

ORIGINAL ARTICLE

Effect of COVID 19 pandemic on time to care, use of ambulance, admission characteristics, demography, injury characteristics, management and outcome of Paediatric Orthopaedic trauma patients admitted to the trauma centre

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Abstract

Background: Lockdown imposed to limit the spread of COVID 19 may have had a significant effect on the time to care, demography, injury causation, injury characteristics, volume and nature of admission, management and outcome of paediatric orthopaedic trauma patients. **Objective:** To document the effect of lockdown on the time to care at KGMU, use of ambulance, volume and type of admissions, demography, injury causation, injury characteristics, management and outcome of paediatric orthopaedic trauma patients. **Methods:** This record review compared age, sex, type of admission, mechanism of injury, injury characteristics, type of treatment, vehicle used for transport, and outcome among patients admitted in pre-lockdown, lockdown and post lockdown. **Results:** Lockdown was associated with decrease in the number of cases ($p < 0.01$), increase in the time since injury to reception ($p < 0.040$), a rise in the share of referred admission ($p < 0.040$), time since reception at KGMU, time to definitive care ($p < 0.001$), high energy falls ($p < 0.001$), injuries at home ($p < 0.001$), higher ISS ($p < 0.001$), non operative treatment ($p = 0.038$) and greater use of ambulance ($p = 0.003$). **Conclusion:** Lockdown resulted in a significant change in the causation and management of injury, significant delays in timeliness of care, reduction in the volume of admissions, an increase in injury severity and share of referral admissions.

Keywords

Pediatric; Orthopedic; Injury; Covid-19

Introduction

The spectrum of Coronavirus induced disease 2019 (COVID-19) ranges from mild to severe. (1). The concept of a lockdown to battle a pandemic is linked to the incubation period of COVID 19 (2). Government of India declared a lockdown on March 22nd, 2020, which included a ban on transport except for essential services and emergency services (3). The lockdown was relaxed in a stepwise manner (4).

The effect of COVID 19 pandemic on hospital planning and injury patterns (5-19) and the type of injuries (13,20-24) has been documented globally.

Restricted outdoor activities due to the lockdown may have led to a reduced practice of risky activity. Travel restrictions imposed during the lockdown in India, fear of unregulated in-hospital exposure to COVID 19 and subsequent self-treatment for minor injuries may have impacted the number of admissions. It is possible that ban

on public transport and mandatory testing for COVID may have led to a delay in care.

The effect of lockdown on the outdoor activities of children may be different from adults, which may result in changes in injury causation and injury characteristics that are different from the adults.

Aim & Objective

To assess the effect of COVID 19 on the epidemiology of paediatric orthopaedic trauma patients admitted to the trauma centre of KGMU.

Material & Methods

Study design: A 'clinical record review' was conducted on musculoskeletal injury patients admitted to the departments of Orthopaedics and Paediatric Orthopaedics of KGMU during the period 1st October 2019 to 31st March 2021.

Study setting: Before the onset of pandemic injured patients were received in the casualty where primary care was provided before being transferred to the concerned department for definitive care. After the onset of pandemic, the patients were received in holding area where primary care was provided before being transferred to covid/non-covid facility for definitive care. Records of the musculoskeletal injury patients less than eighteen years of age admitted to the trauma centre of KGMU during the duration 1st October 2019 to 31st March 2021 were reviewed. Patients admitted in the pre-lock period (1st October 2019 to 21st March 2020), lockdown period (March 2020 to 31st September 2020) and post lockdown period (1st October to 31st March 2021) were compared for time to care at KGMU (primary care and definitive care), use of ambulance for transportation, type of admission (direct or referred), patient demography, injury causation, injury characteristics (severity, type, pattern, nature, regions involved), management (operative or non-operative) and outcome of admission.

Inclusion criteria: Musculoskeletal injury patients below the age of 18 years were included in the study.

Exclusion criteria: Patients with incomplete records were excluded from the study.

Ethical approval: The study was approved by the institutional ethics committee (Ref. Code: 111th ECM 11A/P4)

Written informed consent: The provision of written informed consent was waived as the study involved a review of medical records requiring no contact with human subject, data used for analysis had been entered in the medical records of the patients for routine treatment of the patients, no extra data was collected for the study and identifying information was not obtained to prevent linking with identifiable human subjects

Sample Size: All patients admitted during the study period and meeting the eligibility criteria were included in the study.

Data collection: Medical records of the patients were retrieved from the record sections of the department of

orthopaedics and Paediatric Orthopaedics. These included the case sheet, prescription generated in receiving area, admission slip, X-rays and discharge certificates. These records were used to retrieve information regarding time spent since injury to arrival in receiving area of KGMU (holding area or casualty), time spent by the patient in receiving area (casualty/holding area) before being transferred to concerned department for definitive care, diagnosis, abbreviated injury scale code, Injury severity score (ISS), type of injury (blunt/penetrating/both), mode of injury (road traffic injury/low energy fall/high energy fall/direct blow/sports related/occupation related/domestic accident/deliberate self-harm), site where the injury was sustained (home/public area/school or day care/sports area), district where injury was sustained (Lucknow and adjoining/others), vehicle used for transportation to KGMU (ambulance/non ambulance), type of admission (directly admitted/referred from some other centre), type of treatment (operative or non-operative), clinical fracture type (simple fracture or compound fracture), anatomical regions involved and the type of orthopaedic injury (fracture/fracture dislocation/crush/ amputation/dislocation/physeal injury/combination of more than one type).

Abbreviated injury scale code is an anatomical injury severity scoring system that classifies an individual injury by body region according to a severity scale of 0-6. AIS code and the score were recorded using the description of the injury recorded in the case sheet and the X-rays of the patient. Injury severity score was calculated using the AIS code. In literature low energy falls have been described as those in which the victim fell from a height of less than 20 feet (25). We used the same criterion to classify falls into low energy or high energy. Once a patient reaches the receiving area of KGMU, a prescription paper is generated on which the time at which the patient was received is recorded. When the patient reaches the concerned department for definitive care, an admission slip is generated on which the time of admission to the concerned department is recorded. These were used to calculate the time spent in receiving area before admission for definitive care. Time spent before reaching KGMU was recorded using the prescription generated in the receiving area. Information regarding mechanism of injury, site where injury was sustained, type of admission, vehicle used for transportation to KGMU, injury related information and type of treatment provided was recorded using information recorded in the case sheet of the patient.

Statistical analysis: Continuous data was described using means and standard deviation. Categorical data was summarized using frequency distribution tables and chi-square test. Associations were tested by using chi square test. One way analysis of variance (ANOVA) was used to compare the means of continuous variables.

Results

One hundred seventy four paediatric orthopaedic trauma patients were admitted in the study period. Medical records of eight patients were incomplete and therefore they were not included in analysis. Of the one hundred sixty six paediatric orthopaedic trauma patients with complete records, 78 were admitted in pre-lockdown period, 33 in lockdown period and 55 in post lock down period.

Patient demography: There was no significant effect on the age ($p=0.148$) and sex distribution ($p=0.260$) [Table 1&Table 2](#).

Injury and it's management: In pre-lockdown as well as post lock down periods, the two most common modes of injury were road traffic accidents and high energy fall [Table 3](#). None of the injured subjects admitted during pre-lockdown period and post lockdown period sustained injury as a result of domestic violence. During the lockdown high energy falls were the most common mode of injury ($n=15$;45.45%). Domestic violence was the mode of injury in 6.06% ($n=2$) cases in the lockdown period. There was a significant difference in the mode of injury ($p<0.001$) [Table 3](#). In pre-lockdown as well as post-lockdown periods, the most common site where the subject got injured was a public place ($n=54$; 69.2% for pre-lockdown & $n=40$; 72.7% for post-lockdown). During lockdown, the most common site of injury was home ($n=20$; 60.6%). In the pre-lockdown, 15 (19.2%) subjects sustained injury while in school (other than sports). In the post lockdown 10 subjects (18.2%) got injured while indulging in an outdoor sport. There was a significant difference in the site where injury was sustained ($p<0.001$) [Table 3](#).

During pre-lockdown, 43 subjects (55.1%) sustained injury in Lucknow and adjoining districts. The corresponding figures for lock down and post-lockdown were 13 (39.4%) and 19 (35.2%). There was no significant difference in the district where injury was sustained [Table 3](#). The number of cases using an ambulance for transfer to KGMU was 57 (73.1%) in pre-lockdown, 32 (97%) during lockdown period and 49 (89.1%) during post-lockdown period. Overall, there was a significant difference in the vehicle being used for transport to KGMU by the injured cases [Table 3](#).

Mean injury severity score changed form 7.03 ± 3.93 in pre-lockdown to 12.58 ± 7.64 in lockdown and 9.24 ± 6.44 in post lockdown periods respectively. The difference in injury severity score was significant ($p<0.001$) [Table 4](#).

The number of cases with pure orthopaedic injury was 77 (98.7%) in pre-lockdown period, 30 (90.9%) in lockdown period and 48 (87.3%) in post lockdown period. There was a significant difference in the injury pattern ($p=0.027$) [Table 5](#). The difference in the type of injury ($p=0.567$), nature of injury ($p=0.153$) and the regions involved ($p=0.088$) was not significant [Table 5](#). The percentage of

cases with spinal involvement changed from 5.1% ($n=4$) in pre-lockdown to 24.3% ($n=8$) and 16.4% ($n=9$). However, the difference did not reach significant levels ($p=0.088$) The number of cases managed operatively was 59 (75.6%) in pre-lockdown period, 39 (48.5%) during lockdown period and 39 (70.9%) in post lockdown period. The change in type of definitive management was significant ($p=0.038$) [Table 5](#).

Type and outcome of admission: Lockdown as well as post lockdown periods had a higher percentage of referred admissions. The change in type of admission was significant ($p<0.001$) [Table 6](#). During lockdown a higher percentage of cases were transferred to other departments for further management. However, overall there was no effect on the outcome of admission ($p=0.222$) [Table 6](#).

Time to care at KGMU: Mean time since injury to receiving of the subject changed from 52.54 ± 76.85 hrs in the pre lockdown to 90.03 ± 90.93 hrs in the lockdown and 71.18 ± 51.43 hrs in the post-lockdown periods. The change in time since injury to being received was significant ($p=0.040$). Mean time spent before definitive care was provided to the injured subject changed from 1.05 ± 0.31 hrs in pre-lockdown period to 15.02 ± 7.08 hrs in lockdown period and 17.45 ± 2.13 hrs in post-lockdown period. The change in time spent before definitive care was provided to the injured subject was significant ($p<0.001$) [Table 7](#).

Discussion

A reduction in the volume of paediatric orthopaedic trauma cases as reported by us as well as by other studies (26-28) is likely a result of strict implementation of social distancing measures and consequent reduction of outdoor activities like travel and sports (27). The decrease in number of admissions could also be attributed to a parents preferring to treat the child at home rather than taking the child to the hospital duet to fear of getting infected (26). A number of international studies have reported lockdown to decrease the numbers of road traffic accidents globally (29-31) which might be the reason for an overall decrease in the volume of admissions as reported by us and other studies (26-28). Lockdown is known to decrease the numbers of road traffic accidents resulting in non serious injuries but not those that result in serious injuries (32). This explains the higher mean injury severity score of the admitted patients in the lockdown as reported by us. Patients referred from other centres are known to have a higher injury severity (33). Compound fractures are rated higher on the abbreviated injury scale used to calculate injury severity score compared to their simple fracture counterparts (34). A higher share of compound fractures and a higher share of referred patients during lockdown could be the reason for the significantly higher injury severity score in patients admitted during lockdown in our study.

This study showed an increase in share of high energy falls along with a concomitant decrease in the share of road traffic accidents during the lockdown, which is in keeping with the results of studies that investigated the effect of lockdown on injury causation (26,27). A fall in number of injuries due to road traffic accidents and consequent admissions is expected due to the lockdown due to restriction of traffic. This study demonstrated an increase in share of injuries sustained at home along with a concomitant decline in the share of injuries sustained at public places, schools, residential hostels and sporting activity during lockdown, which is in line with the findings of other studies that investigated the effect of lockdown on injury causation (26,27). This is expected as strict implementation of the lockdown resulted in children being largely confined to homes during the lockdown.

In the present study, the share of patients managed non-operatively went up from 24.4% in pre-lockdown to 51.5% during lockdown and came down to 30.1% in post-lockdown. The reduction in operative cases during lockdown seen in our study is consistent with findings from multi-centric studies from Scotland (35) and Italy (36) as well as single centre studies from Cardiff (37) and Madrid (38). We are unable to comment on the exact cause for this reduction in the share of cases being managed operatively during lockdown as this was beyond the purview of our study. A possible reason could have been the redirection of human resources towards the management of COVID patients

In the present study, there was a significant rise in the share of referral admissions during lockdown. A rise in the share of referral admissions is expected as strict implementation of lockdown may have resulted in patients rushing to the nearest possible health facility instead of trying to come directly to KGMU. However, we cannot infer this on the basis of results of our study. Referral from another centre is known to be associated with a higher time since injury to admission at trauma centres compared to direct admissions to trauma centres (39,40), which could be the case in our study as 97.97% of the patients admitted during lockdown had been referred from some other centre.

This study showed a significantly greater use of ambulance for transportation of trauma patients admitted to KGMU during lockdown. Since an ambulance was allowed to move freely during the lockdown and had an easy access to hospital, it is likely that patients or their parents preferred an ambulance over using other vehicles to reach KGMU. However, we cannot conclude this on the basis of the results of this study.

The present study is the first to record the effect of mandatory RTPCR testing for COVID 19 in the holding area. During lockdown, there was a significant increase in the time spent in the receiving area before transfer to definitive care. In the first week of February, 2020, only 14 laboratories were testing for COVID-19 (41) which

increased to 106 by the end of March (41) and to 1596 by August, 2020 (41). In the absence of testing facilities, the virology lab of KGMU received and conducted RTPCR tests on samples received from other parts of Uttar Pradesh in addition to the patients being admitted to KGMU. Thus an extremely large number of samples might have been the reason for delay in transfer of the patients for definitive care. Once the lockdown was lifted, the time spent in receiving area increased from 15.02±7.08 hrs to 17.45±2.13 hrs. Elective admission was allowed after lockdown, which resulted in an increase in the number of cases being admitted at KGMU, which resulted into more tests and a consequent increase in the time spent in holding area.

A limitation of our study is that it pertains to patients coming to KGMU which is a tertiary care centre and therefore results of our study cannot be generalized to primary and secondary care centers.

Conclusion

This study demonstrated that the lockdown resulted in a significant change in the causation and management of injury, significant delays in timeliness of care, a reduction in the volume of admissions, an increase in injury severity and share of referral admissions in paediatric orthopaedic trauma cases. It also demonstrated that requirement of a negative RTPCR for COVID 19 lead to a significant delay in institution of definitive care, a practice which might be leading to overcrowding in the holding area.

Recommendation

Pandemic can lead to a significant disruption in paediatric orthopaedic trauma services like delay in care, crowding of receiving area, change in choice of treatment and a significantly increased use of government ambulances for transport of injured patients to the trauma centre. Our health care system needs to take these into account to prepare for future outbreaks of COVID 19 variants or other pandemics.

Limitation of the study

This study pertains to patients coming to KGMU, which is a tertiary care centre and therefore results of our study cannot be generalized to primary and secondary care centres.

Relevance of the study

COVID 19 pandemic resulted in significant changes in causation, severity and management of paediatric orthopaedic injuries, overcrowding of holding area and delay in care.

Authors Contribution

AB– Literature review & data collection. VV–Concept, study design, analysis of data & drafting of manuscript. SFA– Study design & revision of manuscript. AR– Literature review, collection and analysis of data. SC–

Drafting of the manuscript. AS– Study design & final approval of manuscript.

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Tables

TABLE 1 EFFECT ON AGE

Period	Age in years		one way ANOVA	
	Mean	SD	F-value	p-value
Pre Lockdown	12.6	3.38	1.93	0.148
Lockdown	13.91	2.31		
Post Lockdown	12.44	4.5		

TABLE 2 EFFECT ON SEX DISTRIBUTION

Variable		Pre-lockdown		Lockdown		Post lockdown		Chi-sq	p-value
		N = 78		N=33		N=55			
		No.	%	No.	%	No.	%		
Sex	Male	57	73.1	19	57.6	36	65.5	2.69	0.26
	Female	21	26.9	14	42.4	19	34.5		

TABLE 3 EFFECT ON THE INJURY CAUSATION (MODE, SITE AND DISTRICT) AND UTILIZATION OF AMBULANCE

Variable		Pre-lockdown		Lockdown		Post-lockdown		Chi-sq	p-value
		N=78		N=33		N=55			
		No	%	No	%	No	%		
Mode	Road traffic accident	48	61.5	13	39.4	37	67.3	34.65	<0.001
	Low energy fall	10	12.8	3	9.1	2	3.6		
	High energy fall	20	25.6	15	45.45	13	23.6		
	Work related	0	0	0	0	3	5.5		
	Domestic violence	0	0	2	6.06	0	0		
	Direct blow	0	0	0	0	0	0		
	Self harm	0	0	0	0	0	0		
Site	Home	5	6.4	20	60.6	5	9.1	53.71	<0.001
	Public place	54	69.2	13	39.4	40	72.7		
	School/Daycare/ Residential	15	19.2	0	0	0	0		
	Outdoor sports	4	5.1	0	0	10	18.2		
	District	Lucknow and adjoining	43	55.1	13	39.4	19		
Others	35	44.9	20	60.6	35	64.8			
Vehicle used for transport	Ambulance	57	73.1	32	97	49	89.1	11.52	0.003
	Others	21	26.9	1	3	6	10.9		

TABLE 4 EFFECT OF LOCKDOWN ON INJURY SEVERITY

Period	ISS Score		one way ANOVA	
	Mean	SD	F-value	p-value
Pre Lockdown	7.03	3.93	11.17	<0.001
Lockdown	12.58	7.64		
Post Lockdown	9.24	6.44		

TABLE 5 EFFECT ON INJURY CHARACTERISTICS AND ITS MANAGEMENT

Variable		Pre-lockdown		Lockdown		Post-lockdown		Chi-sq	p-value
		N=78		N=33		N=55			
		No	%	No	%	No	%		
Injury pattern	Ortho	77	98.7	30	90.9	48	87.3	7.23	0.027
	Ortho-poly	1	1.3	3	9.1	7	12.7		
Clinical type of fracture	Simple	59	78.7	23	74.2	28	56	9.6	0.048
	Compound	15	20	6	19.4	17	34		
	Combination	1	1.3	2	6.5	5	10		
Type of injury	Blunt	77	98.7	33	100	55	100	1.14	0.567
	Penetrating	1	1.3	0	0	0	0		
Nature of injury	Fracture	68	87.2	22	66.7	41	74.5	16.91	0.153
	Crush	1	1.3	0	0	0	0		

Variable		Pre-lockdown N=78		Lockdown N=33		Post-lockdown N=55		Chi-sq	p-value
		No	%	No	%	No	%		
Region involved	Amputation	2	2.6	1	3	1	1.8	19.04	0.088
	Dislocation	1	1.3	0	0	0	0		
	Physal injury	1	1.3	0	0	1	1.8		
	Fracture dislocation	2	2.6	3	9.1	1	1.8		
	Combination	3	3.8	7	21.2	11	20		
	Upper Limb	34	43.6	8	24.2	17	30.9		
	Lower Limb	34	43.6	13	39.4	23	41.8		
	Pelvis	2	2.6	0	0	0	0		
	Spine	3	3.8	6	18.2	4	7.3		
	Pelvis with extremity	3	3.8	2	6.1	2	3.6		
Management	Spine with extremity	1	1.3	2	6.1	5	9.1	10.13	0.038
	Both extremities	1	1.3	2	6.1	4	7.3		
	Operative	59	75.6	16	48.5	39	70.9		
	Non-operative	19	24.4	17	51.5	16	30.1		

TABLE 6 EFFECT ON THE TYPE AND OUTCOME OF ADMISSION

Variable		Pre-lockdown (N=78)		Lockdown (N=33)		Post Lockdown (N=55)		chi sq	p-value
		No.	%	No.	%	No.	%		
Type	Direct	21	26.9	1	3.03	1	1.8	23.98	<0.001
	Referred	57	73.1	32	96.97	54	98.2		
Outcome	Discharged	71	91	28	84.8	53	96.4	8.23	0.222
	Left against medical advice	4	5.1	2	6.1	1	1.8		
	Absconded	3	3.8	1	3	0	0		
	Transfer	0	0	2	6.1	1	1.8		
	Expired	0	0	0	0	0	0		

TABLE 7 EFFECT ON TIME TO CARE (PRIMARY AND DEFINITIVE) PROVIDED AT KGMU

Period	Time since injury to receiving area		one way ANOVA		Time spent before definitive care		One way ANOVA	
	Mean	SD	F-value	p-value	Mean	SD	F-value	p-value
Pre Lockdown	52.54	76.85	3.28	0.04	1.05	0.31	441.34	<0.001
Lockdown	90.03	90.63			15.02	7.08		
Post Lockdown	71.18	51.43			17.45	2.13		