Journal of Surgery
Guidozzi N, et al. J Surg 7: 1665
www.doi.org/10.29011/2575-9760.001665
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Research Article

Effect of the Covid-19 Lockdown Regulations on the Severe Trauma Burden in an Urban Trauma Centre in Johannesburg, South Africa

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Citation: Guidozzi N, Joubert IM, Moeng MS (2022) Effect of the Covid-19 Lockdown Regulations on the Severe Trauma Burden in an Urban Trauma Centre in Johannesburg, South Africa. J Surg 7: 1665. DOI: 10.29011/2575-9760.001665

Received Date: 03 December, 2022; **Accepted Date:** 13 December, 2022; **Published Date:** 16 December, 2022

Abstract

Background: During the Covid-19 pandemic, the South African government introduced stringent lockdown restrictions. Social restrictions affected patient presentation to hospitals with non-Covid related illnesses.

Objectives: The aim of this research is to investigate the effect of lockdown on the major trauma presentation in a level one trauma centre in Johannesburg, as well as to assess how lockdown affected emergency and semi-emergency trauma surgical procedures.

Method: This is a retrospective data analysis of major trauma patients presenting to Charlotte Maxeke Johannesburg Academic Hospital between 26 March to 13 July 2020 and 2019. The Medibank records of priority one patients presenting to the hospital over the time period were reviewed, and data were analysed per level of lockdown- patient demographics, day of the week on presentation, mechanism of injury and patient discharge destination from casualty were recorded. Injury Severity Scores (ISS) were calculated based on presenting injuries, imaging and intra-operative findings. All emergency and semi-emergency procedures over this time were also analysed. The 2019 and 2020 Data was compared, and statistical differences were calculated. A p-value of <0.05 was considered statistically significant.

Results: An analysis of 1060 patients split between 595 patients in 2019 and 465 in 2020 was made. Level 5 lockdown had statistically significantly fewer priority one trauma case presentations in 2020 than 2019 ($p=0.000$), Level 4 had no statistically relevant change in patient number presenting to hospital, and Level 3 had statistically significant more priority one patients presenting in 2020 compared to 2019 ($p=0.000$). Penetrating trauma was persistently the most common mechanism of injury in both years, with a statistically significant reduction in train-related injuries in 2020 ($p=0.011$) and slightly more 'fall from heights' in 2020 (p-0.033). Fewer weekend and public holiday major trauma presentations occurred during the lockdown in 2020 ($p= 0.003$ and $p=0.001$ respectively) compared to 2019. Less emergency/ semi-emergency trauma surgeries were performed in 2020 in contrast to 2019 ($p=0.000$). Core Exam Technique Principles

Conclusion: The results show a decline in major trauma presentation during the most limiting lockdown restrictions (Level 5) with a rebound increase in trauma during more relaxed lockdown regulations (Level 3). Lockdown shifted the presentation of major trauma to predominantly weekdays. There was a decline in surgical emergency and semi-emergency procedures but no change in overall ISS. The data highlights the diversity and complexity of trauma in Johannesburg, with difficulty in identifying primary prevention strategies.

Introduction

On 05 March 2020, the first case of Covid 19/ SARS-CoV-2 infection was confirmed in South Africa. Ten days after this diagnosis, the South African Government declared a National State of Disaster [1]. The anticipated healthcare burden that the virus would cause globally, especially in developing countries, was predicted to be calamitous. This led to a levelled lockdown, where the government implemented various social restrictions. Lockdown ranged from level 5 to 1 with restrictions on movement, trade, social gatherings and the prohibition of alcohol and tobacco sales. Level 5 was 'hard lockdown' with more relaxed restrictions at lower levels. The fundamental social restrictions over this period included the following level limitations;

Level 5 (26 March to 01 May): a ban of all alcohol and tobacco sales, opening of essential services exclusively, retail of essential goods and prohibition of travel There were also limitations on the transport capacity of passengers and a ban on rail and air travel.

Level 4 (01 May to 31 May) relaxed certain parameters, including the softening of the stay-at-home order and the return to work of some industries such as mining. A curfew was implemented between 20h00 and 05h00, and exercise was permitted exclusively between 06h00 and 09h00. Group gatherings of up to 50 people at a funeral were approved. Rail travel at partial capacity was also re-introduced.

June and July 2020 saw the introduction of Level 3 (01 June to 13 July) with the easing of many limitations, followed by a premature cessation of predicted freedom and the re-introduction of strict restrictions from 13 July. The initial Level 3 lockdown criteria included exercise between 06h00 and18h00, the return to educational facilities, a resumption of alcohol sales from Monday to Thursday between 09h00 and 17h00, greater freedom of movement and a residual prohibition of tobacco sales [2-4]. The government deemed these restrictions crucial to stop the spread of the virus and reduce the burden on hospitals to facilitate the care required to treat patients infected with Covid-19. This research contemplates the effect that the restrictions had on the major trauma presentation at a level one trauma centre in Johannesburg during level 3-5 Lockdown. This time frame was chosen as the trend of alcohol sales related to trauma could be easily studied.

South Africa, notoriously, has a high burden of trauma that is multifactorial in origin. [5] According to the 2018/2019 South African crime statistics, 170 979 cases of assault with intent to commit grievous bodily harm and 162 012 common assault cases were recorded.[6] In 2019, 2180 fatal motor vehicle accidents were documented in Gauteng alone, with pedestrians and passengers identified as being most at risk of death.[7] Therefore, it is understandable that trauma strains an already overloaded South African healthcare system. This study took place at Charlotte Maxeke Johannesburg Academic Hospital (CMJAH), a 1088 bed tertiary level state hospital. The hospital is a level one trauma centre serving communities in Gauteng and the surrounding provinces [8].

During the lockdown period, anecdotal reports of reduced priority one trauma patient presentation to CMJAH were noted. The trend of trauma presentation seemed to vary with each level of lockdown, a phenomenon that was observed across the world. As such, the aim of this study was to compare the volume, characteristics and outcomes of trauma priority one patients presenting during the early phases of the Covid-19 lockdown in Johannesburg (Level 3-5) to the corresponding time period from the previous year.

Objectives

The lockdown period offered a unique social experiment on potential primary prevention strategies for trauma. The hypothesis was that there was a reduction in significant trauma (priority one patient) presentation and associated surgery over the fifteen-week period where stringent restrictions were placed on the country.

Method

This study is a retrospective descriptive study where data was collected from all priority one patients seen in a single level one trauma facility, spanning the time frame 26 March to 13 July in 2019 and 2020, respectively. Data was collected using Medi Bank forms which are hospital paper records completed at the time of presentation for all patients deemed to be priority one.

Patient demographics, day of the week on presentation, mechanism of injury and patient discharge destination from casualty were analysed per level of Lockdown for Level 5-3. Injury Severity Scores (ISS) were calculated based on presenting injuries, imaging and intra-operative findings. All emergency trauma surgery operations performed over this period were also included in this study (excluding orthopaedic and neurosurgery procedures). Emergency surgery was regarded as immediate or urgent surgery as per the National Confidential Enquiry into Patient Outcome and Death (NCEPOD1 and NCEPOD2); semi- emergency procedures were based on expediated surgery (NCEPOD3) classification.[9] Trauma operations performed in 2019 were compared to 2020 data, and procedures performed during each level of lockdown were assessed. The Wits Human Research Ethics Committee approved the research. 2019 Data was used as the control group as no social restrictions were yet in place. (M200825 Med 20-05-122)

The data was analysed using SPSS version 25.

Results

The population group studied was predominantly made up of males with a mean age of 32. The sample was based on an analysis of 1060 priority one trauma cases split as 595 cases (56.1%) recorded in 2019 and 465 cases (43.9%) recorded in 2020 over the allocated time period. There was a significant decline of 21.8% in the number of priority one cases presenting to the unit in 2020, as indicated by a p-value of 0.000. The results revealed that statistically fewer Lockdown level 5 priority one cases presented (17,8%) in 2020 compared to 40.5% of cases in 2019 (p=0.000). Level 4 restrictions showed no statistical difference in major trauma patient volume comparing 2019 and 2020. There were significantly more level 3 priority one cases in 2020 than in the pre-Covid era in 2019 (63.4% and 39% p=0.000) (Table 1, Figure 1).

Variable	Option	Year		Total	P-value
		2019	2020		
Total		595 (56.1%)	465 (43.9%)		.000
Age	N (Mean)	592 (32.81)	456 (32.74)	1048 (32.78)	.898
Gender	Female	37 (6.2%)	36 (7.7%)	73 (6.9%)	.332
	Male	558 (93.8%)	429 (92.3%)	987 (93.1%)	
Worst BP (systolic)	N (Mean)	593 (117.16)	464 (120.05)	1057 (118.43)	.065
HR	N (Mean)	593 (97.85)	465 (96.61)	1058 (97.3)	.309
ISS	N (Mean)	594 (12.68)	465 (11.38)	1059 (12.11)	.130
Injury mechanism	Penetrating	344 (57.8%)	257 (55.3%)	601 (56.7%)	.417
	Blunt	250 (42%)	205 (44.1%)	455 (42.9%)	.532
	Other	1 (0.2%)	3 (0.6%)	4 (0.4%)	.325
Level	Level 3	232 (39%)	295 (63.4%)	527 (49.7%)	.000
	Level 4	122 (20.5%)	87 (18.7%)	209 (19.7%)	.485
	Level 5	241 (40.5%)	83 (17.8%)	324 (30.6%)	.000
ISS Category	ISS <15	405 (68.1%)	332 (71.4%)	737 (69.5%)	.253
	ISS 16-75	177 (29.7%)	121 (26%)	298 (28.1%)	.191
	ISS >75	12 (2%)	12 (2.6%)	24 (2.3%)	.541
	ISS unknown	1 (0.2%)	0 (0%)	1 (0.1%)	1.000

*MOI	Stab	222 (37.3%)	151 (32.5%)	373 (35.2%)	.106
	Assault	66 (11.1%)	53 (11.4%)	119 (11.2%)	.922
	Burn	13 (2.2%)	17 (3.7%)	30 (2.8%)	.191
	FFH	30 (5%)	39 (8.4%)	69 (6.5%)	.033
	GSW	122 (20.5%)	101 (21.7%)	223 (21%)	.649
	MBC	11 (1.8%)	9 (1.9%)	20 (1.9%)	1.000
	MVC	68 (11.4%)	47 (10.1%)	115 (10.8%)	.551
	PVC	48 (8.1%)	24 (5.2%)	72 (6.8%)	.066
	Train related	8 (1.3%)	0 (0%)	8 (0.8%)	.011
	Unknown	1 (0.2%)	3 (0.6%)	4 (0.4%)	.325
Day of week	Weekday	293 (49.2%)	295 (63.4%)	588 (55.5%)	.000
	Weekend	248 (41.7%)	152 (32.7%)	400 (37.7%)	.003
	Public holiday	53 (8.9%)	18 (3.9%)	71 (6.7%)	.001
	Unknown Day	1 (0.2%)	0 (0%)	1 (0.1%)	1.000
Outcome	Admission	318 (53.4%)	263 (56.6%)	581 (54.8%)	.320
	D/C	202 (33.9%)	171 (36.8%)	373 (35.2%)	.364
	Refer	59 (9.9%)	12 (2.6%)	71 (6.7%)	.000
	RHT	6 (1%)	7 (1.5%)	13 (1.2%)	.577
	Death	9 (1.5%)	12 (2.6%)	21 (2%)	.268
	Unknown	1 (0.2%)	0 (0%)	1 (0.1%)	1.000

*Breakdown of most common mechanism of injury only (ISS= injury severity score, FFH= fall from height, MBC= motor bike collision, MVC= motor vehicle collision, PVC= pedestrian vehicle collision, D/C= discharge, RHT= refuse hospital treatment)

Table 1: Data comparison from 2019 to 2020.

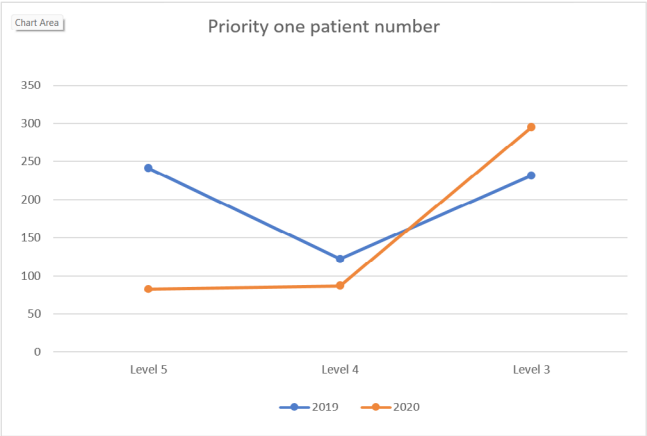
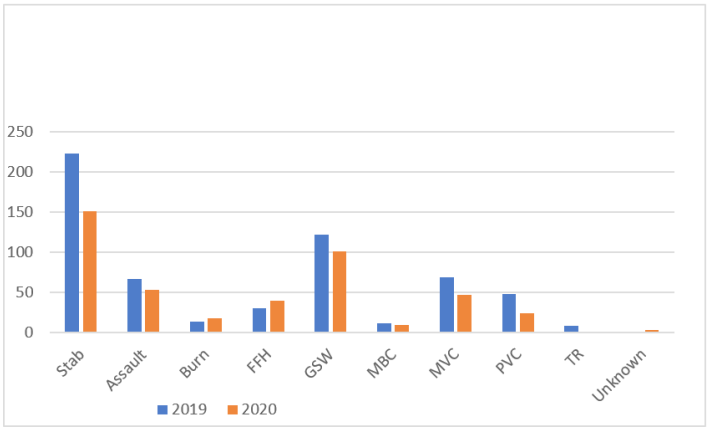


Figure 1: Priority One Patient Presentation to Charlotte Maxeke Academic Hospital in 2019 and 2020 based on Lockdown Levels.

Overall, penetrating trauma was the main mechanism of injury in 2019 and 2020, with the average ISS recorded between eleven and thirteen for both years. Mode of injury broken down further indicated that stab wounds made up the majority of injuries in both 2019 and 2020 (222 patients in 2019 and 151 patients in 2020), followed by gunshot injuries (122 patients in 2019 and 101 patients in 2020) (Table 1).

In 2020, there were considerably more cases reported on weekdays (63.4%), and significantly fewer cases reported on weekends (32.7%) and public holidays (3.9%) compared to 49.2%, 41.7%, and 8.9%, respectively for 2019 (p-value <0.05) (Table 1).

There were significantly less train-related cases in 2020 with 0% recorded compared to 1.3% in 2019 (p-value = 0.011) and slightly more "fall from heights" recorded in 2020 (p-value=0.033). There were no significant differences for the rest of the variables, including the ISS score, injury mechanism, disposition from casualty, age or gender (Table 1, Figure 2). There were, however, fewer patients stepped down to lower levels of care in 2020 compared to 2019.



FFH: Fall From Height , GSW: Gunshot Wound, MBC: Motor Bike Collision, MVC: Motor Vehicle Collision, PVC: Pedestrian Vehicle Collision, TR: Train Related

Figure 2: Most Common Mechanism of Injury in Priority One Patients in 2019 and 2020

The results showed that there were significantly less total emergency / semi-emergency general surgeries performed in 2020 (34.3%) compared to 2019 (65.7%) (p-value = 0.000). Of the patients requiring surgery, 28% of priority one patients required emergency procedures in 2020 as opposed to 37% in 2019. There were no significant differences in the types of surgery performed: laparotomies/ laparoscopies, thoracotomies, damage control surgery and relooks by year. Of the procedures performed in 2020, a greater proportion were emergency procedures than semi-emergent procedures when compared to 2019 (89% in 2020 compared to 78% in 2019) (Table 2).

Procedures	Year		Total	P-value
	2019	2020		
Total surgery	278 (65.7%)	145 (34.3%)	423 (100%)	.000
Total emergency procedure	219 (78.8%)	130 (89.7%)	349 (82.5%)	.005
Total semi emergency procedure	59 (21.2%)	15 (10.3%)	74 (17.5%)	.005
Laparotomy	166 (59.7%)	80 (55.2%)	246 (58.2%)	.406
laparoscopy	1 (0.4%)	0 (0%)	1 (0.2%)	1.000
Thoracotomy	34 (12.2%)	13 (9%)	47 (11.1%)	.334
Damage Control Surgery (DCS)	15 (5.4%)	14 (9.7%)	29 (6.9%)	.108
Relook	60 (21.6%)	30 (20.7%)	90 (21.3%)	.901

Table 2: Surgical procedures recorded in 2019 and 2020.

Discussion

The planned strategies instituted by the South African Government during the lockdown periods were such that if social interactions and movement were limited, the spread of the SARS-COV-2 virus could be curbed. The added benefit to society would be a reduction in patients attending hospitals with non-Covid related pathology, draining precious resources and straining an already burdened healthcare system. There was a clear incentive for national primary prevention of trauma, presumably resulting in a decline in potentially avoidable injuries and, therefore, fewer unnecessary hospital admissions. From the data collected in this study, Johannesburg experienced an initial decline in major trauma in Level 5 followed by a substantial rise in trauma in Level 3. Multiple studies have evaluated trauma trends over various lockdown intensities in different countries. Local studies from Cape Town and Kwa-Zulu Natal have shown similar trends as seen in this study; a significant reduction in trauma initially, followed by a rise in trauma as restrictions eased.[10-12] The causes of

these local findings are probably multifactorial, with a sobering reminder of how complex the South African trauma burden is.

Alcohol Prohibition

The main contributor to local trauma decline is likely due to the prohibition of alcohol sales. South Africa was one of a handful of countries worldwide that implemented an alcohol ban during the Covid-19 pandemic. Alcohol misuse and trauma have been evaluated in much research. In 2004, Bowley et al.[13] showed that 59% of trauma patients from our hospital's catchment area had raised alcohol blood levels, attributing much of our local trauma burden to concomitant alcohol use. [13] Stockwell et al.[14] explored many of the social repercussions related to alcohol misuse and the demand this places on the healthcare system, praising South Africa for restrictive measures.[14] Chu et al.[15] convincingly showed how rates of trauma presentation were directly related to alcohol prohibition during Covid-19, proving that even mild relaxation of sales caused trauma presentation to increase,[15] reflecting the results seen in our study. Chu et al. identified alcohol prohibition as the most effective restrictive measure in reducing hospital trauma presentation during Lockdown [15].

Factors causing a Decrease in Trauma

Other factors to consider when assessing the reduction in trauma presentation initially include the fact that Level 4 and 5 lockdown occurred during the infancy of the pandemic; as such, one should consider the element of fear surrounding Covid-19 infection at this time.[16] It could be surmised that fear of the SARS/COV 2 virus infection and hospital admission during a pandemic, as well as fear of legal repercussions if restrictions were ignored,[17] may have had a role in maintaining social distancing and minimising trauma. The impact that Lockdown Level 5 had on our community may well have been due to the radical restrictions or a "buy-in" by the community, with a view to being compliant with government strategies. A United Kingdom UCL Jill Dando Institute of Security and Crime Science report noted that compliance to restrictions during lockdown might have been driven by an individual's ethical compass to 'do the right thing' and help others. The UK repeatedly coerced good behaviour based on the premise that restrictions would assist healthcare workers during the highest burden of Covid-19 disease.[17] According to the same report, adherence to lockdown protocol was also based on a desire to conform to social norms at the time, in this case, maintaining social distancing [17].

Morris et al.[10] suggested that decreased numbers of vehicles and pedestrians on the road added to the reduction in trauma seen in Kwa-Zulu Natal during Lockdown.[10] A significant decline in motor vehicle-related trauma is not a trend well demonstrated in our study. As such, we cannot draw the same conclusion that transportation restrictions added to the reduction in trauma presentation in Johannesburg; however, this could be looked into in more detail in the future. Exploring the decline in trauma experienced during parts of Lockdown, one must mention that despite significant restrictions, major trauma was not totally eliminated. It may be that other mechanisms of injuries, such as, stab wounds and gunshot injuries account for the numbers that persist. At our hospital, stab wounds and gunshot injuries were the two most common causes of injury in 2019 and 2020. Zsilavecz et al. showed an increase in gunshot wounds in Kwa-Zulu Natal during Lockdown. [11] This parallels research published in Spain, New Zealand and the UK, where the most common mechanisms of injury were motor vehicle collisions and falls [12,18]. Penetrating trauma was not independently dealt with during lockdown in South Africa, which may have been why major trauma persisted during this time. This may be a major factor to address when recognizing primary prevention strategies.

Level 3 Rise in Trauma

The rise in major trauma experienced in Level 3 during 2020 is a trend documented across most of South Africa, although this is not mirrored internationally. The increase in trauma seems to be directly related to the re-initiation of alcohol sales, especially permission for off-site consumption during Level 3.[18] Cape Town reported a 107% increase in trauma post Level 4 and 5 lockdown, citing the re-sale of alcohol as a contributory factor. [12] As compelling as the data is, one must be mindful that other restrictions were lifted simultaneously in Level 3; therefore, this study cannot accurately draw a direct causal relationship between alcohol and trauma, but the inference is there. The rebound increase in major trauma seen in this study may also be related to an increased public understanding of the virus, which dispelled some of the fear surrounding viral spread and disease progression. This may have led to a sense of security and less pressure to conform to social restrictions. The opposite may have also occurred, with individuals experiencing a sense of worsening fear due to social media exposure, resulting in a failure to trust government strategies to safeguard the country, failure to adhere to restrictions, and subsequent high-risk behaviour resulting in major trauma [19]. This is explored in an article by Islam et al.[19] assessing how the Covid-19 infodemic affected people and their behaviour based on rumours, stigmas and conspiracy theories. The article highlights the importance of accurate information dissemination on public platforms and emphasizes the ease at which some people blindly follow misinformation [19].

Weekday Predominance

Trauma presentation related to the day of the week was audited in a 2016 Cape Town study.[20] The audit showed a 130% increase in patient hospital attendance following interpersonal violence during the day on weekends compared to weekdays.

[20] This weekend trauma surge is often noted anecdotally by emergency unit personnel. During Lockdown, this predicted pattern of trauma presentation was not identified. In 2020 there was a reduction in trauma during the weekend, with a similar patient volume during the week compared to 2019. As a proportion of major trauma presentations, the 2020 patient volume during the week is statistically significant. This variation may be a result of people not working (closure of many non-essential jobs), resulting in an increase in vulnerability to trauma during weekdays. It may have also been due to alcohol being sold during the week and not over the weekend, predisposing to high-risk alcohol-related behaviour on weekdays. A noteworthy concept brought up by Navsaria et al.[12] suggested that the increase in domestic interactions during lockdown fuelled trauma presentation based on people being unsafe in their homes. [12] This sentiment is echoed by Zsilavec, who demonstrated a rise in female trauma presentation during Lockdown, thought to be related to domestic violence [11].

Surgeries during Lockdown

The reduction in trauma surgeries performed in 2020 suggests that fewer patients required surgery for the injuries that they presented with. The decrease in semi-emergency procedures is in keeping with a hospital policy to minimise non-emergency procedures during critical periods of the pandemic. The number of surgical procedures performed at each level of Lockdown are in keeping with the volume of trauma presenting at each level. Worldwide similar reductions in trauma surgery have been seen, reporting between a 21%-66% reduction in emergency surgery, with most papers reporting the effect of Covid-19 on orthopaedic trauma surgery [21] (Figure 3).

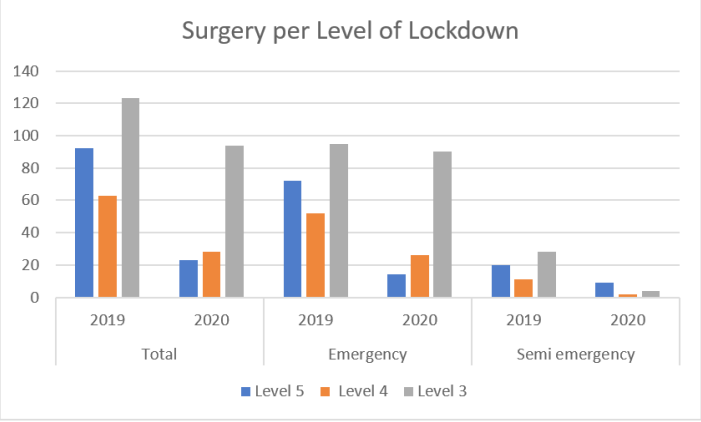


Figure 3: Surgical procedures per Lockdown level.

Internationally the decline in trauma surgery was overwhelmingly due to the 'stay at home order' reducing motor vehicle-associated trauma, which is one of the leading trauma mechanisms of injury in many countries. [21] In this study, orthopaedic surgery was excluded. At our institution, laparotomies were consistently the most common emergency/semi-emergency procedure performed in 2019 and 2020. This may be related to penetrating injuries being the most common mechanism of injury locally. There was no statistical difference between the number of damage control surgeries, implying that significant restrictions may impact on the total number of patients seen with severe trauma. Still, they do not significantly impact on the severity of trauma presentation. This finding is further substantiated by a similar ISS in major trauma patients in 2019 and 2020.

Study Relevance in Low to middle income countries

The South African experience during Coivd-19 Lockdown offers a unique insight into the Johannesburg trauma profile. It is a convenient occasion to assess the role of primary prevention in trauma. The findings in this study suggest that only the most stringent social limitations and restrictions reduce the major adult trauma experienced in South Africa. This study and the data from Cape Town by Navsaria et al.[12] and Stellenbosch by Cho et al.[15] support the notion that partial lockdown measures may worsen the country's major trauma burden. The study is relevant from a trauma primary prevention perspective. The data proves that there may be social factors (transportation and alcohol) that can be addressed to reduce the amount of severe trauma experienced in South Africa, and as a result, ease some of the burden of this nefarious disease in our hospitals. Mahoney et al.[22] suggest visible policing as well as alcohol restrictions as possible prevention strategies. Primary prevention with tighter gun laws and possible "stop and search" protocols may also assist with violence prevention. Other measures to consider may include harsher punishments for possessing illegal weapons and the role of gunshot injuries being made notifiable, as explored by Navsaria et al [12].

The data clearly shows that major trauma in Johannesburg is multifactorial, and that even the most restrictive measures only partially reduce trauma presentation. Current government initiatives fall short of protecting the city from significant trauma. Mahoney et al.[22] highlight that young working-class males are the most vulnerable to trauma, and their loss to society may also have detrimental socio-economic effects on the country. As such, a deeper investigation into governance and policing is urgently required to fully explore if primary prevention against trauma is feasible in South Africa.

Limiting factors to consider in this research are that only priority one patients from a single centre were analysed, and orthopaedic and neurosurgical operative procedures were not included in this study. Moreover, the study was retrospective, relying on accurate information documentation at the time of patient presentation. The overall social implications of enforcing a national Lockdown compared to the benefit of fewer major trauma admissions has not been explored further. Although the restriction imposed by Lockdown Level 5 were beneficial, they would be

very difficult to maintain effectively long term.

Conclusion

Strict social restrictions, as imposed during the beginning of during the Covid-19 pandemic Lockdown, reduced the number of patients presenting with major trauma to Charlotte Maxeke Johannesburg Academic Hospital. Overall, restrictions did not impact the severity of trauma or the mechanism of injury in priority one patients. There was also no significant change in patient disposition from casualty between 2019 and 2020, except for fewer down referrals during Lockdown. Severe restrictions led to higher admissions during weekdays compared to weekends, a concept that is the opposite during periods of no restrictions.. However, only strict social restrictions reduce the burden of significant trauma hospital presentations in South Africa and that relaxed restrictions with variable alcohol sales, curfews and travel constraints may worsen priority one trauma presentation. The more lenient restrictions imposed by Lockdown 3, adversely impacted major trauma numbers, presentation and the need for surgical intervention.

This study does provide important information with a view to the changing patterns of trauma presentation noted, but it does not provide any plausible sustainable solutions. This research supports the government initiative to implement rigid social restrictions to protect the public from trauma and potentially reduce the caseload of patients seeking medical assistance for non-Covid related ailments during critical points of the pandemic.

Further studies are still required to assist us in understanding the impact of restrictions on the Sub-Saharan healthcare systems

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