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The impact of SARS and COVID-19 on major trauma in Hong Kong

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ABSTRACT

Background: The coronavirus disease 2019 (COVID-19) pandemic has been enormously disruptive and harmful to people around the world, but its impact on other illnesses and injuries has been more variable. To evaluate the ramification of infectious disease outbreaks on major traumatic injuries, we compared changes in the incidence of major trauma cases during the 2003 Severe Acute Respiratory Syndrome (SARS) period with COVID-19 in 2020.

Methods: Data were analyzed from the trauma registry of a major, tertiary-care teaching hospital in Hong Kong. Patients presenting with major traumatic injuries during the first six months of 2001–03 and 2018–20 were retrieved for analysis. Patient characteristics, injury mechanism, admitting service, and emergency department (ED)/hospital lengths of stay (LOS) were recorded. Raw and adjusted survival rates (using the modified Trauma Injury Severity Score (TRISS)) were recorded.

Results: The number of trauma cases fell dramatically during 2003 and 2020 compared with previous years. In both 2003 and 2020, the number of trauma registry patients fell by 49% in April (compared to the preceding reference years of 2001/02 and 2018/19, respectively). Patient characteristics, treatments, and outcomes were also different during the outbreak years. Comparing 2003 to 2020 relative to their respective reference baselines, the percentages of injuries that happened at home, patients without co-morbidities, and patients' mean age all increased in 2003 but decreased in 2020. Work-place injuries drastically dropped in 2003, but not in 2020. Average ED LOS dropped in 2003 by 36.4 min (95% CI 12.5, 60.3) but declined by only 14.5 min (95% CI -2.9, 32.1) in 2020. Both observed and expected 30-day mortality declined in 2020 vs. 2003 (observed 4.5% vs. 11.7%, $p = 0.001$, OR 0.352, 95% CI 0.187, 0.661) (expected 4.5% vs 11.6%, $p = 0.002$, OR 0.358, 95% CI 0.188, 0.684).

Conclusion: Major trauma cases dropped by half during both the peak of the 2003 SARS and 2020 COVID-19 pandemics in Hong Kong, suggesting a trend for future pandemic planning. If similar findings are seen at other trauma centers, proactive personnel and resource allocations away from trauma towards medical emergency systems may be more appropriate for future pandemics.

1. Introduction

The coronavirus disease 2019 (COVID-19) outbreak is a worldwide pandemic, with tens of millions diagnosed with Severe Acute Respiratory Syndrome Coronavirus Two (SARS-CoV-2) and over a million people dying [1]. The COVID-19 pandemic has been enormously disruptive and harmful to people around the world, but its impact on rates of other illnesses and injuries has been more variable.

Many have worried about increased rates of domestic violence [2,3] and mental illness [4,5], but anecdotal evidence suggests that various specialties are experiencing lower than usual caseloads. For example, Baracchini et al. found a lower incidence of acute strokes during the initial COVID-19 outbreak in Italy. But the severity of these cases was higher, likely because concern for SARS-CoV-2 exposure led patients to wait longer before seeking treatment [6]. Likewise, Tam et al. showed that overall rates of ST-segment elevation myocardial infarctions (STEMI) decreased in Hong Kong, although the time needed to care for these patients dramatically increased, suggesting there were inefficiencies in the system created by the response to COVID-19 [7]. We recently documented 37% fewer patients seen (year-on-year) in Hong

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Kong Emergency Departments (EDs) between February and April of 2020 (and 24% fewer overall cases in the first half of 2020 in our own ED), confirming a large reduction in total ED patient volume [8].

Although Balogh et al. have claimed that there are no active practicing clinicians with previous pandemic experience and that "the effects of the pandemic on trauma care and injury epidemiology are completely unknown" [9], this is not the case in Hong Kong. Clinicians in Hong Kong experienced the full brunt of the SARS epidemic in 2003, which infected over 8000 individuals in 29 countries with a case fatality rate of nearly 10% [10]. Our institution was hit particularly hard by SARS, treating the city's first local case in March 2003 which ultimately infected over 100 hospital staff and students [11]. With a longstanding trauma registry dating from before the SARS epidemic, data from our institution provides a useful comparison for understanding the effects of widespread infectious outbreaks on trauma rates. Recent studies based on preliminary COVID-19 data have suggested reductions in patient volume at trauma centers in different areas of the world. Leichtle et al. identified a 43% decline in trauma cases at a single center in the USA in 2020 compared to 2018/19, and also found a higher injury severity score and a shorter length of stay (LOS) [12]. Pintado et al. found an 80% reduction in a Peruvian trauma service at the height of the COVID-19 pandemic in April 2020 (even as overall hospital admissions declined only 30%), and noted a non-uniform reduction in certain types of trauma cases (e.g. osteoporotic hip fractures increased as a proportion of overall trauma cases) [13]. Nabian et al. looked at pediatric trauma at a center in Iran during the COVID-19 pandemic and found a 50% decrease in cases, but no statistically significant change in mechanism [14].

Drawing on evidence from our trauma registry to analyze data during the COVID-19 pandemic in comparison to SARS, this study provides a more comprehensive, comparative examination of whether and in what ways pandemics have changed rates of major trauma in Hong Kong. We hypothesized that there would be both absolute and relative differences in the numbers of trauma patients presenting in the spring of 2003 and 2020 compared to the two years prior to each pandemic year. By identifying the impacts of COVID-19 and SARS on traumatic injury at our trauma center in Hong Kong, we hope to enable better evidence-based predictions for trauma center services and staffing to prepare for future pandemics.

2. Methods

This was a retrospective study of prospectively collected data from an established trauma registry of a major, tertiary-care teaching hospital and designated trauma center in Hong Kong. We searched for patients presenting with major traumatic injury during the six months between January 1, 2020 and June 30, 2020. January 1, 2020 was the day after the People's Republic of China informed the World Health Organization of the new virus outbreak in Wuhan, Hubei Province [15]. Although the COVID-19 pandemic has continued through 2020, this comparative paper focuses on the first six-month period of each analysis year in order to align with the 2003 SARS outbreak (which started in Hong Kong in February and tapered off by June of that year). We examined the 2020 trauma registry data in comparison to the corresponding registry data from the same time periods for the previous two years (2018 and 2019). Finally, we compared the 2018–2020 data to corresponding data from 2001 to 2003, which included the spring 2003 outbreak of SARS.

2.1. Inclusion criteria

All patients presenting with major traumatic injury to the hospital who were entered into our institution's trauma registry between January 1, 2020 and June 30, 2020 were included in the analysis. Data from the trauma registry during the same six-month period in 2001–2003 and 2018–2019 were also collected for statistical comparison. The trauma registry only included "major trauma cases," defined as cases of trauma presenting enough threat to life or limb to warrant activation of the trauma team according to an established set of criteria [16]. Major trauma in this study was not restricted to those with an injury severity score (ISS) of 15 or above; rather, the definition was based on inclusion in the hospital major trauma database.

2.2. Data processing and analysis

The primary outcome measure was the absolute number of major trauma patients seen between January 1 and June 30, 2020 compared to the same period in 2001, 2002, 2003, 2018, and 2019. The secondary outcome measures included: injury mechanism (e.g. falls, motor vehicle collisions), nature of traumatic injury (penetrating vs. blunt trauma), location of injury (home, work-place injury)), as well as any differences in patient characteristics (e.g. age, gender). We also examined rates of patient comorbidities, body part injured, blood component transfusion history in the first 24-h, admitting specialty, and whether a surgical operation was performed. LOS for the ED, intensive care unit (ICU) and hospital, as well as the raw and adjusted mortality for trauma patients were recorded for the period studied. For expected mortality, we used a modified Trauma Injury Severity Score (TRISS) [17,18] and defined expected mortality as TRISS Ps < 0.5.

2.3. Statistical analysis

Chi-square and Fisher's exact tests were used for categorical data while *t*-tests were used to compare means of continuous variables. A p-value <0.05 was considered statistically significant. An analysis of the data set was conducted for the six months of data in 2003 and 2020 compared to each other and to the first six months of the two years immediately preceding the year in question (i.e. 2001 and 2002 for 2003; 2018 and 2019 for 2020).

This study was approved by our clinical ethics review board on April 23, 2020.

3. Results

Unadjusted trauma volume numbers are presented in Table 1, patient and injury characteristics are shown in Table 2, and a visual representation of trauma cases by month in 2001–2003 and 2018–2020 can be seen in Fig. 1. We see that in both April 2003 and April 2020, there was a 49% decrease in overall trauma cases compared to an average of the preceding two years, respectively. Overall, in the first six months, there was a 14% decrease in major trauma cases in 2003 and a 16% decrease in 2020.

3.1. 2001–02 vs 2003

Compared to 2001–02, data from 2003 (the SARS outbreak year) demonstrate several statistically significant changes. The mean age of patients increased from 38.8 to 42.2 years ($p = 0.037$, mean difference 3.4, 95% CI 0.2, 6.6). Median ISS decreased from 8 in 2001–02 to 6 in 2003. There was a statistically significant ($p = 0.032$) change in the location of major trauma cases, with cases occurring at home increasing from 17.3% to 21.2%), while road-traffic injuries decreased from 57.6% to 49.8%. Cases involving work-place injuries fell from 16.5% to 5.6% ($p < 0.001$) OR 0.301, 95% CI 0.164, 0.550. Secondary transfers also decreased from 17.5% to 10% ($p = 0.008$) OR 0.522, 95% CI 0.322, 0.848, and more patients were healthy pre-injury with no co-morbidities (78.0% to 86.3%, $p = 0.031$). Finally, ED LOS dropped from 144.3 to 107.9 min ($p = 0.003$, reduction by 36.4 min, 95% CI 12.5, 60.3). There were no other statistically significant differences in causes of trauma, ISS, or injury location.

Table 1
Trauma patient volume, 2001–03 and 2018–20.

Month	2001	2002	2001–02 average	2003	% reduction (2003 vs. 2001–02)	2018	2019	2018–19 average	2020	% reduction (2020 vs. 2018–19)
Jan	43	53	48	51	6%	84	68	76	77	1%
Feb	34	31	32.5	44	35%	64	77	70.5	65	−8%
Mar	36	41	38.5	23	−40%	65	76	70.5	50	−29%
Apr	34	71	52.5	27	−49%	79	89	84	43	−49%
May	38	56	47	44	−6%	77	90	83.5	69	−17%
Jun	45	56	50.5	42	−17%	56	83	69.5	78	12%
Total	230	308	269	231	−14%	425	483	454	382	−16%

Note: numbers are for January 1 to June 30, inclusive, for each year.

3.2. 2018–19 vs 2020

Compared to the same periods in 2018–2019, the first six months of 2020 showed a statistically significant ($p = 0.007$) increase in percentage of road-traffic collisions from 44.2% to 51.1% and a decrease in the fraction of incidents at home from 31.3% to 26.2%. There was also a statistically significant drop in the rate of secondary transfer (23.8% vs. 29.3%, $p = 0.045$) OR 0.755, 95% CI 0.573, 0.994. Only 50.9% ($p = 0.007$) of trauma patients were healthy pre-injury with no co-morbidities, and the median ISS increased from 9 in the previous two years to 10 in 2020. There were no other statistically differences.

3.3. Effect of pandemics on trauma epidemiology

Comparing 2003 to 2020 relative to their 2001–02 and 2018–19 comparisons, we see some noteworthy similarities and differences. The percentage of injuries that happened at home increased in 2003 but decreased in 2020 compared to pre-pandemic years. The percentage of healthy patients without co-morbidities had a statistically significant increase in 2003 but decreased in 2020. Median ISS decreased in 2003 but increased in 2020 (from 6 to 10, $p < 0.001$).

Other differences were not inversions, but rather, of degree. There was no statistically significant increase in mean age or percent of patients who were male in 2020 as there was in 2003. Work-place injuries drastically dropped in 2003, but only a non-statistically significant reduction was seen in 2020. Average ED LOS dropped in 2003 by 36.4 min (95% CI 12.5, 60.3) but declined by only 14.5 min (95% CI −2.9, 32.1) in 2020.

Looking at the ED and the in-hospital course for major trauma patients, we continue to see statistically significant differences between the pandemic years (see Table 3: ED and Hospital Treatment). In 2003 compared to 2001 and 2002, there was a statistically significant reduction in trauma patients who required an operation (29.9% vs. 38.1%, $p = 0.029$) OR 0.692, 95% CI 0.497, 0.963. There were no other statistically significant differences in admitting specialty, intensive care unit (ICU) admission, ICU LOS, or blood transfusion during the first 24 h.

Looking at 2020 compared to 2018 and 2019, there was a non-significant trend towards fewer neurosurgical and more orthopedic admissions. There was a statistically significant increase in the percentage of cases needing an operation from 29.6% to 38.7% ($p = 0.001$) OR 1.502, 95% CI 1.170, 1.930. There was also a statistically significant drop in ICU LOS from 5.1 to 3 days ($p = 0.022$) mean difference 2.0, 95% CI 0.3, 3.8, and in the use of fresh frozen plasma (FFP) during a patient's first 24 h

Table 2
Trauma patient and injury characteristics.

		2001–02 n = 538		2003 n = 231		P value	2018–19 n = 908		2020 n = 382		P value	P value 2003 vs. 2020
Age	Mean (SD)	38.8	20.6	42.2	20.6	0.037*	52.4	24.5	53.0	23.9	0.684	<0.001*
Sex	Male	374	69.5%	162	70.1%	0.865	599	66.0%	257	67.3%	0.650	0.462
Injury place	Home	93	17.3%	49	21.2%	0.032*	283	31.3%	99	26.2%	0.007*	<0.001*
	Road	310	57.6%	115	49.8%		400	44.2%	193	51.1%		
	Industrial/construction site	40	7.4%	31	13.4%		108	11.9%	27	7.1%		
	Parks or sports ground	22	4.1%	11	4.8%		77	8.5%	45	11.9%		
	Others	73	13.6%	25	10.8%		37	4.1%	14	3.7%		
Work-place injury		89.0	16.5%	13	5.6%	<0.001*	171	18.8%	61	16.0%	0.221	<0.001*
Cause	Traffic related	259	48.1%	100	43.3%	0.557	248	27.3%	127	33.2%	0.158	<0.001*
	High fall	70	13.0%	36	15.6%		50	5.5%	17	4.5%		
	Low fall	92	17.1%	43	18.6%		406	44.7%	170	44.5%		
	Burn	17	3.2%	11	4.8%		68	7.5%	23	6.0%		
	Others	100	18.6%	41	17.7%		136	15.0%	45	11.8%		
Secondary transfer		94	17.5%	23	10.0%	0.008*	266	29.3%	91	23.8%	0.045*	<0.001*
ISS	Median (IQR)	8	16	6	15	0.659	9	17	10	15.5	0.132	<0.001*
Blunt/penetrating/burn	Blunt	494	91.8%	207.0	89.6%	0.447	789	86.9%	345	90.3%	0.182	0.432
	Penetrating	28	5.2%	13.0	5.6%		53	5.8%	14	3.7%		
	Burn	16	3.0%	11.0	4.8%		66	7.3%	23	6.0%		
Comorbidity	Healthy	387.0	78.0%	182.0	86.3%	0.031*	482	53.9%	191	50.9%	0.007*	<0.001*
	ill non limit	90.0	18.1%	22.0	10.4%		325	36.3%	160	42.7%		
	ill limit	19.0	3.8%	7.0	3.3%		62	6.9%	23	6.1%		
	ill severe	0.0		0.0			26	2.9%	1	0.3%		
AIS head or neck	3 or more	132.0	24.5%	60.0	26.0%	0.673	358	39.4%	159	42.1%	0.380	<0.001*
AIS face		12	2.2%	5.0	2.2%	0.955	9	1.0%	7	1.9%	0.205	0.788
AIS thorax		73.0	13.6%	29.0	12.6%	0.704	93	10.2%	46	12.2%	0.311	0.888
AIS extremities		96.0	17.8%	32.0	13.9%	0.173	114	12.6%	48	12.7%	0.944	0.682
AIS abdominal		36.0	6.7%	18.0	7.8%	0.584	35	3.9%	15	4.0%	0.923	0.043*
AIS external		19.0	3.5%	10.0	4.3%	0.595	23	2.5%	6	1.6%	0.298	0.040*
ED LOS	Minutes, mean (SD)	144.3	240.9	107.9	95.4	0.003*	156.9	172.5	142.4	132.8	0.102	<0.001*

* Statistically significant result, $p < 0.05$.

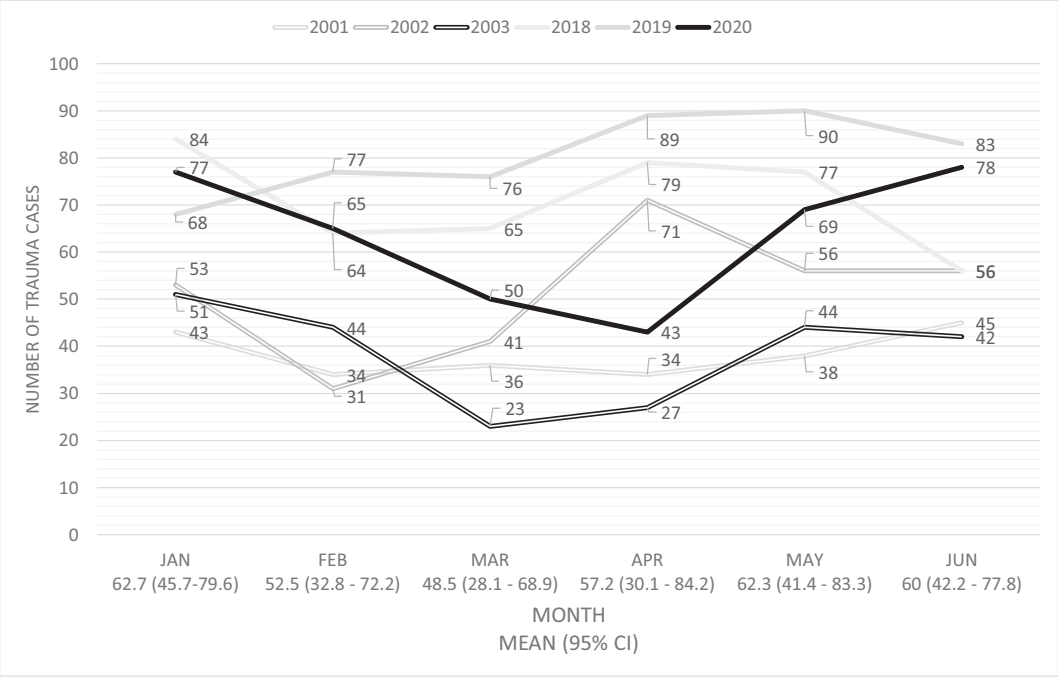

Fig. 1. Changes in the Number of Trauma Registry Patients by Month (2001–03 and 2018–20).

from 2.2% to 0.5% (p = 0.033) OR 0.234, 95% CI 0.054, 1.005. There were no other statistically significant differences in admitting specialty, ICU admission, or blood transfusion during the first 24 h.

The final outcomes for major trauma patients are listed in Table 4: 30-day Mortality and Outcomes. 2003 (relative to 2001–02) saw a statistically significant decrease in overall hospital LOS from 10.4 to 7.4 days (p = 0.022) (mean difference 3.0, 95% CI 0.4, 5.6), but there was no other statistically significant change in 30-day mortality, expected mortality, discharge disposition, discharge GCS, or discharge complication rates.

In 2020, there was a statistically significant change in 30-day outcomes (p = 0.009). Fewer patients were discharged home within 30-days (68.1% vs. 73.6%), while more patients were transferred to a rehabilitation facility (20.4% vs. 13.1%).

3.4. Changes between 2001 and 03 and 2018–20

Both observed and expected 30-day mortality rates declined in 2020 compared to 2003 (4.5% vs. 11.7%, p = 0.001, OR 0.352, 95% CI 0.187, 0.661). Comparing the absolute numbers of cases between 2001 and 03 and 2018–20, we see that overall numbers of trauma patients increased by 60% over the past 20 years (769 to 1290). Average age increased by 13.6 years (from 38.8 years (2001−02) to 52.4 years (2018–19), p = 0.001, mean difference 13.6, 95% CI 11.1, 16.0). Percent of injuries happening at home almost doubled from 17.3% (2001–02) to 31.3% (2018–19). The percentage of patients who were male did not change over the past 20 years (relatively constant around 70%). Although the percentage of all trauma cases caused by road-traffic injuries did decrease, the absolute number of

Table 3
ED and hospital treatment.

		2001–02 n = 538		2003 n = 231		P value	2018–19 n = 908		2020 n = 382		P value	P value 2003 vs. 2020
Admission specialty	Neurosurgery	168	31.2%	69	29.9%	0.111	360	39.6%	145	38.0%	0.059*	<0.001*
	Orthopedics	147	27.3%	75	32.5%		244	26.9%	111	29.1%		
	Gen Surgery + ENT + PS + urology	80	14.9%	32	13.9%		56	6.2%	26	6.8%		
	Burns	16	3.0%	8	3.5%		46	5.1%	12	3.1%		
	Cardiothoracic surgery	14	2.6%	3	1.3%		26	2.9%	15	3.9%		
	Emergency Medicine	104	19.3%	42	18.2%		154	17.0%	53	13.9%		
	Others	9	1.7%	0			22	2.4%	20	5.2%		
Operation		205	38.1%	69	29.9%	0.029*	269	29.6%	148	38.7%	0.001*	0.026*
ICU	yes	69	12.8%	22	9.5%	0.194	153	16.9%	79	20.7%	0.102	<0.001*
ICU LOS	mean among yes, mean (SD)	6.6	8.8	7.6	13.6	0.681	5.1	8.4	3	5	0.022*	0.138
HDU	Yes	0		3	1.3%	0.008*	86	9.5%	24	6.3%	0.060*	0.004*
HDU LOS	mean among yes, mean (SD)	NA		6	2.6		3.2	3.9	2.5	2.2	0.441	0.019*
24 h RBC	Yes	30	5.6%	12	5.2%	0.831	56	6.2%	19	5.0%	0.403	0.904
	mean among used, mean (SD)	8.70	9.2	12.0	14.3	0.379	4.2	5.1	3.3	4.0	0.498	0.063
24 h FFP	Yes	12	2.2%	7	3.0%	0.512	20	2.2%	2	0.5%	0.033*	0.012*
	mean among used, mean (SD)	11.2	8.0	16.6	14.6	0.309	7.2	6.1	6.0	0	0.787	0.362
24 h platelet	Yes	9	1.7%	6	2.6%	0.395	26	2.9%	7	1.8%	0.284	0.524
	mean among used, mean (SD)	13.2	8.4	15.5	9.2	0.627	7.0	6.6	4.6	2.5	0.350	0.032*

* Statistically significant result, p < 0.05.

Table 4
30-day mortality and outcomes of trauma patients.

		2001–02 n = 538		2003 n = 231		P value	2018–19 n = 908		2020 n = 382		P value	P value 2003 vs. 2020
30-day mortality	Crude	61	11.3%	27	11.7%	0.889	60	6.6%	17	4.5%	0.135	0.001*
	Expected (TRISS) Ps < 0.5	57	11.2%	26	11.6%	0.902	53	6.3%	16	4.5%	0.211	0.001*
30-day outcome	Discharged home	368	70.1%	164	71.0%	0.572	668	73.6%	260	68.1%	0.009*	0.005*
	Still in hospital	0		0			2	0.2%	0			
	Transferred to another acute-care hospital	7	1.3%	6	2.6%		19	2.1%	10	2.6%		
	Transferred to rehabilitation	89	17.0%	34	14.7%		119	13.1%	78	20.4%		
	Dead	61	11.6%	27	11.7%		71	7.8%	16	4.2%		
Hospital LOS	Mean (SD)	10.4	22.8	7.4	13.3	0.022*	10.3	20.6	10.4	39.0	0.963	0.267
Discharge GCS	Median (IQR)	15	0	15	0	0.416	15	0	15	0	0.067	NA
Discharge complication severity scale	Critical	60	11.2%	27	11.7%	0.978	71	7.8%	15	4.0%	0.014*	<0.001*
	Severe	1	0.2%	0			11	1.2%	3	0.8%		
	Serious	10	1.9%	4	1.7%		10	1.1%	4	1.1%		
	Moderate	12	2.2%	4	1.7%		16	1.8%	8	2.1%		
	Mild	26	4.8%	10	4.3%		88	9.7%	58	15.5%		
	None	429	79.7%	186	80.5%		710	78.4%	287	76.5%		

* Statistically significant result, $p < 0.05$.

injuries were nearly identical between the two non-pandemic periods examined (259 (2001–02) vs. 248 (2018–19)). Both the absolute number and overall percentage of all trauma caused by high falls (a common method of suicide in Hong Kong) decreased. Percentages of trauma caused by blunt, penetrating, or burn causes remained relatively constant over time. ED LOS overall was longer in 2018–19 than in 2001–02, and the drop in ED LOS was not statistically significant during 2020 compared to 2003.

4. Discussion

The COVID-19 pandemic, like SARS before it, has had a major impact on trauma cases in Hong Kong. Our study is the first to examine changes in major trauma during both coronavirus outbreaks. Strikingly, we found an identical 49% decrease in major trauma cases in April 2003 and April 2020, which corresponds to peaks in hospitalizations of coronavirus-infected patients during both pandemics in Hong Kong (April 2003 and April 2020) [19]. Overall, there was a 14% and 16% decrease overall for the first six months of 2003 and 2020, respectively, as compared to a 24% decrease in general ED cases in 2020 [8]. Both raw and adjusted 30-day mortality rates had a statistically significant decline in 2020 compared to 2003 (4.5% vs. 11.7%, $p = 0.001$), but this is likely a reflection on non-pandemic changes since these mortality rates were in-line (and without a statistically significant difference) from pre-pandemic rates in the two years prior.

In addition to a lower absolute number of major trauma patients during the two pandemic periods, we also found that the percentage of injuries that happened at home increased in 2003 but decreased in 2020 compared to pre-pandemic years. This drop in 2020 is surprising, given the extensive social distancing regulations implemented by the Hong Kong government to control infection transmission, including work from home mandates, school and industry-specific business closures, and restrictions on public gatherings. The higher proportion of major trauma cases occurring outside the home suggests that people in the COVID-19 era may be engaging in more sedentary activities or spending less time at home compared to during the SARS outbreak – which both pose challenges for public health. The percentage of trauma patients with co-morbidities decreased in 2003, but increased in 2020, suggesting that sicker patients overall continued to seek care in 2020. Mean age, number of work-place injuries, and ED LOS did not change in 2020 as it did in 2003. The increase in ED LOS in 2018–2020 may be due to the implementation of ED-based Computed Tomography (CT) scanning beginning in 2004–05; a patient who previously would have transferred out of the ED to obtain a CT before going to the ward or ICU now remained an ED patient for a longer period of time.

Although COVID-19 is still affecting most countries around the world, preliminary studies are beginning to emerge that examine the impact of the pandemic on patient volumes and caseloads in different locations. Articles on trauma care during COVID-19 so far have focused on how to limit viral transmission while still maintaining trauma services [20]. We documented decreases of over 30% in overall ED patient visits to our hospital and others around Hong Kong during the peak of COVID-19 [8]. Although not to the same degree as Pintado et al. [13] found in Peru, we found that our major trauma cases also dropped more than our overall ED patient volume (49% vs. 34%) in the month following the announced pandemic (although this reversed when looking at all six months). Finally, while Boserup et al. found a decrease in the percentage of motor vehicle collisions during COVID-19 in multiple cities in the USA, we found a statistically significant increased percentage of such trauma cases [21].

Looking beyond pandemics, we also identified some intriguing trends for trauma care in Hong Kong that offer important points of comparison for other urban centers around the world. As our analysis uncovered, mortality rates from our trauma registry have been halved over the past 20 years. This is despite finding that the average age of trauma patients has increased faster than the general population – increasing by 13.6 years between 2001 and 2020 compared to an 8.6-year increase in the median age in Hong Kong during the same timeframe [22]. The reduced mortality is also striking given we also found that more trauma patients had pre-existing co-morbidities (49.1% in 2020 vs. 13.7% in 2003, $p < 0.001$), which is likely related to the increasing average age of Hong Kong trauma patients. The absolute numbers of major trauma caused by road traffic collisions remained nearly unchanged over 20 years, despite a growing and aging population, suggesting effective safety measures have been enacted to improve road safety and stabilize the number of serious cases. Finally, despite their frequency in sensational news coverage [23], high falls (often suicidal) in our trauma registry have decreased over the past 20 years.

5. Limitations

This was a single-center study of prospectively acquired trauma data. Although the trauma registry is a robust repository for trauma-related data at our institution, it is limited to only major trauma cases. This study did not examine minor traumatic episodes, and so should not be considered representative for all trauma cases at our institution or for Hong Kong. Additionally, this study was limited to the first half of 2020, and broadening the study to examine the full years of 2001–03 and 2018–2020 may change some of the comparative results. However, as our primary interest was in comparing major trauma

during the SARS and COVID pandemics, and SARS was eliminated in Hong Kong by June 2003, we decided to limit this study to the first six months of all years included.

6. Conclusion

Major trauma cases dropped 49% at the April hospitalization peaks of both the SARS and COVID-19 pandemics in Hong Kong compared to the two years before each pandemic. Both the percentage of injuries that happened at home and the percentage of healthy patients without co-morbidities increased during SARS but decreased during COVID-19.

While COVID-19 and SARS have generated serious public health challenges, the reduction in major traumatic injuries that we documented during both outbreaks in Hong Kong could be considered a 'silver lining' for hospital care during pandemics. Preliminary reports from other locales during the COVID-19 pandemic have described the shift of surgical trainees and consultants from their base specialties into ICU and COVID-19 wards – for example, orthopedic surgeons in the U.K. supervising proning teams for ventilated ICU patients with refractory hypoxia [24]. If more comprehensive trauma registry data from other sites confirm our findings, proactive personnel redeployment away from trauma towards medical emergency care may be warranted in the face of future pandemics.

Availability of data and materials

Data is available from the corresponding author upon reasonable request.

Informed consent, Ethical approval, and Human rights

The authors affirm that: the study was approved by the Joint Chinese University of Hong Kong – New Territories East Cluster Clinical Research Ethics Committee (CRE Ref. No. 2020.212) on April 23, 2020.

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Author statement

We confirm that there is no overlap with previous publications, and we confirm that the manuscript, including related data, figures, and tables, has not been published previously and that the manuscript is not under consideration elsewhere. We also confirm that all authors have made substantial contributions to all of the following: (1) the conception and design of the study, or acquisition of data, or analysis and interpretation of data, (2) drafting the article or revising it critically for important intellectual content, (3) final approval of the version to be submitted.

CRediT authorship contribution statement

Joseph Harold Walline: Conceptualization, Methodology, Writing - original draft, Writing - review & editing. **Kevin Kei Ching Hung**: Methodology, Formal analysis, Writing - review & editing, Visualization. **Janice Hiu Hung Yeung**: Data curation, Writing - review & editing. **Priscilla P. Song**: Writing - review & editing. **Nai-Kwong Cheung**: Resources, Data curation. **Colin A. Graham**: Writing - review & editing, Supervision.

Declaration of Competing Interest

None.

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