Highway Crashes in California During the COVID-19 Pandemic: Insights and Considerations

Offer Grembek, Praveen Vayalamkuzhi, and SangHyouk Oum

Abstract This chapter describes the results of a short-term analysis of highway crashes in California during the first year of the COVID-19 pandemic. The pandemic has had an unexpected and abrupt influence on the demand for mobility. The effect of this was a drastic reduction in the level of activity on the roads. This level of activity defines the exposure of road users to crash risk and represents a focal variable in the sciences of traffic safety. The rapid rate of change in traffic that occurred during the pandemic, triggered a need to monitor highway safety at a higher frequency than what was previously common in traffic safety studies. We compiled data at the weekly level and analyzed six-week periods. Our analysis shows that the minor injury crash rate per 100 million vehicle-miles traveled (VMT) has gone down from 37.58 per 100 million VMT during the before period to 25.52 per 100 million VMT in the first period after the pandemic. This is a reduction of 32% in the minor injury crash rate per 100 million VMT. In contrast, the more severe and often catastrophic, major injury crash rate per 100 million VMT increased from 4.47 per 100 million VMT during the before period to 5.15 per 100 million VMT in the first period after the pandemic. This is an increase of 14.8% in the major injury crash rate per 100 million VMT. The resulting bifurcation across different crash severity levels indicates that although the overall crash rates dropped, the rate of catastrophic crashes (i.e., fatal and severe) got worse. The main implication of this finding is that a reduction in minor injury crashes does not necessarily correspond to a reduction in major crashes. These findings demonstrate that it is possible to reduce the overall crash rate without making the system safer in terms of fatal and severe crashes, and this should be considered when developing roadway safety programs.

O. Grembek (✉) · P. Vayalamkuzhi · S. Oum
Safe Transportation Research and Education Center (SafeTREC), University of California, Berkeley, USA
e-mail: grembek@berkeley.edu

P. Vayalamkuzhi
e-mail: pravi@berkeley.edu

S. Oum
e-mail: shoum@berkeley.edu

A. Loukaitou-Sideris et al. (eds.), *Pandemic in the Metropolis*, Springer Tracts on Transportation and Traffic 20, https://doi.org/10.1007/978-3-031-00148-2_11

1 Introduction

The COVID-19 pandemic has had an unexpected and abrupt influence on many aspects of our lives. One major impact of the pandemic is a dramatic change in the demand for mobility. Various safe-at-home protocols, which require people to work and learn remotely, have temporarily dissolved the ever-increasing pressure on commute patterns. The remaining commute-related travel was mostly for essential work. The non-commute travel also experienced significant changes due to restrictions related to opportunities for shopping and entertainment. The combined effect of this was a drastic reduction in the level of activity on the roads. This level of activity defines the exposure of road users to crash risk and represents a focal variable in the sciences of traffic safety. Moreover, the sudden change in traffic patterns can also trigger other responses that can affect the safe behavior of road users or the safety of the conditions they travel. This includes both the perspectives of individual road users, who might behave a bit differently under different traffic conditions, and also less congestion and other operational considerations.

The societal impact of traffic safety is massive. In 2016, road crashes in the U.S. claimed the lives of 34,439 people. Of those victims, 23,714 were drivers or occupants of a motor vehicle, 5,987 were pedestrians and 4,738 were motorcyclists, bicyclists, and other non-occupants. The estimated economic cost of all motor vehicle traffic crashes in the United States was $242 billion in 2010 and is undoubtedly higher today [7]. However, despite the overwhelming impact and the catastrophic outcome of fatal and severe crashes, traffic crashes are rare events, if we consider the massive numbers of individual daily trips. Considering this, researchers commonly utilize statistical analysis using data collected over multiple years to systematically study traffic safety. The common range of study periods for safety analyses ranges from three to 5 years of data. However, the rapid rate of change in traffic that occurred during the pandemic, triggered a need to monitor highway safety at a higher frequency than what was previously common in studies about the traffic safety of communities.

This study opens opportunities to evaluate common principles that are agreed upon by safety professionals. For example, the traditional expectation is that when traffic volume drops, the number of crashes will drop as well. The rationale is that with less traffic on the streets, the exposure is lower. While this principle is logical, it overlooks core principles of emerging traffic safety approaches, such as vision zero and the safe system [1, 5, 8]. These approaches are policy innovations to move the needle from our currently unsafe system to a safe system in which no one can be severely or fatally injured. To achieve this, the basic elements of the system are identified with the goal of tapping into the protective capabilities of each element, which include safe roads, safe vehicles, safe speeds, safer users, and post-crash care. These approaches also dictate how these elements need to be fused together to create a safe system. The two core principles in this respect are considering kinetic energy as the focal variable of safety, and recognizing that humans make mistakes [2–4, 6, 9, 10] . The COVID-19 pandemic allows us to compare how the traditional perspective and the novel perspective are aligned with the safety outcomes that we are seeing.

Another common principle that can be evaluated here is the "safety pyramid," which postulates that the most severe (i.e., fatal) crashes represent the top of the pyramid, while the less severe crashes compose a wider layer that represents more crashes. In other words, there is some proportional relationship between different levels of crash severity. Again, this is a valid point, but the natural experiment of the pandemic allows us to examine the situations and if we need to revise our assumptions. With this in mind, this chapter describes the results of a short-term analysis of highway crashes in California during the first year of the pandemic.

The chapter is organized into five sections. First, we present the data that was collected for this purpose and the assumptions it was based on. Next, we describe our data processing and analytical methodology, followed by suggested policy actions within each timeframe. In the next section, we present the results of our analysis across different jurisdictions. And finally, we discuss the findings and the policy implications that can be derived from it.

2 Data Sources and Methodology

Traffic safety analysis is commonly comprised of three data types. The first is *transportation safety data,* which is typically sourced from police-reported crashes. It includes the location, date, time, and type of a crash, characteristics of the parties involved, possible presence of intoxication, weather conditions, etc. The second data type is *exposure data*, which approximates the level of activity and is usually based on traffic counts or traffic models. When activity data is not available, it is possible to resort to census or Department of Motor Vehicle (DMV) data sources to represent any population group or licensed road users. Lastly, the third data type, is *infrastructure or land-use data* (e.g., roadway and intersection characteristics, presence of marked or unmarked crosswalks, type of land uses, etc.), which allows for the analysis of the relationship between the built environment and traffic safety.

This chapter is focused on the short-term impact of the pandemic on transportation safety. The roadway infrastructure and land use has not changed during this time and, therefore, data about the built environment was not used in our analysis. Accordingly, the data used here is a combination of safety data and exposure data, as described below.

2.1 Crash Data

The crash data is extracted from police-reported injury crashes that are added to the California Statewide Integrated Traffic Records System (SWITRS) by the California Highway Patrol (CHP). There is a delay related to submitting, processing, and tabulating crash data into SWITRS. The delay is too restrictive for crashes that occur on non-state roads so those were excluded in this effort. Moreover, due to this lag, the data shown may be missing some relevant crashes, particularly those occurring more recently. It is also important to note that while this data is not expected to change, it is considered provisional data until CHP releases the SWITRS Annual Report.

The data displayed in Table 1 was collected at the weekly level for the period between January 6, 2020 and December 28, 2020 and for the corresponding week in 2019 (e.g., Monday March 16, 2020 corresponds to Monday March 18, 2019). The week of March 16, 2020 is highlighted since stay-at-home orders went into effect on March 19, 2020, in response to the COVID-19 pandemic. Our data includes only injury crashes that occurred on the California State Highway System (SHS) during these two chronological segments. The SHS facilities are mostly freeways, but in some jurisdictions, they can also include urban arterials, which are operated by the state.

Table 1 lays out the data as a year-over-year (YOY) comparison between equivalent weeks in 2019 and in 2020. The principles of Vision Zero and the Safe System approach postulate that the fatal and severe crashes are the pertinent ones and need to be monitored separately from other minor crashes. Considering this, the first two columns separate the number of minor injury crashes and the number of Fatal and Severe injuries (labeled as F + SI). The subsequent columns do the same for 2019. The last two columns show the YOY percentage change. The change starts from a 61% decrease in minor injury (March 23, 2020) crashes and slowly changes to a range of 20–30% decrease. We can see that the drop in Fatal and Severe crashes was much smaller and started from a 21% decrease, fluctuating significantly before gradually bouncing back.

A comparison of YOY is not the only way to observe the effect on crashes, however. By looking separately at each of the first two columns, we can also appreciate the longitudinal drop in crashes, from 1,169 minor crashes during the week of March 9, 2020 (before the State-wide stay-at-home orders went into effect) to only 407 during the week of March 23, 2020. Similarly, fatal and severe crashes dropped from 117 to 97.

The data plotted in Fig. 1 can illustrate the longitudinal change in patterns of different crash severity. The fatal and severe crashes are represented by the darker curve and the axis on the left, and the minor injury crashes are represented by the lighter curve and the axis on the right. Figure 1 includes data for 2019 and for 2020. While there are clear fluctuations for both the Fatal + Severe and the Minor Injury curves, the left side of the figure (which mostly represents 2019) has a noticeable overlap. However, two notable differences are observed when we look at the curves during the week of March 16, 2020 (denoted by the vertical dashed line). First, there is a dramatic drop in both curves due to the San Francisco Bay Area Shelter-in-Place order of March 16, 2020 and the overarching California Stay-at-Home order of March 19, 2020. Second, there is a separation of the curves, which shows that the reduction in minor injury crashes was larger and longer-lasting relative to the fatal and severe crashes. Thus, these preliminary observations indicate that the impact of the these stay home orders was not the same across different crash severities.

Table 1 Police-reported injury crashes on state highways in California. Data Source: CHP's Statewide Integrated Traffic Records System (SWITRS). Data retrieved on September 30, 2021

Weekly start date 2020	2020		2019		YOY weekly percent change	
	Minor crashes	F+SI crashes	Minor crashes	F+SI crashes	Minor crashes (%)	F+SI crashes (%)
1/6/2020	986	111	1028	114	−3.9	−2.6
1/13/2020	989	112	1202	111	−16.1	0.9
1/20/2020	939	113	1100	120	−13.8	−5.8
1/27/2020	1049	113	1162	120	−9.4	−5.8
2/3/2020	951	100	1,230	86	−20.1	16.3
2/10/2020	1,030	126	1,168	103	−9.0	22.3
2/17/2020	965	133	964	103	2.9	29.1
2/24/2020	1,068	133	1,145	130	−5.8	2.3
3/2/2020	1,039	131	1,066	105	−0.1	24.8
3/9/2020	1,169	117	1,120	141	2.0	−17.0
3/16/2020	632	87	1,151	108	−42.9	−19.4
3/23/2020	407	97	1,053	116	−56.9	−16.4
3/30/2020	413	82	1,017	99	−55.6	−17.2
4/6/2020	638	89	1,035	122	−37.2	−27.0
4/13/2020	388	91	1,039	119	−58.6	−23.5
4/20/2020	452	116	1,059	137	−52.5	−15.3
4/27/2020	515	93	1,102	133	−50.8	−30.1
5/4/2020	573	109	1,031	101	−39.8	7.9
5/11/2020	586	97	1,256	114	−50.1	−14.9
5/18/2020	651	95	1,057	114	−36.3	−16.7
5/25/2020	594	114	979	126	−35.9	−9.5
6/1/2020	643	126	1,109	140	−38.4	−10.0
6/8/2020	762	108	1,159	129	−32.5	−16.3
6/15/2020	800	135	1,041	152	−21.6	−11.2
6/22/2020	813	122	1,074	138	−22.9	−11.6
6/29/2020	752	117	949	141	−20.3	−17.0
7/6/2020	796	126	1,077	132	−23.7	−4.5

(continued)

Table 1 (continued)

Weekly start date 2020	2020		2019		YOY weekly percent change	
	Minor crashes	F+SI crashes	Minor crashes	F+SI crashes	Minor crashes (%)	F+SI crashes (%)
7/13/2020	762	140	1,190	154	−32.9	−9.1
7/20/2020	779	146	1,105	142	−25.8	2.8
7/27/2020	777	123	1,114	141	−28.3	−12.8
8/3/2020	800	141	1,104	143	−24.5	−1.4
8/10/2020	891	124	1,110	136	−18.5	−8.8
8/17/2020	803	139	1,191	151	−29.8	−7.9
8/24/2020	835	125	1,127	132	−23.7	−5.3
8/31/2020	887	141	1,124	131	−18.1	7.6
9/7/2020	756	156	1,128	127	−27.3	22.8
9/14/2020	840	134	1,171	145	−26.0	−7.6
9/21/2020	959	162	1,129	135	−11.3	20.0
9/28/2020	911	140	1,173	154	−20.8	−9.1
10/5/2020	903	108	1,134	159	−21.8	−32.1
10/12/2020	985	149	1,152	120	−10.8	24.2
10/19/2020	823	143	1,123	151	−24.2	−5.3
10/26/2020	989	157	1,158	129	−11.0	21.7
11/2/2020	921	144	1,231	127	−21.6	13.4
11/9/2020	908	132	1,160	122	−18.9	8.2
11/16/2020	932	116	1,221	120	−21.8	−3.3
11/23/2020	829	136	1,184	149	−27.6	−8.7
11/30/2020	816	103	1,239	108	−31.8	−4.6
12/7/2020	816	110	1,178	116	−28.4	−5.2
12/14/2020	730	119	1,196	118	−35.4	0.8
12/21/2020	734	116	954	109	−20.0	6.4
12/28/2020	702	109	740	104	−3.9	4.8

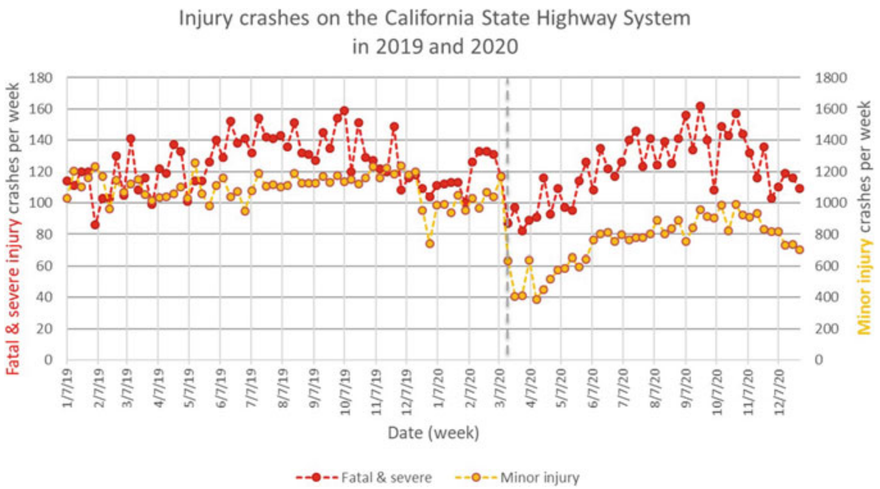

Fig. 1 Weekly police-reported injury crashes on the California State Highway System before and during the COVID-19 pandemic. *Data source* California Statewide Integrated Traffic Records System (SWITRS)

2.2 Exposure Data

Operational data is commonly used as a form of exposure data in traffic safety. It is typically represented using Vehicle-Miles Traveled (VMT), which are calculated using in-pavement loop detectors. The California Department of Transportation (Caltrans) monitors the flow of vehicles using such loop detectors on the California State Highway System. The data is processed and does not suffer from a reporting lag. The output is available online through the Caltrans Performance Measurement System (PeMS). The data includes all the roadway facilities on the California State Highway System. These vast facilities are freeways, but in some jurisdictions, they can also include urban arterials which are operated by Caltrans. Similarly to traffic safety data, we exported the exposure data for this study for each week between January 6, 2020 and December 28, 2020 and the corresponding week in 2019.

Table 2 summarizes Vehicle Miles Traveled on the California State Highway System; this is a measure of exposure calculated by multiplying the amount of daily traffic by the directional distance. This table also lays out the data as a year-over-year (YOY) comparison between equivalent weeks in 2019 and 2020, with the last column being the YOY percent change. By looking at changes in the VMT just before and after the initiation of stay-at-home orders during the week of March 16, 2020, we can also appreciate the drop in VMT, from 2,570 million VMT during the week of March 9, 2020 (before the stay home orders were initiated) to only 1,804 million VMT during the week of March 23, 2020. By examining Fig. 2, we can see that the change starts on March 23, 2020, with a 37% drop in VMT from the previous year, and it consistently converges back to a drop of about 10% by June 2020.

Table 2 Exposure Data: Vehicle miles traveled on the California State Highway System before and during the COVID-19 pandemic. Data source: Caltrans Performance Measurement System (PeMS). Data retrieved on September 30, 2021

Weekly Start Date for 2020	Vehicle-Miles Traveled (Millions)		YOY weekly Percent change
	2020	**2019**	
1/6/2020	2,723.12	2,689.28	1.3
1/13/2020	2,756.82	2,648.92	4.1
1/20/2020	2,759.79	2,757.30	0.1
1/27/2020	2,748.80	2,667.42	3.1
2/3/2020	2,765.44	2,729.04	1.3
2/10/2020	2,817.61	2,728.67	3.3
2/17/2020	2,800.07	2,791.92	0.3
2/24/2020	2,813.64	2,751.28	2.3
3/2/2020	2,789.33	2,779.12	0.4
3/9/2020	2,570.43	2,840.22	−9.5
3/16/2020	2,062.24	2,858.41	−27.9
3/23/2020	1,804.62	2,865.38	−37.0
3/30/2020	1,783.36	2,840.23	−37.2
4/6/2020	1,712.41	2,865.43	−40.2
4/13/2020	1,832.01	2,887.58	−36.6
4/20/2020	1,904.41	2,895.55	−34.2
4/27/2020	1,987.98	2,872.63	−30.8
5/4/2020	2,103.58	2,883.71	−27.1
5/11/2020	2,126.63	2,851.26	−25.4
5/18/2020	2,238.47	2,861.59	−21.8
5/25/2020	2,232.05	2,816.82	−20.8
6/1/2020	2,300.26	2,888.54	−20.4
6/8/2020	2,431.11	2,914.86	−16.6
6/15/2020	2,501.35	2,888.87	−13.4
6/22/2020	2,499.59	2,900.37	−13.8
6/29/2020	2,430.13	2,780.64	−12.6
7/6/2020	2,495.30	2,891.99	−13.7
7/13/2020	2,486.06	2,914.37	−14.7
7/20/2020	2,507.41	2,915.13	−14.0

(continued)

Table 2 (continued)

Weekly Start Date for 2020	Vehicle-Miles Traveled (Millions)		YOY weekly Percent change
	2020	**2019**	
7/27/2020	2,535.39	2,914.10	−13.0
8/3/2020	2,548.31	2,920.36	−12.7
8/10/2020	2,558.07	2,898.30	−11.7
8/17/2020	2,531.36	2,890.24	−12.4
8/24/2020	2,546.71	2,886.82	−11.8
8/31/2020	2,566.98	2,800.77	−8.3
9/7/2020	2,475.91	2,873.06	−13.8
9/14/2020	2,557.28	2,876.22	−11.1
9/21/2020	2,582.53	2,867.18	−9.9
9/28/2020	2,576.19	2,861.75	−10.0
10/5/2020	2,586.04	2,843.22	−9.0
10/12/2020	2,599.15	2,864.92	−9.3
10/19/2020	2,581.25	2,833.36	−8.9
10/26/2020	2,557.73	2,803.18	−8.8
11/2/2020	2,496.13	2,826.48	−11.7
11/9/2020	2,531.62	2,809.71	−9.9
11/16/2020	2,521.89	2,798.89	−9.9
11/23/2020	2,415.38	2,655.73	−9.1
11/30/2020	2,459.47	2,725.49	−9.8
12/7/2020	2,396.11	2,813.44	−14.8
12/14/2020	2,458.64	2,845.80	−13.6
12/21/2020	2,305.32	2,605.68	−11.5
12/28/2020	2,249.19	2,674.12	−15.9

2.3 Crash Rates

It is important to mention that the total number of injury crashes across all levels of severity decreased during the observation period in 2020 (during the pandemic) as compared to the previous year (before the pandemic). This is a desirable outcome, but not sufficient to quantify the traffic safety impact. To better assess the impact

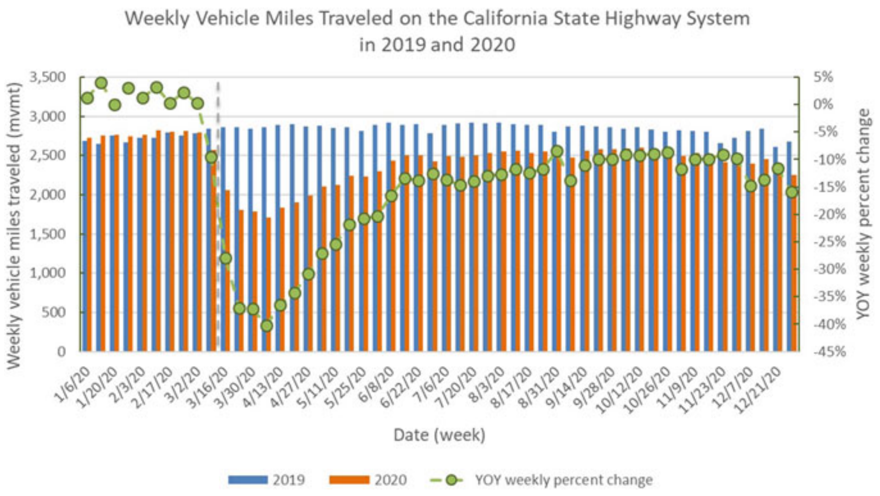

Fig. 2 Weekly vehicle-miles traveled on the California state highway system before and during the COVID-19 pandemic. *Data source* Caltrans performance measurement system (PeMS)

on traffic safety, we also need to analyze the crash rates by controlling for exposure using VMT.

While this data is technically considered provisional, at this point only minor changes to the data are expected, if any. Considering this, it is already possible to make some important observations by conducting a naïve before-after comparison. The before data is based on the six weeks prior to California's Stay Home orders and include the week of January 6, 2020 through the week of March 9, 2020. The week of March 16, 2020 is excluded since it was a transitional week between the before and after periods. The after data included seven separate six-week periods after California's Stay Home orders. These weeks are considered individual observation points, and the result of this analysis is described in the next section.

3 Findings

Table 3 summarizes the results of the six-week observations and analysis of the crash rates across minor injury crashes (two lowest injury levels) and major injury crashes (severe and fatal) for the year 2020 and the pre-pandemic year. The results of our analysis can provide some valuable insights.

The first observation is that the impact on safety was different for different levels of crash severity. Table 3 shows that the minor crash rates in 2020 across all the periods after the initiation of the stay-at-home order are lower than on March 9, 2020 when the rate was 37.58 per 100 million VMT. Note that the rates are also lower in 2020 for the before period than in 2019 (37.79 vs. 41.21), but this difference is much

Table 3 Injury crash rate on the SHS during 2020 and 2019

Weekly start date for six-week period	Minor crash rate (crash/mvmt)	F + SI crash rate (crash/mvmt)
2/25/2019	41.21	4.03
4/8/2019	37.79	4.05
5/20/2019	37.93	4.16
7/1/2019	36.71	4.81
8/12/2019	38.39	4.86
9/23/2019	39.96	4.77
11/4/2019	40.93	4.93
12/16/2019	43.11	4.40
1/27/2020	34.77	4.07
3/9/20	37.58	4.47
4/27/20	25.52	5.15
6/8/20	28.36	4.83
7/20/20	31.52	5.27
8/31/20	32.66	5.19
10/12/20	34.82	5.52
11/23/20	35.77	5.48
12/28/20	32.31	4.67

Data sources Caltrans performance measurement system (PeMS); California statewide integrated traffic records system (SWITRS)

smaller than the previous one. However, when we look at the severe crash rates, the impact is reversed. We can see that the F + SI crash rate is higher in each of the after periods. This opposite change in the impact of the pandemic on crash severity is non-intuitive to traditional safety principles, which would expect a more similar effect.

As we continue to examine this, we can more explicitly see the immediate impact and the trend in the longitudinal impact on the two levels of severity in 2020. This can be observed in Fig. 3, which provides a visual illustration of the impact and the bifurcation across different crash severity levels. The chart includes two different curves with a different vertical axis, one for minor crashes and one for fatal and severe crashes.

The minor injury crash rate per 100 million VMT has gone down from 37.58 per 100 million VMT during the *before* period to 25.52 per 100 million VMT in the first *after* period. This is a reduction of 32% in the minor injury crash rate per 100 million VMT. The following *after* periods demonstrate a smaller but noticeable reduction. It can also be observed that the reductions are gradually recovering and slowly moving back up towards the rate of the before period.

In contradiction, the more important, and often catastrophic, major injury crash rate per 100 million VMT has gone up from 4.47 per 100 million VMT during the

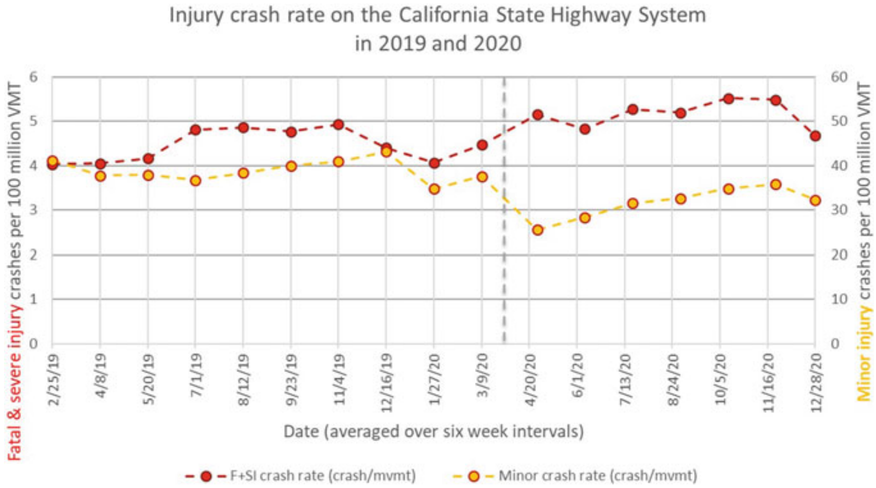

Fig. 3 Injury crash rate on the California SHS during the COVID-19 pandemic. *Data sources* Caltrans Performance Measurement System (PeMs); California Statewide Integrated Traffic Records System (SWITRS)

before period to 5.15 per 100 million VMT in the first *after* period. This is an increase of 14.8% in the major injury crash rate per 100 million VMT. The following *after* periods also demonstrate a smaller but noticeable increase and have stayed somewhat stable.

4 Discussion

The findings discussed in the previous section indicate that although the overall crash rates dropped, the rate of catastrophic crashes (i.e., fatal and severe) got worse. There are probably several factors that have led to this outcome. If we use a Safe System lens to evaluate this, we can review the different elements of the system across roads, vehicles, speeds, users, and post-crash care to help us understand this outcome.

We know that the design elements (vehicle and road) did not change during this time. We expect some changes in post-crash care due to COVID-19 protocols. We also expect some changes in user behavior due to the emotional toll of the pandemic, which can include situations of excessive speeding. However, the element which can explain this dramatic change is a systemic change of operational average speed. We suggest that this change in speed is associated with a reduction in traffic congestion during the pandemic and goes beyond the impact of individual speeding events. The lower occurrence of congested periods has the implication of an increase in average speeds and more opportunities for excessive speeding than before the pandemic. Again, while reducing traffic congestion is a desirable thing, the result is that the average amount of kinetic energy for a trip is now higher. In turn, this increases the magnitude of the safety problem. In other words, the roads and vehicles are now expected to contain or control higher levels of kinetic energy. If we combine this with the Safe System principle that expects human error, the outcome is that the consequence of each human error will now be larger. This has additional policy implications for traffic operations, since it might justify coupling congestion mitigation efforts with safety improvements.

This postulation can also explain the reduction in minor crashes. Since there is less congestion, there are fewer human errors during low-speed trips, which commonly lead to minor injury or property damage only. Another practical implication of this finding is that a reduction in minor injury crashes does not necessarily correspond to a reduction in major crashes. If the focus is the ability to prevent fatal and severe crashes, these findings demonstrate that it is possible to reduce the overall crash rate without making the system safer. Accordingly, to reduce fatal and severe crashes, it is critical to make sure that the most pertinent data is used. If all crash severity levels are used together, it can dilute an agency's ability to allocate life-saving resources to the situations that need it the most.

Lastly, the findings here open opportunities to further examine our understanding of the safety pyramid. While the findings do not challenge the existence of the safety pyramid, they do demonstrate that the relationship between different layers of the pyramid is not static. The idea of the crash pyramid does indeed hold when we are looking at a specific crash type (i.e., all else equal) but may not be transferable to other types of crashes. Furthermore, if the causal mechanism of many minor crashes is different from that of catastrophic crashes, one can question the value of using the number of minor crashes as a proxy for major crashes. The policy implications here are again valuable, since we also want to make sure we are focusing our countermeasures on these fatal and severe crashes, as opposed to all crashes.

Appendix: Data Dashboard

In addition to the efforts to track the crash data, the UC Berkeley Safe Transportation Research and Education Center has made the data available on the center's website. The data was updated daily/weekly as part of a provisional Injury Crashes During COVID-19 dashboard. The dashboard allows users to view the data across three geographical areas for all the state highways in California and covering the two main urban metros. Additional tables include a breakdown by crash severity, primary collision factors, and transportation modes.

The dashboard is shown in Fig. 4 and can be found at https://tims.berkeley.edu/covid19.php.


Provisional weekly police-reported injury crashes on state highways in California

Data on this page is updated daily and can be used to monitor the frequency and type of crashes that occur in the weeks prior, during, and after California's stay home order, which went into effect on March 19, 2020 in response to the COVID-19 pandemic.

Note:

Provisional crash data are based on police reports of crashes that occurred on state highways. Crashes are added to the California Statewide Integrated Traffic Records System (SWITRS) by the California Highway Patrol (CHP) and we download them from the I-SWITRS website on a daily basis. There is a delay related to submitting, processing, and tabulating crash data into SWITRS. Due to this lag, the data shown on this page may exclude some relevant crashes, particularly those occurring in the most recent two to three weeks. Crash counts for all weeks are revised as new and updated crash data are received. These data do not currently include crashes that occurred on non-state roads.

Last Updated:

— Collisions as of October 20, 2020 from *CHP I-SWITRS*
— Vehicle Miles Traveled as of October 13, 2020 from *Caltrans Performance Measurement System (PeMS)*

Area: California

Table Option: Overall Summary By Primary Collision Factor By Ped & Bike

Fig. 4 UC Berkeley SAFETREC weekly injury crashes dashboard COVID-19

References

1. Belin MÅ, Tillgren P, Vedung E (2012) Vision zero–A road safety policy innovation. Int J Inj Contr Saf Promot 19(2):171–179
2. Dumbaugh E, Signor K, Kumfer W, LaJeunesse S, Carter D (2019) Safe systems: guiding principles and international applications. DRAFT CSCRS Report
3. Ecola L, Popper SW, Silberglitt R, Fraade-Blanar L (2018) The road to zero: a vision for achieving zero roadway deaths by 2050. Rand Corporation, Santa Monica, CA
4. Forum International des Transports (2016) Zero road deaths and serious injuries: leading a paradigm shift to a safe system. OECD Publishing
5. Job RF (2017) Re-invigorating and refining safe system advocacy. J Australas College Road Saf 28(1):64–68
6. Mooren L, Grzebieta R, and Job S (2011) Safe system-comparisons of this approach in Australia. Australasian College of Road Safety National Conference, Melbourne.
7. National Center for Statistics and Analysis (2018) Summary of motor vehicle crashes: 2016 data. (Traffic Safety Facts. Report No. DOT HS 812 580). National Highway Traffic Safety Administration, Washington, DC
8. Sakashita C, Job RF (2016) Global road safety: second special issue. J Australas College Road Saf 27(3):3
9. Welle B, Sharpin AB, Adriazola-Steil C, Job S, Shotten M, Bose D, Imamoglu T (2018) Sustainable & safe: a vision and guidance for zero road deaths. World Resources Institute. https://files.wri.org/d8/s3fs-public/sustainable-safe.pdf
10. Woolley J, Stokes C, Turner B., Jurewicz C (2018) Towards safe system infrastructure: a compendium of current knowledge austroads, Research Report AP-R560-18

Offer Grembek is a researcher and lecturer at the University of California Berkeley, the co-Director of the Safe Transportation Research and Education Center (SafeTREC), and the Associate Director of the Collaborative Sciences Center for Road Safety, a National University Transportation Center. His research includes injury risk in multimodal environments, pedestrian and bicycle safety, exposure estimates, systemic approach to road safety management, and the Safe System Approach. He received his B.Sc. in Industrial Engineering from the Ben Gurion University of the Negev, his MS and Ph.D. degrees in Civil and Environmental Engineering from the University of California, Berkeley.

Praveen Vayalamkuzhi is a postdoctoral researcher at the University of California Berkeley Safe Transportation Research and Education Center, where he leads implementable transportation safety management research projects. He is passionate about data-driven safety analysis, and its role in forensic investigations in developing transportation safety decision making tools. He holds a Ph.D. in Civil Engineering from the Indian Institute of Technology Madras (IITM), where he studied the level of safety of highways operated under heterogeneous traffic flow.

SangHyouk Oum is an Applications Program Manager at the University of California Berkeley Safe Transportation Research and Education Center (SafeTREC). He has been working on creating and managing various web tools for transportation safety that include: Transportation Injury Mapping System (TIMS), California Strategic Highway Safety Plan (SHSP) Tracking Tool, California Tribal Data Viewer, Street Story, etc. His areas of expertise are transportation safety data, GIS analysis, and web programming.