

Racial and ethnic disparities in motor vehicle crash-related outcomes in North Carolina surrounding the COVID-19 pandemic

Lucas M Neuroth ,^{1,2} Bhavna Singichetti,^{1,2} Katherine J Harmon ,^{2,3} Anna E Waller,^{2,4} Rebecca B Naumann^{1,2}

¹Department of Epidemiology, The University of North Carolina at Chapel Hill Gillings School of Global Public Health, Chapel Hill, North Carolina, USA

²The University of North Carolina at Chapel Hill Injury Prevention Research Center, Chapel Hill, North Carolina, USA

³The University of North Carolina at Chapel Hill Highway Safety Research Center, Chapel Hill, North Carolina, USA

⁴The University of North Carolina at Chapel Hill Carolina Center for Health Informatics, Chapel Hill, North Carolina, USA

Correspondence to

Lucas M Neuroth, Department of Epidemiology, The University of North Carolina at Chapel Hill Gillings School of Global Public Health, Chapel Hill NC 27599, North Carolina, USA; neuroth@unc.edu

ABSTRACT

Long-term impacts of the COVID-19 pandemic on racial and ethnic disparities in motor vehicle crash (MVC) injuries and death are poorly understood. This study aimed to characterize trends and investigate the heterogeneity of MVC-related disparities in North Carolina across several data sources. Crash reports, emergency department visit records, and death certificates from 2018 to 2021 were used to calculate monthly population-rates of MVC-related public health outcomes. We estimated trendlines using joinpoint regression and compared outcomes across racial and ethnic classifications. MVC and MVC-related injury rates declined in conjunction with NC's stay-at-home order, while rates of severe outcomes remained unimpacted. By December 2021 rates of MVC-related outcomes met or exceeded pre-pandemic levels, with the highest rates observed among non-Hispanic Black individuals. Racial and ethnic disparities in MVC-related outcomes remained prevalent throughout the COVID-19 pandemic. These results highlight the importance of a holistic approach to traffic injury surveillance when assessing the impact of MVCs.

INTRODUCTION

Implemented in March 2020 to decrease the spread of COVID-19, stay-at-home orders (SOs) led to decreased mobility and immediate shifts in travel patterns. Associations between SOs, motor vehicle crashes (MVCs), and their subsequent injuries are well quantified in the period immediately following the implementation of SOs, though findings are both outcome and measure dependent.¹⁻¹⁴ Vehicle miles travelled (VMT) and absolute counts of MVCs decreased following the onset of SOs,^{5-8 14} while the rate of MVCs per VMT remained constant or declined over the pandemic period.^{3 6} However, when stratified by MVC-related injury severity, heterogeneity was observed: counts decreased for less severe injuries following SOs and increased for severe/fatal injuries.^{1 3 5 6 9 11 14}

The nuances of this heterogeneity are difficult to understand, as prior studies typically utilise a single data source, often crash reports or hospital discharge records, to investigate a single crash- or injury-related outcome.^{3 5-9 11-15} This, in conjunction with the relatively narrow timescale of previously conducted studies,^{15 16} impacts one's ability to holistically understand the impact of the COVID-19 pandemic on MVC-related public health outcomes.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Rates of motor vehicle crash-related outcomes vary by race and ethnicity, but little is known regarding COVID-19's impact on these disparities.

WHAT THIS STUDY ADDS

- ⇒ Upon investigating three data sources, racial and ethnic disparities in five motor vehicle-related outcomes remained prevalent throughout the COVID-19 pandemic.
- ⇒ Though heterogeneity in outcome trends was observed by race and ethnicity, for each outcome rates were consistently highest among non-Hispanic Black individuals.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE, OR POLICY

- ⇒ Holistic approaches to traffic injury surveillance provide important context regarding disparities research and better inform targeted prevention efforts.

Further, although trends in MVCs and related injuries are known to vary by racial and ethnic classifications, few studies have examined COVID-19-related trends within these subgroups.^{1 2} To address these gaps in the literature, we leveraged data from multiple sources across North Carolina (NC) for the period of 2018 through 2021 to: (1) compare various MVC-related outcomes across multiple data sources during this 4-year period surrounding the COVID-19 pandemic and (2) examine potential heterogeneity in these trends by race and ethnicity.

METHODS

Data sources

MVC outcomes from 2018 through 2021 were described using three data sources: crash reports, emergency department (ED) visit records, and death certificates, obtained from the NC Division of Motor Vehicles, the NC Division of Public Health's Communicable Disease Branch, and the NC Division of Public Health's Office of Vital Records, respectively. Population denominators by race and ethnicity classification were obtained from the US Census Bureau and the National Centre for Health Statistics and accessed via the Centres for Disease Control and Prevention's Web-based

Table 1 Joinpoint analysis of trends in motor vehicle crash involvement by race and ethnicity, North Carolina 2018–2021.

Figure	Race and Ethnicity	Data*	Number of joinpoints†	Period‡	Month/Year	Monthly percent change	95% CI	P-value
1 a	Non-Hispanic White	All Crash	2	Cumulative	Jan 2018-Dec 2021	0.1	(-1.1, 1.3)	0.908
				First	Jan 2018-Dec 2019	0.3	(-0.3, 0.9)	0.259
				Second	Dec 2019-Apr 2020	10.4	(-21.6, 2.3)	0.101
				Third	Apr 2020-Dec 2021	2.0	(1.2, 2.8)	<0.001
1 b	Non-Hispanic Black	All Crash	2	Cumulative	Jan 2018-Dec 2021	0.2	(-1.4, 1.8)	0.833
				First	Jan 2018-Dec 2019	0.4	(-0.2, 0.9)	0.158
				Second	Dec 2019-Apr 2020	10.2	(-30.1, 15.4)	0.392
				Third	Apr 2020-Dec 2021	1.5	(2.2, 4.5)	<0.001
1 c	Non-Hispanic Asian	All Crash	2	Cumulative	Jan 2018-Dec 2021	0.1	(-1.4, 1.6)	0.900
				First	Jan 2018-Dec 2019	0.4	(-0.2, 1.0)	0.206
				Second	Dec 2019-Apr 2020	17.2	(-30.2, to 1.7)	0.032
				Third	Apr 2020-Dec 2021	3.6	(2.7, 4.5)	<0.001
1 d	Non-Hispanic AI/AN	All Crash	2	Cumulative	Jan 2018-Dec 2021	0.5	(-0.8, 1.7)	0.462
				First	Jan 2018-Dec 2019	0.6	(-0.1, 1.2)	0.072
				Second	Dec 2019-Apr 2020	7.4	(-19.3, 6.1)	0.261
				Third	Apr 2020-Dec 2021	2.0	(1.2, 2.8)	<0.001
1 e	Hispanic	All Crash	2	Cumulative	Jan 2018-Dec 2021	0.7	(-0.5, 2.0)	0.247
				First	Jan 2018-Dec 2019	0.8	(0.2, 1.5)	0.011
				Second	Dec 2019-Apr 2020	10.0	(-21.7, 3.4)	0.132
				Third	Apr 2020-Dec 2021	2.9	(2.1, 3.7)	<0.001

Note: Joinpoint analyses were conducted using crude rates and SE for Poisson variance by month with log transformation.

*“All Crash” derived from NC crash reports.

†Number of joinpoints used in each trend is based on results recommended from the permutation model.

‡Periods are delineated by joinpoints.

Injury Statistics Query and Reporting System.¹⁷ This study was approved by the University of North Carolina at Chapel Hill’s Institutional Review Board (#22–1190).

Measures

Crash report-captured injury severity was classified according to the KABCO injury severity scale. Levels included “involved in an MVC” (KABCO), “injured in an MVC” (KABC), and “severely/fatally injured in an MVC” (KA). Persons fatally injured (“MVC-related decedent”) or treated in NC EDs (“MVC-related ED visit”) were identified using relevant ICD-10-CM codes. Among MVC-related ED visits, patients who were transferred or admitted to the hospital were classified as “MVC-related hospital admissions”. Racial and ethnic classifications were harmonised across data sources to match the crash data’s categories: non-Hispanic White, non-Hispanic Black, non-Hispanic Asian, non-Hispanic American Indian or Alaskan Native (AI/AN), and Hispanic. Individuals falling into other racial and ethnic categories were excluded from these analyses due to inconsistencies in coding across the data sources.

Statistical analysis

We produced monthly counts and percentages of MVC-related outcomes overall and by race and ethnicity from January 2018 through December 2021 (online supplemental table 1). Counts were divided by yearly population estimates to produce crude rates per 1000 (involved in an MVC), 10 000 (injured in an MVC, MVC-related ED visit), or 100 000 (severely/fatally injured in an MVC, MVC-related hospital admission, MVC-related decedent) population. Crude rates were analysed using joinpoint regression (Version 4.9.1.0) to estimate and describe trends.¹⁸ Joinpoint regression fits linear trendlines, identifying up to five points in time (joinpoints) at which trends changed direction

via permutation testing.¹⁹ Average monthly percent change (AMPC) over the study period and joinpoint period-specific monthly percent changes (MPC) were presented tabularly with their corresponding 95% confidence intervals (CIs).

RESULTS

From January 2018 through December 2021, trends in the monthly rate of MVC-involvement per 1000 population were similar across racial and ethnic subgroups, with changes in trends identified in December 2019 and April 2020 (table 1). Rates increased moderately from January 2018 to December 2019, followed by substantial decreases from December 2019 to April 2020 and significant increases from April 2020 through the end of 2021. Though general trends in MVC-involvement were similar across racial and ethnic classifications, magnitudes were notably different (figure 1). Non-Hispanic Asian and AI/AN individuals had the lowest rates of MVC involvement, typically under 5 individuals per 1000 population. Non-Hispanic Black individuals had the highest rates of MVC-involvement, peaking at approximately 10 individuals per 1000 population.

Patterns in MVC-related injury outcomes were not consistent across racial and ethnic classifications, ranging from zero to five joinpoints (online supplemental table 2). Temporary declines in injury rates following SOs were observed for all individuals except those classified as non-Hispanic AI/AN. Though the rates of AI/AN individuals injured in an MVC decreased over the study period (AMPC = -0.2%), there was a sharp increase in MVC-related ED visits beginning in June 2020 (MPC: 6.7%). Non-Hispanic Black individuals saw higher rates of MVC-related ED visits compared with injurious MVC involvement (as captured in crash reports) across the study period and had the highest rates across all racial and ethnic classifications (figure 2). Higher rates of individuals injured in an MVC relative to MVC-related ED visits

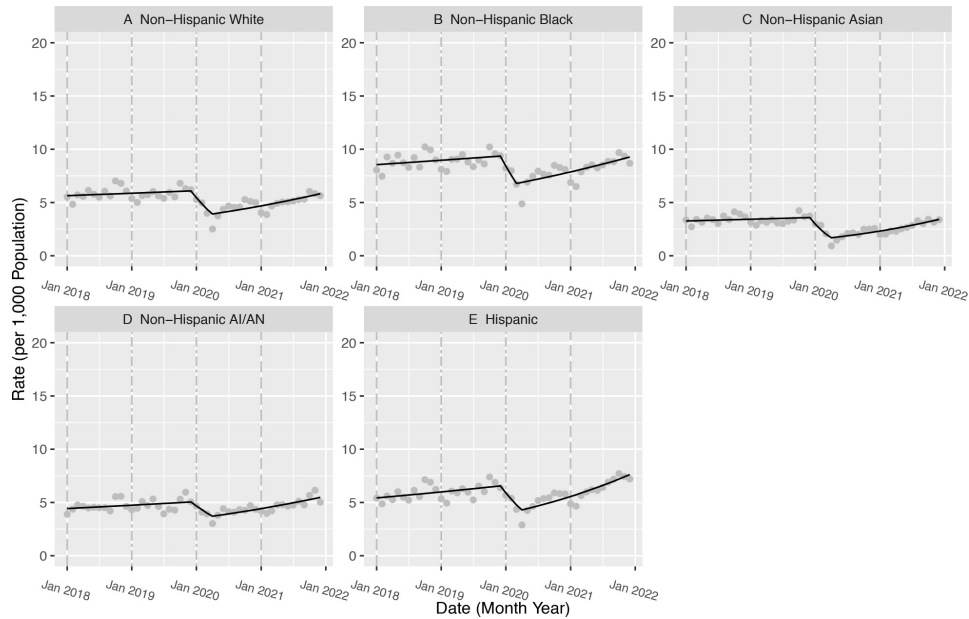


Figure 1 Trends in motor vehicle crash involvement* by race and ethnicity, North Carolina 2018–2021. notes: points represent crude rates per population; linear trendlines represent model predicted crude rates fit using joinpoint software (version 4.9.1.0) with the ideal number of joinpoints identified using the permutation model; vertical lines indicate start of new year (2018–2021). * rate of individuals involved in a MVC per 1000 population as derived from NC crash reports.

were observed for non-Hispanic White and Asian individuals, as well as those classified as Hispanic.

Rates of severe and fatal MVC injuries increased for all racial and ethnic subgroups from 2018 to 2021, except among non-Hispanic Asians, who experienced a decline in the rate of hospital admissions over the study period (figure 3). Non-Hispanic Black individuals experienced the largest increases in the rate of severe/fatal injury, with sharp increases occurring in the periods beginning April 2020

(MPC: 16.5%) and February 2021 (MPC: 18.3%). Non-Hispanic Black individuals also saw the largest increase in the rate of MVC-related deaths, with an MPC of 19.4% beginning April 2020. Lastly, sustained increases in the rates of all severe/fatal MVC-related outcomes were observed for both non-Hispanic AI/AN and Hispanic individuals, with AMPCs ranging from 0.3% to 0.7% (online supplemental table 3).

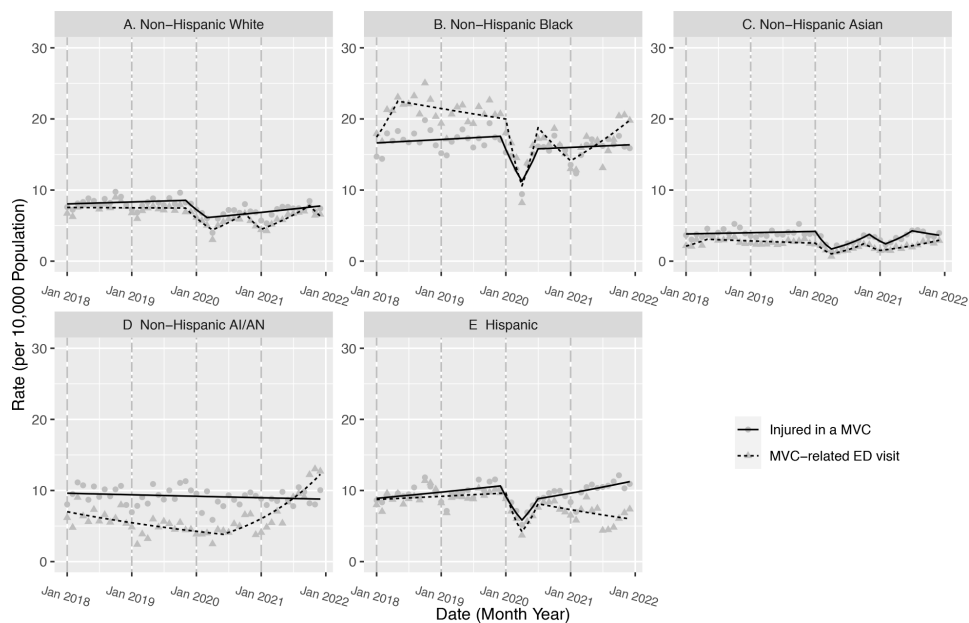


Figure 2 Trends in overall motor vehicle crash-related injuries by race and ethnicity and data source*, North Carolina 2018–2021. notes: points represent crude rates per population; linear trendlines represent model predicted crude rates fit using joinpoint software (version 4.9.1.0) with the ideal number of joinpoints identified using the permutation model; vertical lines indicate start of new year (2018–2021). * “injured in a MVC” represents the rate of individuals injured in a MVC as derived from crash reports, while “MVC-related ED visit” represents the rate of MVC-related ED visits as derived from ED visit data.

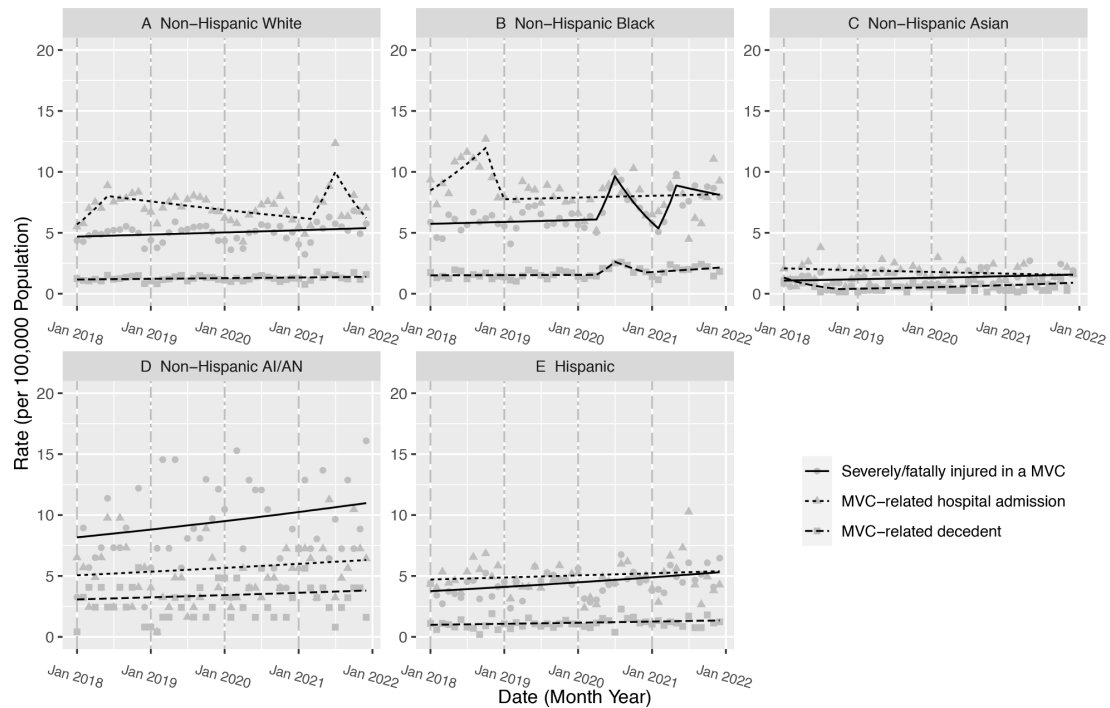


Figure 3 Trends in severe/fatal motor vehicle crash-related injuries by race and ethnicity and data source*, North Carolina 2018–2021. notes: points represent crude rates per population; linear trendlines represent model predicted crude rates fit using joinpoint software (version 4.9.1.0) with the ideal number of joinpoints identified using the permutation model; vertical lines indicate start of new year (2018–2021). * “Severely/fatally injured in a MVC” represents the rate of individuals sustaining a severe/fatal MVC-related injury as derived from crash reports; “MVC-related hospital admissions” represents the rate of hospital admissions from the ED as derived from ED visit data; and “MVC-related decedents” represents the rate of MVC-related deaths as derived from death certificate records.

DISCUSSION

Overall MVC and MVC-related injury trends followed a similar pattern: decreasing from December 2019 to April 2020, then increasing to pre-pandemic levels by the end of 2021. Generally, joinpoints were observed at the time of NC’s SOs. This is likely due to the impact of decreased mobility stemming from the implementation of SOs.^{6–8 13} Severe/fatal MVC-related outcomes, however, rarely had a joinpoint corresponding with SOs and often increased over the pandemic period. These results contrast the decreases observed in Utah¹⁵ and New York City.¹⁶ With fewer vehicles on the road early into the pandemic, the prevalence of risky driving behaviours increased.^{7 13 15} As these behaviours are associated with increased risk of severe injury, potential regional differences could explain the higher rates observed in NC.

MVC-related rates varied by racial and ethnic classification. The highest rates consistently observed among non-Hispanic Black individuals, matching findings for MVC-related hospitalizations¹ and fatalities.² Alongside underlying factors perpetuating disparities in MVC-related outcomes among racial and ethnic minority individuals that were unlikely to change in the face of the COVID-19 pandemic, these individuals were also more likely to remain on the road as essential workers,²⁰ increasing their risk of MVC injury. The magnitude of MVC-related racial and ethnic disparities also depended on the data source used, as each captured a different population of road users. This underscores the importance of thoughtfully selecting the best data source for the research question at hand.

Strengths of the present study include its novel examination of multiple MVC outcomes across a longer post-pandemic period than prior research, and the use of

joinpoint regression to identify statistically significant changes in those trends. One limitation was the use of population-based rates instead of VMT-based rates. While VMT-based rates may more accurately reflect vehicle occupant exposures, reliable VMT data was unavailable for these analyses. That said, the presented population-based rates resulted in comparable findings to several other studies. Further, researchers have argued for a refocus on population-based rates, as VMT-based rates can hide unequal distributions in MVC morbidity and mortality due to auto-centric land use patterns and increased car dependency. Second, due to inconsistencies in terminology across datasets, those with other racial and ethnic classifications were excluded from these analyses; representing a small percentage of individuals across outcomes. Taken together, future research should examine MVC-related outcomes using a variety of denominators across more granular racial and ethnic classifications, appropriately considering the context of those outcomes when interpreting and disseminating findings.

Our study found population rates of MVC-related public health outcomes returned to or exceeded pre-pandemic levels by the end of 2021, potentially exacerbating racial and ethnic disparities in traffic injury and death. We found both the magnitude and trend of these outcomes varied by the data source under investigation, highlighting the necessity of a holistic approach towards traffic injury surveillance, particularly for disparities research. Through this approach we can target interventions to more effectively mitigate the results of behaviour changes that can and will occur in the face of large-scale social disruptions, such as the COVID-19 pandemic.

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ORCID iDs

Lucas M Neuroth <http://orcid.org/0000-0002-0097-6631>

Katherine J Harmon <http://orcid.org/0000-0003-2330-2645>

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