume of contacts subsequently increased, reaching pre-lockdown levels in week 22 (May 25 – May 31).

[Insert Figure 1 here]

In the three weeks prior to the lockdown (February 21 – March 12), an average of 1,968 injured patients were registered per day (Table 1). In the following three lockdown weeks (March 13 – April 2), this number was 1,114 patients, corresponding to an overall reduction of 43.4% (95% CI: -48.4% to -38.3%) from the pre-lockdown period. The change in patient contacts did not differ between men and women. While all age groups experienced a substantial decrease, the reduction was most pronounced for children (0-17 years) and adults between 18 and 44 years of age.

[Insert Table 1 here]

Compared to the pre-lockdown period, the number of injured patients during lockdown decreased across all levels of care and levels of urgency (Table 1). For level of care, the lowest reduction occurred for in-patient admissions. Overall, the reduction in contacts was higher for acute treatment than for elective treatment, but further analyses revealed that there was an interaction between level of care and level of urgency. While the reduction in contacts was higher for elective treatment than acute treatment for in-patient (44.9% vs. 33.6%) and day patient (48.5% vs. 23.5%) contacts, this pattern was reversed for outpatient consultations, where the reduction was higher for acute treatment (52.7%) than for elective treatment (37.5%). As for type of contact (restricted to day-patient care and outpatient consultations), the decrease in injury registrations was most marked for medical investigations. Indirect patient contacts increased nearly fourfold in the weeks following lockdown. This type of contact was almost exclusively used for outpatient consultations.

Table 1 further shows that the change in patient contacts between the pre-lockdown and lockdown periods varied considerably by injury type. The largest reduction occurred for dislocations/sprains/strains, where the number of daily patients more than halved. A substantial reduction was also observed for head injuries. The decrease was much lower for burns/corrosions and poisoning.

Finally, Table 2 shows that the reduction in patient contacts during lockdown did not vary much between men and women for most types of injury. The change in contacts across injury types varied more by age. For dislocations/sprains/strains and fractures, the reduction was largest for children (0-17 years). This age group also experienced the least change in contacts due to burns/corrosions and poisoning, along with adults aged 45-64 years. For older individuals (65 years or older), the decrease was much more uniform across injury types.

[Insert Table 2 here]

DISCUSSION (1507 words)

To our knowledge, this register study is the first to use nationwide data to investigate the impact of the COVID-19 pandemic on treatment of injuries. In line with past research documenting that pandemics and other disasters can dramatically alter the provision of health care services [1-3], our results show a substantial reduction in injured patients in the wake of lockdown measures implemented on the 12th of March 2020 to contain the spread of SARS-CoV-2 infections in Norway. Compared to pre-lockdown levels, the number of injured patients decreased overall by 43% during the first weeks of lockdown. Substantial reductions were observed in both genders and across all age groups, levels of care, levels of urgency and types of contact, with the exception of indirect patient contacts. Furthermore, although the effect of lockdown varied considerably by type of injury, we found overall reductions in patient contacts for each of the injury types examined.

Our results are broadly consistent with studies from other countries documenting significant lockdown reductions in injury-related admissions and referrals [19-23]. Given the ubiquity and sheer magnitude of this change, it seems plausible to attribute at least part of the observed decrease in contacts to a reduction in the true incidence of injury in the population, as the societal and behavioural consequences of some of the lockdown measures (e.g., less traffic, more time spent at home, less physical and social activity) have likely contributed to an overall reduction in injury risk. In support of this claim, European countries have witnessed unprecedented reductions in road traffic deaths coinciding with large drops in traffic volume during lockdown, with the largest reductions recorded in countries with the most stringent lockdown measures [25].

However, there are clearly other factors at play. The threat of a major outbreak of COVID-19 disease in Norway necessitated a redistribution of health care services, leading to a reduction in non-essential activity. While hospitals were instructed to maintain the capacity to provide urgent care for other patients, we cannot rule out the possibility that the observed decrease in contacts during lockdown may partly be explained by a reduced capability to treat injured patients who are in need of specialist care and would ordinarily be hospitalised. Another potential explanation is that the spread of SARS-CoV-2 may have resulted in a higher threshold for seeking medical attention in the case of symptoms of illness and injury, either because people did not want to burden already taxed health care services or in fear of contracting the coronavirus itself. At least for injuries of moderate severity, the reduction in contacts during lockdown may thus partly reflect lower health care utilisation.

Consistent with earlier indications of a shift in the age distribution of injured patients during lockdown [19-20, 23], we found that the reduction in contacts was most pronounced among young people and attenuated with advancing age. One possible explanation for this pattern is that many of the measures implemented to contain the rate of transmission (closing schools, universities and businesses, prohibiting cultural events and organised sporting activities, working from home etc.) to a greater degree impacted the lives of young people, while resulting in less change in daily routines for older people (many of whom do not work and spend much time at home). However, this age effect could also indicate a higher degree of injury severity, combined with more co-morbidity, among older people, reflecting a greater need for treatment for this vulnerable group.

Our study further suggests that the effect of lockdown varies according to type of injury. The largest reduction was observed for dislocations/sprains/strains. Restrictions in organised sporting activities (especially for children) and the adoption of a more sedentary lifestyle during the lockdown may partly explain this finding. Alternatively, as these injuries typically are of moderate severity, this reduction could also reflect a higher threshold for seeking medical treatment during the pandemic. We also observed a substantial reduction in treatment of head injuries, which may be attributed to fewer road traffic collisions and restrictions imposed on nightlife activities. In contrast, burns/corrosions and poisoning were less affected, possibly because many of these injuries occur at home or during activities that were not disrupted as much by the lockdown. In fact, there have been reports of an increase in calls to poison centres for exposures to cleaning products and disinfectants during the pandemic [26, 27]. The finding that children experienced the least change in burns and poisoning during lockdown may reflect a social gradient in the occurrence of such paediatric injuries [28-30], whereby the risk of burns and poisoning may well increase for children from poor and potentially unsafe households when forced to spend more time at home. Exploring injury patterns in more detail would probably reveal yet more variation. For instance, previous studies have found significant lockdown reductions for some types of fractures (e.g., simple fractures) but not for others (e.g., hip fractures) [20-23].

Our results also show that the reduction in injured patients during lockdown was lower for in-patient admissions than for day patient care and outpatient consultations. Since injuries requiring in-patient treatment are generally more severe, we would expect these contacts to be less affected by the redistribution of hospital resources. By the same logic, one would also expect that the impact of the COVID-19 pandemic on treatment of injury would be greater for elective than for acute treatment, as the instruction to redistribute was primarily intended to affect elective treatment. However, we found this trend only for in-patient and day patient contacts. For outpatient consultations, which comprise roughly 75% of all injury contacts, the reduction was larger for acute treatment than for elective treatment. One possible explanation for this seemingly paradoxical finding is that reduced activity during lockdown may have had a greater effect on injuries of moderate severity (e.g., dislocations or sprains) treated at outpatient clinics than on major injuries (e.g., burns or poisoning) that require acute hospital treatment.

We observed one exception to the overall reduction in patient contacts during lockdown. For outpatient consultations, there was a substantial increase in the use of indirect patient contacts. This type of contact, which includes the use of video consultations and other telecommunication technologies that enable remote health care, may thus provide an alternative for some consultations that do not require the injured patient to be physically present. Increased use of telemedicine is especially apt during outbreaks of infectious diseases such as COVID-19, by preventing overcrowding and thus reducing the risk of spread [31-32]. However, even during lockdown, indirect patient contacts still comprised a small proportion of all consultations, and there are clearly many instances where remote health care cannot maintain the same quality that traditional care provides. Moreover, this type of contact may not be suitable for all patients and may even create new inequalities in health care utilisation due to differential access to technology.

Strengths of this study include the use of a nationwide register of high quality and the ability to conduct analyses on near real-time data. In addition, since reporting of these data is mandatory and directly linked to the reimbursement of hospitals, we consider it unlikely that the observed reduction in patient contacts can be explained by a potential delay in registration during the pandemic (e.g., due to redeployment of registrars to other tasks). Furthermore, by comparing trends in patient contacts with corresponding periods in preceding years, we were able to rule out the possibility that the observed decrease in the lockdown period was due to normal seasonal variation [33-35]. Hence, our findings strongly suggest that the sudden reduction in patient contacts can be tied directly to efforts implemented to control the pandemic.

A shortcoming of this study is that we lacked information about the external circumstances that contribute to injuries, as our analyses were restricted to diagnostic codes from chapter XIX in ICD-10 (which primarily provide a medical/anatomical description of the injury). In absence of vital information such as place of occurrence, activity at the time of injury and injury mechanism, we were unable to describe the impact of the lockdown on important injury categories such as home injuries, falls, road traffic crashes, sports injuries and occupational injuries. It would also have been useful to know the intent of injury and thus be able to separate assault and self-harm from unintentional injuries (i.e., accidents). The need to assess the impact of the lockdown for intentional injuries is especially urgent for young people, as concerns have been voiced about the consequences of the COVID-19 pandemic on the capacity to uncover neglect and violence among vulnerable children and youth [36]. Finally, as we had limited information about sociodemographic characteristics of injured patients, we were unable to investigate whether the effect of the lockdown varied according to factors such as socioeconomic position, ethnicity and marital status.

CONCLUSIONS

In the weeks following the implementation of lockdown measures to contain the spread of COVID-19 in Norway, hospital contacts due to injury decreased by 43%. The reduction was most pronounced for young people and for dislocations/sprains/strains, while contacts due to burns/corrosions and poisoning were less affected during the lockdown.

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DECLERATION OF CONFLICTING INTEREST

The Authors declare that there is no conflict of interest.

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DISCLAIMER

Data from the Norwegian Patient Register has been used in this publication. The interpretation and reporting of these data are the sole responsibility of the authors, and no endorsement by the Norwegian Patient Register is intended or should be inferred.

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Table 1: Percent change (95% CI) in mean daily number of injured patients registered pre-lockdown (21 February – 12 March) and during lockdown (13 March – 2 April) in 2020, overall and by gender, age, level of care, level of urgency, type of contact and injury type. Note: type of contact is only registered for day patient care and outpatient consultations.

	Pre-lockdown	**Lockdown**	**% Change (95% CI)**
Overall	1,968	1,114	43.4 (-48.4 to -38.3)
Gender			
Men	997	567	- 43.1 (-46.5 to -39.6)
Women	972	547	- 43.7 (-50.8 to -36.7)
Age group			
0-17	364	186	- 48.8 (-53.5 to -44.1)
18-44	590	303	- 48.6 (-54.3 to -42.8)
45-64	489	292	- 40.3 (-47.0 to -33.7)
65-79	348	219	- 36.9 (-42.0 to -31.8)
80+	177	113	- 36.3 (-41.2 to -31.2)
Level of care			
In-patient	335	215	- 35.8 (-41.0 to -30.6)
Day patient	66	35	- 46.5 (-58.4 to -34.7)
Outpatient	1596	884	- 44.6 (-50.1 to -39.1)
Level of urgency			
Acute	1,004	523	- 47.9 (-56.3 to -39.6)
Elective	974	598	- 38.6 (-43.2 to -34.0)
Type of contact			
Medical investigation	80	22	- 73.2 (-78.8 to -67.6)
Treatment	1,002	472	- 52.9 (-60.6 to -45.2)
Control	560	296	- 47.2 (-53.0 to -41.3)
Indirect patient contact	28	137	389.8 (346.6 to 432.9)
Injury type			
Fractures	782	483	- 38.3 (-43.6 to -32.9)
Head injuries	166	86	- 48.1 (-58.7 to -37.4)
Open wounds	125	79	- 36.6 (-47.1 to -26.1)
Dislocations/sprains/strains	214	96	- 55.3 (-59.6 to -50.9)
Burns/corrosions	23	18	- 20.9 (-40.6 to -1.2)
Poisoning	23	20	- 15.2 (-27.1 to -3.3)

Table 2: Percent change (95% CI) in mean daily number of injured patients registered pre-lockdown (21 February – 12 March) and during lockdown (13 March - 2 April) in 2020, by injury type, gender and age.

	Fractures	Head injuries	Open wounds	Dislocations/sprains /strains	Burns/corrosions	Poisoning
Gender						
Men	-39.1 (-43.4 to -34.8)	-46.8 (-57.5 to -36.1)	-34.3 (-42.9 to -25.8)	-56.3 (-62.4 to -50.2)	-18.6 (-36.8 to -0.4)	-15.1 (-30.1 to 0.0)
Women	-37.6 (-44.3 to -30.9)	-49.9 (-61.7 to -38.1)	-40.2 (-56.5 to -24.0)	-54.0 (-58.6 to -49.4)	-23.5 (-55.7 to 8.8)	-15.3 (-37.3 to 6.6)
Age group						
0-17	-47.2 (-56.8 to -37.5)	-51.1 (-69.2 to -32.9)	-38.7 (-58.2 to -19.2)	-66.5 (-71.3 to -61.7)	-7.4 (-23.0 to 8.1)	1.6 (-21.1 to 24.4)
18-44	-41.0 (-47.1 to -35.0)	-57.4 (-70.5 to -44.3)	-42.6 (-53.7 to -31.5)	-57.4 (-62.8 to -51.9)	-36.6 (-69.5 to 3.8)	-21.2 (-45.3 to 2.9)
45-64	-35.6 (-45.3 to -25.9)	-36.4 (-44.7 to -28.1)	-25.7 (-35.3 to -16.1)	-46.7 (-51.5 to -41.8)	0.0 (-22.0 to 22.0)	-3.0 (-15.9 to 9.8)
65-79	-34.1 (-38.5 to -29.7)	-38.0 (-47.1 to -28.8)	-26.3 (-38.1 to -14.6)	-34.0 (-41.7 to -26.4)	-40.4 (-97.1 to 16.3)	-19.2 (-61.7 to 23.4)
80+	-31.4 (-35.6 to -27.3)	-46.8 (-56.8 to -36.7)	-45.3 (-62.4 to -28.2)	-43.6 (-69.8 to -17.4)	-28.6 (-79.7 to 22.5)	-17,2 (-113.3 to 78.8)

FIGURE CAPTIONS

Figure 1: Mean daily number of injured patients overall, by week of year.