

Epidemiology of Traffic Injuries before, during and 1 Year after the COVID-19 Pandemic Restrictions: National Findings from the Saudi Red Crescent Authority

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Abstract

Background: Road traffic injuries are a leading cause of death in Saudi Arabia. Studies have examined the impact of the COVID-19 pandemic on traffic injuries treated in healthcare institutions, but its impact on patients seeking emergency medical transport for traffic injuries remains unclear.

Objective: This study aimed to determine changes in traffic injuries' distribution and outcomes among patients seeking emergency medical transport before, during, and after the COVID-19 restrictions were imposed in Saudi Arabia.

Methods: This is a nationwide retrospective study of all injuries reported to the Saudi Red Crescent Authority (SRCA) between January 1st, 2020, and May 31st, 2021. The cases in the study were categorized based on the following three time periods: (1) Pre-restriction (January 1 to March 23, 2020), (2) restriction (March 24 to June 21, 2020), and (3) post-restriction (June 22, 2020, to May 31, 2021).

Results: A total of 142,763 cases of traffic-related injuries were recorded at the SRCA during the study period: pre-restriction, 27,811 (19.5%); restriction, 14,414 (10.1%); post-restriction, 100,538 (70.4%). Males accounted for most cases throughout the study period, but a significant increase in the number of females was observed in the post-restriction period compared with the first two timeframes (12.2% vs. 3.4% and 3.4%, respectively; $P < 0.01$). During the restriction period, the rate of mortality was the highest, and rollover crashes were significantly higher (18.2% vs. 14.0% and 14.6%; $P < 0.01$). Overall, pedestrians were almost three times more likely to die following injuries than occupants or drivers (OR = 2.7).

Conclusions: Further prevention programs to reduce traffic injuries are needed to improve traffic safety and improve population health.

Keywords: COVID-19, emergency medical service, mortality, Saudi Arabia, Saudi Red Crescent Authority, traffic accidents

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INTRODUCTION

Traumatic injuries are significant contributors of morbidity and mortality to the global burden.^[1] In the Kingdom of Saudi Arabia (KSA), road traffic-related injury is a leading cause of death.^[2,3] A significant proportion of the population in Saudi Arabia belong to younger age groups; concurrently, higher road crashes-related morbidity and mortality have also been noted in the younger age groups.^[4,5] Such years of life lost due to premature mortality and years lived with disability contribute to significant increase in the country's economic and social burden.

Effective prevention strategies can reduce the number of traumatic injuries and the associated mortality.^[6] A significant contributor for prevention is continued monitoring and description of the burden of injuries.^[7] In addition, traffic injuries can be affected by other factors such as changes in traffic exposure or policy to improve traffic safety. Therefore, epidemiologic studies are required to recognize trends and risk factors of incidence and mortality relating to traffic injuries.

The SARS-CoV-2 resulted in significant increase in disease burden and impacted the sustainability of healthcare systems worldwide. As a countermeasure against the morbidity and mortality caused by COVID-19, drastic public health measures were introduced by governments and authorities worldwide, including complete or partial lockdowns, strict social distancing guidelines, reducing non-essential travels and school/university/office closures over prolonged periods. In trauma epidemiology, these measures resulted in mixed results.^[8] Regarding traffic-related trauma, in the United States, significant decreases have been found in automobile versus pedestrian injuries as well as motorcycle and bicycle injuries, but not in motor vehicle collisions.^[9] Another study found that while road traffic crashes resulting in minor/no injuries significantly decreased during the lockdown, no such decrease was noted in crashes resulting in serious/fatal injuries.^[10] In Italy, a study showed significant reduction in traffic injuries during the lockdown period relative to 2019.^[11]

In Saudi Arabia, single center studies have examined changes in the burden of injuries due to COVID-19 in inpatient setting as well as adult emergency departments' visits characteristics, including injuries as a cause of presentation.^[12,13] A study with a nationally representative sample showed a significant increase in the overall number of cases being handled by the Saudi Red Crescent Authority (SRCA) dispatch center during the COVID-19

period, but those related to overall injuries declined by 6.1%.^[14] To fill the gap regarding lack of road traffic-related injury data, the current study was conducted to determine change in traffic injuries and mortality among patients seeking prehospital emergency medical transport before, during, and after the COVID-19 restrictions were imposed in Saudi Arabia. Findings of this study may help understand the impact of COVID-19 on injuries to reduce the trauma burden in Saudi Arabia as well as serve as temporal data for future studies.

METHODS

This is a retrospective study of all traffic-related injuries recorded in the SRCA database between January 1, 2020, and May 31, 2021. The study was approved by the Institutional Review Board of the SRCA.

The SRCA is the primary provider of emergency medical services across Saudi Arabia, and thus, its datasets are highly representative.^[15] In SRCA, a case is recorded when a call is made to the emergency number (997) for prehospital services, irrespective of the eventual transportation to a healthcare facility. The paramedics, who respond to the call, record the data using electronic tablets, and all data are stored in a secure central server of SRCA. The cases are classified as medical, injuries, cardiac, or others.^[14] Motor vehicle crash, rollover, or a pedestrian injury are subcategorized under traffic injuries.

Participants

The study included all traffic injuries reported to the SRCA, as specified above. These include non-transported cases for any reason, including death, refusal, treatment on-site, or leaving the reported site. Recorded data are available for variables such as age, gender, nationality, cause of injury, location of incident, region, time (of incident, call, transport, and reaching hospital), and occurrence within urban/rural limits (SRCA defines urban is as being within the defined city limits and rural as outside these limits).

In Saudi Arabia, absolute COVID-19 restrictions were implemented between March 23 and June 21, 2020. During this period, there were complete or partial lockdowns in addition to strict social distancing protocol implementation, school closure, and eventual reduction in all non-essential travel. Considering this, the data were segregated into the following three categories: (1) Pre-restriction, comprising cases recorded in the 3 months prior to the implementation of the above-stated absolute restrictions (i.e., January 1 to March 23, 2020); (2) restriction, comprising cases during the period when COVID-19 restrictions were implemented;

and (3) post-restriction, comprising cases after the absolute restrictions were withdrawn (i.e., June 22, 2020) up to May 31, 2021.

Outcome variables

The primary study outcome was to compare the frequency of traffic injuries across the three time periods. Other outcomes analyzed are death on site and predictors of mortality. The SRCA database underwent improvements for further standardization of the data collected in January 2021. Therefore, a secondary objective of this study was to determine differences in data completeness of variables across the time spans to guide future improvement and modifications.

Statistical analysis

STATA 15 (STATA Corp LP, College Station, TX, USA) was used for all statistical analyses. The data were imported from the SRCA repository in an Excel format (Microsoft® Excel 365 for Mac). Descriptive statistics such as frequencies, means, and standard deviations were used. Differences in categorical variables were assessed using Chi-square test, while differences in continuous variables were assessed using ANOVA. Statistical significance was set at $P < 0.05$. To explore predictors of mortality, a multiple logistic regression model was constructed with variables significant at the univariate analysis and were adjusted for other covariates. Results are presented as odds ratios (ORs) along with associated 95% confidence intervals.

RESULTS

A total of 142,763 cases of traffic-related injuries were recorded at the SRCA during the study period: 27,811 (19.5%) in the pre-restriction period, 14,414 (10.1%) during restrictions, and 100,538 (70.4%) post-restrictions [Table 1].

The average age across the three periods was similar. However, in the postrestriction period, the percentage of injuries in the ≤ 18 -year-old age group (11.9%) was significantly higher than both other time periods ($P < 0.01$). Males accounted for most cases across all three time periods, but there was a significant increase in the number of females in the post-restriction period compared with the first two timeframes (12.2% vs. 3.4% and 3.4%, respectively; $P < 0.01$). In terms of nationality, in the first two time periods, non-Saudis accounted for nearly three-fourth of all cases, while in the post-restriction period, Saudis accounted for more than half of the cases. Regarding the mechanism of injury, there was a higher percentage of rollover injuries during the restriction

period (18.2% vs. 14.0% and 14.6%; $P < 0.01$). There was a higher proportion of injuries reported in rural areas during the restriction period compared to the other periods (37% vs. 29.1 and 30.1%, respectively). Mortality was marginally higher in the restriction period than the other periods (2.2% vs. 1.6% and 1.9%, respectively) [Table 1].

Regression analyses identified several variables as predictors of mortality [Table 2]. Expectedly, higher age was associated with higher odds of death, and males were twice as likely to die following injuries than females. In the multivariable analysis, pedestrians were almost three times more likely to die following injuries than occupants or drivers (OR = 2.7). Across the time periods, those injured during the restriction period were 81% more likely to die following an injury than those injured during the pre-restriction period.

Data completeness was significantly different across the two years: a significantly higher proportion of age and gender values were missing in 2020 compared to 2021 ($P < 0.0001$) [Table 3].

DISCUSSION

This is the first national-level study from Saudi Arabia that comprehensively examined the epidemiology of road traffic-related injuries before, during, and after the COVID-19 restriction periods. The number of traffic injuries decreased in all regions of Saudi Arabia during the restriction period compared with the similar time span prior to this period (pre-restriction). A similar reduction in traffic injuries during the restriction periods were noted in the U. S.,^[16] Tarragona province of Spain,^[17] Northern Ireland,^[18] and Peru.^[19]

Surprisingly, during the restriction period, the rate of mortality was the highest and there was a significant increase in rollover crashes. Collectively, this is suggestive of drivers speeding on emptier roads in a way that exposes them to fatal crashes.^[20,21] Another possible contributing factor for the higher mortality is that the emergency medical systems and ambulances were, in general, overburdened due to the effect of the pandemic.^[22] The higher mortality during the restriction period in our study is in contrast to the findings of some studies.^[16,19,23] but also in concurrence with others, including one published from the United Arab Emirates.^[10,24,25] In that study, mortality doubled during the restriction phase; however, delay in admitting critically injured patients to the ICU during the COVID-19 period (approximately 4 hours) while waiting for PCR results had a significant impact on the outcome.^[24] While such an analysis was beyond the scope of our study given that SRCA is unable to track patient

Table 1: The burden of traffic injuries during the three study periods

| Variable | Prerestriction | Restriction | Post-restriction | P |
|-----------------------------|----------------|---------------|------------------|---------|
| Average daily injuries (SD) | 343.3 (42.6) | 160.1 (40.4) | 293.1 (34.7) | <0.0001 |
| Age-average (SD) | 29.9 (20.1) | 30.8 (15.3) | 30.1 (12.8) | <0.0001 |
| Age group (years) (%) | | | | |
| 0–18 | 1837 (6.6) | 835 (5.7) | 12,012 (11.9) | <0.000 |
| 19–40 | 6687 (24.0) | 5019 (34.4) | 62,620 (62.3) | |
| 41–65 | 1517 (5.5) | 1118 (7.7) | 13,247 (13.2) | |
| >65 | 182 (0.7) | 123 (0.8) | 1391 (1.4) | |
| Missing | 17,588 (63.2) | 7477 (51.3) | 11,268 (11.2) | |
| Gender (%) | | | | |
| Female | 932 (3.4) | 492 (3.4) | 12,245 (12.2) | <0.000 |
| Male | 10,138 (36.5) | 6728 (46.2) | 77,025 (76.6) | |
| Missing | 16,741 (60.2) | 7352 (50.5) | 11,268 (11.2) | |
| Nationality (%) | | | | |
| Saudi | 7309 (26.3) | 4723 (32.4) | 56,499 (56.2) | <0.000 |
| Non-Saudi | 19,623 (70.5) | 9521 (65.3) | 37,897 (37.7) | |
| Missing | 879 (3.1) | 328 (2.2) | 6142 (6.1) | |
| Region (%) | | | | |
| Aseer | 2383 (8.6) | 1863 (12.8) | 9312 (9.3) | <0.000 |
| Baha | 505 (1.8) | 406 (2.8) | 1864 (1.9) | |
| Eastern | 3280 (11.8) | 1576 (10.8) | 10,762 (10.7) | |
| Hail | 757 (2.7) | 525 (3.6) | 2917 (2.9) | |
| Jazan | 1381 (5.0) | 749 (5.1) | 4236 (4.2) | |
| Jouf | 385 (1.4) | 300 (2.1) | 1613 (1.6) | |
| Madinah | 1985 (7.1) | 840 (5.8) | 6131 (6.1) | |
| Makkah | 7075 (25.4) | 3053 (21.0) | 25,643 (25.5) | |
| North borders | 308 (1.1) | 229 (1.6) | 1192 (1.2) | |
| Najran | 424 (1.5) | 309 (2.1) | 1431 (1.4) | |
| Qassim | 1484 (5.3) | 843 (5.8) | 4960 (4.9) | |
| Riyadh | 6874 (24.7) | 3302 (22.7) | 27,213 (27.1) | |
| Tabuk | 970 (3.5) | 577 (4.0) | 3264 (3.2) | |
| Mechanism of injury (%) | | | | |
| Crash | 21,354 (76.8) | 10,805 (74.1) | 76,837 (76.4) | <0.000 |
| Pedestrian | 2560 (9.2) | 1116 (7.7) | 9007 (9.00) | |
| Rollover | 3897 (14.0) | 2651 (18.2) | 14,694 (14.6) | |
| Rural versus urban (%) | | | | |
| Rural | 8091 (29.1) | 5397 (37.0) | 30,231 (30.1) | <0.000 |
| Urban | 19,720 (70.9) | 9175 (63.0) | 70,307 (69.9) | |
| Death on the scene (%) | | | | |
| Yes | 433 (1.6) | 324 (2.2) | 1903 (1.9) | <0.000 |
| No | 27,378 (98.4) | 14,248 (97.8) | 98,635 (98.1) | |

SD – Standard deviation

data following admission to a hospital, research exploring the impact of delay in ICU admission due to COVID-19 testing guidelines may guide further improvement in health outcomes.

According to our study, youth male drivers were more likely to sustain injuries. This finding is consistent with a previous local study on the burden of traumatic injuries as well as with the age-wise population distribution in the country.^[4,5] Saudi Arabia lifted the ban on women driving around late 2017, and since then, there has been a steady increase in the number of women drivers.^[26] The larger pool of women drivers could possibly be the reason for this significant increase in the number of women with traffic injuries in the post-lockdown period. Riyadh and Makkah are the country’s most populous areas and, unsurprisingly, had the highest number of crashes, a finding consistent with studies from other countries.^[27,28]

Between 2016 and 2020, severe traffic crashes decreased by 36% and traffic-related deaths by 30%,^[29] in line with a key objective of KSA Vision 2030. In our study, during the restriction phase, the traffic injuries in rural areas were fewer but resulted in high mortality rates. Speculatively, this could be due to lower adherence to the safety procedures and regulations, and/or longer distance to a specialized trauma health-care center. However, further research is needed to determine the exact factors, but detailed and unified information from other sectors (i.e., police, hospitals, etc.) is currently limited. This highlights the need for a unified national platform for data related to traffic crashes to help policymakers design effective interventional strategies for such preventable morbidity and mortality.

Limitations

Our study has a few limitations. First, critical variables were not available in the dataset, such as the speed at

Table 2: Predictors of mortality

| Predictors | OR (95%CI) | |
|--------------------|---------------|---------------|
| | Univariate | Multivariate |
| Age group | | |
| 0–18 | Reference | Reference |
| 19–40 | 1.7 (1.4–2.0) | 1.4 (1.2–1.7) |
| 41–65 | 2.3 (1.9–2.7) | 1.6 (1.3–2.0) |
| >65 | 3.6 (2.6–4.9) | 3.2 (2.4–4.4) |
| Gender | | |
| Female | Reference | Reference |
| Male | 2.1 (1.8–2.6) | 1.7 (1.4–2.1) |
| Nationality | | |
| Non-Saudi | Reference | Reference |
| Saudi | 0.4 (0.4–0.4) | 0.5 (0.4–0.5) |
| Rural versus urban | | |
| Urban | Reference | Reference |
| Rural | 2.5 (2.3–2.7) | 2.2 (2.0–2.4) |
| Mechanism | | |
| Crash | Reference | Reference |
| Pedestrian | 2.7 (2.4–3.0) | 2.7 (2.4–3.1) |
| Rollover | 1.5 (1.3–1.6) | 1.2 (1.1–1.4) |
| Time period | | |
| Pre-restriction | Reference | Reference |
| Restriction | 1.4 (1.2–1.7) | 1.8 (1.4–2.4) |
| Post-restriction | 1.2 (1.1–1.4) | 1.9 (1.6–2.4) |

OR – Odds ratio; CI – Confidence interval

Table 3: Missing values in 2020 and 2021

| Variable | 2020 (%) | 2021 (%) | P |
|---|---------------|---------------|--------|
| Age | 32,604 (34.2) | 3729 (7.8) | <0.000 |
| Gender | 31,632 (33.2) | 3729 (7.8) | <0.000 |
| Nationality | 4623 (4.9) | 2726 (5.7) | <0.000 |
| Reason for not transporting the patient | 35,143 (36.9) | 17,326 (36.4) | <0.116 |

which the crash occurred, the types of vehicles involved, the use of a seatbelt, driving under the effect of alcohol or drugs, and the use of mobile phones while driving. In addition, when comparing data from 2020 and 2021, several missing variables were noted, most of which were related to demographics. Second, our analysis may have included injured patients who died after hospital admission but were not classified as deceased, as the SRCA does not record data post-hospital admissions. Therefore, patient status after hospital admission needs to be incorporated in national data sources to better reflect patient outcomes. Finally, the SRCA database does not capture minor injuries that do not require medical attention, which may underestimate the national burden of injuries.

CONCLUSION

There was a relative increase in the severity of traffic-related injuries and mortality rates during the COVID-19 restriction period, but the absolute number of road traffic injuries declined. Future studies are required that examine additional factors related to drivers' behaviors, emergency medical service response time, and the cost of road traffic injuries. These findings will not only help for road

traffic-related injury prevention in the present, but also to support future programs.

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Ethical considerations

This study was approved by the Institutional Review Board of SRCA (approval number: 21-E1) on September 15, 2021. Requirement for informed consent was waived owing to the retrospective study design and adherence to the Declaration of Helsinki, 2013.

Data availability statement

The datasets generated during and/or analyzed during the current study are not publicly available but are available from the corresponding author on reasonable request.

Peer review

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Conflicts of interest

There are no conflicts of interest.

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