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The effect of the COVID-19 pandemic during the Dutch lockdown: less traumatic injuries, however,more emergency trauma surgery.

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Abstract

Objectives What is the impact of the Dutch lockdown measures during the COVID-19 pandemic on the number and type of trauma related injury presented on the Emergency Department (ED).

Design A single centre retrospective cohort study.

Setting A level II trauma centre in Breda, The Netherlands

Participants All trauma patients seen at the ED between March 4th and May 10th 2020 (the Dutch lockdown period) were included in this study**.** Comparable groups were generated for 2019 and 2018.

Main outcome measures Primary outcomes were the total number of trauma patientsadmitted to the ED and the trauma mechanism. Secondary outcomes were triage categories, time of ED visit, trauma severity (ISS>12), anatomic region of injury and treatment.

ResultsA total of 5193 patients were included in this study. During first months of the COVID-19 pandemic there was a decrease of 29.8% in traumatic injury at the ED (n=1349) compared tothe preceding years2019 (n=1900) and 2018 (n=1944) (p<0.001). Sports related injuries were most decreased during the lockdown (n=193) compared to 2019 (n=417) and 2018 (n=404) (p<0.001). We observed a higher rate of injury after a fall from person height and hobby- and work related injury. (p<0.05). The mean age was significantly higher (mean 47 years vs 42 and 43), no difference in anatomical place of injury or ISS>12 was observed. The amount of patients admitted for emergency surgery was significantly higher (14.2% vs 9.1%; 8.7%, p<0.001). Seven patients (0.5%) were tested positive for COVID-19.

Conclusions Measures taken in the COVID outbreak result in an obvious decrease in the total number of trauma patients, especially sports related trauma. Although the trauma burden on the ER appears to be lower, this is not the case for the numbers of trauma related injury in the emergency operation theatre.

Introduction

Thecoronavirus 2019 (COVID-19) was first reported in Huwan - China, in December 2019 [1]. The virus spread globallyand was declared a pandemic by the World Health organization on March 11th 2020. The COVID-19 pandemic poses great challenges for healthcare systems all over the world.Restrictive measures were taken worldwide to lower the infection transmission rate in order to delay and lower the height of the epidemic peak, and thereby easing the burden on healthcare systems.During the early outbreak various local measures were taken as of March 4th 2020.The Dutch government pursued the following policy from March 11th 2020: hygiene advices, social distancing (1.5 meters), working at home as much as possible, closing of schools, sports facilities, hairdressers, cultural places, all theatres, cafes and restaurants.It was also forbidden to visit relatives living in a nursing home.

The COVID pandemic, together with these restrictive measures,was of great impact on the way of living in the Netherlands, resulting in a social behavioural change such as less traffic and less or different sports activities. At the same timepeople started to renovate their houses and 'do it yourself' stores were busier than ever before. Moreover, morepeople were reluctant to visit their general practitioner or the hospital because of a high corona infectivity setting. It has already been shown that this reluctance can lead to increased morbidity in vascular patients, resulting in an increase in limb amputations [2].

The Amphia Hospital was one of the first hospitals in the Netherlands assigned as 'COVID hospital' during the early stages of the outbreak. Elective procedures were cancelled and most of the hospital recourses were restructured for COVID patient related care. However, acute trauma care on the ED, wards and operation rooms did continue. The question raised to what extent the lockdownrules resulted in a change in the volume of trauma patients that presented at the ED. Previous studies reporteda decrease of ED visits during early stages of the COVID up to 43% [3]–[6]. Yet, little information is available on the effect of the COVID pandemic on trauma care in particular. A hospital

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must be able to provide trauma care at all times. A better understanding of the consequences of the COVID-19 pandemicon traumatic injurymight help future prioritisation of hospital resourcesand management of the operation theatre, especially with the possibility of a second lockdown period.The objective of this study is to examine the impact of the COVID-19 pandemicand the lockdown on the epidemiology and patterns of trauma related injury on alevel 2 trauma centre in the Netherlands.

Methods

Study design and setting

A single-centre retrospective observational study was conducted at the AmphiaHospital, a level 2 trauma centre in the south of the Netherlands serving 400.000 people. This study was approved by the hospital's research ethics board (N2020-0330).

Patients

To examine the impact of COVID-19 on trauma related injury and ED visits, we selected a time interval fromMarch 4th, 2020 (the first outpatient clinic in the Amphia Hospital that closed due to the COVID outbreak) until May 10th, 2020 (the first alleviating lockdown measures; opening of primary schools).This time interval is further specified as 'the lockdown period'. For comparison a control group was selected using the same time interval for 2019 and 2018.

We included all trauma patients that presented to our ED from March 4th2020 until May10th 2020 (the period from the start of the lock-down until loosening of the lockdown measures). These patients were compared to the patients from the same periods in the years 2019 and 2018. We excluded patients who had sustained injury as a result of a different underlying medical condition (e.g. fracture due to malignancy). Patients and the public were not involved in any way in this study.

Outcome measures

Primary endpoints were: total number of trauma-related admissions on the ED during the lockdown period in comparison with the same period the years before and differences in trauma mechanism. Secondary endpoints were differences in triage categories, time of ED arrival, trauma severity, anatomic region of injury and distribution of the treatment employed.

Covariates

A patient database was generated using ED registrations. Demographic and clinical data was obtained frommedical records. The collected demographic data were gender and age (categorised in; infant/toddler 0–3 years, preschool and grade-schoolers 4-12 years, teenager 13–17 years, adult 18–64 years andsenior ≥65 years). Other collected variableswerethe Injury Severity Score (minor to moderate injury ISS < 12, major injury ISS > 12)[7], Emergency Severity Index (Table 1),time of EDvisit (Table 2) (early morning (00.00 – 08.00), daytime (08.00 – 16.00), evening (16.00-24.00)),trauma mechanism (Table 3),anatomical region of the injury (AIS body regions Table 4 [8]) and treatment. Treatment was categorised into surgical (acute admission for surgery or planned surgery) vs. non-surgical (admission for observation or outpatient follow-up). Definitions like high energy trauma (HET) were used according to the ATLS guidelines.[9]

Information on COVID was obtained for all patients included in 2020. COVID-related data points were the number of COVID tests performed, type of test (Polymerase Chain Reaction: PCR and / or CT-thorax), the amount of patients who were tested positive for COVID and COVID-related mortality.

Data analysis

Statistical analysis was performed with SPSS version 25 (IBM Corp., Armonk, NY) for Mac. Group differences in proportions (both nominal and ordinal data) were tested using a chi-squared test. All years were compared independently. A Bonferroni correction was performed for multiple comparison. An ANOVA test was performed to examine differences between years for continuous data. A post-hoc analysis was performed to be able to express the difference between subgroups in *p*-values. Confidence intervals and *p*-values were obtained based on a 5% significance level and all tests were two-sided.

Patient and public involvement

No patient involved

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Results

The computer generated database and medical record review yielded a total of 1.574 trauma patients presented on the ED between March4th and May10th, 2020. Of those, 225 patients were excludedas considered non-acute traumatic injuries or because there was another medical cause of the injury, 1.349 patients were suitable for analysis. In the same period in 2019 and 2018, respectively 1900 and 1944 patients were included. This is an overall decrease in trauma-related admissionsof 29.8% (95% CI 0.68 – 0.72, $p<0.001$).

Baseline characteristics are displayed in table 2. The mean age was significantly higher in 2020 compared to 2019 and 2018 with fewer adolescents and more senior patients presented at the emergency department ($p<0.001$). Gender distribution did not differ between the years ($p=0.097$).In 2020 there were fewer patients triaged in category U3 and U4 ($p<0.01$) as compared to 2019. Because of the use of different triage criteria in 2018 no direct comparison could be made. The overall distribution of time ofarrival on the ED did not differ significantly between years ($p=0.11$). However, in 2020 fewer patients arrived at the emergency room early in the morning (00.00-08.00). In addition in 2020 (compared to 2018) more people visited the emergency room during daytime (08.00-16.00). The rate of patients with an Intensity Severity Scores higher than 12 did not differ over the years ($p=0.240$).

Trauma mechanism

The types of trauma mechanismwere divided into 13 categories as displayed in table 3. Injuries classified as ‘other’ injury wereankle sprains, molested patients, burns and local impact injuries like a boxers’ fracture after punching a wall. Each year, a fall from standing height is the most common type of injury, followed by sports injuries. Although there is an absolute decrease of numbers in each category, the distribution was significantly different. In 2020 a significant increase was present in the percentage fall from standing height, work-related injury and hobby accidents (e.g. mechanical chores around the house). An absolute significant decrease was observed in sports related injury: 193 patients in the lockdown compared to 417 patients in 2019 and 404 patients in 2018 ($p<0.001$).

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Anatomic region of injury

Upper extremity injuries were most common,encompassing half of all injuries sustained in 2020. The distribution of the anatomical place of injury was not significantly different in 2020 compared to previous years. (Table 4)

Treatment

A significant decrease was seen in the rate of patients that were treated non-surgically with outpatient follow upwhen 2020 is compared with preceding years ($p<0.001$). Theamount of patients that was admitted for emergency surgery was significantly higher in 2020 (14.2% vs. 9.1% in 2019 and 8.7% in 2018, $p<0.001$). (Table 5)

COVID-19

Between March 4th and May10th 2020, 36 patients of our study population were tested for COVID-19 (2.7%). A PCR - test was used as diagnostic in 26 of these cases. In 10 other cases both a PCR as chest computed tomography (CT) were performed. Of all patients tested on COVID-19, seven were found positive (19.4%). Two patients (0.1%) died due to the consequences of their COVID-19 infection.

Discussion

The results of our study demonstrate that the COVID-19 pandemic and the lockdown measures taken by the Dutch governmenthad a significant impact on trauma-related-injury presented at the emergency department of our hospital. During the early outbreak, there was an overall decrease in traumatic injury (29.8%) with fewer sports-related injuries. This decrease also applied to the number of patients with injury after a fall from standing height, but the proportion was significantly higher than in previous years. Remarkable is the increase of trauma patients that needed to be admittedfor acute surgery.

Thedecrease of trauma-related ED admissions is explainable by the effect of the restrictive measures taken due to the COVID pandemic. For example, lesstrafficlead to a reduction of the number of car and motorcycle-accidents. There were less organized sports activities (e.g. soccer) and people were

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advised to stay at home as much as possible. Another reason for the decrease in the number of trauma patients seen at the ED may be the change in human behaviour; the dangers of a COVID infection were extensively illustrated in the media, making people more reluctant to visit the hospital[2]. Moreover, patients may not want to visit the hospital to prevent an excessive burden on healthcare professionalswho would be busy treating COVID-19 patients. We do not expect that there is a direct effect of a COVID-19 infection in relation to the decrease of the number of trauma patients, since only 0.5% of the patients in this study tested positive for corona.This decrease in trauma cases presented on the ED is in line with known literature, percentages varied between 33 and 65 percent [4], [10]–[14].

This study shows an absolute decrease of trauma-related ED admissions in every age-category, however a significant shift was observed towardselderly people (age >65) being admitted with traumatic injury.This is remarkable since especially senior people were advised to stay home as much as possible because of their vulnerability of being infected by the COVID-19 virus. A possible explanation can be sought in the COVID measures that may have more beneficial effects on the amount of traumatic-injury among children, adolescents and adults compared to senior people. Activities such as school, sports and work were all affected by the measures taken whereas on average, senior citizens experienced less change in activity levels. In addition, due to the lockdown, there was less attendance for the elderly by their families and nurse staff, making them more at risk to fall. In this light of this finding, one can consider if contact-reducing measures, as been taken for the elderly, were the right thing to do.

With regard to the triage categories, we found that the amount of patients with high urgency levels upon arrival (U1 and U2) nearly remained the same compared to 2019 and 2018. Only the numberof lower urgency level patients (U3 and U4) has decreasedduring the lockdown period. This outcome is in line with our expectations that, except for a decrease due to a reduction in (sport) activity, a large part of the decrease concerns patients that do not require a ED visit.

Considering the distribution of trauma mechanism our results showed anincrease in the rateof traumatic injuryafter a fall from a standing height. This finding is in line with the increased ratio of elderly trauma patients admitted to our hospital.As mentioned above, we expect there to be a greater risk of falls in the elderly due to less attendance. In addition, theincreased rate of injury after a fall

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from standing height could be due to the drop in sports-related injuries. The drop in sports-related injury is alogical consequence of the restrictive COVID-19 measuresas popularDutch sports such as soccer or hockeywere cancelled. Sports as skateboarding, inline skating and running did increase, however with no significant impact. Finally, it appears that the rate of hobby- and work-related accidents was significantly higher in 2020.We hypothesize that most people, who were able to work at home during the lockdown, are people with office jobs, having a low injury riskon sustaining injury. People withhigh risk occupations on the other hand(e.g. transportation professionals, construction workers or agricultural workers)were allowed to work during the lockdown.

Focusing hospital resources on COVID-patients together with underestimating the trauma burden, potentially jeopardises the quality of acute care. This study shows thatmore trauma patients were admitted directly for acute surgery during the lockdown period. In addition, productivity and turnover in the operating theatres were lower due to strict insulation and extra hygiene measures. This phenomenon is also described by Murphy et al. [11] and Tahmassebi et al. [14]. Based on these findings, our advice would be not to reduce the staff and resources needed for trauma care.

Strengths of this study are the large patient groups included over the entire lockdown periodand the applicability in hospitals around the world. Limitations are the retrospective single-centre cohort setting, in which the researchers were dependent on data obtained from medical records. This study contains data from the first two months of the COVID-19 outbreak. Further research is needed to assess the long-term impact of the COVID-19 pandemic on trauma related injury and its impact on the hospital setting.

Conclusion

This study shows that during the COVID-19 lockdown period there was a decrease of 29.8% in the total number of trauma patients on the ED, mainly due to less patients with minor trauma.The majority of the remaining trauma patients were elderly people sustaining a fall from standing height. The number of trauma-patients requiring hospital admission remained the same despite the lockdown measurements.Therefore hospital recourses for trauma related injury should not be lowered in a possible next pandemic period to provide proper trauma-care.Further research is needed to assess the long-term impact of the COVID-19 pandemic on trauma related injury and its impact on hospital functionality.

Keywords

Attendance; Emergency department; COVID; Trauma; Triage; Epidemiology; Injury

Declarations

Funding

Not applicable

Conflicts of interest/Competing interests

The authors declare that they have no conflicts of interest. Patients and the public were not involved in any way in this study.

Availability of data and material

Yes , dissemination of the results to the patientsis not applicable.

Code availability

Not applicable

Authors' contributions

Not applicable

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Summary Box

What is already known about this subject:

- During a pandemic with associated restrictive measures, there is a reduction in the number of patients visiting the emergency room.

What does this study contribute:

- Our study shows that during the corona outbreak there is a reduction in the number of trauma patients.
- The majority of patients who present themselves during the corona outbreak in the emergency room are over 65 years of age.
- The most common trauma mechanism is a fall from a person's height.
- Despite a reduction in the number of trauma patients there is an increase in the number of emergency trauma surgery.

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Strengths and limitations of this study

Strengths:

- Large patient population
- Good reproducibility
- Various contributory outcome measures

Limitations:

- Single center, retrospective study design

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Tables and Figures

Table 1. Emergency Severity Index (ESI) (Gilboy et al. 2012 edition)

Level	Name	Description	Examples
1	Resuscitation	Immediate, life-saving intervention required without delay	Cardiac arrest Massive bleeding
2	Emergent	High risk of deterioration, or signs of a time-critical problem.	Cardiac-related chest pain, Asthma attack
3	Urgent	Stable, with multiple types of resources needed to investigate or treat (such as lab tests plus X-ray imaging)	Abdominal pain High fever with cough
4	Less Urgent	Stable, with only one type of resource anticipated (such as only an X-ray, or only sutures)	Simple laceration Pain on urination.
5	Nonurgent	Stable, with no resources anticipated except oral or topical medications, or prescriptions	Rash Prescription refill

Table 2. Patiënt characteristics

	2020 N = 1349	2019 N = 1900	2018 N=1944	P-value
Age mean (range)	47 (0-98) [a, b]	42 (0-100) [c]	43 (0-97) [c]	<0.001*
Age Categories (%)<0.001*				
Infant (0-3y)	54 (4.0%)	57 (3.0%)	52 (2.7%)	0.04**
Child (4-12y)	163 (12.1%)	282 (14.8%)	261 (13.4%)	0.06**
Adolescent (13-17y)	73 (5.4%) [a, b]	177 (9.3%) [c]	197 (10.1%) [c]	<0.001**
Adult (18-65y)	620 (46.0%)	873 (45.9%)	902 (46.4%)	0.92**
Senior (>65)	439 (32.5%) [a, b]	511 (26.9%) [c]	532 (27.4%) [c]	<0.001**
Gender = Female (%)	699 (51.8%)	912 (48.0%)	957 (49.2%)	0.10*
Triage Categories (ESI) (%)<0.001*				
1	3(0.2%)	3 (0.2%)		0.69**
2	60(4.4%)	76 (4.0%)		0.55**
3	339(29.6%) [b]	660 (34.7%) [c]		<0.05**
4	879(65.2%) [b]	1132 (59.6%) [c]		0.001**
5	8(0.6%) [b]	29 (1.5%) [c]		0.05**

	2020	2019	2018	P-value*
Time of arrival category(%)				0.11*
Morning (00.00 - 08.00)	72 (5.3%)[b]	142 (7.5%)[c]	137 (7.0%)	<0.05**
Daytime (08.00 - 16.00)	730 (54.2%)[a]	952 (50.1%)	948 (48.8%)[c]	<0.05**
Evening (16.00 - 24.00)	546 (40.5%)	806 (42.4%)	859 (44.2%)	0.07**
ISS>12= Yes (%)	9 (0.7%)	16 (0.8%)	8 (0.4%)	0.24*

*Chi-square test with Bonferroni correctionfor categorical variables; ANOVA analysis for continuous variables **Post-hoc analysis, difference between 2020 compared to the overall average

[a]The observed number of patients differs significantly from 2018

[b]The observed number of patients differs significantly from 2019

[c]The observed number of patients differs significantly from 2020

Table 3. Trauma mechanism

	2020 N = 1349	2019 N = 1900	2018 N=1944	P-value*
Trauma mechanism (%)				<0.001*
Fall from standing	466 (34.9%) [a, b]	568 (30.0%) [c]	556 (28.8%)[c]	<0.001**
Fall from height	33 (2.5%)	50 (2.6%)	36 (1.9%)	0.62**
Fall from stairs	73 (5.5%)	88 (4.7%)	89 (4.6%)	0.23**
MVA high speed	33 (2.5%)	41 (2.2%)	48 (2.5%)	0.76**
MVA moderate speed	6 (0.4%)	13 (0.7%)	16 (0.8%)	0.23**
MBA	25 (1.9%)	50 (2.6%)	57 (2.9%)	0.06**
Pedestrian vs. Car	13 (1.0%)	7 (0.4%)	10 (0.5%)	0.03**
Cyclist vs. Car	8 (0.6%)	19 (1.0%)	21 (1.1%)	0.13**
Cycle accident	98 (7.3%)	134 (7.1%)	162 (8.4%)	0.62**
Sports	193 (14.4%) [a, b]	417 (22.1%)[c]	404 (20.9%)[c].	0.001**
Hobby	33 (2.5%)	28 (1.5%)	34 (1.8%)	<0.05**
Work	70 (5.2%) [a, b]	71 (3.8%)[c]	58 (3.0%)[c]	<0.05**
Other	286 (21.4%)	405 (21.4%)	442 (22.9%).	0.55**
Missing	12	9	1	

MVA: Motor vehicle accident, High speed: >30km/h, Moderate speed: <30km/h, MBA: Motor Bike accident

*Chi-square test with Bonferroni correction ** Post-hoc analysis, difference between 2020 compared to the overall average

[a]The observed number of patients differs significantly from 2018

[b]The observed number of patients differs significantly from 2019

[c]The observed number of patients differs significantly from 2020

Table 4. Place of injury (AIS regions)

	2020 N = 1349	2019 N = 1900	2018 N=1944	P-value
Place of injury(%)				<0.001*
Head	57 (4.2%)	98(5.2%)	102 (5.2%)	0.16**
Face	51 (3.8%)	98(5.2%) [a]	64 (3.3%) [b]	0.48**
Neck	15 (1.1%)	26(1.4%)	17 (0.9%)	1.00**
Thorax	33 (2.5%)	46(2.4%)	70 (3.6%)	0.27**
Abdomen	5 (0.4%)	12(0.6%)	14 (0.7%)	0.19**
Spine	30 (2.2%)	42(2.2%)	41 (2.1%)	0.92**
Upper limbs	673 (50.0%) [a]	932(49.4%)	885 (45.5%) [c]	0.09**
Lower limbs	422 (31.3%)	543 (28.8%) [a]	644 (33.1%) [b]	0.76**
Unspecified	14 (1.0%) [a]	23(1.2%) [a]	66 (3.4%)[b, c]	<0.001**
Multiple regions	45 (3.3%)	68(3.6%) [a]	41 (2.1%) [b]	0.37**
Missing	4	12	0	

*Chi-square test with Bonferroni correction ** Post-hoc analysis, difference between 2020 compared to the overall average

[a]The observed number of patients differs significantly from 2018
[b]The observed number of patients differs significantly from 2019
[c]The observed number of patients differs significantly from 2020

Table 5. Treatment

	2020 N = 1349	2019 N = 1900	2018 N=1944	P-value
Treatment(%)<0.001*				
Surgically				
Emergency surgery	191 (14.2%) [a, b]	173 (9.1%) [c]	169 (8.7%) [c]	<0.001**
Elective surgery	85 (6.3%)	133 (7.0%)	126 (6.5%)	0.55**
Non-surgically				
Admission for observation	65 (4.8%)	85 (4.5%)	91 (4.7%).	0.69**
Outpatient follow up	1008 (74.7%) [a, b]	1509 (79.4%) [c]	1558 (80.1%) [c]	<0.001**

*Chi-square test with Bonferroni correction ** Post-hoc analysis, difference between 2020 compared to the overall average
[a]The observed number of patients differs significantly from 2018
[b]The observed number of patients differs significantly from 2019
[c]The observed number of patients differs significantly from 2020

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STROBE Statement—Checklist of items that should be included in reports of ***cohort studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	4
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	4
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	6
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7
		(*b*) Describe any methods used to examine subgroups and interactions	
		(*c*) Explain how missing data were addressed	
		(*d*) If applicable, explain how loss to follow-up was addressed	
		(*e*) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7-8
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8
		(b) Indicate number of participants with missing data for each variable of interest	
		(c) Summarise follow-up time (eg, average and total amount)	
Outcome data	15*	Report numbers of outcome events or summary measures over time	8

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Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (*b*) Report category boundaries when continuous variables were categorized (*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	8-9
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	8-9
Discussion			
Key results	18	Summarise key results with reference to study objectives	9-10
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	11
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	11
Generalisability	21	Discuss the generalisability (external validity) of the study results	11
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	12

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.

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The effect of the COVID-19 pandemic during the first lockdown in the Netherlands on the number of trauma related admissions, trauma severity and treatment. The results of a retrospective cohort study in a level 2 trauma centre.

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The effect of the COVID-19 pandemic during the first lockdown in the Netherlands on the number of trauma related admissions, trauma severity and treatment. The results of a retrospective cohort study in a level 2 trauma centre.

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Abstract

Objectives What is the impact of the first lockdown in the Netherlands measures during the COVID-19 pandemic on the number and type of trauma related injury presented on the Emergency Department (ED).

Design A single centre retrospective cohort study.

Setting A level II trauma centre in Breda, The Netherlands

Participants All trauma patients seen at the ED between March 11^{th} and May 10^{th} 2020 (the first Dutch lockdown period) were included in this study**.** Comparable groups were generated for 2019 and 2018.

Main outcome measures Primary outcomes were the total number of trauma patients admitted to the ED and the trauma mechanism. Secondary outcomes were triage categories, time of ED visit, trauma severity (Injury Severity Score>12), anatomic region of injury and treatment.

Results A total of 4674 patients were included in this study. During first months of the COVID-19 pandemic there was a decrease of 32% in traumatic injury at the ED (n=1182) compared to the preceding years 2019 (n=1717) and 2018 (n=1775) (p<0.001). Sports related injuries decreased most during the lockdown (n=164) compared to 2019 (n=386) and 2018 (n=367) (p<0.001). We observed more frequent injuries due fall from person height (p<0.001) and work related injuries. (p<0.05). The mean age was significantly higher (mean 48 years vs 42 and 43), no difference in anatomical place of injury or ISS>12 was observed. The amount of patients admitted for emergency surgery was significantly higher (14.6% vs 9.4%; 8.6%, p<0.001). Seven patients (0.6%) were tested positive for COVID-19.

Conclusions Measures taken in the COVID outbreak result in an obvious decrease in the total number of trauma patients, especially sports related trauma. Although the trauma burden on the ER appears to be lower, more people have been admitted for trauma surgery. Possibly due to increased throughput in the operating theatres.

Strengths and limitations of this study

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Strengths:

- The study covers a large patient population.
- The current study is reproducible with clearly defined inclusion criteria.
- There are different types of outcome measures which give a broad impression of the impact of the COVID-19 outbreak.

Limitations:

- Limitations accompanying the single-centre, retrospective study design.
- The study contains only data from the first COVID-19 outbreak.

Introduction

The coronavirus 2019 (COVID-19) was first reported in Huwan - China, in December 2019 [1]. The virus spread globally and was declared a pandemic by the World Health organization on March 11th 2020. The COVID pandemic poses great challenges for healthcare systems all over the world. Restrictive measures were taken worldwide to lower the infection transmission rate in order to delay and lower the height of the epidemic peak, and thereby easing the burden on healthcare systems. During the early outbreak the Dutch government pursued the following policy from March 11th 2020; hygiene advices, social distancing (1.5 meters), working from home as much as possible and closing of all schools, universities, sports facilities, hairdressers, cultural places, all theatres, cafes and restaurants. It was also forbidden to visit relatives living in a nursing home.

The COVID pandemic, together with these restrictive measures, is of great impact on the way of life in the Netherlands, resulting in a social behavioural change such as less traffic and less or different sports activities [2-3]. Moreover, more people could be reluctant to visit their general practitioner or the hospital out of fear of being infected with the coronavirus.

The Amphia Hospital was one of the first hospitals in the Netherlands assigned as ‘COVID hospital’ during the early stages of the outbreak. Scheduled procedures were cancelled and most of the hospital recourses were restructured for COVID patient related care. However, acute trauma care on the ED,

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wards and operation rooms did continue. The question raised to what extent the lockdown rules resulted in a change in the volume of trauma patients that presented at the ED. Previous studies reported a decrease of ED visits during early stages of the COVID up to 71% [4]–[10] . A better understanding of the consequences of the COVID pandemic on trauma related injury might help future prioritisation of hospital resources and management of the operation theatre, especially with the possibility of additional lockdown periods. The objective of this study was to examine the impact of the COVID pandemic and the lockdown on the epidemiology of trauma related injury on a level 2 trauma centre in the Netherlands.

Methods

Study design and setting

A single-centre retrospective observational study was conducted at the Amphia Hospital, a level 2 trauma centre in the south of the Netherlands serving 400.000 people. This study was approved by the Medical Ethics Review Committee (METC) of Amphia Breda (N2020-0330).

Patients

To examine the impact of COVID-19 on trauma related injury and ED visits, we included all patients with trauma related injuries, that presented on our ED between the time interval from March 11th, 2020 (the start of the first nationwide restrictive measures; advice to limit the number of social contacts and to work from home) until May 10th, 2020 (the first alleviating lockdown measures; opening of primary schools). This time interval is referred to as 'the lockdown period'. For comparison a control group was selected using the same time interval for 2019 and 2018. Patients with injuries secondary to another medical problem were excluded, provided that the injury did not require surgical intervention (e.g. contusion after a fall in the event of a stroke or heart attack). Patients and the public were not involved in any way in this study.

Outcome measures

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Primary endpoints were: total number of trauma-related admissions on the ED during the lockdown period in comparison with the same period the years before and differences in trauma mechanism. Secondary endpoints were differences in triage categories, time of ED arrival, trauma severity, anatomic region of injury and distribution of surgical versus non-surgical treatment of injuries. Non-scheduled surgical procedures were further specified in time to surgery and type of surgery.

Covariates

A patient database was generated using ED registrations. Demographic and clinical data was obtained from medical records. The collected demographic data were gender and age (categorised in; infant/toddler 0–3 years, preschool and grade-schoolers 4-12 years, teenager 13–17 years, adult 18–64 years and senior ≥65 years). Other collected variables were the Injury Severity Score (minor to moderate injury ISS < 12, major injury ISS > 12) [11], Emergency Severity Index (Table 1)[12], time of ED visit (Table 2) (early morning (00.00 – 08.00), daytime (08.00 – 16.00), evening (16.00-24.00)), trauma mechanism (Table 3), anatomical region of the injury (AIS body regions, Table 4 [13]) and treatment. Treatment was categorised into surgical (admission for surgery or scheduled for secondary surgery) vs. non-surgical (admission for observation or outpatient follow-up). The direct surgical interventions were categorised on the model of the classification by Dayananda et al [14]: Minor trauma, Major trauma, Polytrauma, Neck of femur (NOF), soft tissue injury and Paediatrics. High energy traumas (HET) were classified according to the ATLS guidelines [15] (Table 5).

Information on COVID was obtained for all tested patient. During this first outbreak, patients were only tested for COVID-19 in case of fever and/or cough. In general, only a PCR was performed. However, if waiting for the results would cause logistic problems, a CT scan of the thorax was used for diagnosis. A chest CT is a reliable diagnostic because of the specific lung image in case of a COVID pneumonia [16]. COVID-related data points were the number of COVID tests performed, type of test (Polymerase Chain Reaction: PCR and / or CT-thorax), the amount of patients who were tested positive for COVID and COVID-related mortality symptoms.

Data analysis

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Statistical analysis was performed with SPSS version 25 (IBM Corp., Armonk, NY) for Mac. Group differences in proportions (both nominal and ordinal data) were tested using a chi-squared test. All years were compared independently. A Bonferroni correction was performed for multiple comparison. An ANOVA test was performed to examine differences between years for continuous data. A post-hoc analysis was performed to be able to express the difference between subgroups in *p*-values. Confidence intervals and *p*-values were obtained based on a 5% significance level and all tests were two-sided.

Patient and public involvement

No patient involved

Results

The computer generated database and medical record review yielded a total of 1.380 trauma patients presented on the ED between March 11th and May 10th, 2020. Of those, 188 patients were excluded as these patients had been incorrectly identified in the database. Ten patients were excluded because the injury was secondary to another non-surgical cause and the injury did not require any intervention. Leaving 1.182 patients suitable for analysis. In the same period in 2019 and 2018, respectively 1717 and 1775 patients were included. This translates into an overall decrease in trauma-related admissions of 32.2% (95% CI 0.24 – 0.27, p<0.001).

Baseline characteristics are displayed in table 2. The mean age was significantly higher in 2020 compared to 2019 and 2018 with fewer adolescents and more senior patients presented at the emergency department (p<0.001). Gender distribution did not differ between the years (p=0.082). In 2020 there were fewer patients triaged in category U3 and U4 (p<0.05) as compared to 2019. Because of the use of different triage criteria in 2018 no direct comparison could be made. The overall distribution of time of arrival on the ED was significantly different between years (p<0.05). In 2020 the proportion of patients arriving at the emergency room early in the morning (00.00-08.00) was lower and the proportion of patients arriving during daytime (08.00-16.00) was higher. The rate of patients with an Injury Severity Scores higher than 12 did not differ over the years (p=0.40).

Trauma mechanism

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Trauma mechanisms were divided into 13 categories as displayed in table 3. Injuries classified as ‘other’ injury were ankle sprains, molested patients, burns and local impact injuries like boxers’ fractures. Each year, a fall from standing height is the most common type of injury seen in our hospital, followed by sports injuries. Although there is an absolute decrease of numbers in each category, the distribution was significantly different. In 2020 a significant increase was present in the percentage fall from standing height and work-related injury. Hobby accidents (e.g. mechanical chores around the house), however not significant, did increase as well. An absolute significant decrease was observed in sports related injury: 164 patients in the lockdown compared to 386 patients in 2019 and 367 patients in 2018 ($p<0.001$).

Anatomic region of injury

Upper extremity injuries were seen most common, encompassing half of all injuries sustained in 2020. The distribution of the anatomical place of injury was not significantly different in 2020 compared to previous years. (Table 4)

Treatment

A significant decrease was seen in the rate of patients treated non-surgically with outpatient follow up in comparison with preceding years ($p<0.001$). The amount of patients that were admitted for surgical intervention was significantly higher in 2020 (14.6% vs. 9.4% in 2019 and 8.6% in 2018, $p<0.001$). (Table 6). In the group of patients admitted for surgery, no significant difference was found in the percentage of people who were operated on the admission day. In 2020 37.6% was operated on the admission day, 50.6% in 2019 and 39.2% in 2018. (Table 5). In 2020 there was a significantly larger proportion that underwent minor surgery; 23 patients (8.1%) in 2020 vs. 9 (2.5%) and 14 patients (7.8%) in 2019 en 2018 respectively. In all years, neck of femur surgery was by far the most common procedure with 50.3 - 54.9% (Table 7).

COVID-19 Status

Between March 11th and May 10th 2020, all patients were screened for symptoms of coughing and / or having a fever. Thirty-one patients of our study population were tested for COVID-19 (2.6%). A PCR - test was used as diagnostic in 22 of these cases. In 9 other cases both a PCR as chest computed

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tomography (CT) of the thorax were performed. Of all patients tested on COVID-19, seven were found positive (22.6%). Two patients (0.2%) died due to the consequences of their COVID-19 infection.

Discussion

The results of our study demonstrate that the COVID-19 pandemic and the first lockdown measures taken by the Dutch government had a significant effect on trauma-related-injury presented at the emergency department of our hospital. During the early outbreak, there was an overall decrease in traumatic injury (32.2%) with fewer sports-related injuries. This decrease also applied to the absolute number of patients with injury after a fall from standing height, but the proportion was significantly higher compared to previous years. Remarkable is the increase of trauma patients that needed to be admitted for acute surgery.

The decrease of trauma-related ED admissions is explainable by the effect of the restrictive measures taken due to the COVID pandemic. For example, less traffic led to a reduction of the number of car and motorcycle-accidents. There were less organized sports activities (e.g. soccer) and people were advised to stay at home as much as possible. Another reason for the decrease in the number of trauma patients seen at the ED may be the change in human behaviour; the dangers of a COVID infection were extensively illustrated in the media, making people more reluctant to visit the hospital. Moreover, patients may not want to visit the hospital to prevent an excessive burden on healthcare professionals who would be busy treating COVID-19 patients. We do not expect that there is a direct effect of a COVID-19 infection in relation to the decrease of the number of trauma patients since only seven out of the 31 tested patients were tested positive for corona. This decrease in trauma cases presented on the ED is in line with known literature, percentages varied between 33 and 71 percent reduction, citing the same arguments [4-10], [16-20].

An absolute decrease of trauma-related ED admissions in every age-category was seen, however a significant shift was observed towards elderly people (age >65) being admitted with traumatic injury. This is remarkable since especially senior people were advised to stay home as much as possible because of their vulnerability of being infected by the COVID-19 virus. A possible explanation can be that the COVID measures may have had more beneficial effects on the amount of traumatic-injury among children, adolescents and adults compared to senior people. Activities such as school, sports

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and work were all affected by the measures taken whereas on average, senior citizens experienced less change in their daily activity. Another possible explanation for the relative increase in the number of senior patients, is less attendance for the elderly by their families and nurse staff, making them more at risk for falling. This conclusion cannot be drawn from the data of this study and more research would be justified to investigate the controversy of contact-reducing measures in the elderly.

With regard to the triage categories, the number of patients with high urgency levels upon arrival (U1 and U2) nearly remained the same compared to 2019 and 2018. Only the number of low urgency level patients (U3 and U4) decreased during the lockdown period. A study conducted by Zagra et al. showed similar results with a decrease of 65% in the low urgency level patients. [21] This again can be explained by a decrease due to a reduction in daily (sport) activities, normally responsible for a large part of injuries seen at the ED.

Considering the distribution of trauma mechanism our results showed an increase in the rate of traumatic injury after a fall from a standing height and an increased ratio of elderly trauma patients admitted to our hospital. Similar results were seen in previous literature [8], [9], [22]. However, the increase of the percentage in the number of falls could also be the result of a decrease in the distribution elsewhere, such as the reduced number of sports injuries. The drop in sports-related injury seems an obvious result of the restrictive COVID-19 measures as popular Dutch sports such as soccer or hockey were cancelled. Individual sport injuries (e.g. skateboarding, inline skating and running) did increase, however with no significant impact. Finally, the rate of work-related accidents was significantly higher in 2020, probably for the same reason as the increase in the elderly. We hypothesize that most people, who were able to work from home during the lockdown, are people with office jobs, normally having a low injury risk on sustaining injury. People with high risk occupations on the other hand (e.g. transportation professionals, construction workers or agricultural workers) were allowed to work during the lockdown.

It is a striking finding that despite the overall decrease in the number of trauma patients and no change in urgency level upon arrival, more patients had been admitted for surgery. This difference is mainly due to an increased number of minor trauma; requiring surgery lasting less than 45 minutes and injuries that do not require immediate surgery. As expected, the total number of surgeries (admission for surgery and scheduled surgery combined) has decreased compared to previous years. We suspect that the

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increase in admission for surgery is due to an increase in operating capacity as a result of the cancellation of scheduled surgery. We suspect that this capacity also lies in the trauma wards because no clear difference has been found in the number of days to surgery. If only the throughput in the operating theatre had been greater, this would probably have translated into a larger number of operations performed on the day of admission.

This trend towards trauma related surgery was also found in literature [8], [22], [23]. On the other hand, an Italian study conducted by Benazzo et al. [10] found a decrease in the number of trauma operations (15 to 20%). The authors of this study stated that this decrease could be due to a reduced propensity for surgery to relieve the burden on the hospital. An explanation for the difference between our results is that the capacity in our clinic was still sufficient, which did not change the indication for surgical intervention. However, the question remains why the total number of surgeries (admission for surgery and scheduled surgery combined) in 2020 has remained equal to previous years despite the decrease in the total number of injuries.

Strengths of this study are the large patient groups included over the entire first lockdown period and the applicability in hospitals around the world. Limitations are the retrospective single-centre cohort setting, in which the researchers were dependent on data obtained from medical records. This research was conducted in a level two trauma centre making the results less generalizable for level one or level three trauma centres. Literature for comparison was mainly made in level one trauma centres and therefor it is a less reliable comparison. Since this study only contains data from the first two months of the COVID-19 outbreak, further research is needed to assess the long-term impact of the COVID-19 pandemic on trauma related injury and its impact on the hospital setting.

Conclusion

This study shows a decrease of more than 32% in the total number of trauma patients on the ED during the first COVID-19 lockdown period in the Netherlands, mainly due to a drop in sports-related injury and less patients with minor injuries. The majority of the remaining trauma patients were elderly people sustaining a fall from standing height. The number of patients with high urgency levels upon arrival (U1 and U2) remained the same. Controversially the number of injury related admissions for surgery increased in 2020. This was mainly due to an increase in the number of minor trauma needing surgery.

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Further research is needed to assess the long-term impact of the COVID-19 pandemic on trauma related injury and its impact on hospital functionality and resources.

Contributors

G.J.J. van Aert was involved in data collection, data analysis and writing of the manuscript. D.I. Vos and L. van der Laan were involved in study supervision, data verification, study design and editing of the manuscript. L.J.M. Boonman – de Winter was involved in study design, statistical coding for data analysis and editing of the manuscript. C.A.S. (Niels) Berende, H.G.W de Groot, P. Boele van Hensbroek, P.M.J. Schormans and M.B. Winkes were all involved in editing of the manuscript.

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Keywords

Attendance; Emergency department; COVID; Trauma; Triage; Epidemiology; Injury

Declarations

Funding

Not applicable

Conflicts of interest/Competing interests

The authors declare that they have no conflicts of interest. Patients and the public were not involved in any way in this study.

Availability of data and material

Yes , dissemination of the results to the patients is not applicable.

Code availability

Not applicable

Authors' contributions

Not applicable

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Tables and Figures

Table 1. Emergency Severity Index (ESI) Version 4. (Gilboy et al.)[12]

Level	Name	Description	Examples
1	Resuscitation	Immediate, life-saving intervention required without delay	Cardiac arrest Massive bleeding
2	Emergent	High risk of deterioration, or signs of a time-critical problem.	Cardiac-related chest pain, Asthma attack
3	Urgent	Stable, with multiple types of resources needed to investigate or treat (such as lab tests plus X-ray imaging)	Abdominal pain High fever with cough
4	Less Urgent	Stable, with only one type of resource anticipated (such as only an X-ray, or only sutures)	Simple laceration Pain on urination.
5	Nonurgent	Stable, with no resources anticipated except oral or topical medications, or prescriptions	Rash Prescription refill

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Table 2. Patiënt characteristics

	2020 N = 1182	2019 N = 1717	2018 N=1775	P-value
Age mean (range)	48 (0-97) [a, b]	42 (0-99) [c]	43 (0-97) [c]	<0.001*
Age Categories (%)				<0.001*
Infant (0-3y)	43 (3.6%)	51 (3.0%)	46 (2.6%)	0.13**
Child (4-12y)	149 (12.6%)	258 (15.8%)	240 (13.5%)	0.16**
Adolescent (13-17y)	54 (4.6%) [a, b]	168 (9.8%) [c]	181 (10.2%) [c]	<0.001**
Adult (18-65y)	537 (45.4%)	771 (44.9%)	813 (45.8%)	0.97.**
Senior (>65)	399 (33.8%) [a, b]	469 (27.3%) [c]	495 (27.9%) [c]	<0.001**
Gender = Female (%)	615 (52.0%)	821 (47.8%)	874 (49.2%)	0.082*
Triage Categories (ESI) (%)				<0.001*
1	3 (0.3%)	2 (0.1%)		0.38**
2	56 (4.7%)	64 (3.7%)		0.18**
3	364 (30.8%) [b]	604 (35.2%) [c]		<0.05**
4	752 (63.6%) [b]	1022 (59.5%) [c]		<0.05**
5	7 (0.6%) [b]	25 (1.5%) [c]		<0.05**
Time of arrival category (%)				<0.05.*
Morning (00.00 - 08.00)	63 (5.3%)	128 (7.5%)	122 (6.9%)	<0.05**
Daytime (08.00 - 16.00)	634 (53.6%) [a]	857 (49.9%)	860 (48.5%) [c]	<0.05**
Evening (16.00 - 24.00)	485 (41.0%)	732 (42.6%)	793 (44.7%)	0.11**
ISS>12 = Yes (%)	9 (0.8%)	11 (0.6%)	7 (0.4%)	0.40*

*Chi-square test with Bonferroni correction for categorical variables; ANOVA analysis for continuous variables **Post-hoc analysis, difference between 2020 compared to the overall average
[a]The observed number of patients differs significantly from 2018
[b]The observed number of patients differs significantly from 2019
[c]The observed number of patients differs significantly from 2020

Table 3. Trauma mechanism

	2020 N = 1182	2019 N = 1717	2018 N=1775	P-value*
Trauma mechanism (%)				<0.001*
Fall from standing	424 (35.9%) [a, b]	513 (29.9%) [c]	505 (28.5%) [c]	<0.001**
Fall from height	29 (2.5%)	45 (2.6%)	33 (1.9%)	0.65**
Fall from stairs	63 (5.3%)	80 (4.7%)	78 (4.4%)	0.25**
MVA high speed	28 (2.4%)	37 (2.2%)	44 (2.5%)	0.91**
MVA moderate speed	6 (0.5%)	11 (0.6%)	10 (0.6%)	0.72**
MBA	21 (1.8%)	45 (2.6%)	55 (3.1%)	0.04**
Pedestrian vs. Car	11 (0.9%)	6 (0.3%)	10 (0.6%)	0.06**
Cyclist vs. Car	7 (0.6%)	14 (0.8%)	16 (0.9%)	0.37**
Cycle accident	86 (7.3%)	130 (7.6%)	152 (8.6%)	0.39**
Sports	164 (13.9%) [a, b]	386 (22.5%) [c]	367 (20.7%) [c.]	0.001**
Hobby	30 (2.5%)	27 (1.6%)	32 (1.8%)	0.06**
Work	60 (5.1%) [a, b]	61 (3.6%) [c]	54 (3.0%) [c]	<0.05**
Other	243 (20.6%)	352 (20.5%)	408 (23.0%).	0.4**
Missing	10	10	11	

MVA: Motor vehicle accident, High speed: >30km/h, Moderate speed: <30km/h, MBA: Motor Bike accident
*Chi-square test with Bonferroni correction ** Post-hoc analysis, difference between 2020 compared to the overall average
[a]The observed number of patients differs significantly from 2018
[b]The observed number of patients differs significantly from 2019
[c]The observed number of patients differs significantly from 2020

Table 4. Place of injury (AIS regions)

	2020 N = 1182	2019 N = 1717	2018 N=1775	P-value
Place of injury (%)				<0.001*
Head	52 (4.4%)	89 (5.2%)	93 (5.2%)	0.56**
Face	46 (3.9%)	94 (5.5%) [a]	58 (3.3%) [b]	0.27**
Neck	15 (1.3%)	20 (1.2%)	15 (0.8%)	0.50**
Thorax	32 (2.7%)	43 (2.5%)	63 (3.5%)	0.44**
Abdomen	5 (0.4%)	11 (0.6%)	11 (0.6%)	0.56**
Spine	25 (2.1%)	37 (2.2%)	33 (1.9%)	0.42**
Upper limbs	590 (49.9%) [a]	854 (49.7%)	812 (45.7%) [c]	0.81**
Lower limbs	361 (30.5%)	485 (28.2%) [a]	588 (33.1%) [b]	0.19**
Unspecified	13 (1.1%) [a]	19 (1.1%) [a]	64 (3.6%) [b, c]	<0.05**

Multiple regions	40 (3.4%)	54 (3.1%) [a]	38 (2.1%) [b]	0.18**
Missing	3	10	0	

*Chi-square test with Bonferroni correction ** Post-hoc analysis, difference between 2020 compared to the overall average
[a]The observed number of patients differs significantly from 2018
[b]The observed number of patients differs significantly from 2019
[c]The observed number of patients differs significantly from 2020

Table 5. Surgery classification based on the example Dayananda et al

Minor trauma	Estimated operative duration <45 minutes	Weber B ankle fracture
Major trauma	Estimated operative duration >45 minutes OR A strict indication for direct surgery	Femoral shaft fracture, crush injury
Polytrauma	Trauma to >1 anatomical regions or ISS>15	Femoral fracture combined with a pneumothorax
NOF	Neck of Femur fracture	Medial collum fracture
Soft tissue trauma	Isolated soft tissue injury	Laceration with tendon injury
Pediatrics	Age<16	Supracondylar humeral fracture in a 10-year old.

Table 6. Treatment

	2020 N = 1182	**2019** N = 1717	**2018** N=1775	**P-value**
Treatment (%)				<0.001*
Surgically				
Admission for direct surgery	173 (14.6%) [a, b]	162 (9.4%) [c]	153 (8.6%) [c]	<0.001**
Scheduled surgery	77 (6.5%)	116 (6.8%)	107 (6.1%)	0.84**
Non-surgically				
Admission for observation	61 (5.2%)	71 (4.1%)	84 (4.7%).	0.27**
Outpatient follow up	871 (73.7%) [a, b]	1368 (79.6%) [c]	1431 (80.6%) [c.]	<0.001**

*Chi-square test with Bonferroni correction ** Post-hoc analysis, difference between 2020 compared to the overall average
[a]The observed number of patients differs significantly from 2018
[b]The observed number of patients differs significantly from 2019
[c]The observed number of patients differs significantly from 2020

Table 7. Admission for surgery

	2020 N = 173	**2019** N = 162	**2018** N=153	**P-value**
Time to operation				0.112*
0 Days	65 (37.6%)	82 (50.6%)	60 (39.2%)	0.06**
1-2 Days	91 (52.6%)	67 (41.4%)	79 (51.6%)	0.31**
3-4 Days	11 (6.4%)	7 (4.3%)	6 (3.9%)	0.31**
6 or more days	5 (2.9%)	1 (0.6%)	2 (1.3%)	0.12**
Operation type				0.318*
Minor trauma	23 (8.1%) [b]	9 (2.5%) [c]	14 (7.8%)	0.03**
Major trauma	26 (21.4%)	24 (17.9%)	23 (16.3%)	0.98**
Polytrauma	10 (4.6%)	9 (5.6%)	4 (2.6%)	0.41**
NOF	87 (50.3%)	87 (53.7%)	84 (54.9%)	0.40**
Soft tissue trauma	10 (5.8%)	6 (3.7%)	7 (4.6%)	0.41**
Pediatrics	17 (9.8%)	27 (16.7%)	21 (13.7%)	0.09**

*Chi-square test with Bonferroni correction ** Post-hoc analysis, difference between 2020 compared to the overall average
[a]The observed number of patients differs significantly from 2018
[b]The observed number of patients differs significantly from 2019
[c]The observed number of patients differs significantly from 2020

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STROBE Statement—Checklist of items that should be included in reports of ***cohort studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	4
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	4
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	6
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7
		(*b*) Describe any methods used to examine subgroups and interactions	
		(*c*) Explain how missing data were addressed	
		(*d*) If applicable, explain how loss to follow-up was addressed	
		(*e*) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7-8
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8
		(b) Indicate number of participants with missing data for each variable of interest	
		(c) Summarise follow-up time (eg, average and total amount)	
Outcome data	15*	Report numbers of outcome events or summary measures over time	8

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Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (*b*) Report category boundaries when continuous variables were categorized (*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	8-9
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	8-9
Discussion			
Key results	18	Summarise key results with reference to study objectives	9-10
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	11
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	11
Generalisability	21	Discuss the generalisability (external validity) of the study results	11
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	12

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.

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The effect of the COVID-19 pandemic during the first lockdown in the Netherlands on the number of trauma related admissions, trauma severity and treatment. The results of a retrospective cohort study in a level 2 trauma centre.

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Abstract

Objectives What is the impact of the first lockdown in the Netherlands measures during the COVID-19 pandemic on the number and type of trauma related injuries presenting to the Emergency Department (ED).

Design A single centre retrospective cohort study.

Setting A level II trauma centre in Breda, The Netherlands

Participants All trauma patients seen at the ED between March 11th and May 10th 2020 (the first Dutch lockdown period) were included in this study**.** Comparable groups were generated for 2019 and 2018.

Main outcome measures Primary outcomes were the total number of trauma patients admitted to the ED and the trauma mechanism. Secondary outcomes were triage categories, time of ED visit, trauma severity (Injury Severity Score>12), anatomical region of injury and treatment.

Results A total of 4674 patients were included in this study. During first months of the COVID-19 pandemic there was a decrease of 32% in traumatic injuries at the ED (n=1182) compared to the previous years 2019 (n=1717) and 2018 (n=1775) ($p<0.001$). Sports related injuries decreased most during the lockdown (n=164) compared to 2019 (n=386) and 2018 (n=367) ($p<0.001$). We observed more frequent injuries due to a fall from standing height ($p<0.001$) and work related injuries. ($p<0.05$). The mean age was significantly higher (mean 48 years vs 42 and 43). There was no difference in anatomical place of injury or ISS>12. The amount of patients admitted for emergency surgery was significantly higher (14.6% vs 9.4%; 8.6%, $p<0.001$). Seven patients (0.6%) tested positive for COVID-19.

Conclusions Measures taken in the COVID outbreak result in a predictable decrease in the total number of trauma patients, especially sports related trauma. Although the trauma burden on the ER appears to be lower, more people have been admitted for trauma surgery. Possibly due to increased throughput in the operating theatres.

Strengths and limitations of this study

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Strengths:

- The study covers a large patient population.
- The current study is reproducible with clearly defined inclusion criteria.
- There are different types of outcome measures which give a broad impression of the impact of the COVID-19 outbreak.

Limitations:

- Limitations accompanying the single-centre, retrospective study design.
- The study contains only data from the first COVID-19 outbreak.

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Introduction

The coronavirus 2019 (COVID-19) was first reported in Huwan - China, in December 2019 [1]. The virus spread globally and was declared a pandemic by the World Health organization on March 11th 2020. The COVID pandemic poses great challenges for healthcare systems all over the world. Restrictive measures were taken worldwide to lower the infection transmission rate in order to delay and lower the height of the epidemic peak, and thereby easing the burden on healthcare systems. During the early outbreak the Dutch government pursued the following policy from March 11th 2020; hygiene advice, social distancing (1.5 meters), working from home as much as possible and closing of all schools, universities, sports facilities, hairdressers, cultural places, theatres, cafes and restaurants. It was also forbidden to visit relatives living in a nursing home.

The COVID pandemic, together with these restrictive measures, has had an immense impact on the way of life in the Netherlands, resulting in a social behavioural change such as less traffic and less or different sporting activities [2-3]. Moreover, more people could be reluctant to visit their general practitioner or the hospital due to fear of being exposed to the coronavirus. These changes could fundamentally alter the dynamics of an emergency room at the time of a pandemic.

The Amphia Hospital was one of the first hospitals in the Netherlands assigned as 'COVID hospital' during the early stages of the outbreak. Scheduled procedures were cancelled and most of the hospital

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resources were restructured for COVID patient related care. However, acute trauma care on the ED, wards and operation rooms continued. The question raised to what extent the lockdown rules resulted in a change in the volume of trauma patients that presented to the ED. Previous studies reported a decrease of ED visits during early stages of the COVID up to 71% [4]–[10] . A better understanding of the consequences of the COVID pandemic on trauma related injuries might help future prioritisation of hospital resources and management of the operation theatre, especially with the possibility of additional lockdown periods. The objective of this study was to examine the impact of the COVID pandemic and the lockdown on the epidemiology of trauma related injuries at a level 2 trauma centre in the Netherlands.

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Methods

Study design and setting

A single-centre retrospective observational study was conducted in the Amphia Hospital, a level 2 trauma centre in the south of the Netherlands serving 400.000 people. This study was approved by the Medical Ethics Review Committee (METC) of Amphia Breda (N2020-0330).

Patients

To examine the impact of COVID-19 on trauma related injuries and ED visits, we included all patients with trauma related injuries, that presented to our ED between the time interval from March 11th, 2020 (the start of the first nationwide restrictive measures; advice to limit the number of social contacts and to work from home) until May 10th, 2020 (the first alleviating lockdown measures; opening of primary schools). This time interval is referred to as 'the lockdown period'. For comparison a control group was selected using the same time interval for 2019 and 2018. Patients with injuries secondary to another medical problem were excluded, provided that the injury did not require surgical intervention (e.g. contusion after a fall in the event of a stroke or heart attack). Patients and the public were not involved in any way in this study.

Outcome measures

Primary endpoints were: total number of trauma-related admissions to the ED, and differences in trauma mechanism during the lockdown period in comparison to the same period in the preceding years. Secondary endpoints were differences in triage categories, time of ED arrival, trauma severity, anatomical region of injury, and distribution of surgical versus non-surgical treatment of injuries. Non-scheduled surgical procedures were further specified in time to surgery and type of surgery.

Covariates

A patient database was generated using ED registrations. Demographic and clinical data was obtained from medical records. The collected demographic data were gender and age (categorised in; infant/toddler 0–3 years, preschool and grade-schooler 4-12 years, teenager 13–17 years, adult 18–64 years and senior ≥65 years). Other collected variables were the Injury Severity Score (minor to moderate injury ISS < 12, major injury ISS > 12) [11], Emergency Severity Index (Table 1)[12], time of ED visit (Table 2) (early morning (00.00 – 08.00), daytime (08.00 – 16.00), evening (16.00-24.00)), trauma mechanism (Table 3), anatomical region of the injury (AIS body regions, Table 4 [13]) and treatment. Treatment was categorised into surgical (admission for surgery or scheduled for secondary surgery) vs. non-surgical (admission for observation or outpatient follow-up). The direct surgical interventions were categorised on the model of the classification by Dayananda et al [14]: Minor trauma, Major trauma, Polytrauma, Neck of femur (NOF), soft tissue injury and Paediatrics. High energy traumas (HET) were classified according to the ATLS guidelines [15] (Table 5).

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We obtained information on COVID status for all tested patients. During the first outbreak, COVID testing was only indicated if patients had a fever and/or cough. In general, only a PCR was performed. However, if waiting for the results would cause logistic problems, a chest CT scan was used for diagnosis. A chest CT scan is a reliable diagnostic because of the specific lung image in case of a COVID pneumonia [16]. COVID-related data points were the number of COVID tests performed, type of test (Polymerase Chain Reaction: PCR and / or CT-thorax), the amount of patients who tested positive for COVID, and COVID-related mortality.

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Data analysis

Statistical analysis was performed with SPSS version 25 (IBM Corp., Armonk, NY) for Mac. We used chi-squared tests to assess the group differences in proportions for both nominal and ordinal data. All years were compared independently. A Bonferroni correction was performed for multiple comparisons. An ANOVA test was performed to examine differences between years for continuous data. A post-hoc analysis was performed to express the difference between subgroups in *p*-values. Confidence intervals and *p*-values were obtained based on a 5% significance level and all tests were two-sided.

Patient and public involvement

No patients involved

Results

According to the hospital database, 1.380 trauma patients were seen in the ED between between March 11th and May 10th, 2020. Of those, 188 patients were excluded as these patients had been incorrectly identified in the database. Ten patients were excluded because the injury was secondary to another non-surgical cause and the injury did not require any intervention. Leaving 1.182 patients suitable for analysis. In the same period in 2019 and 2018, respectively 1717 and 1775 patients were included. This translates into an overall decrease in trauma-related admissions of 32.2% (95% CI 0.24 – 0.27, $p<0.001$).

Baseline characteristics are displayed in table 2. The mean age was significantly higher in 2020 compared to 2019 and 2018, with fewer adolescents and more senior patients presenting to the emergency department ($p<0.001$). Gender distribution did not differ between the years ($p=0.082$). In 2020 there were fewer patients triaged in category U3 and U4 ($p<0.05$) compared to 2019. A difference in triage criteria in 2018 meant that no direct comparison could be made. The overall distribution of arrival time to the ED was significantly different between the years ($p<0.05$). In 2020 the proportion of patients arriving to the ED early in the morning (00.00-08.00) was lower and the proportion of patients arriving during daytime (08.00-16.00) was higher. The rate of patients with an Injury Severity Score higher than 12 did not differ between the years ($p=0.40$).

Trauma mechanism

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Trauma mechanisms were divided into 13 categories as displayed in table 3. Injuries classified as 'other' injury were ankle sprains, molested patients, burns and local impact injuries like boxers' fractures. Each year, a fall from standing height is the most common type of injury seen in our hospital, followed by sports injuries. Although there is an absolute decrease of numbers in each category, the distribution was significantly different. In 2020, there was a significant increase in the percentage fall from standing height and work-related injuries. Hobby accidents (e.g. mechanical chores around the house), increased as well, although not significantly. An absolute significant decrease was observed in sports related injury: 164 patients in the lockdown compared to 386 patients in 2019 and 367 patients in 2018 ($p<0.001$).

Anatomical region of injury

Upper extremity injuries were most common, encompassing half of all injuries sustained in 2020. The distribution of the anatomical place of injury was not significantly different in 2020 compared to previous years. (Table 4)

Treatment

Non-surgical treatment with outpatient follow-up decreased during the lockdown ($p<0.001$). Admission for surgical intervention was significantly higher in 2020 (14.6% vs. 9.4% in 2019 and 8.6% in 2018, $p<0.001$). (Table 6). There was no significant difference in the percentage of people who were operated on the day of admission. In 2020, 37.6% of patients were operated on the admission day, 50.6% in 2019 and 39.2% in 2018. (Table 5). In 2020, significantly more patients underwent minor surgery; 23 patients (8.1%) in 2020 vs. 9 (2.5%) and 14 patients (7.8%) in 2019 and 2018 respectively. In all years, neck of femur surgery was by far the most common procedure composing 50.3 - 54.9% of operations (Table 7).

COVID-19 Status

Between March 11th and May 10th 2020, all patients were screened for coughing and / or a fever. Thirty-one patients of our study population were tested for COVID-19 (2.6%). A PCR - test was performed as diagnostic in 22 of these cases. In 9 other cases both a PCR and a chest computed tomography (CT)

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of the thorax were performed. Of all patients tested for COVID-19, seven were positive (22.6%). Two patients (0.2%) died due to the consequences of their COVID-19 infection.

Discussion

The results of our study demonstrate that the COVID-19 pandemic and the first lockdown measures taken by the Dutch government had a significant effect on trauma related injuries presented at the emergency department of our hospital. During the early outbreak, there was an overall decrease in traumatic injuries (32.2%) with fewer sports-related injuries. This decrease also applied to the absolute number of patients with injury after a fall from standing height, but the proportion was significantly higher compared to previous years. Remarkable is the increase of trauma patients that needed to be admitted for acute surgery.

The restrictive measures due to the COVID pandemic can explain the decrease of trauma-related ED admissions. For example, less traffic led to a reduction of the number of car and motorcycle-accidents. There were less organized sports activities (e.g. soccer) and people were advised to stay at home as much as possible. Furthermore, a change in behaviour could contribute to the decrease in trauma patients, for instance fear of exposure to COVID might make people more reluctant to visit the hospital. Moreover, patients may not want to visit the hospital to prevent an excessive burden on healthcare professionals who would be busy treating COVID-19 patients. We do not expect that there is a direct causal relation between a COVID-19 infection and the decrease of the number of trauma patients since only seven out of the 31 tested patients were tested positive for corona. This decrease in trauma cases presenting to the ED is in line with known literature, percentages varied between 33 and 71 percent reduction, citing the same arguments [4-10], [16-20].

An absolute decrease of trauma-related ED admissions in every age-category was seen, however a significant shift was observed towards elderly people (age >65) being admitted with traumatic injuries. This is remarkable since especially senior people were advised to stay home as much as possible because of their vulnerability of being infected by the COVID-19 virus. A possible explanation can be that the COVID measures may have had more beneficial effects on the amount of traumatic injuries among children, adolescents and adults compared to senior people. Activities such as school, sports and work were all affected by the measures taken whereas on average, senior citizens experienced

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less change in their daily activity. Another possible explanation for the relative increase in the number of senior patients, is less attendance for the elderly by their families and nurse staff, increasing there risk of falling. This conclusion cannot be drawn from the data of this study and more research would be justified to investigate the controversy of contact-reducing measures in the elderly.

With regard to the triage categories, the number of patients with high urgency levels upon arrival (U1 and U2) nearly remained the same compared to 2019 and 2018. Only the number of low urgency level patients (U3 and U4) decreased during the lockdown period. A study conducted by Zagra et al. showed similar results with a decrease of 65% in the low urgency level patients. [21] This again can be explained by a decrease due to a reduction in daily (sport) activities, normally responsible for a large part of injuries seen in the ED.

Our results showed an increased rate of traumatic injury after a fall from standing height and an increased ratio of elderly trauma patients admitted to our hospital. Similar results were seen in previous literature [8], [9], [22]. However, the increase of the percentage in the number of falls could also be the result of a decrease in the distribution elsewhere, such as the reduced number of sports injuries. The drop in sports related injuries seems an obvious result of the restrictive COVID-19 measures as popular Dutch sports such as soccer or hockey were cancelled. Individual sport injuries (e.g. skateboarding, inline skating and running) increased, however with no significant impact. Finally, the rate of work-related accidents was significantly higher in 2020, probably for the same reason as the increase in the elderly. We hypothesize that most people, who were able to work from home during the lockdown, are people with office jobs, normally having a low injury risk on sustaining injury. People with high risk occupations on the other hand (e.g. transportation professionals, construction workers or agricultural workers) were allowed to work during the lockdown.

It is a striking finding that despite the overall decrease in the number of trauma patients and no change in urgency level upon arrival, more patients had been admitted for surgery. This difference is mainly due to an increased number of minor trauma; requiring surgery lasting less than 45 minutes and injuries that do not require immediate surgery. As expected, the total number of surgeries (admission for surgery and scheduled surgery combined) decreased compared to previous years. We suspect that the increase in patients admitted for surgery is due to an increase in operating capacity as a result of the cancellation of scheduled surgery. We suspect that the increased operating capacity was also due to a

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sufficient capacity on the trauma wards because the number of days until surgery was similar between years. Just a larger operating capacity would likely have translated in more operations performed on the day of admission.

This trend towards trauma related surgery was also found in literature [8], [22], [23]. On the other hand, an Italian study conducted by Benazzo et al. [10] found a decrease in the number of trauma operations (15 to 20%). The authors of this study stated that this decrease could be due to a reduced propensity for surgery to relieve the burden on the hospital. An explanation for the difference between our results is that the capacity in our clinic was still sufficient, which did not change the indication for surgical intervention. However, the question remains why the total number of surgeries (admission for surgery and scheduled surgery combined) in 2020 has remained equal to previous years despite the decrease in the total number of injuries.

The strengths of this study are the large patient groups included over the entire first lockdown period and the applicability to hospitals around the world. The limitations are the retrospective single-centre cohort setting, in which the researchers were dependent on data obtained from medical records. This research was conducted in a level two trauma centre making the results less generalizable for level one or level three trauma centres. Literature for comparison was mainly made in level one trauma centres and therefore it is a less reliable comparison. Since this study only contains data from the first two months of the COVID-19 outbreak, further research is needed to assess the long-term impact of the COVID-19 pandemic on trauma related injuries and its impact on the hospital setting.

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Conclusion

This study shows a decrease of more than 32% in the total number of trauma patients in the ED during the first COVID-19 lockdown period in the Netherlands, mainly due to a drop in sports related injuries and less patients with minor injuries. The majority of the remaining trauma patients were elderly people sustaining a fall from standing height. The number of patients with high urgency levels upon arrival (U1 and U2) remained the same. Controversially the number of injury related admissions for surgery increased in 2020. This was mainly due to an increase in the number of minor injuries requiring surgery. Further research is needed to assess the long-term impact of the COVID-19 pandemic on trauma related injuries and its impact on hospital functionality and resources.

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Contributors

G.J.J. van Aert was involved in data collection, data analysis and writing of the manuscript. D.I. Vos and L. van der Laan were involved in study supervision, data verification, study design and editing of the manuscript. L.J.M. Boonman – de Winter was involved in study design, statistical coding for data analysis and editing of the manuscript. C. Lovern, C.A.S. (Niels) Berende, H.G.W de Groot, P. Boele van Hensbroek, P.M.J. Schormans and M.B. Winkes were all involved in editing of the manuscript.

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Attendance; Emergency department; COVID; Trauma; Triage; Epidemiology; Injury

Declarations

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Conflicts of interest/Competing interests

The authors declare that they have no conflicts of interest. Patients and the public were not involved in any way in this study.

Availability of data and material

Yes , data are available on request. Data can be retrieved from the first author.

Code availability

Not applicable

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The effect of the COVID-19 pandemic during the Dutch lockdown on the number of trauma related admissions, trauma severity and treatment. The results of a retrospective cohort study in a level 2 trauma centre.

Tables and Figures

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Table 1. Emergency Severity Index (ESI) Version 4. (Gilboy et al.)[12]

Level	Name	Description	Examples
1	Resuscitation	Immediate, life-saving intervention required without delay	Cardiac arrest Massive bleeding
2	Emergent	High risk of deterioration, or signs of a time-critical problem.	Cardiac-related chest pain, Asthma attack
3	Urgent	Stable, with multiple types of resources needed to investigate or treat (such as lab tests plus X-ray imaging)	Abdominal pain High fever with cough
4	Less Urgent	Stable, with only one type of resource anticipated (such as only an X-ray, or only sutures)	Simple laceration Pain on urination.
5	Nonurgent	Stable, with no resources anticipated except oral or topical medications, or prescriptions	Rash Prescription refill

Table 2. Patiënt characteristics

	2020 N = 1182	2019 N = 1717	2018 N=1775	P-value

	2020	2019	2018	P-value
Age mean (range)	48 (0-97) [a, b]	42 (0-99) [c]	43 (0-97) [c]	<0.001*
Age Categories (%)				<0.001*
Infant (0-3y)	43 (3.6%)	51 (3.0%)	46 (2.6%)	0.13**
Child (4-12y)	149 (12.6%)	258 (15.8%)	240 (13.5%)	0.16**
Adolescent (13-17y)	54 (4.6%) [a, b]	168 (9.8%) [c]	181 (10.2%) [c]	<0.001**
Adult (18-65y)	537 (45.4%)	771 (44.9%)	813 (45.8%)	0.97.**
Senior (>65)	399 (33.8%) [a, b]	469 (27.3%) [c]	495 (27.9%) [c]	<0.001**
Gender = Female (%)	615 (52.0%)	821 (47.8%)	874 (49.2%)	0.082*
Triage Categories (ESI) (%)				<0.001*
1	3 (0.3%)	2 (0.1%)		0.38**
2	56 (4.7%)	64 (3.7%)		0.18**
3	364 (30.8%) [b]	604 (35.2%) [c]		<0.05**
4	752 (63.6%) [b]	1022 (59.5%) [c]		<0.05**
5	7 (0.6%) [b]	25 (1.5%) [c]		<0.05**
Time of arrival category (%)				<0.05.*
Morning (00.00 - 08.00)	63 (5.3%)	128 (7.5%)	122 (6.9%)	<0.05**
Daytime (08.00 - 16.00)	634 (53.6%) [a]	857 (49.9%)	860 (48.5%) [c]	<0.05**
Evening (16.00 - 24.00)	485 (41.0%)	732 (42.6%)	793 (44.7%)	0.11**
ISS>12 = Yes (%)	9 (0.8%)	11 (0.6%)	7 (0.4%)	0.40*

*Chi-square test with Bonferroni correction for categorical variables; ANOVA analysis for continuous variables **Post-hoc analysis, difference between 2020 compared to the overall average
[a]The observed number of patients differs significantly from 2018
[b]The observed number of patients differs significantly from 2019
[c]The observed number of patients differs significantly from 2020

Table 3. Trauma mechanism

	2020 N = 1182	2019 N = 1717	2018 N=1775	P-value*
Trauma mechanism (%)				<0.001*
Fall from standing	424 (35.9%) [a, b]	513 (29.9%) [c]	505 (28.5%) [c]	<0.001**
Fall from height	29 (2.5%)	45 (2.6%)	33 (1.9%)	0.65**
Fall from stairs	63 (5.3%)	80 (4.7%)	78 (4.4%)	0.25**
MVA high speed	28 (2.4%)	37 (2.2%)	44 (2.5%)	0.91**
MVA moderate speed	6 (0.5%)	11 (0.6%)	10 (0.6%)	0.72**
MBA	21 (1.8%)	45 (2.6%)	55 (3.1%)	0.04**
Pedestrian vs. Car	11 (0.9%)	6 (0.3%)	10 (0.6%)	0.06**
Cyclist vs. Car	7 (0.6%)	14 (0.8%)	16 (0.9%)	0.37**
Cycle accident	86 (7.3%)	130 (7.6%)	152 (8.6%)	0.39**
Sports	164 (13.9%) [a, b]	386 (22.5%) [c]	367 (20.7%) [c.]	0.001**
Hobby	30 (2.5%)	27 (1.6%)	32 (1.8%)	0.06**
Work	60 (5.1%) [a, b]	61 (3.6%) [c]	54 (3.0%) [c]	<0.05**
Other	243 (20.6%)	352 (20.5%)	408 (23.0%).	0.4**
Missing	10	10	11	

MVA: Motor vehicle accident, High speed: >30km/h, Moderate speed: <30km/h, MBA: Motor Bike accident
*Chi-square test with Bonferroni correction ** Post-hoc analysis, difference between 2020 compared to the overall average
[a]The observed number of patients differs significantly from 2018
[b]The observed number of patients differs significantly from 2019
[c]The observed number of patients differs significantly from 2020

Table 4. Place of injury (AIS regions)

	2020 N = 1182	2019 N = 1717	2018 N=1775	P-value
Place of injury (%)				<0.001*
Head	52 (4.4%)	89 (5.2%)	93 (5.2%)	0.56**
Face	46 (3.9%)	94 (5.5%) [a]	58 (3.3%) [b]	0.27**
Neck	15 (1.3%)	20 (1.2%)	15 (0.8%)	0.50**
Thorax	32 (2.7%)	43 (2.5%)	63 (3.5%)	0.44**
Abdomen	5 (0.4%)	11 (0.6%)	11 (0.6%)	0.56**
Spine	25 (2.1%)	37 (2.2%)	33 (1.9%)	0.42**
Upper limbs	590 (49.9%) [a]	854 (49.7%)	812 (45.7%) [c]	0.81**
Lower limbs	361 (30.5%)	485 (28.2%) [a]	588 (33.1%) [b]	0.19**
Unspecified	13 (1.1%) [a]	19 (1.1%) [a]	64 (3.6%) [b, c]	<0.05**
Multiple regions	40 (3.4%)	54 (3.1%) [a]	38 (2.1%) [b]	0.18**
Missing	3	10	0	

*Chi-square test with Bonferroni correction ** Post-hoc analysis, difference between 2020 compared to the overall average
[a]The observed number of patients differs significantly from 2018
[b]The observed number of patients differs significantly from 2019
[c]The observed number of patients differs significantly from 2020

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Table 5. Surgery classification based on the example Dayananda et al

Minor trauma	Estimated operative duration <45 minutes	Weber B ankle fracture
Major trauma	Estimated operative duration >45 minutes OR A strict indication for direct surgery	Femoral shaft fracture, crush injury
Polytrauma	Trauma to >1 anatomical regions or ISS>15	Femoral fracture combined with a pneumothorax
NOF	Neck of Femur fracture	Medial collum fracture
Soft tissue trauma	Isolated soft tissue injury	Laceration with tendon injury
Pediatrics	Age<16	Supracondylar humeral fracture in a 10-year old.

Table 6. Treatment

	2020 N = 1182	2019 N = 1717	2018 N=1775	P-value
Treatment (%)				<0.001*
Surgically				
Admission for direct surgery	173 (14.6%) [a, b]	162 (9.4%) [c]	153 (8.6%) [c]	<0.001**
Scheduled surgery	77 (6.5%)	116 (6.8%)	107 (6.1%)	0.84**
Non-surgically				
Admission for observation	61 (5.2%)	71 (4.1%)	84 (4.7%).	0.27**
Outpatient follow up	871 (73.7%) [a, b]	1368 (79.6%) [c]	1431 (80.6%) [c.]	<0.001**

*Chi-square test with Bonferroni correction ** Post-hoc analysis, difference between 2020 compared to the overall average
[a]The observed number of patients differs significantly from 2018
[b]The observed number of patients differs significantly from 2019
[c]The observed number of patients differs significantly from 2020

Table 7. Admission for surgery

	2020 N = 173	2019 N = 162	2018 N=153	P-value
Time to operation				0.112*
0 Days	65 (37.6%)	82 (50.6%)	60 (39.2%)	0.06**
1-2 Days	91 (52.6%)	67 (41.4%)	79 (51.6%)	0.31**
3-4 Days	11 (6.4%)	7 (4.3%)	6 (3.9%)	0.31**
6 or more days	5 (2.9%)	1 (0.6%)	2 (1.3%)	0.12**
Operation type				0.318*
Minor trauma	23 (8.1%) [b]	9 (2.5%) [c]	14 (7.8%)	0.03**
Major trauma	26 (21.4%)	24 (17.9%)	23 (16.3%)	0.98**
Polytrauma	10 (4.6%)	9 (5.6%)	4 (2.6%)	0.41**
NOF	87 (50.3%)	87 (53.7%)	84 (54.9%)	0.40**
Soft tissue trauma	10 (5.8%)	6 (3.7%)	7 (4.6%)	0.41**
Pediatrics	17 (9.8%)	27 (16.7%)	21 (13.7%)	0.09**

*Chi-square test with Bonferroni correction ** Post-hoc analysis, difference between 2020 compared to the overall average
[a]The observed number of patients differs significantly from 2018
[b]The observed number of patients differs significantly from 2019
[c]The observed number of patients differs significantly from 2020

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STROBE Statement—Checklist of items that should be included in reports of ***cohort studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	4
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	4
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	6
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7
		(*b*) Describe any methods used to examine subgroups and interactions	
		(*c*) Explain how missing data were addressed	
		(*d*) If applicable, explain how loss to follow-up was addressed	
		(*e*) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7-8
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8
		(b) Indicate number of participants with missing data for each variable of interest	
		(c) Summarise follow-up time (eg, average and total amount)	
Outcome data	15*	Report numbers of outcome events or summary measures over time	8

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Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (*b*) Report category boundaries when continuous variables were categorized (*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	8-9
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	8-9
Discussion			
Key results	18	Summarise key results with reference to study objectives	9-10
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	11
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	11
Generalisability	21	Discuss the generalisability (external validity) of the study results	11
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	12

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.

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