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RADAR

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Effects of the COVID-19 pandemic on the status of road safety

THEMATIC AREA 5 (TA5): TRANSPORT SAFETY AND COVID-19

RADAR – Risk Assessment on Danube Area Roads

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Authors (per company, if more than one company provide it together)	Klaus Machata & Aggelos Soteropoulos (KFV) Marko Ševrović, EIRA-EuroRAP		
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Abbreviation list

RSEG	Road Safety Expert Group
TA	Thematic Area

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1. Introduction

The RADAR project (Risk Assessment on Danube Area Roads) aims at fostering infrastructure-based safety assessments of roads and at bringing about improved safety levels in the Danube region. RADAR's Road Safety Expert Group (RSEG) focuses on six Thematic Areas (TA), one of them being "TA5- Transport safety and COVID-19". This report contains an overview of available literature on the impacts of COVID-19 on mobility, behaviour and safety as well as recommendations for remedial interventions, targeted at decision-makers and stakeholders in Danube Area countries. It also contains information and data from the Danube region, collected through a questionnaire sent out to RSEG members and presented at the RSEG group meeting in May 2021. If not otherwise stated, the presented information and data for the Danube Area countries was derived from that questionnaire.

The COVID-19 pandemic and the related measures to contain and reduce its spread in countries all over the world had extensive impact on many areas of our lives. Staying at home requirements, closures of educational institutions, non-essential businesses and events, working from home restrictions and travel bans are characterizing the period since March 2020 when the World Health Organization declared COVID-19 a world-wide pandemic (Vingilis et al. 2020; ETSC 2020, ITF 2021). These measures together with *social distancing*, i.e., reducing interactions between individuals to slow down the spread of the virus, have led to a sharp decline in economic and social life and in some areas even to a complete standstill (de Vos 2020).

The implementation of containment measures at the beginning or the first wave of the pandemic in March and April 2020, i.e., mostly very stringent lockdowns in many countries, and also the re-introduction of (parts of) these measures at the beginning of the following waves of the spread of the pandemic (e.g. autumn 2020 in Europe) also had traffic impacts and changed the number and types of out-of-home activities people performed, and how people reached these activities (Boroujeni, Saberian & Li 2021; de Vos 2020). Overall, traffic volumes and mobility activities have dropped, and this also had impacts on traffic safety, as with the reduction of traffic volumes exposure to road traffic accidents was reduced (Katrakazas et al. 2020, Yannis et al. 2020). However, effects of COVID-19 and the related containment measures have been varied in several countries: because of the reduction in traffic volumes, streets became less crowded, potentially increasing opportunities for speeding and stunt driving (Vingilis et al. 2020). In addition, as social distancing has also influenced travel mode choice, some transport modes – particularly individual means of transport – have been used to a greater extent (e.g. passenger cars) than others (e.g. public transport), which might also affect road safety (de Vos 2020; Campisi et al. 2020, ITF 2021). Moreover, the increased stress and anxiety brought about by the pandemic could affect driving behaviour and increase aggressive or risky driving and collision risk. Furthermore, an increase in alcohol sales and substance use has been observable during the pandemic in some countries, which might affect the prevalence of impaired drivers (Vingilis et al. 2020). In addition, as schools switched to distance learning, in several countries also a distinct focus on teaching and catching up on the core subjects was observable, resulting in less children receiving traffic safety and mobility education (ETSC 2021).

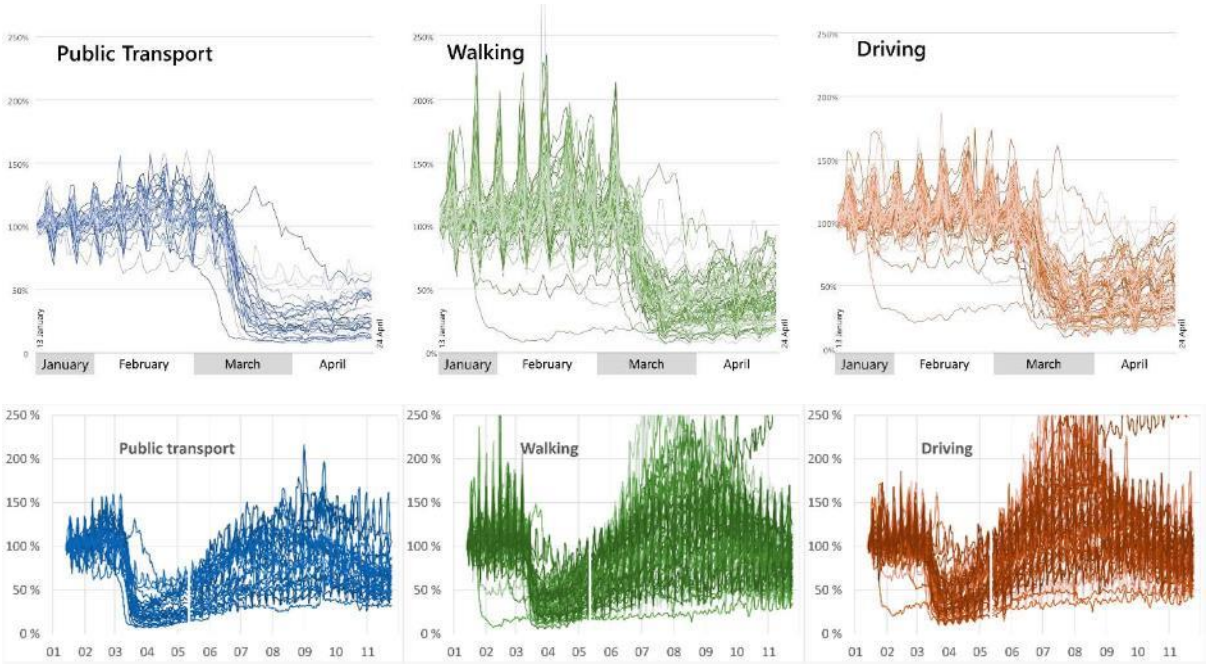
It can be assumed that some effects of COVID-19 and related containment measures are temporal and that travel demand will rise again when the measures are lifted – which will also have impacts on traffic safety (de Vos 2020). However, some of the changes may be structural and long lasting, e.g., people might still fear social contact when travelling even after social distancing rules are no longer in force, which might affect activity participation and travel. Therefore, the development of road safety strategies in relation to the new reality of COVID-19 and considering the respective changes are needed (Vingilis et al. 2020; de Vos 2020).

2. Effects of COVID-19 and related containment measures

2.1. Effects on mobility: transport volume, trips and travel behaviour

Several studies investigated the effects of COVID-19 and the related restrictive measures to contain the spread of the virus on transport volumes, trips and travel behaviour. Data from several sources were used, including mobile phone data, data from GPS navigation providers such as TomTom, Apple or Google or data from surveys (ETSC 2020).

Apple (2020) gives an overview of changes in **worldwide** routing requests for different means of transport, before COVID-19 and during the pandemic. For all ravel modes, a significant reduction is observable in March 2020. However, in contrast to public transport, walking and driving quickly reached the same levels or even higher levels than before the pandemic (January 2020) – especially during the summer months.



Routing requests are a proxy for travel demand and do not include most habitual trips. They give an indication of the scale of travel demand contraction where Apple devices are present and Apple routing services are used.

Figure 1 Development of apple device trip routing requests in countries around the world and different modes of transport for January to April 2020 (above) and from January to December 2020 (below), Source: ITF 2020 and Frey et al. 2020 based on Apple 2020

Santamaria et al. (2021) analysed the impact of COVID-19 confinement measures on mobility using mobile phone positioning data for **15 European countries**. Comparing the total mobility during March and June 2020 with data in February 2020 before the lockdown, results show that a sharp reduction in mobility occurred during the first three weeks of March, first in Italy and then followed a week later also in other European countries. In the following months, mobility gradually recovered in all European countries as the confinement measures were lifted. However, the magnitude of the reduction of mobility, especially in March, varied significantly across countries: countries like Spain, Italy, France, Austria and Portugal experienced a stricter lockdown and therefore also harsher declines in mobility up to 60 to 70% than countries like Belgium,

Finland, Denmark, Norway and Sweden, where lockdown measures were less strict and also smaller mobility declines (between 20 to 40%) were noted.

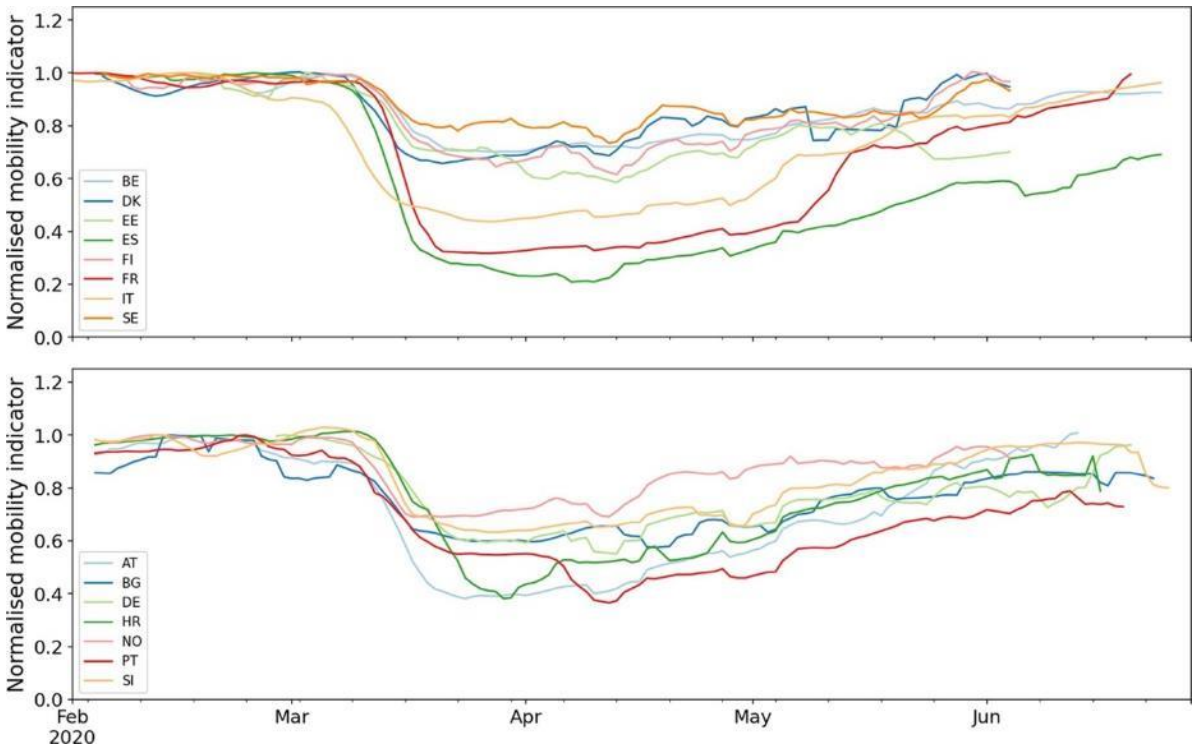


Figure 2 Change of mobility at country level (7-day moving average) between February 2020 and March to June 2020, Source: Santamaria et al. 2021

For the **USA**, the Bureau of Transport Statistics (2021) investigated the changes in trips due to COVID-19 pandemic for the time period January 2020 to March 2021. Results show a sharp decline in the number of trips in March 2020 during the lockdown. Although, beginning with May 2020, the number of trips increased again, they did not fully recover to the level before the pandemic during the summer. Only lately, in February and March 2021, the number of trips reached the same level as before the pandemic.

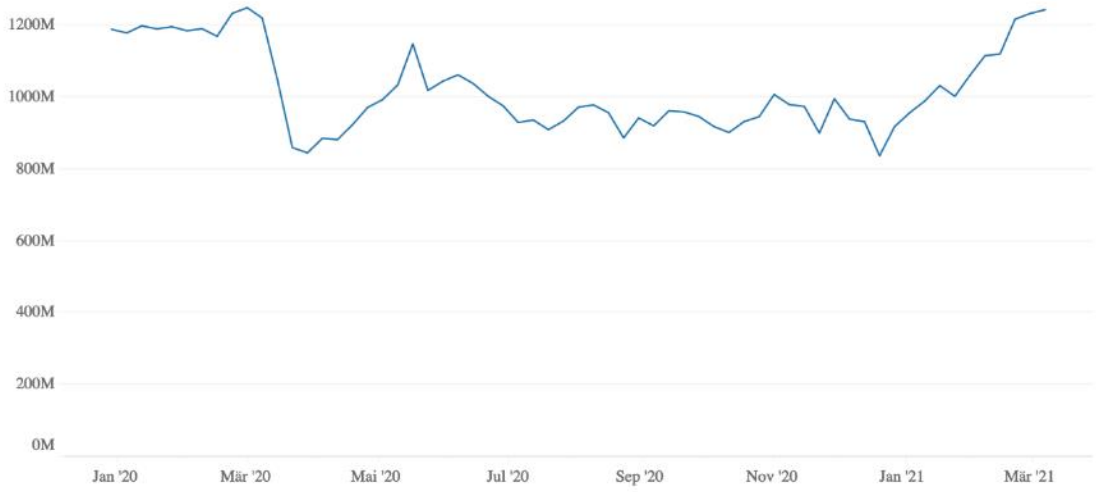


Figure 3 Trips per day over time in the USA, January 2020 to March 2021, Source: Bureau of Transport Statistics 2021

Analysing the trips per day in more detail with regard to trip lengths and comparing the months of 2020 to 2019, results indicate that while the overall number of trips was lower in 2020 compared to 2019, the share of short trips (trips <1 Mile) was higher both during the first wave of the COVID-19 pandemic in March and April 2020 and during the summer months compared to 2019. In autumn 2020 the share of trips <1 mile was lower than in autumn 2019, while instead the share of longer trips (more than 10 miles) was higher than in 2019.

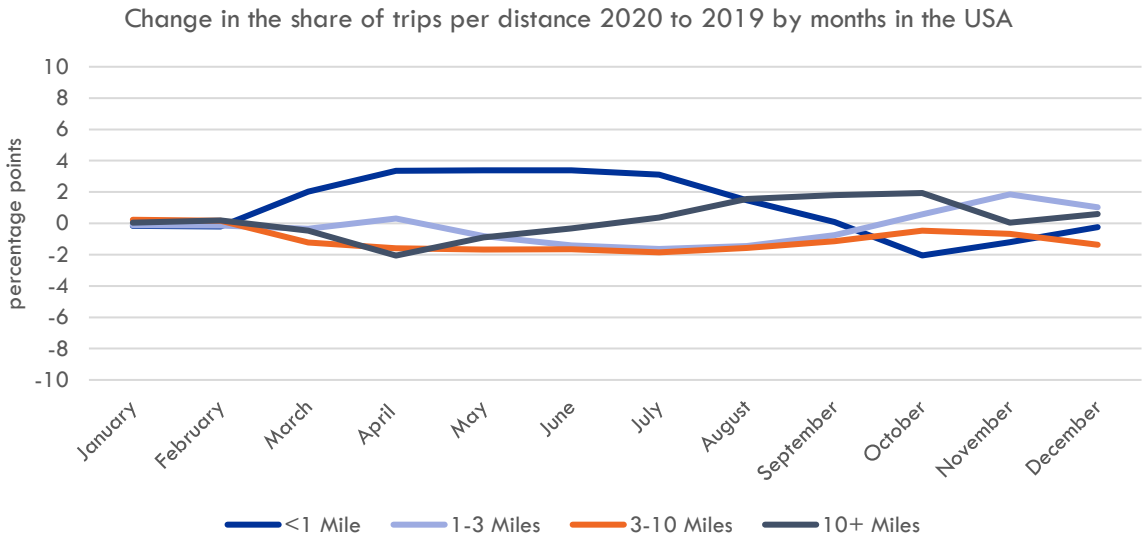


Figure 4 Change in the share of trips per distance 2020 to 2019 by months in the USA in percentage points, Source: Bureau of Transport Statistics 2021

Similarly, Pishue (2020) analysed the national traffic volume in the USA based on INRIX anonymous location real time data before and during the COVID-19 pandemic between March and end of October 2020. He reports that by early April, vehicle miles travelled (VMT) in the USA dropped 46% from pre-COVID levels, taking 11 weeks to rebound – by end of June. However, between August to October 2020, vehicle miles travelled in the USA were still a bit lower than before the COVID-19 pandemic in January or February 2020.

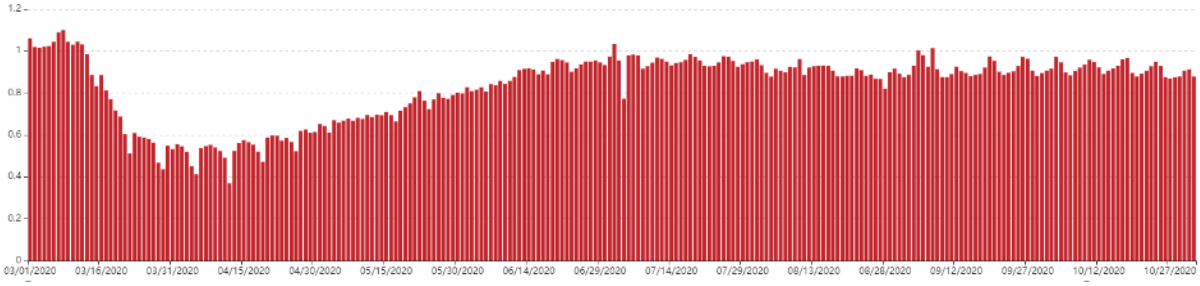


Figure 5 Normalized Weekly Vehicle Miles Travelled (Passenger Vehicle Travel) in the USA, March to October 2020, Source: Pishue 2020, INRIX 2020

Based on mobile phone data, the German Federal Statistical Office (2021a) analysed the change in mobility since the beginning of the COVID-19 pandemic in 2020 in comparison to the year 2019. The results show a significant decrease in mobility of around 40% in March 2020 compared to 2019 when the first lockdown in **Germany** was in place. For the period between

June and end of October 2020 the mobility figures have largely converged with those of the previous year. Since November 2020, with the beginning of the second lockdown, mobility again decreased in Germany and only reached the same level as in 2019 again around Christmas 2020, when travelling was allowed. With the beginning of 2021, mobility is still under the level of 2019 for nearly the whole of the first quarter of 2021. However, the level of reduction in mobility from the first lockdown has not been reached during the other lockdowns or waves of the COVID-19 pandemic.

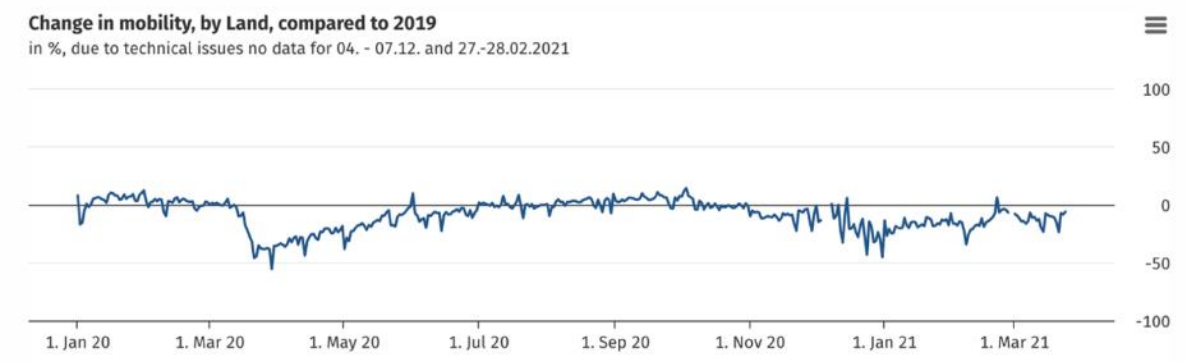


Figure 6 Change in mobility in Germany 2020 and 2021 compared to 2019, Source: German Federal Statistical Office 2021a

Follmer (2020) and Zehl & Weber (2020) also investigated the impacts of COVID-19 and related measures on the number of trips per day, daily kilometres travelled and the daily travel time in May and October 2020 compared to May and October 2017 (**Germany**). For both May 2020 and October 2020 in comparison to the same months of 2019, results indicate a reduction in the number of trips per day, daily kilometres travelled and the daily travel time. Higher reductions in comparison to 2017 were noted for May 2020 than for October 2020 regarding the number of trips per day (-31% for May 2020; -19% for October 2020), while a higher reduction in daily kilometres travelled was noted for October 2020.

Table 1: Change in number of trips per day, daily kilometres travelled and daily travel time May and October 2020 compared to the same month 2017 in Germany, Source: Follmer 2020, Zehl & Weber 2020

Time period	Number of trips per day (in comparison to same month 2017)	Daily kilometres travelled (in comparison to same month 2017)	Daily travel time (in comparison to same month 2017)
May 2020	-31%	-24%	-22%
October 2020	-19%	-30%	-23%

Hagen et al. (2021) conducted a representative online survey with around 2.000 participants in August 2020 in Germany on the use of different means of transport during COVID-19 and in comparison to 2019. With regard to the number of days per week on which different means of transport are used, survey results indicate a slight increase for bicycle and car use for (August) 2020 compared to 2019, whereas for public transport a (larger) decrease is observable. Similarly, with respect to the means of transport for the trip to work, compared to 2019, a (larger) decrease is noted in the share of public transport, while an increase is observable in the share of the bicycle. Here, also the share of the car experienced a slight decrease in 2020 compared to 2019, mainly due to working from home. Survey results for the period after COVID-19 indicate a similar modal share like in 2019 before COVID-19.

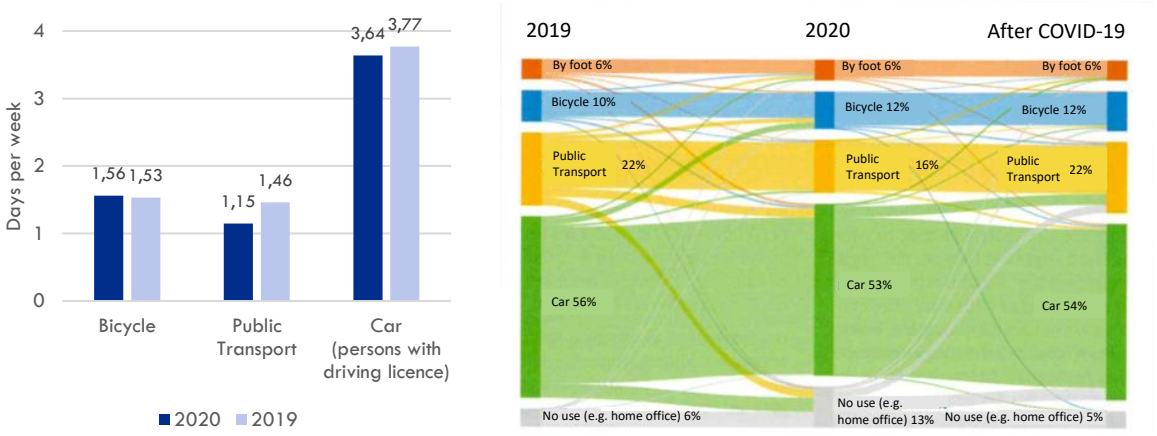


Figure 7 Use of different means of transport in Germany, per week 2020 compared to 2019 (left) and main means of transport used for the trip to work in 2020 and changes in the means of transport compared to 2019 and after COVID-19 (right), Source: Hagen et al. 2021

The UNECE (2021) investigated the impacts of COVID-19 and the related restrictions on vehicle miles travelled during the period March to June 2020 in **Berlin, London, New York and Paris** based on INRIX GPS and traffic volume data. They report a decline in vehicle miles travelled up to 80 percent during the first lockdown phase for Paris compared to pre-COVID-levels, whereas traffic levels in the other cities remained higher. However, after the restrictions were lifted in May 2020, traffic levels recovered again faster in Paris than in the other cities.

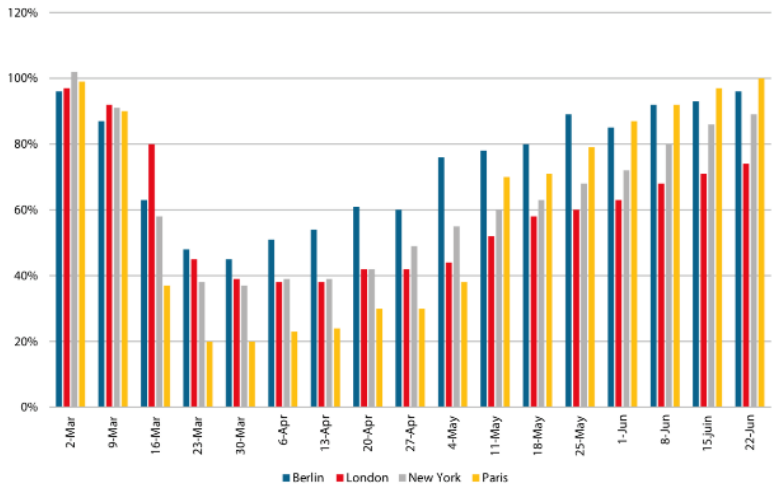


Figure 8 Weekly vehicle miles travelled in Berlin, London, New York and Paris as a percentage of pre-COVID-19 Level, 2 March-22 June 2020, Source: UNECE 2021, Traffic Technology Today 2020

Hara & Yamaguchi (2021) investigated the impacts of the COVID-19 pandemic and the related "state-of-emergency" declarations for **Japan** by using data based on the mobile phone network. Although in the early stages of the COVID-19 pandemic the Japan government did not impose strong restrictions as in several other countries, results show a notable reduction of trips even without strong restrictions by the government: with January 2020 assumed to be normal, school closures in March 2020 reduced trips by 4% compared with the normal number, and the "state of emergency" declaration by the Japanese government in April 2020 reduced trips

further by another 4,6%. The number of trips was the lowest during Japan's major holiday period in early May, but it increased again with the lifting of the state of emergency in May 2020.

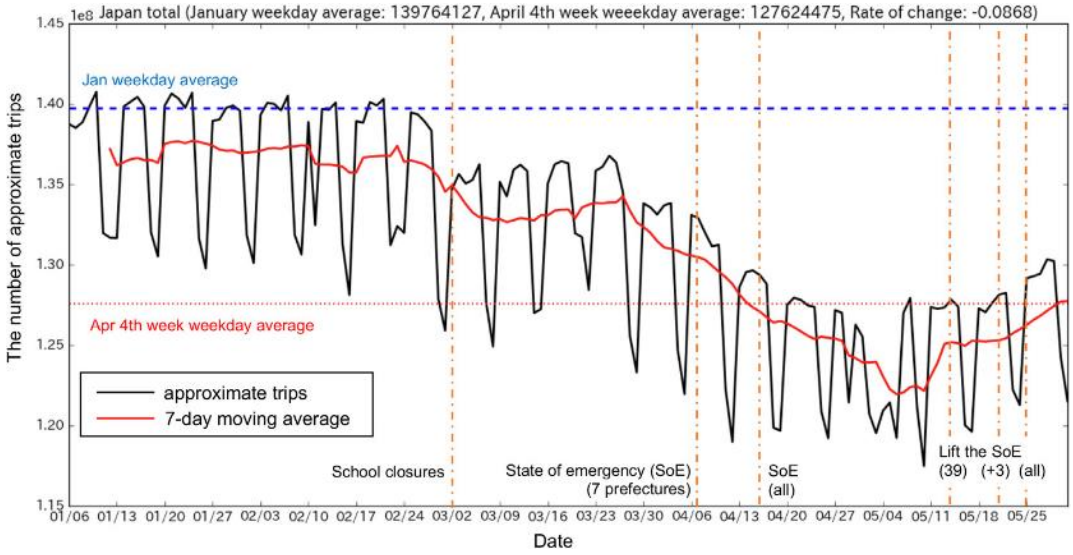


Figure 9 Number of approximate trips in Japan from January to May 2020, Source: Hara & Yamaguchi 2021

For **Switzerland**, Moser, Mikosch & Fischer (2021) investigated changes in mobility patterns due to the COVID-19 pandemic and related measures based on smartphone tracking data from 2.561 persons and analysed changes for different means of transport. Compared to the time before restrictive measures were in place (January to February 2020), the daily distances by car and motorcycle and public transport dropped significantly in March 2020. In the following months, mobility increased especially for walking and driving (car or motorcycle) and reached levels higher than before the pandemic (January 2020) during the summer months. However, although for public transport also increases are observable in May 2020 and during the summer months, the level of mobility for public transport still was lower than before the pandemic and even lowered again in autumn.

Figure 10 Percentage changes in Switzerland (7-days-average) of the daily distances by different means of transport in comparison to the average daily distance between 10 January to 29 February 2020 (black: car & motorcycle, blue: public transport, red: pedestrian, grey: other – including bicycle, cable car, ship) , Source: Moser, Mikosch & Fischer 2021

Hadjidemetriou et al. (2020) investigated the impact of government control measures due to the COVID-19 pandemic on human mobility in the **UK** using driving, walking and transit real-time data. They indicate a drop in people driving and using public transport with the beginning of measures imposed by the government from 8th March 2020. Until the end of April 2020, driving, public transport and walking remained 60%, 80% and 60% reduced compared to the same period of the previous year. From May 2020 on – when the government started to lift the lockdown restrictions – walking and driving increased and was only 20 to 30% reduced at the beginning of June 2020 compared to the same period of 2019, whereas the increase in public transport was considerably lower and it remained 70% reduced compared to 2019.

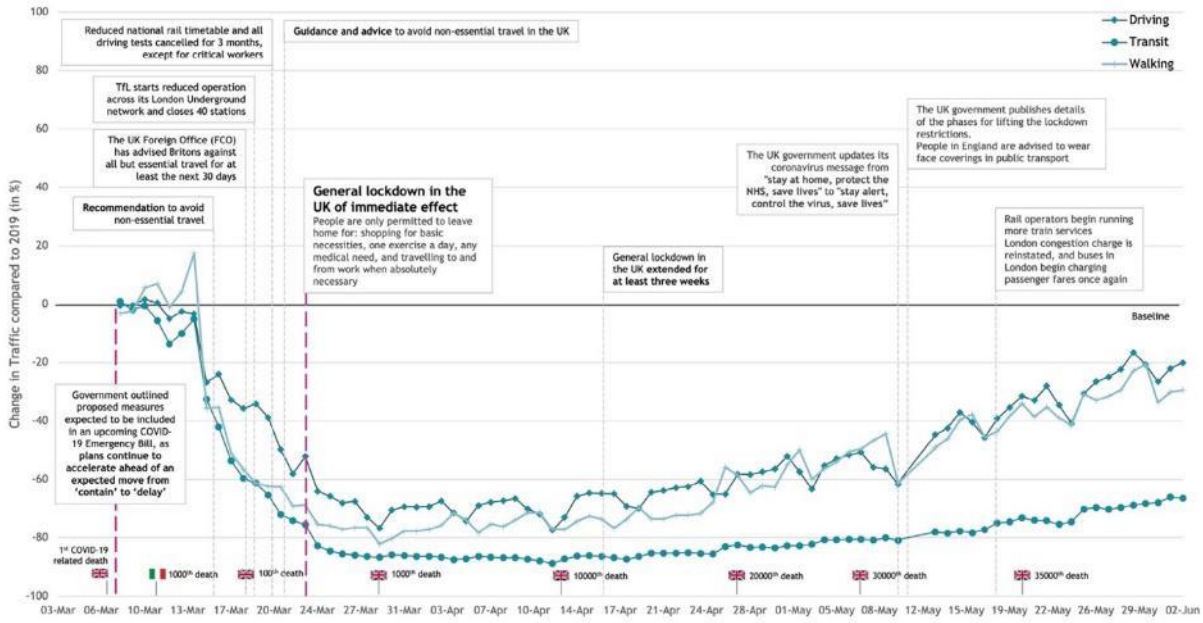


Figure 11 Change in traffic in the UK after 8th March 2020 compared to 2019 and measures implemented by the government, Source: Hadjidemetriou et al. 2020

Similarly, Owen (2021) analysed the impacts of COVID-19 and the related measures in the UK on traffic between March and June 2020. Results indicate that while traffic with regard to all motor vehicles decreased between March and June by 39%, cycling traffic increased by 68%, beginning with May 2020.

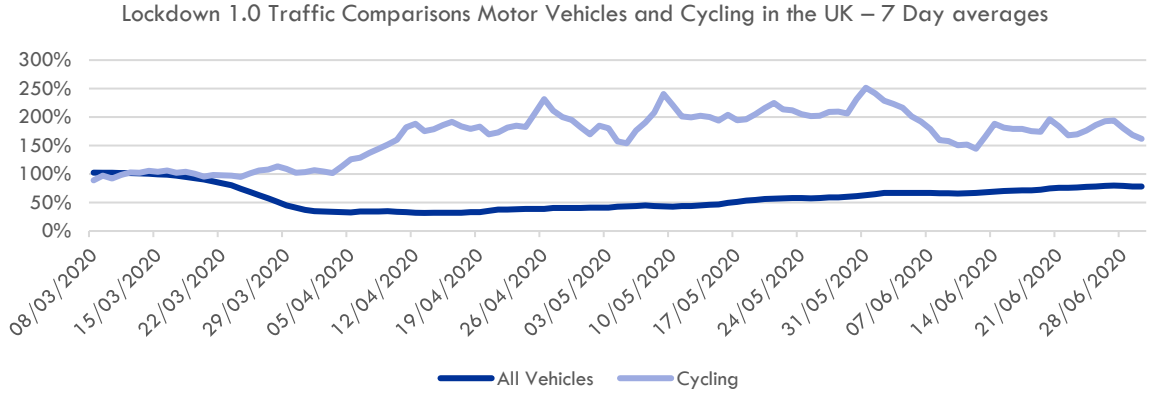


Figure 12 Change in traffic of all motor vehicles and cycling between March and June 2020 in the UK, 7-day averages, Source: Owen 2021, Department of Transport 2021a

Similarly, Stone (2021) investigated the impact of COVID-19 on the traffic volumes in the **UK**, but not only for 2020 but also for 2021 and reports that whereas overall traffic volumes decreased especially during the lockdown measures during March to June 2020 as well as during the winter months in 2020 and 2021, since May 2021 – for the first time (after nearly reaching the pre-COVID levels in Summer 2020) – the overall traffic volume again exceeds pre-Covid levels (March 2020). However, regarding the proportions of different vehicle types accounting to that increase in overall traffic volume, they report that goods vehicles account for a greater proportion of all vehicles than before COVID-19.

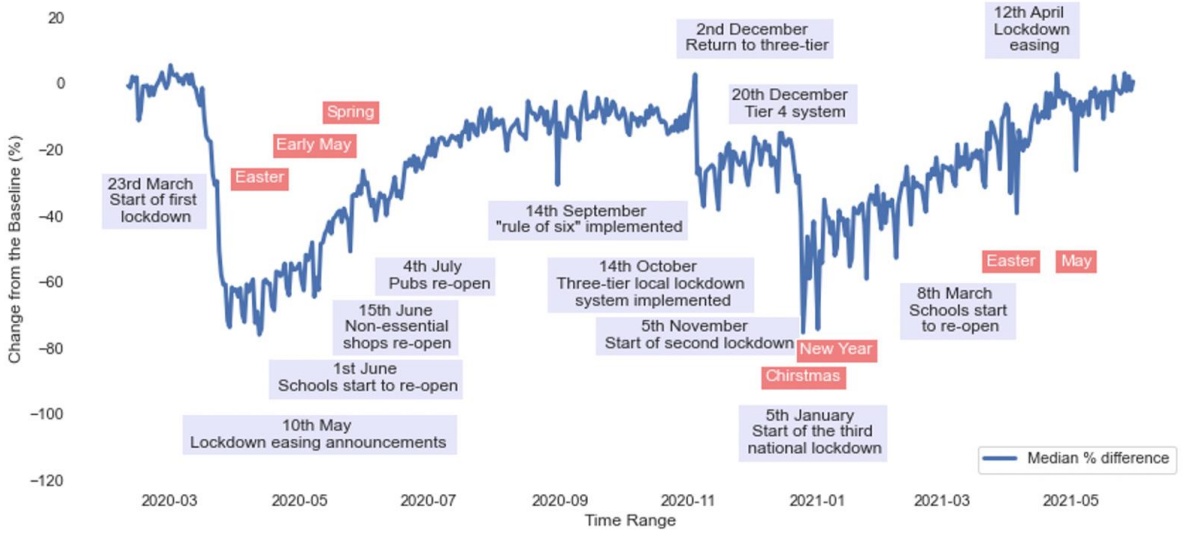


Figure 13: Development of the change in the overall traffic volume for the United Kingdom compared to the baseline before COVID (23rd March 2021), Source: Stone 2021

With respect to the impact of COVID-19 in **Croatia,** a reduction in total vehicle kilometres in 2020 compared to the average 2017-2019 by 24% was noted. Regarding different means of transport, reductions were highest for buses and coaches (-25%) and passenger cars (-24%), while a lower reduction was observed for goods vehicles (-18%).

Table 2: Vehicle kilometres (in million) travelled in Croatia 2020 and compared to the average 2017-2019

Road user type	Vehicle kilometres 2020 (in Million)	Change compared to average 2017-2019
Passenger cars	15,400	-24%
Buses and coaches	244	-25%
Motorcycles and mopeds	185	-23%
Goods vehicles	2,114	-18%
Total	**17,943**	**-24%**

Shibayama et al. (2021) carried out an **international** survey about changes in everyday mobility during the COVID-19 outbreak and present results of fourteen countries with 100 or more responses between March and May 2020 also analysing effects for different transport modes. Amongst other things they found that public transport lost users both due to home office and

shifts to other modes, while shifts from car to other modes were commonly rare in all of the fourteen countries.

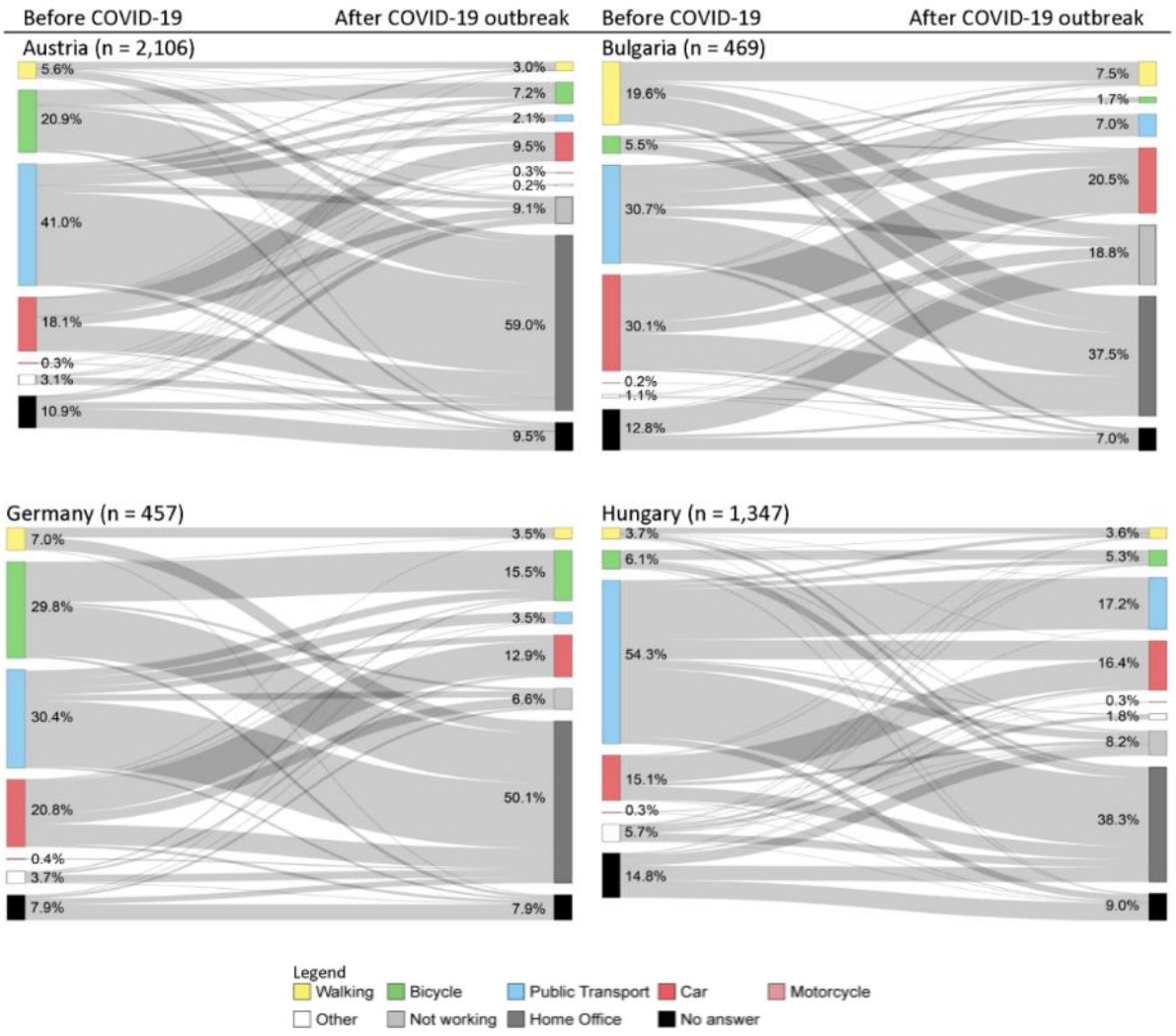


Figure 14 Changes in commuting mode choice between before COVID-19 (left) and during the COVID-19 outbreak (right) for selected Danube Area countries, taken from a survey in 14 countries around the globe, Source: Shibayama et al. 2021

Buehler & Pucher (2021) analysed the percentage change in cycling levels in 2020 compared to 2019 in **11 European Countries, Canada and the USA** for entire weeks, weekends and weekdays. For the European countries, they report an averaged overall increase in cycling by 8%, but a much larger increase on weekends (+23%) than on weekdays (+3%). For the USA, an averaged overall increase in cycling by 16% is reported, but similar to the EU, with higher increases on weekends (+29%) than on weekdays (+10%). For Canada, an averaged overall increase in cycling by 3% is observable with again a higher increase (+28%) on weekends, and (even) a decline of 8% on weekdays. It is stated that the higher increases on weekends are due to more cycling as physical and recreation activity as exception to travel restrictions during lockdowns, while daily trips on weekdays were replaced by remote working, learning and shopping.

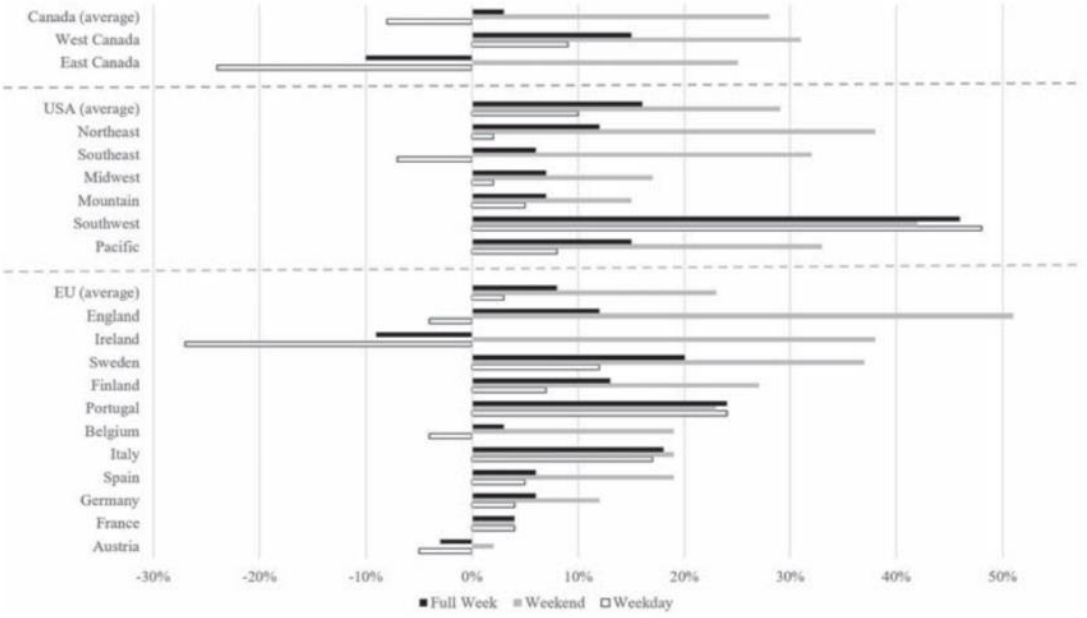


Figure 15 Percentage change in cycling levels in 2020 compared to 2019 in 11 European Countries, Canada, and the USA (for entire weeks, weekends, and weekdays), Source: Buehler & Pucher 2021

Besides comparing percentage changes in cycling levels for the whole year 2020 and 2019 they also investigate the fluctuation of the percentage changes in 2020 cycling levels relative to 2019 and report that in the lockdown periods in March and April 2020 cycling declined in most European countries, Canada and the USA. After lifting of lockdowns (or their relaxation) during the summer months, cycling rose sharply.

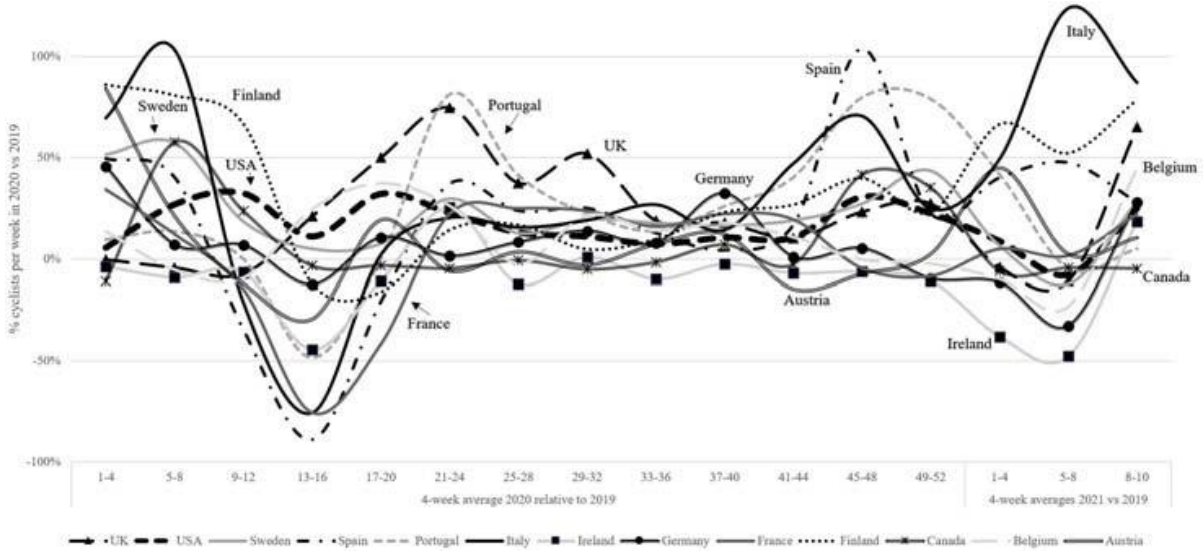


Figure 16 Fluctuation in percentage change in 2020 cycling levels relative to 2019 in 11 European countries, Canada and the USA (four-week averages compared to the same period in 2019), Source: Buehler & Pucher 2021

Focussing on the impacts of COVID-19 on the usage of public transport, the UNECE (2021) – based on data of the mobility-as-a-service company Moovit – show a considerable decline in the usage of public transport during the first wave of the COVID-19 pandemic for **European cities and cities in the USA**. For April 7th for example Moovit's Public Transit index shows a

reduction in public transport use by over 80% for Paris, Madrid and Rome and by 60 to 70% for Helsinki and Los Angeles. In the following months, the usage of public transport fluctuated in many cities, i.e., increase during the summer and in early autumn, but decrease in late autumn during the second lockdown phase e.g. in Paris and Berlin. However, usage of public transport still remained at a lower-than-normal level, i.e., lower level than before the pandemic.

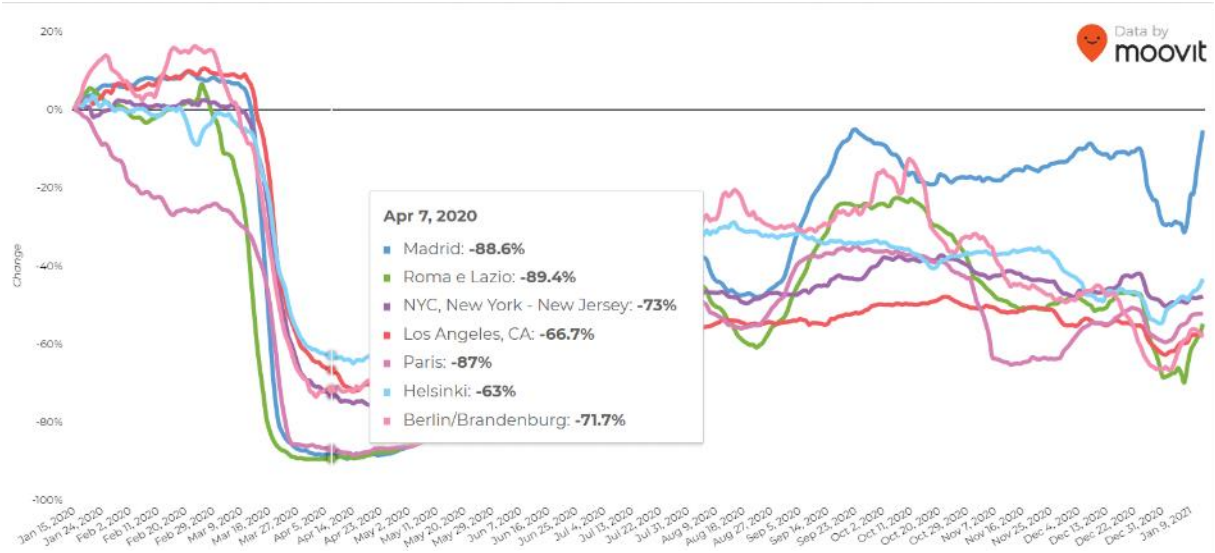


Figure 17 Use of public transport in selected cities in Europe and the USA, 15 January 2020 – 9 January 2021, Source: UNECE 2021, Moovit 2020

Similar effects are shown based on public transport data, i.e., bus and underground railway usage, from **London**: During the first wave of the pandemic, bus and underground railway usage in London fell to only about 15 and 5%, respectively, of the pre-pandemic level from the end of March 2020.

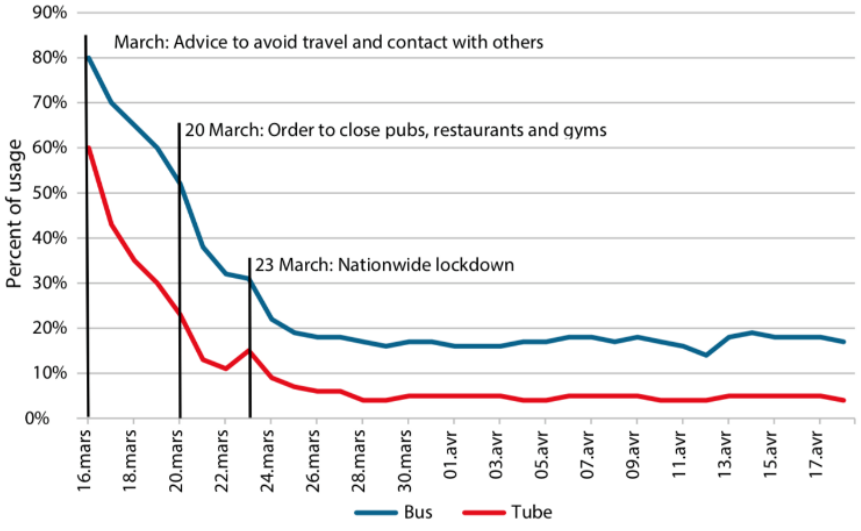


Figure 18 Use of bus and underground railway in London, 16 March – 17 April 2020, Source: UNECE 2021, UK Prime Minister's Office 2020

Based on data of a weekly survey conducted in the **United Kingdom and Northern Ireland**, the UNECE (2021) further reports that since May 2020, after a slight recovery during the summer,

the use of public transport declined again in the autumn of 2020 during the second wave of COVID-19 pandemic.

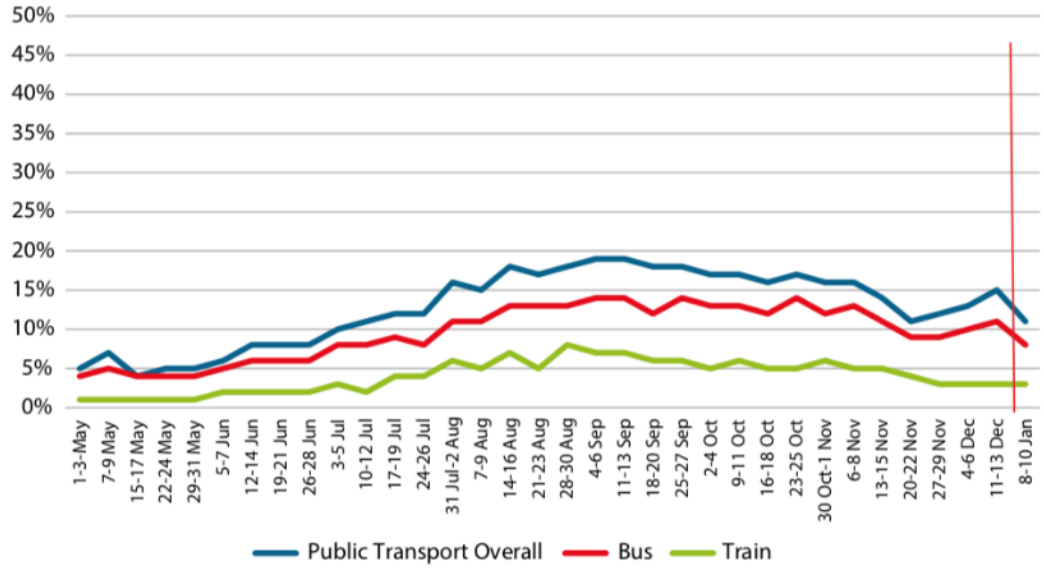


Figure 19 Use of public transport in the United Kingdom and Northern Ireland, 1-3 May 2020 to 8-10 January 2021, Source: UNECE 2021, Transport Focus 2021

In **Hungary,** data on the average daily traffic from several traffic counters at four motorways (M0, M1, M3 and M7) from March 2020 and March 2021 in comparison to March 2019 (for each year in calendar week 12) shows a reduction in the average daily traffic in 2020 of between 35% to 52% compared to 2019. In 2021, at some motorways still reductions of up to 21% compared to 2019 are observable but at others the level of average daily traffic nearly also reached the pre-COVID-19 levels (all data for the month of March).

Table 3: Average daily traffic in March 2019, 2020 and 2021 at motorways in Hungary and change compared to 2019

Year	Date (Calendar week 12)	Number of Motorway							
		M0		M1		M3		M7	
		ADT (number of vehicles)	Change compared to 2019	ADT (number of vehicles)	Change compared to 2019	ADT (number of vehicles)	Change compared to 2019	ADT (number of vehicles)	Change compared to 2019
2019	03.18-24	67,575	-	40,582	-	55,636	-	31,190	-
2020	03.16-22	46,986	-30%	19,417	-52%	36,073	-35%	19,833	-36%
2021	03.22-28	68,980	+2%	31,965	-21%	43,774	-21%	28,554	-8%

For **Slovenia,** results of a survey on the usage of different transport modes after the first lock-down in May 2020 indicate an increase in bicycle use and walking, and a reduction in the use

of the passenger car: 31% of the survey participants reported they walked more than before the lockdown (only 8% reported they walk less) and 18% used the bicycle more (only 9% reported they use the bicycle less). 62% reported that they use the car less than before the lockdown (only 3% reported they use the car more).

Bucsky (2020) analysed the impact of COVID-19 on transport in **Budapest, Hungary** and reports that the demand for transport halved during the spring 2020 lockdown with an 80% decline in demand for public transport. In addition, results indicate a significant shift in transport modes: the use of private cars grew from 43% to 65% compared to a 2018 baseline and conversely, the share of public transport decreased from 43% to 18%.

For the **Czech Republic**, data from traffic counters during Spring 2020 in comparison to data from 2019 shows a decrease in the number of passenger cars per day by 20% on working days and by 40% on weekends.

In addition, data on changes in the number of passengers transported by public passenger buses in the Czech Republic in 2020 compared to the average 2017-2020 indicate a decrease by 32%. These decreases were especially high in the second quarter (-54%) and fourth quarter (-45%) of 2020.

Table 4: Number of passengers (in thousand) transported by public passenger buses in 2020 in the Czech Republic and change compared to the average 2017-2019

	Number of passengers transported by public passenger buses in 2020 (in thousand)	Change compared to average 2017-2019
1st quarter 2020	77,469	-13%
2nd quarter 2020	40,062	-54%
3rd quarter 2020	67,040	-14%
4th quarter 2020	48,419	-45%
Total	**232,990**	**-32%**

Moreover, for **Prague, Czech Republic**, a decrease in the number of daily passenger trips by public transport during spring 2020 by 85% compared to spring 2019 was noted. In autumn 2020, still a reduction in daily passenger trips by public transport by 60% compared to autumn 2019 was observable.

Boroujeni, Saberian & Li (2021) investigated amongst other things changes in mobility trends and traffic during the first and second waves of COVID-19 and the respective lockdowns in **Victoria, Australia**. Results show that during the second wave of the pandemic from 11 September to 23 October 2020 in Victoria with a stringent lockdown in place, especially the mobility trends of public transport hubs, retail and recreation venues, and workplaces experienced a significant drop in movements at respective values of 85%, 83%, and 76% compared to the period of 5 weeks from 3 January to 6 February 2020.

Summary of COVID-19 effects on mobility: transport volume, trips and travel behaviour

- A **reduction in mobility, transport volumes and the number and distance of trips** was observable during the first wave of the pandemic in March and April 2020 in countries in Europe, North America and Asia. The reduction was noted for all transport modes, but for **public transport with particularly high reductions** of 80 to 90% (e.g. in Switzerland, the United Kingdom, and cities like Paris and Prague) compared to pre-pandemic levels.

- The intensity of the reduction in mobility, i.e., number and distance of trips, was **related to the strictness of the measures** taken by governments to contain the COVID-19 pandemic.

- While overall, a reduction in the number of trips was observable during the first wave of the pandemic, the **share of short trips was higher** during spring 2020 and also in the summer months compared to 2019 (e.g. for the USA).

- After the **first wave** of the pandemic during May 2020 and during the summer months when containment measures were lifted, mobility and transport volumes increased again. High increases (faster recoveries) were observable for walking, cycling (e.g. UK) and driving. However, **public transport still is far behind** its level before the pandemic because of working from home or transport mode shifts to individual transport modes like driving, cycling (or walking), resulting also in **comparatively more vulnerable road user travel on the urban and suburban system** (PIARC 2020). However, in cities (e.g. Paris) that experienced a strong decrease in public transport traffic during the first lockdown, traffic levels of public transport also recovered faster than in cities that experienced a low decrease in public transport traffic during the first lockdown (e.g. Berlin). With respect to changes in cycling traffic, in European countries, but also in the USA and Canada, **cycling levels particularly increased on weekends**.

- During the **second wave** of the pandemic in autumn 2020, mobility of all transport modes again decreased (with stronger reductions for public transport than for walking or driving), however these reductions were **not in the same intensity** as during the first wave of the pandemic.

- The **higher shares in individual mobility**, i.e. driving, cycling and walking, compared to the public transport share **may possibly prevail** even after the pandemic has passed, as (a share of) people who shifted from public transport to cycling or the car during the pandemic may continue to do so. Indeed, for the USA, a consumer study found that 45% of the respondents reported that they intend to use public transport and ride hailing less than previously, even after the pandemic (Consulting.us 2021). However, effects seem to be mixed as surveys (e.g. from Germany) indicate a return to a similar modal share like before the pandemic.

2.2. Effects on road crashes and road fatalities

The effects of the COVID-19 pandemic and the related containment measures on road crashes and fatalities have been in the focus of recent research. While some studies solely investigated changes in the absolute number of road crashes or fatalities, others also considered the reduction in traffic volume and analysed changes in collisions risk and crash rates or investigated road crashes and fatalities in more detail, e.g. by road user type, age group, gender, crash type or road type.

2.2.1. Total number and risk of road crashes and fatalities

Country Level

The European Commission (2021) analysed the change in road deaths per million inhabitants in the year 2020 compared to 2019 for all **27 EU member states** as well as for **Switzerland**, **Norway** and **Iceland**. Results indicate that EU-wide deaths fell by an average of 17% compared to 2019 with the largest decreases in Malta (-31%), Bulgaria (-26%), Hungary (-25%), Italy (-25%), Belgium (-22%), Denmark (-22%) and Slovenia (-22%). In contrast, Luxembourg (+18%), Estonia (+15%), Latvia (+7%), Ireland (+6%) and Finland (+4%) recorded an increase in fatalities, although it should be noted that the numbers in small countries are subject to fluctuation.

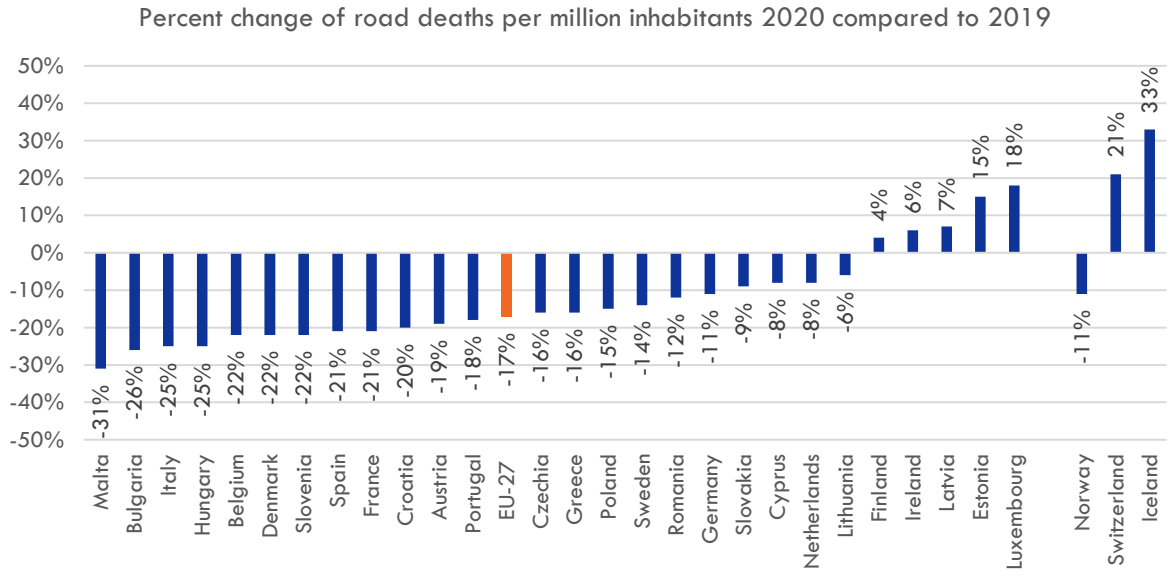


Figure 20 Percent change of road deaths per million inhabitants 2020 compared to 2019, Source: European Commission 2021a

In addition, the European Commission investigated the monthly EU total of fatalities in 2020 compared to the average 2017-2019. Here, higher reductions are observable in the periods of the first and the second wave of the COVID-19 pandemic in Europe in March, April and May 2020 (reduction up to 40% in April) as well as in October and December 2020 (reduction up to 26% in December). During the summer, particularly in July, August and September, the reductions in road fatalities compared to the average 2017-2019 were much lower (reduction up to 14%). In this regard was also stated that lower traffic volumes, as the result of the pandemic and the related containment measures had a clear impact on the road fatalities.

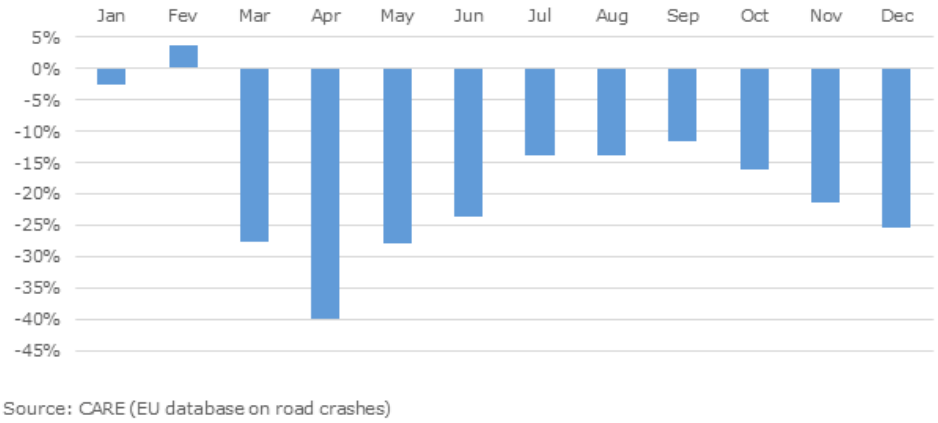
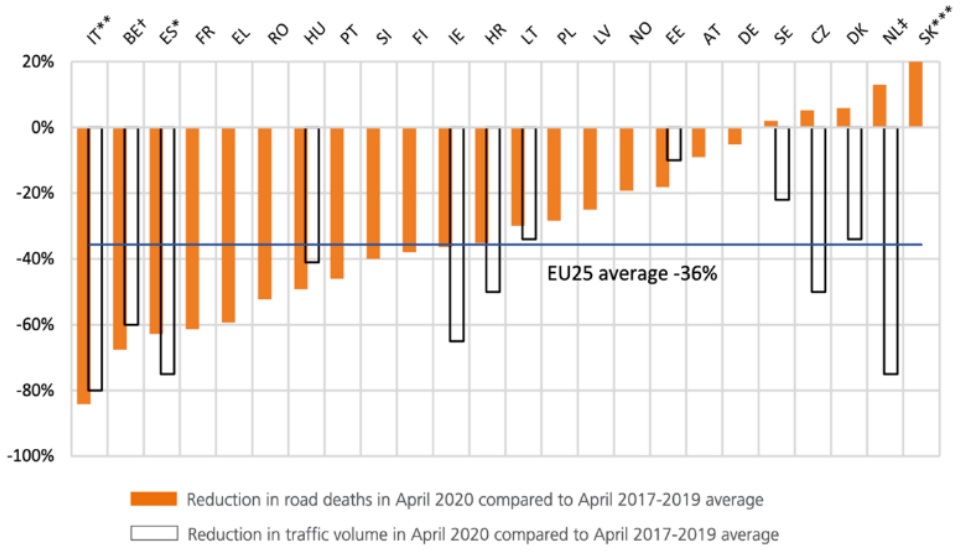


Figure 21 Trend in the monthly number of EU road fatalities 2020 compared to average 2017-2019, Source: European Commission 2021b

With respect to the first wave of the COVID-19 pandemic, ETSC (2020) investigated changes in road deaths and traffic volumes in April 2020 compared to the April 2017-2019 average in **several EU countries** for which data was available. Although road deaths decreased in many countries with highest reductions for Italy (84%), Belgium, Spain and Greece, road deaths for Denmark and the Netherlands were higher than in previous years. Moreover, a general observation was that road deaths did not usually decrease by the same proportion as traffic volume. Countries in the Danube Area mostly experienced decreases in road deaths (e.g. Romania, Hungary, Slovenia, Croatia and Austria) during the first wave of the COVID-19 pandemic, while increases were observable for Slovakia and the Czech Republic, although the latter experienced a reduction in traffic volume. For Croatia, the decrease in road deaths was lower than the decrease in traffic volume, while Hungary experienced a somewhat higher reduction in road deaths than in traffic volume.



ES* - data on road deaths on non-urban roads and represent road deaths within 24 hours only.
IT** - data on road deaths at the site of the collision only.
SK*** - road deaths within 24 hours.
BE† - an estimation of road deaths over the period between 15/03 and 30/04 based on a survey by VIAS in 13 police zones.
NL‡ – data based on police records and not comparable with BRON (Statistics Netherlands) publication.

Figure 22 Percentage change in road deaths in April 2020 compared to road deaths in April 2017-2019 (three years average) and corresponding change in traffic volume, Source: ETSC 2020

Similarly, ITF (2020) investigated changes in road deaths and traffic volume in **ITF/OECD countries** in April 2020 in comparison to April 2019 and reports that the number of road fatalities fell significantly – up to 80% – due to the strict containment measures. However, they also mention that the number of road deaths has not fallen in proportion to the decrease in traffic. Instead, some countries (e.g. Denmark or the Netherlands) even show a small increase in road deaths although they experienced a reduction in traffic volumes. In countries of the Danube Area like Austria, the Czech Republic, and Slovenia a reduction of road deaths by 11% (Czech Republic and Slovenia) to 40% (Austria) during the first wave of COVID-19 was observable, however, this reduction was lower than the decreases in traffic (about -50 to -53.5%). In contrast, in Hungary the reduction in the number of road deaths (-43%) was higher than the decrease in traffic (-33%).

Country	Road deaths (% change)	Traffic (% change)	Lockdown in spring 2020
Australia	-23	-43	From 23 March; gradual lifting in May/June
Austria	-30	-50	16 March-14 April (gradual lifting)
Canada	-34	n.a.	Varies by jurisdictions
Chile	-24 (June on June)	-56.5 (Santiago)	18-Mar-14 May partial, to 24 June total
Czech Rep.	-11	-50 (motorways)	13 March-17 May
Denmark	+9	-25	13 March-15 April (gradual lifting)
Finland	-24	-34	17 March- 4 May (gradual lifting)
France	-56	-75	17 March-10 May (gradual lifting)
Germany	-1	-48 (overall), -19 (HGV)	22 March-19 April (gradual lifting)
Greece	-58	n.a.	23 March-27 April (gradual lifting)
Hungary	-43	-33	28 March-4 May (18 May in Budapest)
Ireland	-22	-62 (cars), -17 (HGV)	13 March-18 May (gradual lifting)
Israel	-28	-60	15 March-29 April
Italy	-79	-75 (overall), -39 (HGV)	9 March-18 May (gradual lifting)
Japan	-21	n.a.	9 March-18 May (gradual lifting)
Lithuania	-71	-36 (overall), -15 (HGV)	17 March-17 June
Mexico	-23	-59	23 March-1 June
Morocco	-65	n.a.	20 March-24 June
Netherlands	+6	-35	No full lockdown
New Zealand	-80	-74	26 March-14 May
Norway	n.a.	-25	12 March-11 May
Poland	-32	n.a.	13 March-20 April (gradual lifting)
Portugal	-59	n.a.	19 March-18 May
Serbia	-49	n.a.	15 March-4 May
Slovenia	-11 (Mar to May)	-53.5	15 March-18 May (gradual lifting)
South Africa	-78	-77	26 March through July
Spain	-49	-75	15 March-11 May
Sweden	+6	-22	No lockdown
Uruguay	-51	n.a.	No mandatory measures

Changes in road deaths based on provisional data, for Canada based on preliminary data from a sample of jurisdictions.

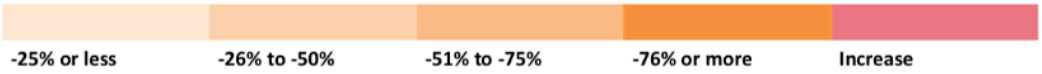


Figure 23 Road deaths and traffic in April 2020 compared to April 2019, Source: ITF 2020

For the **USA**, NHTSA (2020a) reports that, while for the period April and June 2020 the absolute number of traffic fatalities decreased by 1.1% compared to the same period 2019, due to the large drop in vehicle miles travelled (VMT), the fatality rate increased to 1.45 fatalities per 100 million miles of VMT, up from 1.08 during the same quarter in 2019 – an increase by 34%. For the period July and September 2020, when lockdown restrictions were lifted, the absolute number of traffic fatalities increased by 13.1% compared to the same quarter 2019 and the fatality rate further increased to 1.48 per 100 million miles of VMT (compared to 1.17 in the same period 2019).

Table 5: Fatalities and fatality rate by quarter in the USA 2019 and 2020, Source: NHTSA 2020a

Year	1st Quarter (Jan–Mar)	2nd Quarter (Apr– Jun)	3rd Quarter (Jul–Sep)	4th Quarter (Oct–Dec)	Total (Full Year)	1st Nine Months (Jan–Sep)
Fatalities and Percentage Change in Fatalities for the Corresponding Quarter From the Prior Year						
2019	7,816 [-4.7%]	9,172 [-1.6%]	9,953 [+0.2%]	9,155 [-2.3%]	36,096 [-2.0%]	26,941 [-1.9%]
2020*	7,860 [+0.6%]	9,070 [-1.1%]	11,260 [+13.1%]	-	-	28,190 [+4.6%]
Fatality Rate per 100 Million Vehicle Miles Travelled (VMT)**						
2019	1.05	1.08	1.17	1.12	1.10	1.10
2020*	1.11	1.45	1.48	-	-	1.35

* 2020 Statistical projections and rates based on these projections.
** VMT: FHWA September 2020 Traffic Volume Trends for 2019 & 2020 VMT

For the **UK**, the Department for Transport (2021b) analysed the number and changes in fatalities and casualties between January and June 2020 in comparison to the same months 2019. Whereas before COVID-19, i.e., in January and February 2020, only a small reduction or even a small increase for the number of all casualties compared to 2019 was observed, a high reduction for all casualties in the months March to June 2020 compared to 2019 was noted, with the highest reductions in April (67%) and May (45%). Overall, these reductions in casualties were at a similar extent as the changes in road traffic volumes which decreased by 49% for April to June 2020 and 8% for January to March 2020 compared to 2019. However, smaller reductions are observable for the number of fatalities for March to June 2020 compared to 2019. Highest reductions were again observable for April (-48%) and May (-30%), but these reductions in fatalities were smaller than the reductions in casualties and also lower than the reductions in road traffic volumes.

	Number/percentage change compared with same month in the previous year (P)					
FATALITIES AND ALL CASUALTIES	January	February	March	April	May	June
Killed						
Number	160	130	110	80	90	110
Percentage change	↓7%	↓10%	↓20%	↓48%	↓30%	↓9%
All casualties						
Number	12,310	11,030	8,190	3,930	7,040	8,650
Percentage change	↑4%	↓3%	↓33%	↓67%	↓45%	↓33%

P Provisional estimates (rounded to the nearest 10)

Figure 24 Percentage change of all casualties and fatalities in the UK, January to June 2020 compared to 2019, Source: Department for Transport 2021b

Similarly, Owen (2021) investigated changes in the number of all casualties and KSI (killed or seriously injured) casualties in the period March to June 2020 compared to the same period 2019 for the UK and reports a reduction for all casualties by 48%, while the reduction for KSI casualties, at 37%, was smaller.

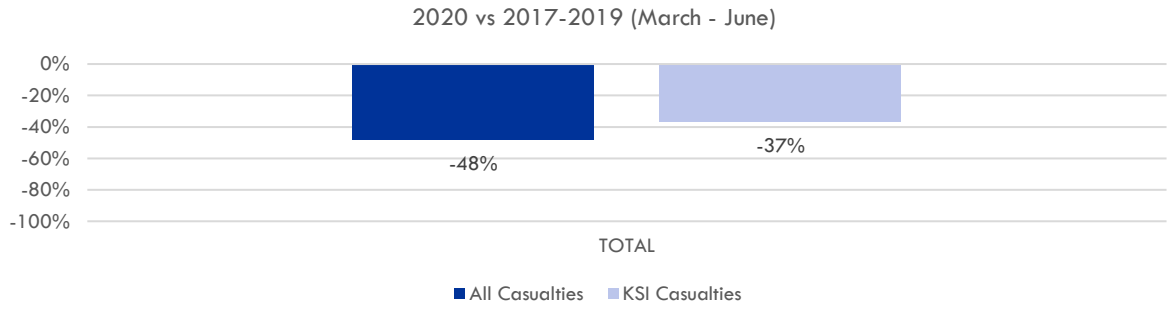


Figure 25 Percentage change for all casualties and KSI casualties between March and June 2020 compared to the same period 2019, Source: Owen 2021

For **Germany**, the German Federal Statistical Office (2021b) reports that compared to 2019 road fatalities decreased by 10.7% in 2020 and the total mileage of all motor vehicles decreased by almost 11%. Higher reductions were observable for the number of severe injuries (-11.1%), accidents involving personal injury (-11.9%) and particularly slight injuries (-15.5%). Regarding changes in injury accidents, fatalities, serious injuries and slight injuries in 2020 by month compared to the same months 2019, an overall trend is observable with higher reductions during March to June and November to December when lockdown measures were in place and traffic was reduced. During the summer months in July to September in which measures were lifted, the numbers aligned with the numbers of 2019 and only minor reductions or even some increases are observable. Interestingly, while the highest reductions in the number of road fatalities were noted in March (-31%) and June (-26%), in April (although containment measures were in place) the number of fatalities was 2% higher compared to 2019.

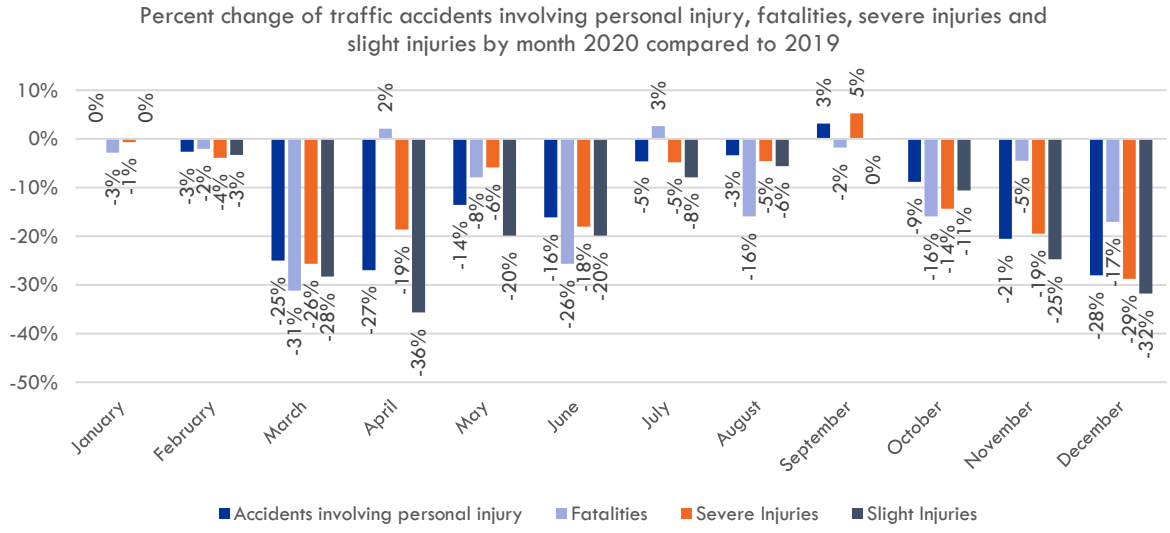


Figure 26 Percent change of traffic accidents involving personal injury, fatalities, serious injuries and slight injuries by 2020 compared to 2019, Germany, Source: German Federal Statistical Office 2021b

Donkers & Broos (2021) analysed the monthly number of road accidents and victims in the **Netherlands** in 2020 and compared them to expected numbers for 2020 that were calculated based on trends of accident records from 2016 to 2019. For the number of road accidents, they report 23% less accidents in comparison to the expectation in the period March to December 2020, with the highest reduction during the first wave of the pandemic in April 2020 (-40%). In summer, when containment measures were less strict, the number of road accidents increased and came close to the expected (projected) levels. During the second wave of the pandemic in October to December 2020 when a partial lockdown was in place, the number of accidents deceased again. However, with about 30% less accidents than expected the reduction in accidents was not as high as during the first wave of the pandemic in March and April.
With respect to the number of road victims, a similar trend is observable: for the period March to December 2020, 13% less road victims than expected are reported. However, in comparison to the number of road accidents, in almost every month a smaller decrease for the number of road victims is observable. In April for example, there were 29% less road victims than the expectation, but for road accidents this difference was -40%. During the summer months, the number of road victims again increased and for August and September, the number of road victims were even higher than the expected numbers.

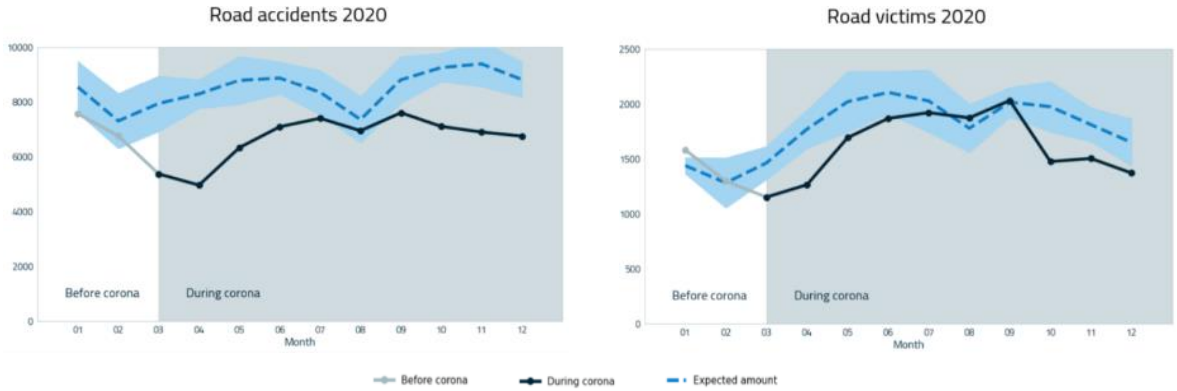


Figure 27 Monthly number of road accidents (left) and road victims (right) in 2020 in the Netherlands compared to the expected number of road accidents and road victims based on former accident records with a spread of 95% reliability, Source: Donkers & Broos 2021

By comparing the trend of road victims and the trend of road accidents, they also analysed the risk to become a road victim and report that it was higher than the expected risk for all months in 2020, except for July and October, but it was particularly higher in April and May. It is explained that during the COVID measures the number of road accidents decreased faster than the number of road victims which led to a significantly higher risk of becoming a road victim than normal.

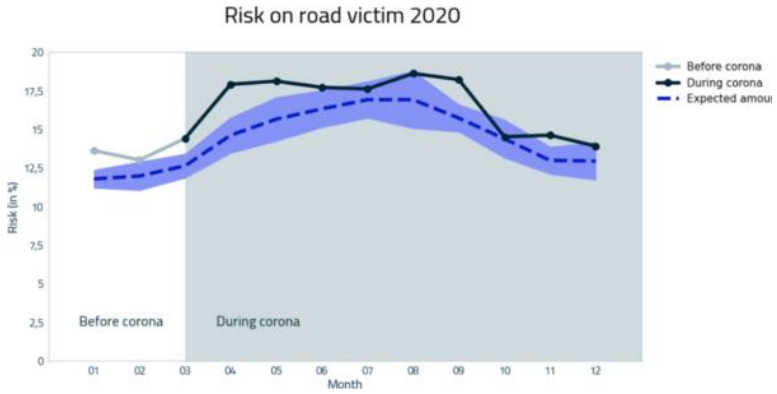


Figure 28 Risk to become a road victim during a road accident by month (based on the number of road accidents and road victims) in 2020 in the Netherlands compared to expected risk with a spread of 95% reliability, Source: Donkers & Broos 2021

For **Greece,** Vandoros (2021) investigated the effects of the COVID-19 pandemic and the related lockdown measures on traffic crashes during March and April 2020 in comparison to the same time period in 2015 to 2019. Results indicate that during March and April 2020 there was a reduction in collisions by 62%, a reduction in deaths by 86%, a reduction in serious injuries by 48% and a reduction in minor injuries by 6% compared to what would have been expected in the absence of the pandemic.

In **Croatia,** for road fatalities, a reduction by 25% from 315 (average 2017-2019) to 237 (2020) was noted, with higher reductions especially in April and May as well as in October when restrictions were in place. Similarly, a reduction for severe injuries with similar extent (24%) from 2.666 (average 2017-2019) to 2.295 (2020) is apparent, with highest reductions in April and May but also in August.

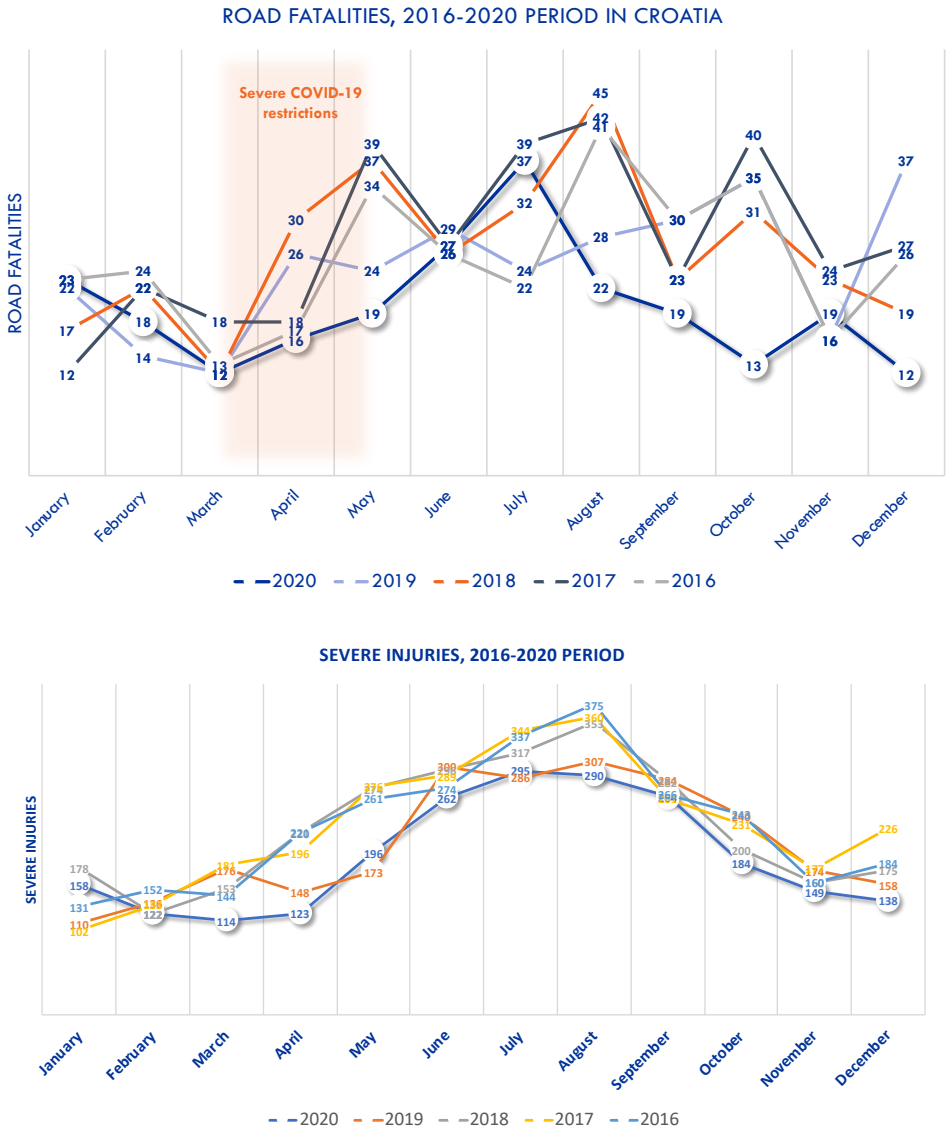


Figure 29: Development of road fatalities (above) and severe injuries (below) in Croatia 2016 to 2020 by month

For the **Czech Republic** a reduction in road fatalities by 14% was recorded, whereas the reduction was considerably higher for severe injuries (-22%) and only a bit higher for light injuries

(-15%) in 2020 compared to the average 2017-2019. Looking at the changes per months, reductions in road fatalities are observable for May and during the autumn and winter months, when mostly restrictions were in place, while in August the number of road fatalities in 2020 nearly reached the level of the average 2017-2019. For severe injuries, interestingly, during the summer months their number in 2020 also was lower than the average 2017-2019. For slight injuries however, after a small reduction especially during March and May 2020, their number nearly reached the level of the average 2017-2019 in the summer months, and only decreased again beginning from October, when restrictions were in place again.

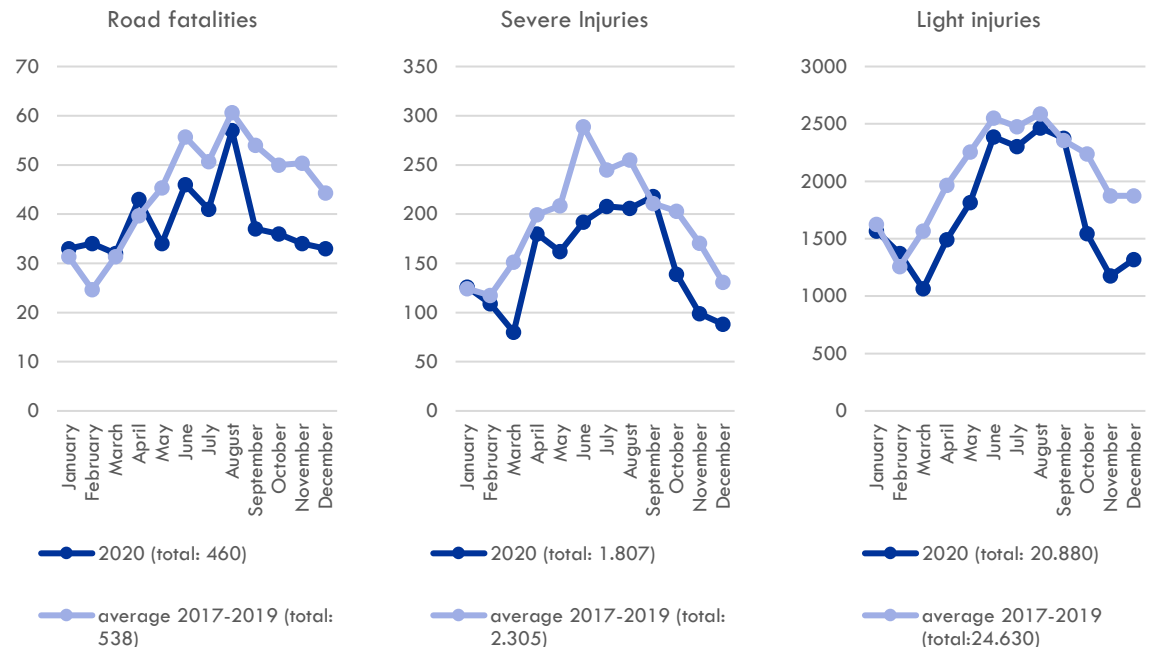


Figure 30: Road fatalities, severe injuries and light injuries in the Czech Republic in 2020 compared to the average 2017-2019 in total and by month

For **Hungary** the comparison of the numbers of road fatalities and serious injuries for different months for 2020 with those of the previous years shows that they were lower in 2020, especially during the period April to June as well as in November and December – these were also the periods in which most of the COVID restrictions were in place in Hungary. For May 2020, the number of road fatalities (32 fatalities) was 39% lower than the average 2017-2019 (45 fatalities).

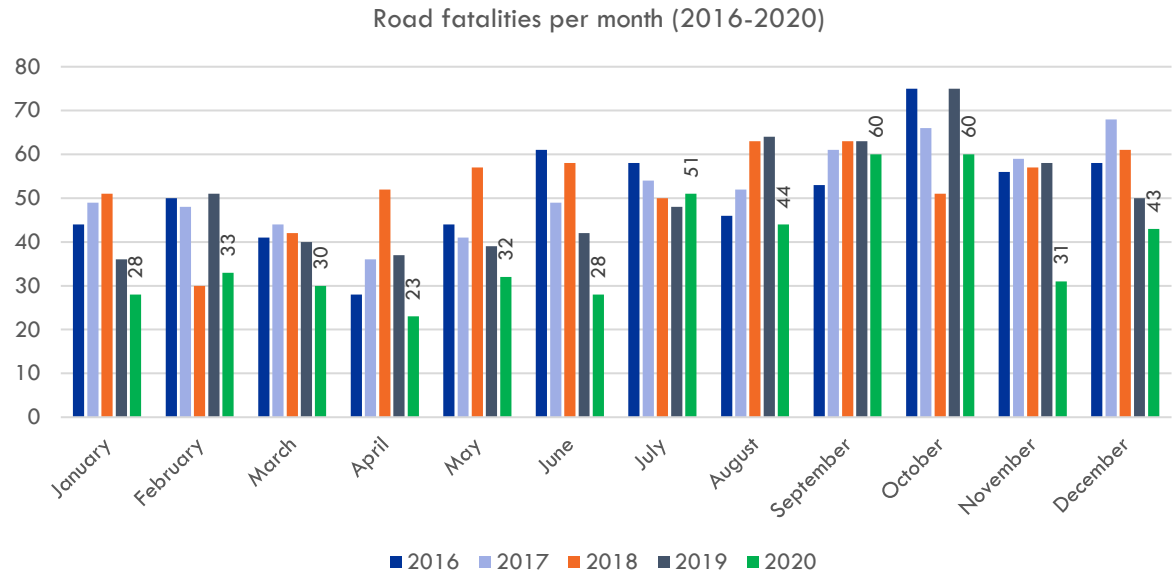


Figure 31 Development of road fatalities in Hungary 2016 to 2020 by month

Similarly, for serious injuries, highest reductions in 2020 compared to the previous years are observable especially for May to June 2020 and for October to December 2020. However, reductions in the number of serious injuries often were lower than the respective reductions for road fatalities. For May 2020 for example, the number of serious injuries (361) was 28% lower than the average 2017-2019 (500). In addition, during the summer months in July to September, the number of serious injuries again reached the level of the previous years, while this was not the case for road fatalities to the same extent.

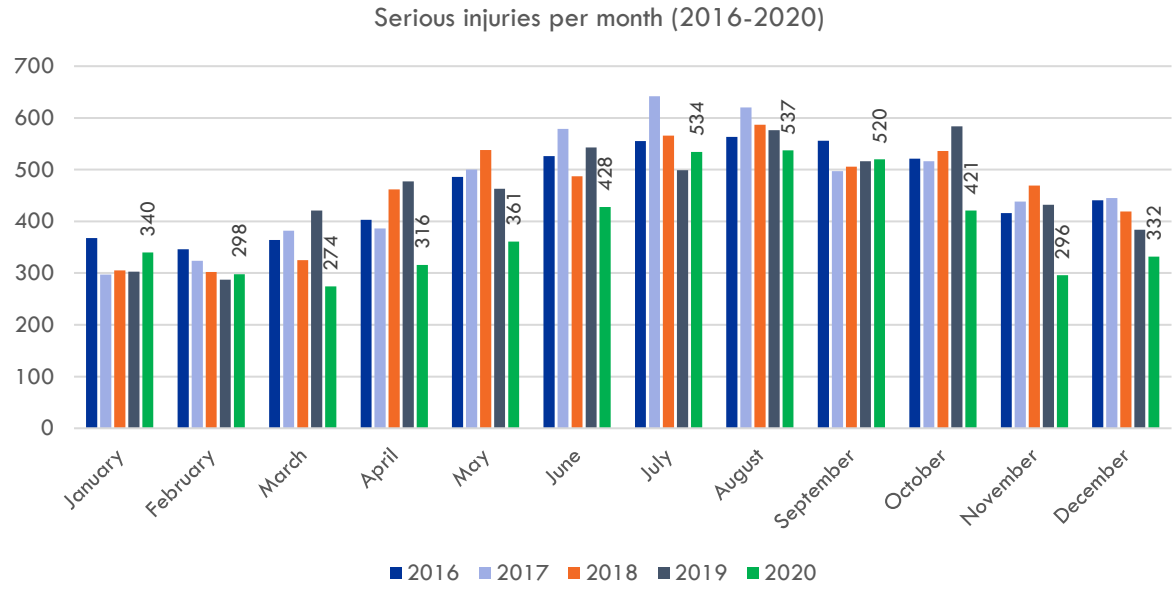


Figure 32 Development of serious injuries in Hungary 2016-2020 by month

For **Moldova,** the number of road fatalities in 2020 decreased by 14% compared to the average 2017-2019. For the number of injuries and crashes the respective reductions were higher: the number of injuries in 2020 decreased by 26% compared to the average 2017-2019 and the number of crashes decreased by 23%.

Table 6: Number of road fatalities, injuries and crashes in Moldova 2020 and change compared to the average 2017-2019

	Total 2020	Change compared to average 2017-2019
Fatalities	245	-14%
Injuries	2,265	-26%
Crashes	2,005	-23%

For **Slovenia,** with 80 road fatalities in 2020, their number in 2020 was 19% lower compared to the average 2017-2019 (99). When comparing the 2020 figures to the average 2017-2019 by month, it is observable that the number of road fatalities in 2020 was particularly low during March and May as well as during October and December when restrictions were in place.

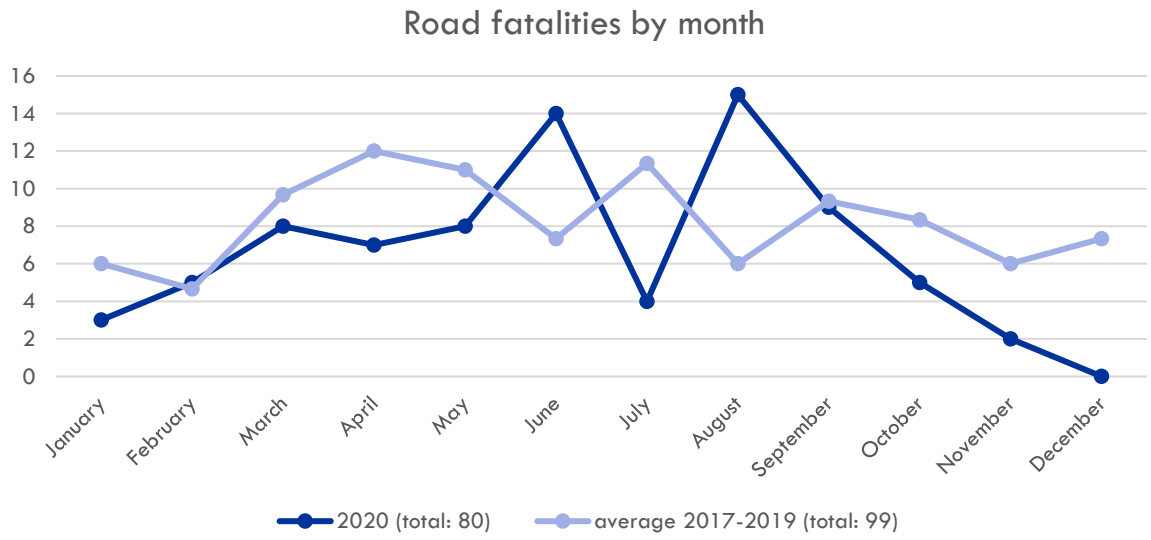


Figure 33 Road fatalities in Slovenia in 2020 compared to the average 2017-2019 by month

For **France,** ONISR (2021) reports that compared to 2019 the number of fatalities decreased by 22% and the number of injuries by 21% in 2020. The respective reduction for injury accidents was only slightly lower (-19%).
Regarding changes in 2020 by weeks compared to the same weeks 2019, reductions for the number of victims and fatalities in 2020 compared to 2019 are observable especially during the first lockdown in spring 2020. During the summer months – when restrictions were lifted – in particular the number of victims in 2020 reached again the same levels like in 2019. During autumn and winter, when restrictions were in place again, for both, the number of victims and

fatalities, reductions are observable, however, these reductions were not as high as during the first lockdown in spring.

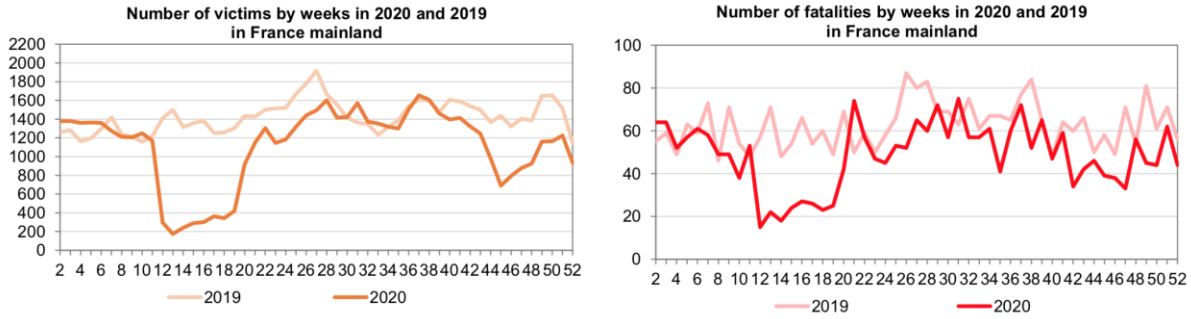


Figure 34: Number of victims (left) and fatalities (right) in France in 2020 by weeks and in comparison to 2019, Source: ONISR, 2021

Regional Level

Pishue (2020) investigated the effects of COVID-19 on vehicle miles travelled and collisions in the largest **25 metropolitan areas in the USA** for the time period April to June 2020 and August to October 2020 in comparison to the same periods in 2019. For all 25 metro areas he reports a median 35% reduction in vehicle miles travelled in the period April to July 2020 and a median reduction in collisions by 42%. However, he also reports that collisions quickly rebounded to pre-COVID levels with only a median reduction by 9% in the period between August and October 2020, while the reduction in vehicle miles travelled was 21%, resulting in a higher collision rate during August and October 2020.

Table 7: Median Changes in Vehicle Miles Travelled and Collisions among top 25 Metro Areas, Source: Pishue 2020

Time period	Median VMT Change (in comparison to same period 2019)	Median Collision Change (in comparison to same period 2019)
April – July 2020	-35%	-42%
August – October 2020	-21%	-9%

Saladié, Bustamente & Gutiérrez (2020) analysed the impact of COVID-19 and the related lockdown on mobility and traffic accidents in the **Tarragona province in Spain** during March and April 2020 in comparison to February 2020 as well as in comparison to the same period in 2018-2019. They indicate that the number of accidents per day fell by 74,3% in comparison to February 2020 and that this reduction in the number of accidents was higher than the reduction of mobility during the same reference period (62.9%). For the comparison of the number of traffic accidents during March and April 2020 and the same period 2018-2019, they report a 76% reduction.

Waetjen & Shilling (2021) analysed the effect of COVID-19 and the related stay-at-home orders on traffic collisions on highways in **California, USA** over the first half year of 2020. They report fewer incidents across Californian highways due to fewer cars on the road: injury and fatal incidents and property damage only crashes all decreased after the shelter-at-home order was given, but then began to climb again during the summer as restrictions were lifted. Likewise for California, the Economist (2021) investigated the impacts of COVID-19 and related

measures on traffic collisions and deaths by comparing the numbers of 2020 to the year 2019. It reports that the number of collisions in 2020 fell by 24% compared to 2019, a higher reduction than vehicle miles driven (VMT), which fell by 13%.

Doucette at al. (2021) analysed the impact of the COVID-19 pandemic and related measures on vehicle miles travelled and motor vehicle crashes in **Connecticut, USA** from 1 January to 30 April 2017, 2018, 2019 and 2020 using an interrupted time series design. Results show that vehicle miles travelled decreased by 43% in the post stay-at-home period in 2020 and also mean daily counts of crashes decreased by 55% in 2020 after the stay-at-home order.

Summary of COVID-19 effects on road crashes and road fatalities

- For the whole year 2020 compared to 2019, a **reduction of road fatalities** was observable in most of the 27 EU member States with the largest reductions (25% or more) in Bulgaria, Hungary and Italy. In contrast, Estonia, Latvia, Ireland and Finland recorded an increase in fatalities.

- A **reduction of the number of road crashes and fatalities** was particularly observable during the first wave of the pandemic in March and April 2020 in most countries in Europe and North America. However, **some countries in Europe** also experienced small **increases in road fatalities**, with the latter also being linked to less stricter containment measures (e.g. in Sweden) but interestingly Germany also experienced an increase in fatalities in April 2020 compared to April 2019, although containment measures were in place and mobility was reduced.

- The **reduction in road fatalities** during the first wave of the pandemic in most countries in Europe and in the USA was **often not in proportion to the decrease in traffic volume**, resulting in a **higher fatality rate** and a higher fatal collision risk. This also applies to most of the countries in the Danube area, with the exception of Hungary.

- The **reduction of non-fatal crashes** during the first wave of the pandemic in March and April 2020 was **around the same extent as the decrease in traffic volume** or even higher (for the USA, Spain and the UK). However, the number of crashes quickly rebounded during the summer months in 2020 when containment measures were lifted and this increase in crashes was higher than the increase in traffic volume in the same period, resulting in a higher collision rate.

- Overall, in most countries (e.g. the UK, the Netherlands, Germany, Czech Republic, Moldova), the **reduction in the number of road crashes** was **higher than the reduction in the number of casualties, KSI casualties and road fatalities**, with the latter decreasing the least or even increasing.

- For the USA, an increase in the number of road fatalities (as well as for the fatality rate) was observable between July and September 2020 in comparison to the same period 2019.

- During the **second wave** of the pandemic in Europe in October, November and December 2020, the number of fatalities (e.g. in the EU, Slovenia, Croatia, Czech Republic), road crashes (e.g. Germany) and **road victims** (e.g. the Netherlands, France) again **decreased** compared to the same months 2019.

2.2.2. Detailed analysis of road crashes and fatalities: road user type, gender, age group, road type

Country Level

For the **UK**, the Department for Transport (2021b) analysed the change in the number of all casualties by road user type and age group between January and June 2020 in comparison to the same months in 2019. Regarding changes for all casualties by road user type, reductions for all types between March and June 2020 (with the highest reduction in April) were reported. A larger percentage reduction is indicated for pedestrians and for car occupants, whereas pedal cyclists experienced only a smaller reduction. However, as also seen in Figure 12, it is also stated that there has been an increase in pedal cyclist traffic volume over the period March to June 2020 following the COVID-19 restrictions, while motor vehicle traffic has declined.

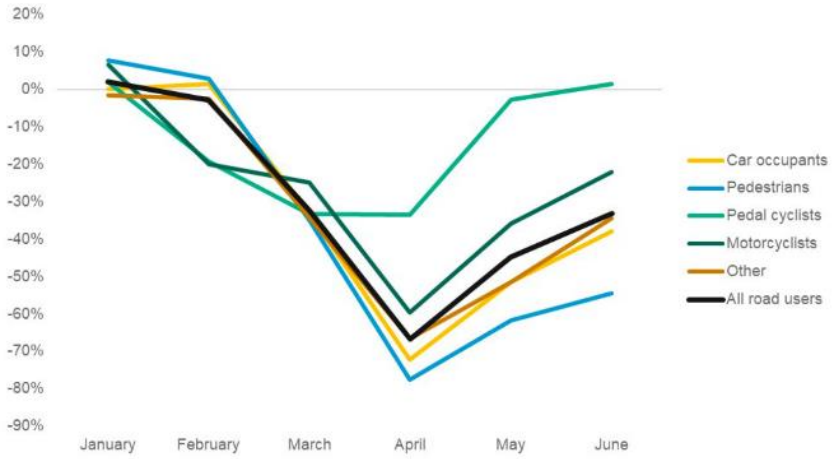


Figure 35 Percentage change of all casualties in January to June 2020 compared to 2019 by road user type in the UK, Source: Department for Transport 2021b

Regarding changes for all casualties by age, reductions for all age groups between March and June 2020 are reported, with the highest reductions in April. However, there was a larger percentage reduction for children (aged 15 or under) and a smaller reduction for adults (aged 16 and over) during this period.

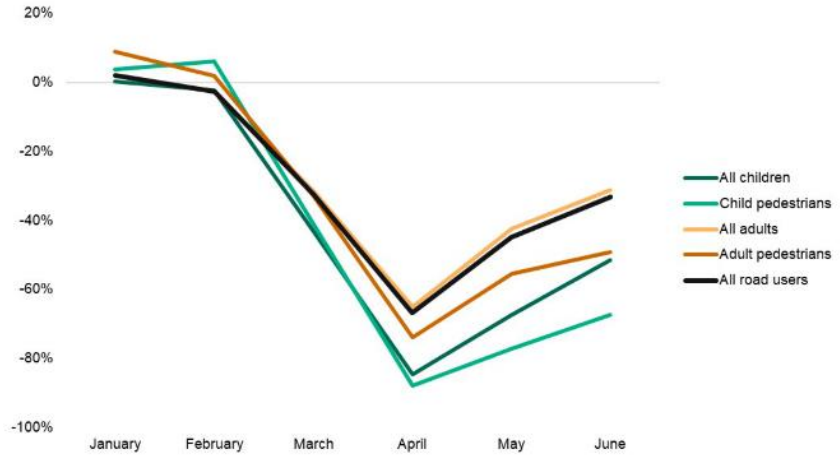


Figure 36 Percentage change of all casualties in January to June 2020 compared to 2019 by age group in the UK, Source: Department for Transport 2021b

Similarly, Owen (2021) investigated changes in the number of all casualties in the period March and June 2020 compared to the same periods in 2017-2019 (averaged) for the UK, but his analysis also included changes in the number of KSI casualties and more detailed information on road user types and age groups as well as gender and time of day.
Regarding different road user types, he reports higher reductions (over 50%) for all casualties and KSI casualties for pedestrians, busses and cars – but for the latter a reduction over 50% was reported only for all casualties (52%), while the reduction for KSI casualties was lower (38%). For motorbikes and goods vehicles, a slightly lower reduction for all casualties and KSI casualties is observable (between 30 to 40%), while the reduction for cyclists was much lower for all casualties (21%) and KSI casualties (6%) in particular. However, with regard to cyclist casualties, he also reports that when considering exposure (see Figure 12) cycling became safer.

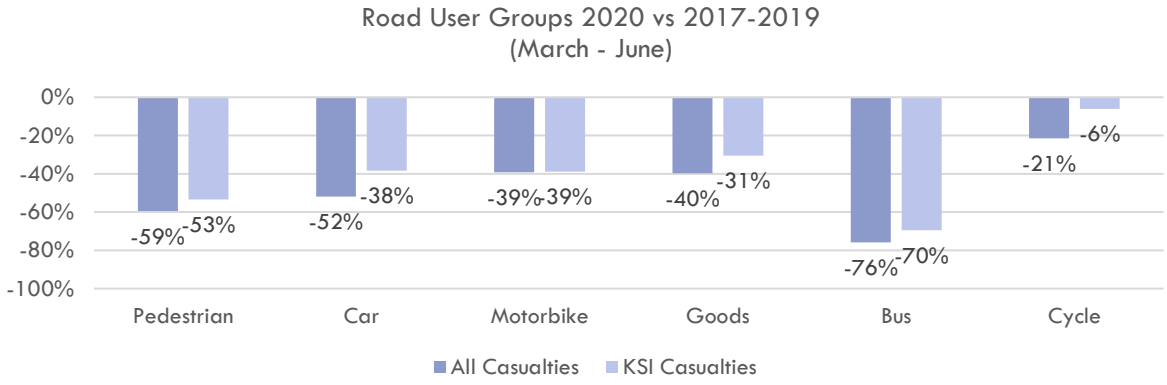


Figure 37 Percentage change of all casualties and KSI casualties between March and June 2020 compared to 2017-2019 (averaged) by road user groups in the UK, Source: Owen 2021

Regarding gender, higher reductions both for all casualties and KSI casualties are reported for women (57%; 48%) compared to men (43%; 32%). With respect to different age groups, higher reductions both for all casualties und KSI casualties are reported for age groups under 24 years and age groups over 75 years, while for age groups between 25 and 64 years lower reductions for all casualties and particularly KSI casualties are observable.

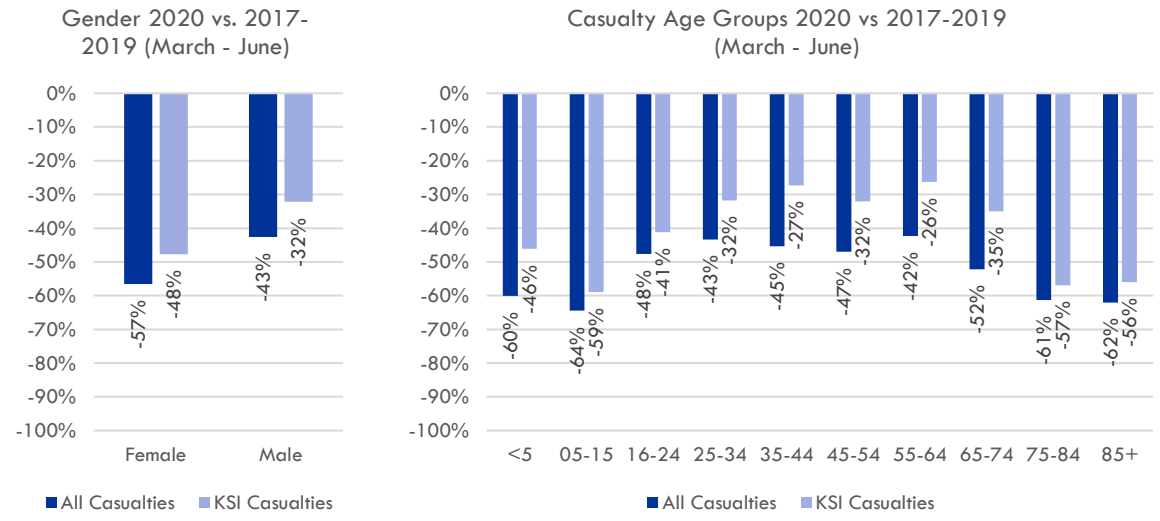


Figure 38 Percentage change of all casualties and KSI casualties between March and June 2020 compared to 2019 by gender (left) and age group (right) in the UK, Source: Owen 2021

Regarding the changes for all casualties and KSI casualties for different times of day, higher reductions for all casualties and KSI casualties are reported for morning peak hours (6 am to 9 am), while reductions were lower for the time between noon and 3 pm.

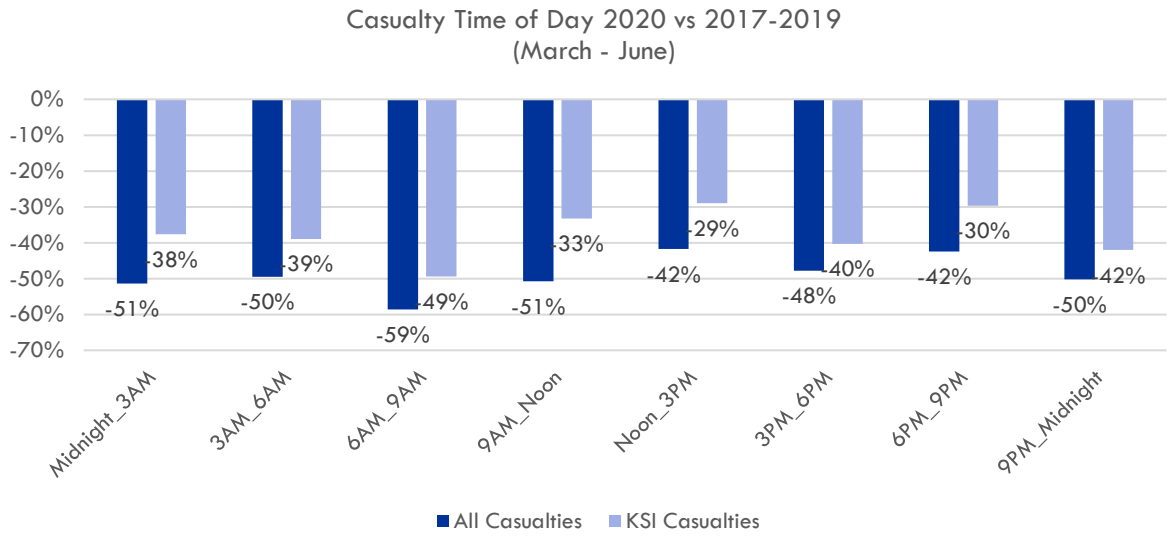


Figure 39 Percentage change of all casualties and KSI casualties between March and June 2020 compared to 2019 by time of day in the UK, Source: Owen 2021

For **Austria**, Kräutler, Robatsch & Soteropoulos (2021) investigated the change in the number of fatalities by road user type in 2020 compared to the average of 2017 to 2019 as well as the change in the number of casualties by road user type in the period January to June 2020 compared to the average of the same period in 2017 to 2019.
For fatalities, they report higher reductions for cars (24%) and pedestrians (23%), while for occupants of heavy goods vehicles (HGV) (+18%) and bicyclists (+13%) increases in the number of fatalities are reported.

Table 8: Fatalities by road user type 2020 and change compared to average 2017-2020 in Austria, Source: Kräutler, Robatsch & Soteropoulos 2021, BMI 2021

Road user type	Fatalities 2020	Change compared to average 2017-2019
Pedestrian	49	-23%
Cyclists	40	+13%
Car (occupants)	143	-24%
Motorcycle	73	-17%
Moped	4	-61%
HGV occupants	20	+18%

Regarding changes for all casualties between January and June 2020 compared to the average of the same period 2017-2019, similarly, higher reductions are reported for cars (34%), pedestrians (34%) and motorcycles & mopeds (33%), while a small increase is noted for cyclist casualties (6%).

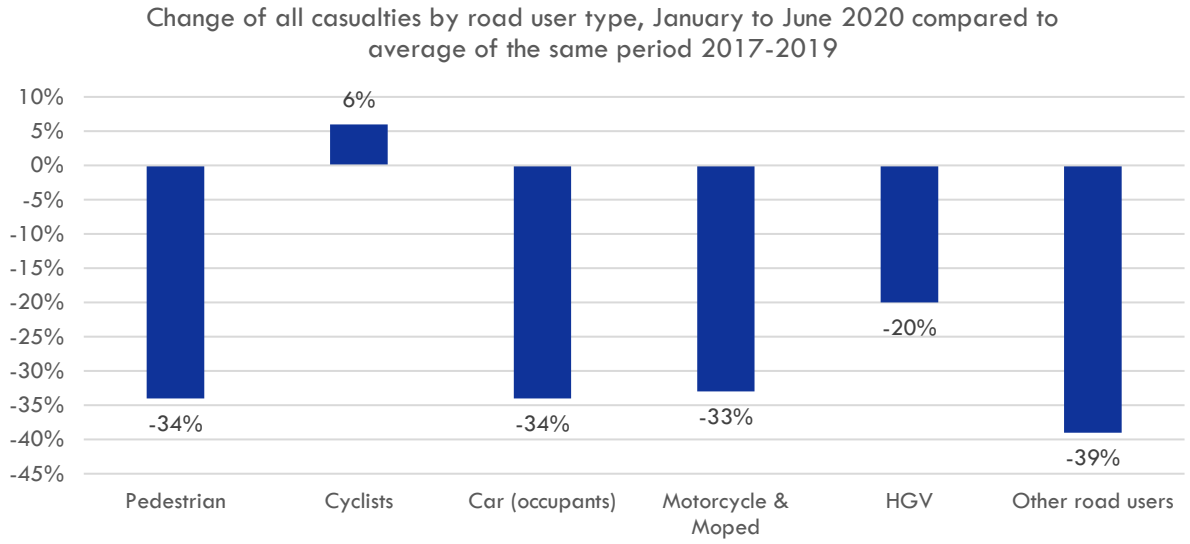


Figure 40 Percentage change of all casualties by road user type between January and June 2020 compared to average of the same period 2017-2020 in Austria, Source: Kräutler, Robatsch & Soteropoulos 2021, Statistik Austria 2020

For **Germany,** the German Federal Statistical Office (2021d) investigated the change in road fatalities and in the number of injuries by road user type and age groups in 2020 in comparison to the average 2017-2019.
Regarding changes in fatalities, reductions for passenger cars (17%) and motorcycles & mopeds (17%) are reported, while for the number of cyclist fatalities no change (±0%) is observable.

Table 9: Fatalities by road user type 2020 and change compared to average 2017-2020 in Germany, Source: German Federal Statistical Office 2021c

Road user type	Fatalities 2020	Change compared to average 2017-2019
Bicycles	426	±0%
Motorcycle & Moped	552	-15%
Passenger Cars	1,170	-17%
Bus and coach	10	-21%
Goods motor vehicles	124	-25%
Pedestrians	376	-17%

With respect to changes in the number of injuries by road user type in 2020 compared to the average 2017-2019, higher reductions are reported for pedestrians (24%), while reductions for passenger cars (12%) and motorcycles and mopeds (13%) were lower and not as high as for fatalities. However, an increase in the number of cyclist injuries by 8% in 2020 compared to the average 2017-2019 is reported.

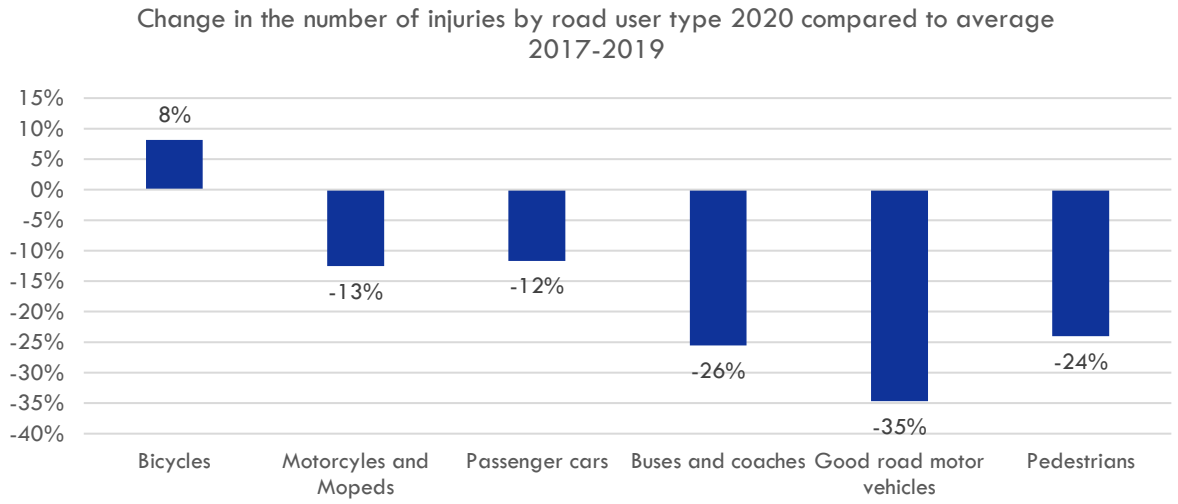


Figure 41 Change in the number of injuries by road user type 2020 compared to average 2017-2020 in Germany, Source: German Federal Statistical Office 2021d

Regarding changes in the number of fatalities and injuries by age groups in 2020 compared to the average 2017-2019, higher reductions are observable for the age group under 15 years both for fatalities (26%) and injuries (22%). The lowest reduction for the number of injuries is reported for the age group 65+ years (11%).

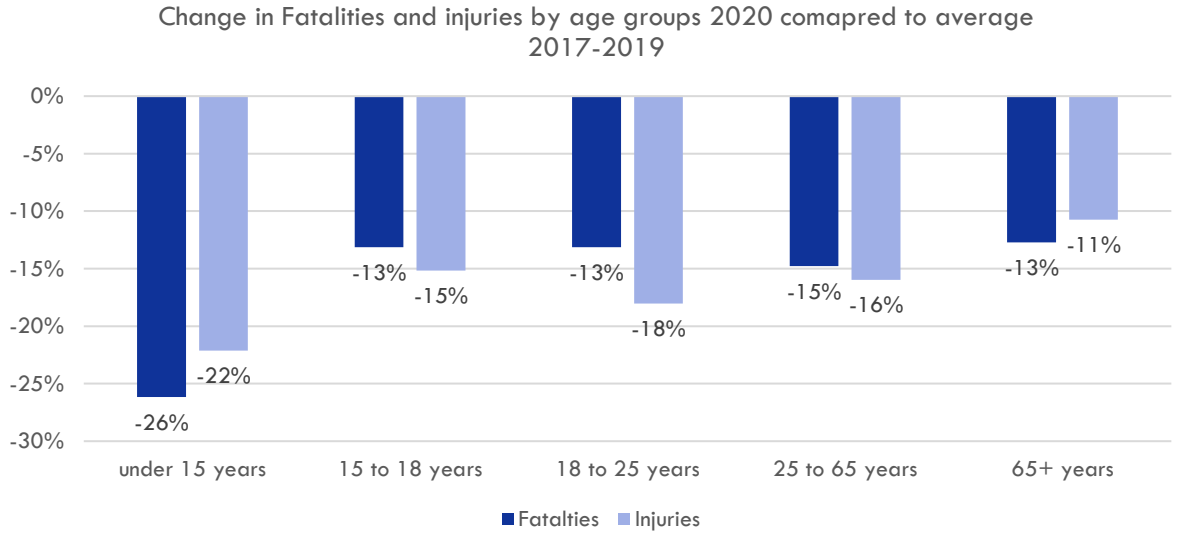


Figure 42 Change in the number of fatalities and injuries by age group 2020 compared to average 2017-2020 in Germany, Source: German Federal Statistical Office 2021e, German Federal Statistical Office 2021f

For **Switzerland**, the Swiss Federal Roads Office (2021) analyzed the change in the number of road fatalities and in the number of severe injuries by road user type in 2020 compared to the average 2017-2019.
With regard to changes in road fatalities, reductions are observable for pedestrians (13%) and for passenger cars (4%), while the number of cyclist fatalities as well as the number of motorcycle & moped fatalities increased, by 19% and 29% respectively.

Table 10: Fatalities by road user type 2020 and change compared to average 2017-2020 in Switzerland, Source: Federal Roads Office – ASTRA 2021

Road user type	Fatalities 2020	Change compared to average 2017-2019
Passenger Cars	71	-4%
Goods motor vehicles	5	-17%
Motorcycle & Moped	58	29%
Bicycles	29	19%
Pedestrians	36	-13%

Similarly, with respect to the change in the number of severe injuries in 2020 compared to the average 2017-2019, reductions are observable for pedestrians (23%) and passenger cars (20%). For both pedestrians and passenger cars, reductions in the number of severe injuries are also higher than for fatalities, and for motorcycle and mopeds even a reduction in the number of severe injuries (1%) is observable. However, like for the number of bicyclist fatalities, also the number of severe injuries for bicyclists increased in 2020 compared to the average 2017-2019, although to a lesser extent (12%) compared to bicyclist fatalities.

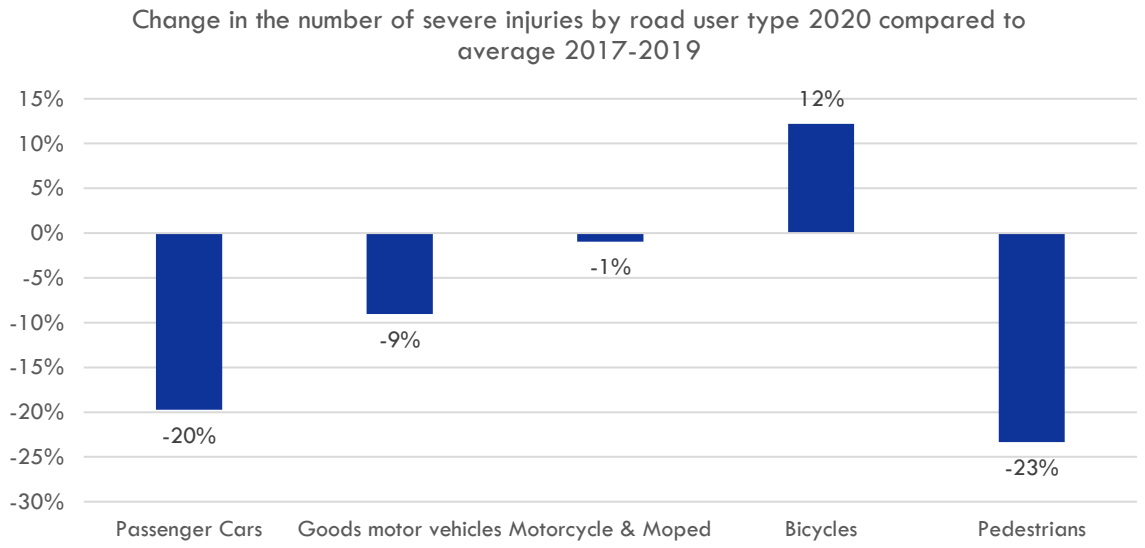


Figure 43 Change in the number of severe injuries by road user type 2020 compared to average 2017-2020 in Switzerland, Source: Federal Roads Office – ASTRA 2021

Donkers & Broos (2021) analysed the monthly number of road victims by road user type and age groups in the **Netherlands** in 2020 and compared them to expected numbers of road accidents and road victims for 2020 that were calculated based on trends in accident records from 2016 to 2019.

Regarding road user types, i.e., the number of road victims of vulnerable modes of transport (pedestrians and two-wheeled (motor) vehicles) and non-vulnerable modes of transport (remaining modes like passenger cars and goods vehicles), less accidents for the non-vulnerable modes of transport than the expectation are reported for all months in 2020, but particularly for April and October. For vulnerable modes of transport however, the number of road victims for most months is around the expected numbers or only slightly lower - and for August and September it is even higher than the expectation.

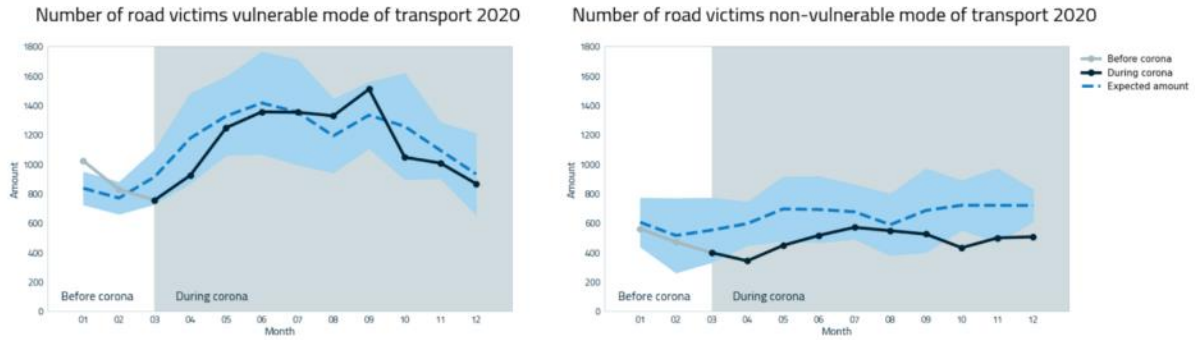


Figure 44 Monthly number of road victims in 2020 in the Netherlands for vulnerable modes of transport (pedestrians and two wheeled (motor) vehicles, left) and non-vulnerable modes of transport (remaining traffic like cars and goods vehicles, right) compared to the expected number of road victims based on former accident records with a spread of 95% reliability, Source: Donkers & Broos 2021

With respect to age groups, it is reported that for adults (25-64 years) in most of the months in 2020 (except for August and September) there were less accidents than the expectation. A similar trend is also observable for young people (0-24 years). In contrast the elderly (>65 years) show the least difference and monthly road victims in 2020 were mostly in line with the expectation.

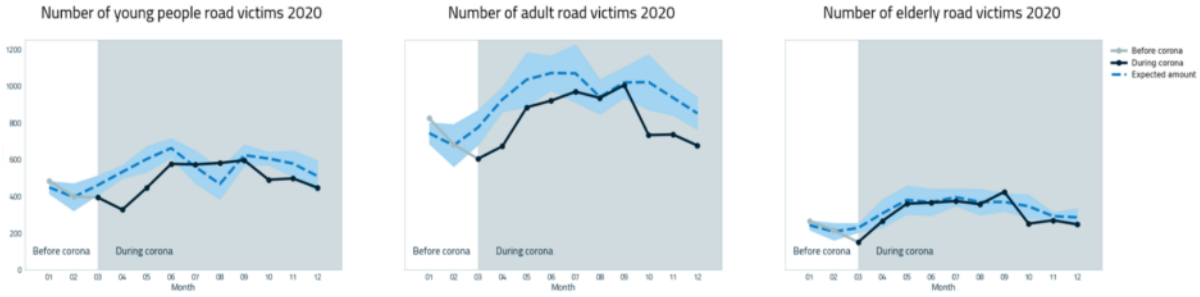


Figure 45 Monthly number of road victims in 2020 in the Netherlands by age groups compared to the expected number of road victims based on former accident records with a spread of 95% reliability, Source: Donkers & Broos 2021

For the **USA,** NHTSA (2020b) investigated fatal crash rates during the COVID-19 pandemic between March and June 2020 by road types and compared it with the fatal crash rates of the same period in 2019. Results indicate that the overall increase of the total fatality rate per 100 million miles of vehicle miles travelled (VMT) from March to June 2020 in the USA is mainly driven by increase of the fatality rate on the rural local/collector/street, arterial and interstate roadways. In addition, higher shares for fatal single-vehicle-crashes during March to June 2020 compared to the same period 2019 are reported.

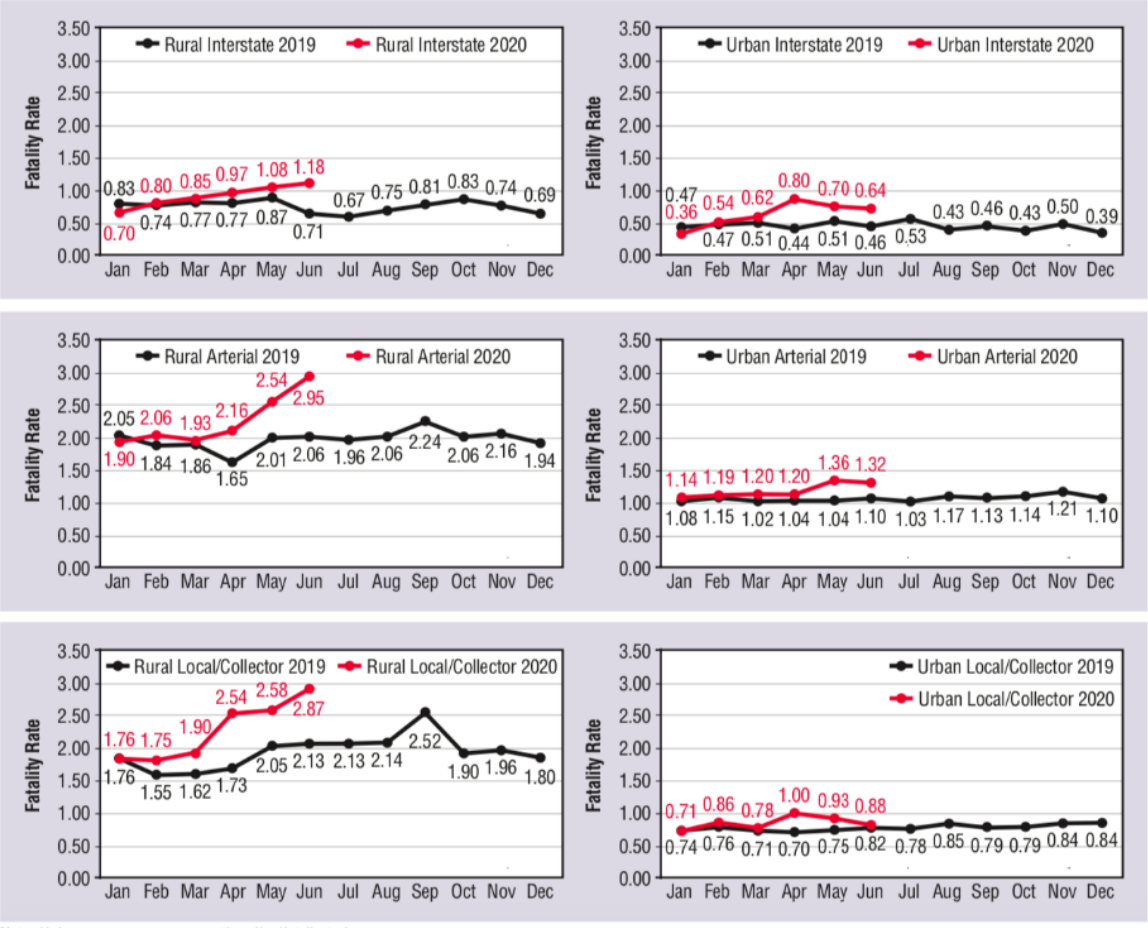


Figure 46 Fatality Rate by Roadway Function Class for 2019 to June 2020, Source: NHTSA 2020b

The GHSA (2021) analysed the pedestrian fatalities per one billion vehicles miles travelled (VMT) in the USA between January and June 2020 in comparison to the same period of the four previous years. They report that, compared to 2019, the pedestrian fatality rate in the first half of 2020 increased by 20%. It is mentioned that this is the result of a reported 16.5% reduction in VMT for the first six months of 2020 compared with 2019 with no corresponding reduction in pedestrian deaths.

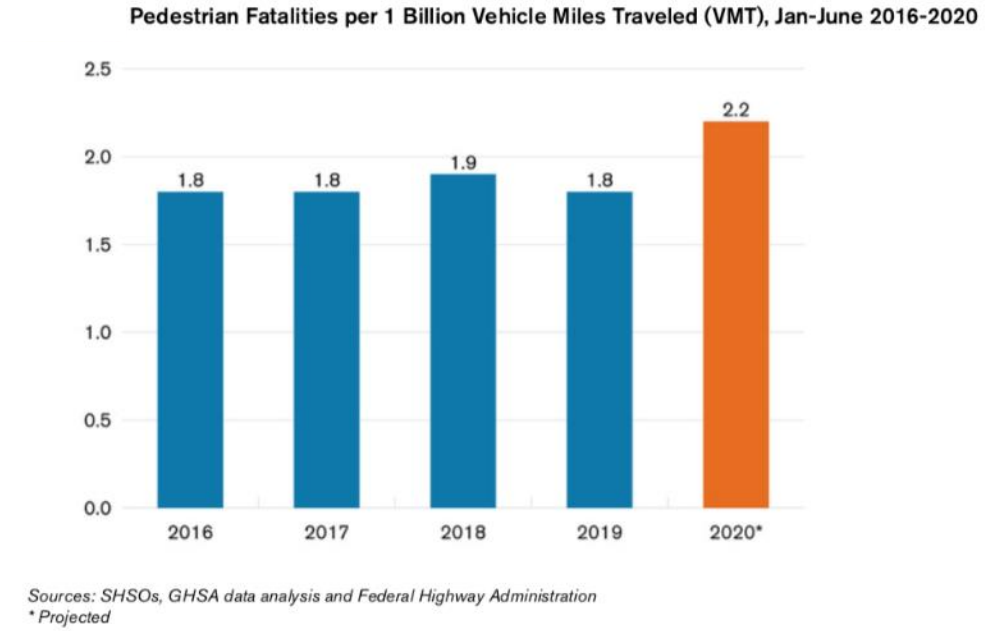


Figure 47 Pedestrian fatalities per 1 billion vehicle miles travelled in January to June 2016-2020 in the USA, Source: GHSA 2021

For **Croatia**, with regard to changes in road fatalities, reductions are observable especially for passenger cars (-21%) and pedestrians (-13%), while the number motorcycle fatalities decreased by only 10% – the number of cyclist fatalities also decreased to a larger extent, however the absolute number of cyclist fatalities is comparatively low.

Table 11: Fatalities by road user type 2020 and change compared to average 2017-2020 in Croatia

Road user type	Fatalities 2020	Change compared to average 2017-2019
Personal Car	129	-21%
Motorcycle	49	-10%
Bicycle	9	-56%
Pedestrians	38	-13%
Heavy vehicles	8	4%
Bus	0	0%
Other vehicles	4	-52%

Similarly, with respect to the change in the number of injuries in 2020 compared to the average 2017-2019, reductions are observable especially for pedestrians (-33%) and passenger cars (-30%). For both, pedestrians and passenger cars, reductions in the number of severe injuries are also higher than for fatalities – this is also the case for motorcycle injuries. However, the number of injuries for heavy vehicles (-1%) and for bicycles (-10%) only slightly decreased in 2020 compared to the average 2017-2019 in comparison to the respective reductions for the other modes of transports.

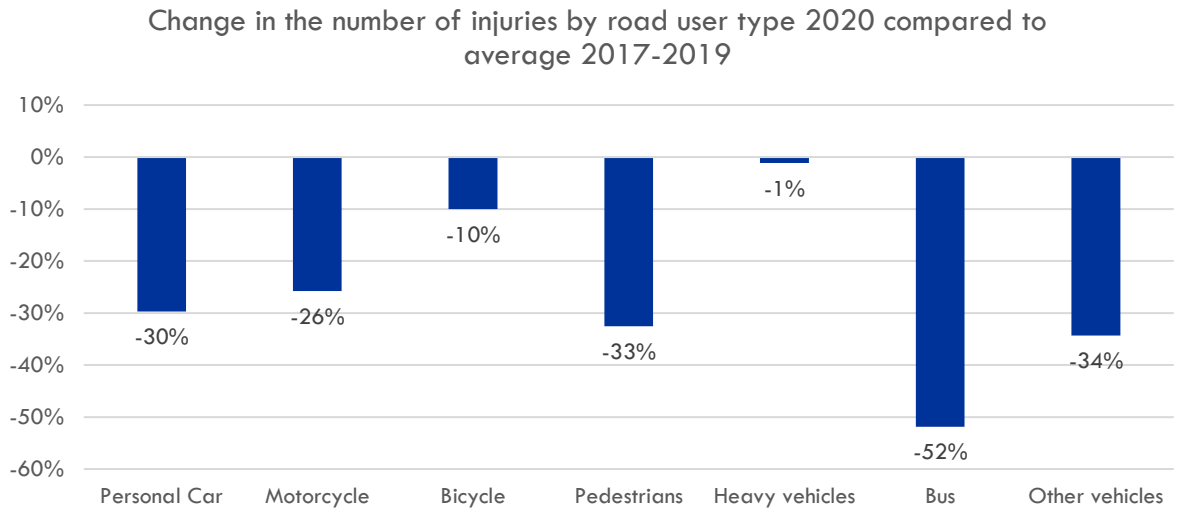


Figure 48 Change in the number of injuries by road user type 2020 compared to average 2017-2019 in Croatia

For **Hungary**, the number of road fatalities showed the highest reductions in 2020 compared to the average 2017-2019 for cyclists (-44%) and pedestrians (-32%), whereas the reduction in the number of fatalities was lower for cars (-21%) and PTWs (-11%) in particular.

Table 12: Fatalities by road user type 2020 and change compared to average 2017-2020 in Hungary

Road user type	Fatalities 2020	Change compared to average 2017-2019
Pedestrians	109	-32%
Cyclists	40	-44%
Powered-Two-Wheelers	58	-11%
Cars	222	-21%
Vans	20	-25%
HGVs	4	-48%
Public Transport	2	-25%

Similarly, for serious injuries also reductions for all road user types in 2020 compared to the average 2017-2019 are observable. However, these reductions– except for powered two-wheelers – were mostly lower than the respective reductions for fatalities. The highest reductions are observable for public transport (-41%) and for pedestrians (-29%). However, the reduction for cyclists is only 12% (compared to 44% for the number of cyclist fatalities) and also the reduction of serious injuries for cars (-16%) is lower than the respective reduction of fatalities.

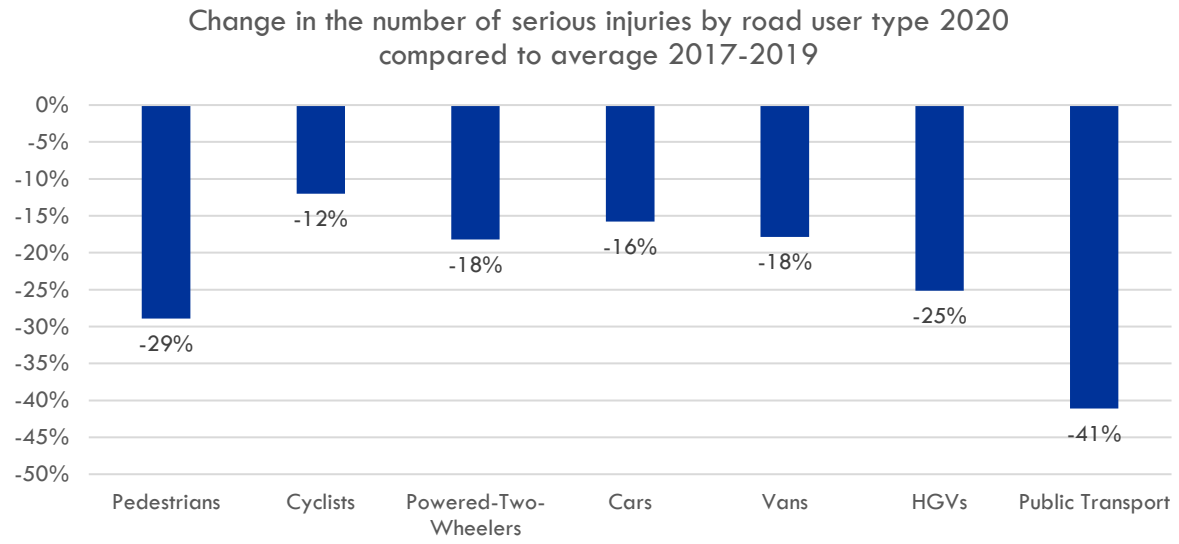


Figure 49: Change in the number of serious injuries by road user type 2020 compared to average 2017-2019 in Hungary

Regarding different age groups, higher reductions in the number of fatalities in Hungary in 2020 compared to the average 2017-2019 are apparent for the age group 75 years and older as well as for the age group 55 to 74 years (-25%), whereas for the age group below 18 years a lower reduction (-6%) is observable.

Table 13: Fatalities by age group 2020 and change compared to average 2017-2020 in Hungary

Age group	Fatalities 2020	Change compared to average 2017-2019
0-17 years	16	-6%
18-24 years	39	-20%
25-54 years	219	-22%
55-74 years	139	-25%
75+ years	49	-44%

For different road types, data on the number of fatalities in Hungary in 2020 compared to the average 2017-2019 indicate a higher reduction for urban roads (-36%), whereas the reduction on rural roads (-19%) was lower.

Table 14: Fatalities by road type 2020 and change compared to average 2017-2020 in Hungary

Road type	Fatalities 2020	Change compared to average 2017-2019
Urban roads	150	-36%
Rural roads	280	-19%
Motorways	33	-24%

With regard to the change in the number of road fatalities in 2020 in **Moldova** compared to the average 2017-2019 by age groups, data indicate that whereas especially for the age group of 0 to 17 years a high reduction (-20%) in 2020 is observable, the number in the age group of the elderly (65+ years) increased by 10%. For the other age groups (18-30 years and 31-64 years) reductions of around 12% are apparent.

Table 15: Fatalities by age group 2020 and change compared to average 2017-2020 in Moldova

Age group	Fatalities 2020	Change compared to average 2017-2019
0-17 years	12	-20%
18-30 years	49	-12%
31-64 years	122	-12%
65+ years	39	10%
unknown	21	-47%

For **Slovenia,** data on the number of road fatalities and serious injuries in 2020 compared to the average 2017-2019 by age groups shows that higher reductions in the number of fatalities are observable for the age group 25-34 years (-39%) as well as for the age group 35-44 years (-31%), while for the age groups below 25 years lower reductions or even increases in road fatalities in 2020 compared to the average 2017-2019 are apparent.

Table 16: Fatalities by age group 2020 and change compared to average 2017-2020 in Slovenia

Age group	Fatalities 2020	Change compared to average 2017-2019
0-14 years	3	125%
15-17 years	3	50%
18-24 years	9	-21%
25-34 years	11	-39%
35-44 years	8	-31%
45-54 years	15	-20%
55-64 years	15	2%
64+ years	16	-25%

For serious injuries, similarly, higher reductions in the number of serious injuries in 2020 compared to the average 2017-2019 are observable for the age group 25 to 34 years (-37%) as well as for the age groups 18 to 24 years (-33%) and 64+ years (-27%). For the age groups below 18 years, increases in the number of serious injuries in 2020 compared to the average 2017-2019 are apparent, in particular for the age group 0 to 14 years (+19%).

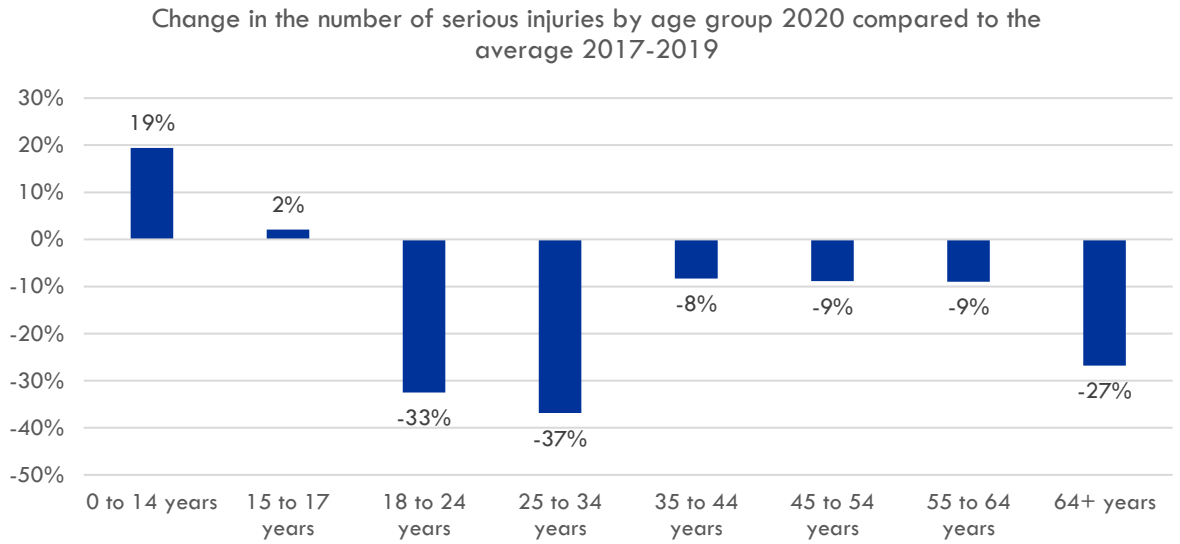


Figure 50: Change in the number of serious injuries by road user type 2020 compared to average 2017-2019 in Slovenia

ONISR (2021) investigated the change in the number of fatalities in 2020 compared to 2019 by age group, road user type and road type in **France**. Regarding changes in the number of fatalities by age group, higher reductions in 2020 compared to 2019 are observable for the age groups 75+years (-34%), 55-64 years (-28%) and 25-34 years (-23%). However, for age groups of lower ages lower reductions or even small increases in the number of fatalities in 2020 compared to 2019 are reported: for the age group 14-17 years, only a small reduction (-3%), and for the age group 0-13 years a small increase (+2%) is observable.

Table 17: Number of fatalities in France in 2020 by age group and change compared to 2019, Source: ONISR, 2021

Age group	Fatalities 2020	Change compared to 2019
0-13 years	62	+2%
14-17 years	89	-3%
18-24 years	449	-18%
25-34 years	399	-23%
35-44 years	280	-27%
45-54 years	324	-15%
55-64 years	295	-28%
65-74 years	291	-8%
75+ years	352	-34%

With regard to changes in the number of fatalities by road user type, higher reductions in 2020 compared to 2019 are reported for utility vehicles (-40%), mopeds (-25%), cars (-23%) and motorcycles (-22%), while the respective reduction for bicycles was considerably lower (-5%).

Table 18: Number of fatalities in France in 2020 by road user type and change compared to 2019, Source: ONISR, 2021

Road user type	Fatalities 2020	Change compared to 2019
Pedestrians	391	-19%
e-Scooter	7	-30%
Bicycle	178	-5%
Moped	100	-25%
Motorcycle	479	-22%
Car	1,243	-23%
Utility vehicles	59	-40%
Heavy goods vehicles	33	-8%
Public transport	3	-25%
Others	48	-13%

Concerning the change in the number of road fatalities in 2020 compared to 2019 in France by road type, ONISR (2021) reports higher reductions for motorways (-24%) and rural roads (-23%) than for urban streets (-19%).

Table 19: Number of fatalities in France in 2020 by road user type and change compared to 2019, Source: ONISR, 2021

Road type	Fatalities 2020	Change compared to 2019
Motorways	201	-24%
Rural roads	1,497	-23%
Urban streets	843	-19%

Regional Level

Doucette at al. (2021) analysed the impact of the COVID-19 pandemic and the related stay-at-home measures on vehicle miles travelled and motor vehicle crashes in **Connecticut, USA** from 1 January to 30 April 2017-2020 using an interrupted time series design. When accounting for the reductions in vehicle miles travelled it was shown that crash rates of single vehicle crashes significantly increased 2.29 times and specifically single vehicle fatal crash rates significantly increased 4.10 times when comparing the pre-stay-at-home and post-stay-at-home periods. The authors hypothesize that the increase in single vehicle crashes is due in part to increased driving speeds associated with decreased traffic volume and reduced police presence.

For **California, USA,** The Economist (2021) investigated the relation between population density and deaths from traffic collisions in 2020 compared to 2019 and reports that rural areas, where roads are less crowded, account for a disproportionately high share of traffic fatalities (higher than in cities) and that the gap in death rates between rural areas and cities shrank in 2020.

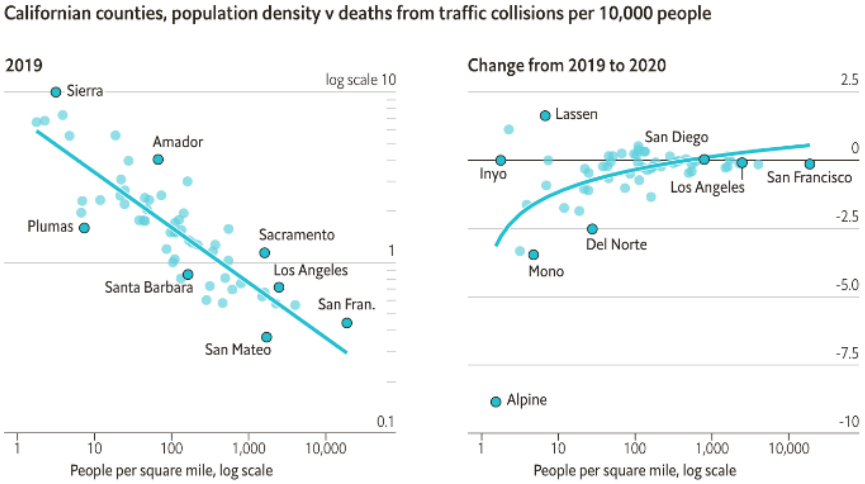


Figure 51 Comparison of population density versus deaths from traffic collisions per 10,000 people in Californian countries 2019 to 2020, Source: The Economist 2021

Summary of detailed analysis of road crashes and fatalities: road user type, gender, age group, road type

- Detailed analysis of road fatalities and casualties with regard to different road user types both for the whole year 2020 (e.g. in Germany, Austria, Switzerland and France) as well as only during the period from March to June 2020 (e.g. in the UK) indicate **higher reductions** in the number of **fatalities and casualties** for **pedestrians and cars**, while only **smaller reductions or** even **increases** are reported for **bicyclists**. However, it should be noted that an **increase in bicycle traffic** was noted during these periods in most of the countries. However, in contrast, particularly in Hungary and Croatia the number of cyclist fatalities reduced considerably in 2020 compared to 2019. For the USA, an increase in pedestrian fatalities per 1 billion VMT in the first half of 2020 compared to 2019 was noted, i.e., no corresponding reduction in pedestrian deaths in relation to the reduction in VMT.
  Overall, **reductions** for the different road user types were **higher for all casualties compared to KSI casualties or fatalities**.

- Regarding different age groups, **higher reductions** for all casualties, KSI casualties (e.g. in the UK), as well as for injuries and fatalities (e.g. in Germany, Moldova) are reported particularly for the **age group under 15 years**, while lower reductions are reported for the age group 25 to 65 years. For the latter, however, results from the Netherlands also indicate (higher) reductions. Results for the elderly (age group 65+) are mixed with amongst the highest reductions for all casualties and KSI casualties in the UK, but lowest reductions for injuries and fatalities in Germany and for road victims in the Netherlands. In Hungary, Slovenia and France interestingly for the age group under 18 years smaller reductions or even increases in the number of fatalities and injuries in 2020 compared to 2019 were observed.

- For the UK, **higher reductions** with regard to all casualties and KSI casualties are reported for **women in comparison to men** and with regard to different times of day, **higher reductions** are reported for **morning peak hours**, while reductions were lower for the time between noon and 3 pm.

- With regard to different road types, for Hungary, the **lowest reduction in the number of fatalities** in 2020 compared to 2019 is observable on **rural roads**, and similarly, for the USA a **higher fatality rate for rural** (collector, arterial) **roads** in particular is indicated. However, for France the lowest reduction in the number of fatalities in 2020 compared to 2019 was recorded on motorways.

- For the USA, **higher shares for fatal single-vehicle-crashes** during March to June 2020 are indicated.

2.3. Effects on risky driving behaviour: speeding, drink driving, driving while using a mobile phone, failure to use seatbelt

Besides effects of the COVID-19 pandemic on mobility and road crashes, several studies also investigated the impact on risky driving behaviour, i.e., speeding, drink driving or driving while using a mobile phone etc. Methodologies included surveys, measurements or mobile phone data (i.e., driving speed), data from statistics on traffic violations or analysis of accidents statistics, such as on (main) causes of accidents.

Katrakazas et al. (2020) analysed the effect of COVID-19 and related governmental counter-measures on driving behaviour and traffic safety in **Greece** and **Saudi Arabia** using microscopic trip data of a specially developed smartphone application of the time span from January to April 2020. Their results show that reduced traffic volumes due to lockdown led to a slight increase in speeds by 6 to 11%, and a 12% increase in frequent harsh acceleration and harsh braking events as well as a 42% increase in mobile phone use.

Pishue (2020) investigated the effects of COVID-19 on vehicle speeds on interstates and high-ways in the largest **25 metropolitan areas in the USA** for the time period April to June 2020 and August to October 2020 in comparison to the same periods in 2019. For all 25 metro areas he reports an increase in median speed by 33% for the period April to July 2020 and an increase in median speed by 22% for the period August to October 2020 during the 5:00pm rush hour. High increases of travel speeds of more than 60% for the period April to July 2020 were observed for Philadelphia (64%) and San Francisco (63%) and for the period August to October 2020 increases of up to 45% were observed for Boston and San Francisco.

For **Japan**, Inada, Ashraf & Campbell (2020) used police crash data from January 2010 to February 2020 to forecast the numbers of fatal motor vehicle collisions due to speed-related violations for March to May 2020 and compared it with the actual number observed during lockdown measures between March and May 2020. They found that the observed ratio was higher than the forecasted ratio in April and thus, drivers were more likely to commit speed-related violations that caused fatal motor vehicle collisions in the second month of the lockdown than before the lockdown.

Amberger et al. (2021) investigated traffic volumes, road crashes as well as speeds before and during the COVID-19 measures and within the re-opening phase during the time period January to June 2020 in **Toronto, Canada**. Results indicate, amongst other things, a 35% increase in speeding tickets and an almost 200% increase in stunt driving in mid-March compared with a year prior as well as a 31% greater odds of speeding during school activity times after schools were closed.

Kräutler, Robatsch & Soteropoulos (2021) analysed the causes of fatal crashes in **Austria** in 2020 and compared it to the average of the years 2017 to 2019. They found that the proportion of fatal crashes in which inappropriate speed was the main cause increased from 26% (average 2017 to 2019) to 36% in 2020.

Table 20: Main causes of fatal crashes in Austria 2020 in comparison to the average 2017-2019, Source: Kräutler, Robatsch & Soteropoulos 2021, BMI 2021

Main accident cause	2020	Average 2017-2019
Inappropriate speed	36%	26%
Distraction	23%	30%
Yield / right of way violation	16%	15%
Misconduct of pedestrian	7%	8%
Health	6%	3%
Overtaking	5%	8%
Alcohol	4%	7%
Technical defect	2%	1%
Fatigue	2%	3%

Data on the causes for *injury* crashes in **Austria** in 2020 in comparison to the average of the years 2017 to 2019 shows that in contrast to fatal crashes (for which nearly no change is observable), the proportion in which right of way violation was the main cause increased from 13% (average 2017-2019) to 25% (2020). The proportion of injury crashes in which inappropriate speed was the main cause decreased from 23% (average 2017-2019) to 16% (2020), however, the share of injury crashes in which safety distance was the main cause increased considerably from 1% (average 2017-2019) to 11% (2020).

Table 21: Main causes of injury crashes in Austria 2020 in comparison to the average 2017-2019

Main accident cause	2020	Average 2017-2019
Inappropriate speed	16%	23%
Distraction	28%	27%
Yield / right of way violation	25%	13%
Safety distance	11%	1%
Alcohol	6%	6%

Kräutler, Robatsch & Soteropoulos (2021) also analysed speed measurements of 3.6 million motor vehicles, conducted at different road locations inside and outside built-up areas throughout **Austria** during the year 2020, i.e., 1) before COVID-19 and the related measures, 2) during the first lockdown, 3) between lockdowns when restrictions were lifted and 4) during the second lockdown. Results show that, particularly during the first lockdown inside built-up areas with a speed limit of 50 km/h, a higher proportion of speeding (50.5% exceeding the speed limit) was observed than before COVID-19 (43.9% exceeding the speed limit). Outside built-up areas a somewhat lower proportion of speeding was observable in the first lockdown compared to speed measurements before COVID-19. However, the proportion of extensive violations with speed levels of more than 30 km/h over the limit inside built-up areas (speed limit = 50 km/h) was three times higher in all three phases since the beginning of the COVID-19 pandemic (0.3% or even 0.4% in the first lockdown) than before COVID-19 (0.1%).

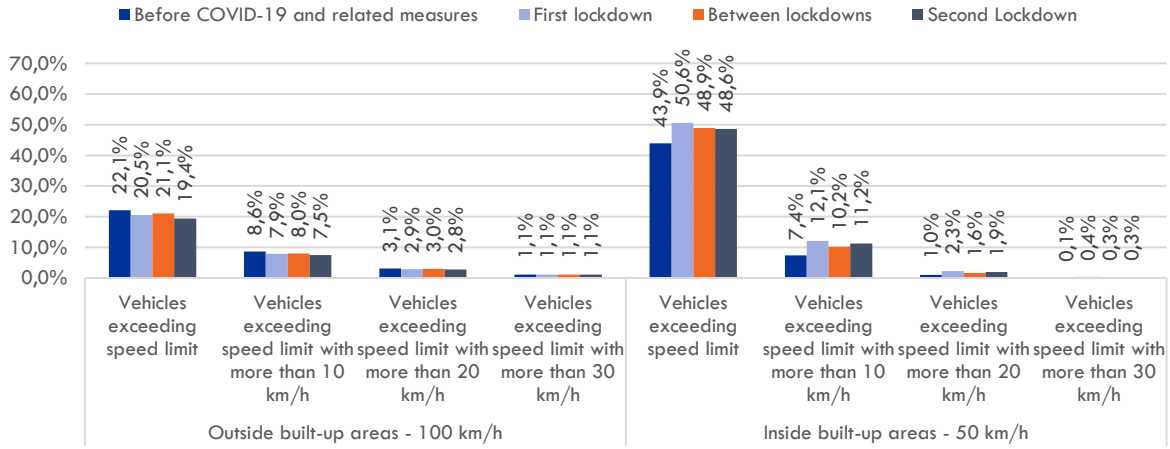


Figure 52 Share of vehicles exceeding the speed limit inside and outside built-up areas in different COVID-19 phases in Austria, n=3.6 million, Source: Kräutler, Robatsch & Soteropoulos 2021

For **Croatia**, data on the main accident causes of road fatalities and injuries in 2020 in comparison to 2019 indicate that, whereas the number of fatalities for which improper vehicle movement was the main cause of the accident decreased by 43% in 2020 compared to the average 2017-2019, the number of fatalities for which speed was the main cause of the accident increased by 16%. However, the number of fatalities for which the main accident cause was that the speed was not adapted to the road conditions decreased by 28%.

Table 22: Number of fatalities in Croatia 2020 by main accident cause in comparison to 2019

Main accident cause	Fatalities 2020	Change compared 2019
Speed not adapted to road conditions	84	-28%
Other driver errors	39	3%
Improper vehicle movement	23	-43%
Speed	22	16%
Pedestrian errors	19	-10%
Non-compliance with the right-of-way	16	-20%

For injuries however, for nearly all common main accident causes in Croatia reductions in injuries in 2020 compared to 2019 are observable. This is particularly the case for injuries for which improper vehicle movement was the main accident cause (-42%). In contrast, for injuries for which non-compliance with the right-of-way was the main cause a small increase (1%) in injuries is observable. For speed-related injuries, in contrast to speed-related fatalities – reductions in 2020 compared to 2019 are apparent.

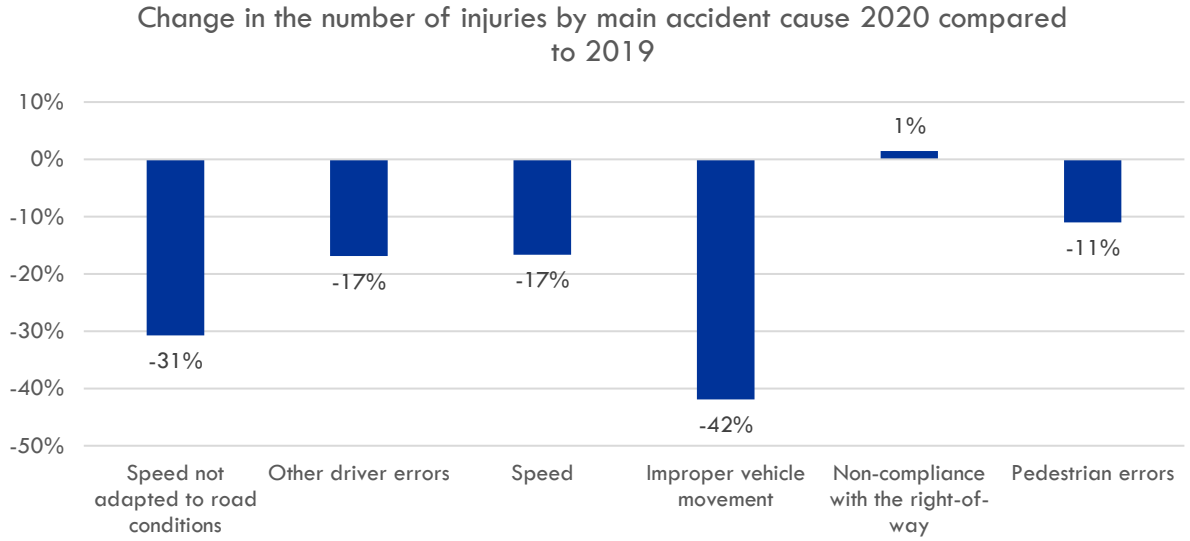


Figure 53 Change in the number of injuries by main accident cause 2020 compared to average 2019 in Croatia

In addition, data on changes in speeds in Croatia in 2020 in comparison to the average 2017-2019 based on speed measurements indicate an increase in average speed by 1.2% in 2020 compared to the average 2017-2019 and an increase in the 85-percentile speed by 0.7%.

Table 23 Change of Average speed and v85 for 2020 and the average 2017-2019 in Croatia based on speed measurements

	2020	average 2017-2019	**Change compared to average 2017-2019**
Average speed	69.6 km/h	68.8 km/h	1.2%
v85	80.6 km/h	80.0 km/h	0.7%

Furthermore, data on the changes in the number of traffic violations in Croatia in 2020 in comparison to the average 2017-2019 show that while the number of traffic violations with regard to driving under the influence of alcohol (-16%) and seatbelt use (-8%) decreased in 2020, the number of traffic violations with regard to distraction (+11%) and speeding (+3%) increased.

Table 24 Number of different types of traffic violations in Croatia 2020 and change compared to the average 2017-2019

Type of traffic violation	**Traffic violations 2020**	**Change compared to average 2017-2019**
Speeding	296,499	3%
Seatbelt use	72,704	-8%
Driving under the influence of alcohol	30,797	-16%
Distraction (mobile devices)	45,066	11%

For **Hungary**, the share of road fatalities for which inappropriate speed was the primary cause increased from 39.2% (average 2016-2019) to 41.5% in 2020. Increases are also observable

for the share of road fatalities for which errors while changing direction or turning was the primary cause (from 19.3% to 21.2%) or failure while overtaking (from 6.9% to 8.2%).

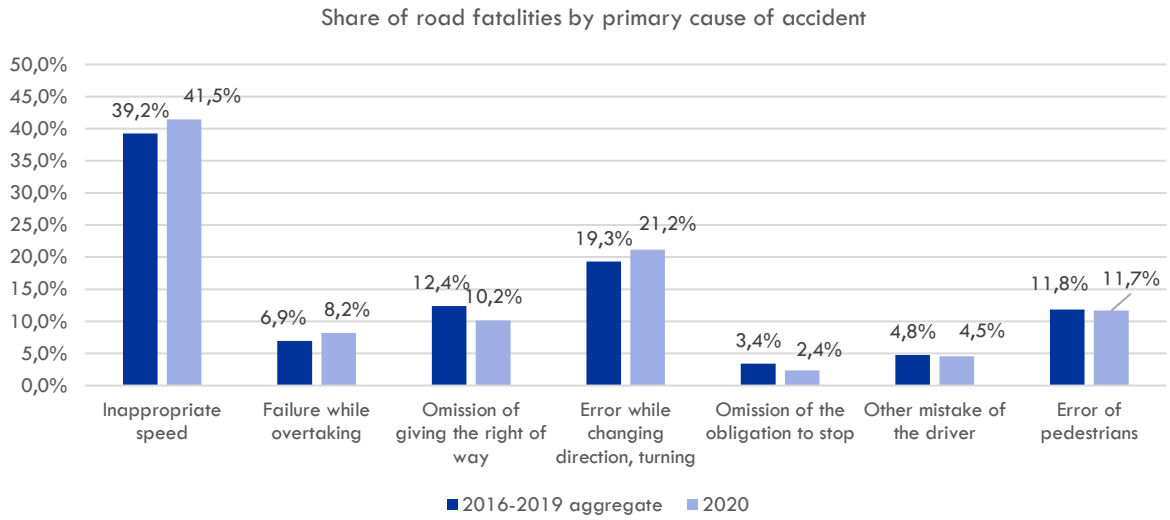


Figure 54: Share of road fatalities by primary cause of accident in 2020 in Hungary compared to the average 2016-2019

For serious injuries, similarly, an increase in the share of serious injuries for which inappropriate speed was the primary cause from 34.8% (average 2016-2019) to 38.8% in 2020 is apparent. This increase was even higher than the increase of the respective share of road fatalities. Regarding the shares for which other causes were the primary cause of accident, only minor changes or small reductions were noted.

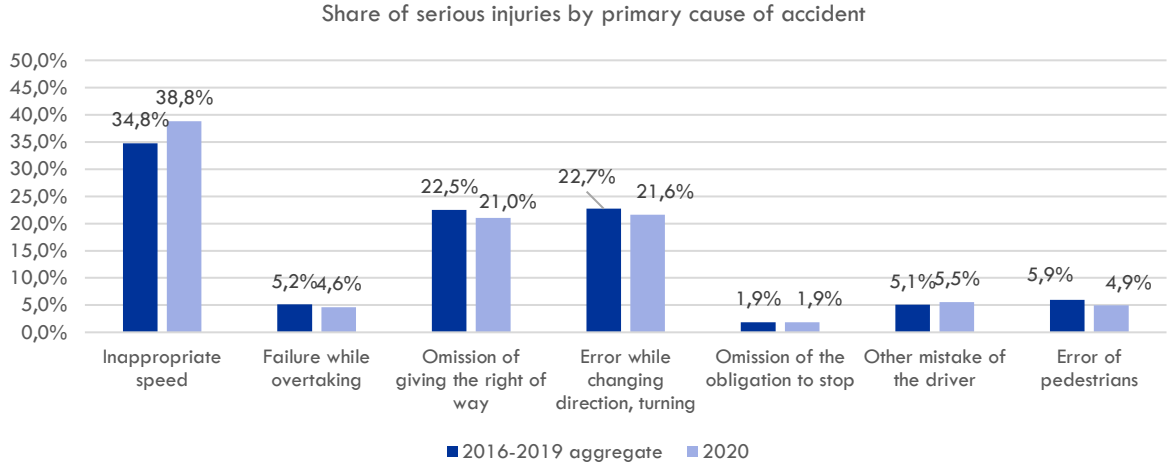


Figure 55: Share of serious injuries by primary cause of accident in 2020 in Hungary compared to the average 2016-2019

Based on data from speed measurements at two Hungarian motorways (M0 at the 28+255 km section and M7 at the 71+330 km section) during April and June 2020 in comparison with measurements from 2019, for M0 an increase in the average speed of passenger cars by 1-

3% compared to 2019 is indicated. For M7 also an increase by 1-2% compared to 2019 is apparent.

Regarding changes in the number of violations for speeding and driving under the influence of alcohol in Hungary, for both infringements reductions in 2020 compared to the years before are apparent.

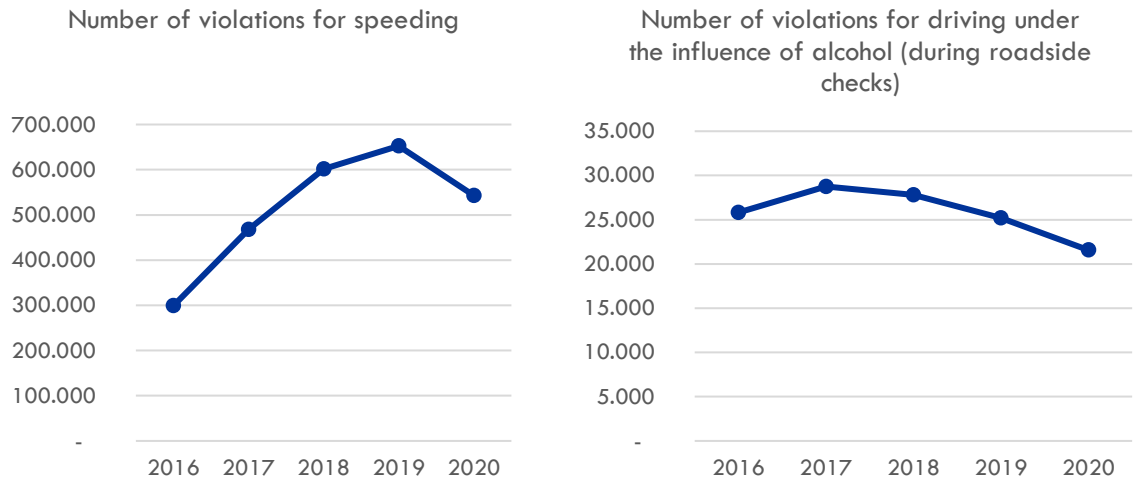


Figure 56: Development of the number of violations for speeding (left) and for driving under the influence of alcohol (right) in Hungary 2016-2020

For **Moldova,** data on the number of road fatalities by accident cause in 2020 in comparison to the average 2017-2019 shows that the highest reduction is observable for the number of fatalities for which distracted driving was the main cause (-58%), whereas reductions for fatalities for which drink driving was the main cause decreased by only 3%. The number of road fatalities in 2020 for which speeding was the main cause also decreased by 16% compared to the average 2017-2019.

Table 25 Number of fatalities in Moldova in 2020 and in comparison to the average 2017-2019 by main accident cause (5 main causes of road fatalities)

Main accident cause	Fatalities 2020	Change compared to average 2017-2019
Speeding	119	-16%
Drink driving	22	-3%
Pedestrians illegal crossing	20	-5%
Fail to offer priority to pedestrians	11	-25%
Distracted driving	8	-58%

Data on the change in the number of different types of registered traffic violations in Moldova in 2020 in comparison to the average 2017-2019 indicate higher reductions for drink driving (-20%) and for speeding (-19%). However, the number of mobile phone use violations in 2020 increased by 32% compared to the average 2017-2019.

Table 26 Number of different types of traffic violations in Moldova 2020 and change compared to the average 2017-2019

Type of traffic violation	Traffic violations 2020	Change compared to average 2017-2019
Drink driving	361	-20%
Speeding	104,762	-19%
Seatbelt	7,846	-10%
Mobile phone use	910	32%

However, based on speed measurements around schools during the COVID lockdowns, also an increase in operational vehicles speeds in Moldova was noted.

For the **Czech Republic** data on the main causes of fatal crashes in 2020 in comparison to 2019 indicate reductions in fatalities for all of the most common accident causes. However, the number of fatalities for which speeding was the main accident cause only decreased by 5%, whereas for fatalities related to other main accident causes like improper vehicle movement (-27%), overtaking (-26%) and right of way violation (-23%) considerably higher reductions are observable.

Table 27 Number of fatalities in the Czech Republic 2020 by main accident cause in comparison to 2019

Main accident cause	Fatalities 2020	Change compared to 2019
Speeding	179	-5%
Overtaking	23	-26%
Right of way violation	63	-23%
Improper vehicle movement	152	-27%

For **Slovenia**, data on the number of road fatalities by accident cause in 2020 in comparison to the average 2017-2019 for the three most frequent accident causes shows that the number speeding as the main cause decreased by 38%, wrong side or wrong direction of driving as the main cause increased by 9%.

Table 28 Number of fatalities in Slovenia in 2020 by main accident cause and in comparison to the average 2017-2019 (3 main causes of road fatalities)

Main accident cause	Fatalities 2020	Change compared to average 2017-2019
Wrong side / direction of driving	29	9%
Inadequate speed	27	-38%
Failure of give way	11	-13%

Harantová, Hájnik & Kalašová (2020) investigated the flow rate and speed of vehicles before and after the implementation of measures related to COVID-19 at two points of the first-class road I/11 in the **Kysucké Nové Mesto district in Slovakia.** Traffic flow and average speed of vehicles at these points were measured before (5th March 2020) and after (2nd April 2020)

the implemented measures due to COVID-19. Results indicate that average speed increased by about 42% (point 1) and 21% (point 2).

Vandoros & Papailias (2021) investigated motor vehicle collisions and speeding fines and fines related to driving under the influence of alcohol for **Northern Ireland** and found that there was a steep increase in speeding fines in May and June 2020 compared to the years 2017, 2018 and 2019. However, they mention that this could be a result of both increased speeding traffic violations and a greater police crackdown because of more speeding-related accidents. Regarding alcohol and drug violations, no relative increase compared to the years before is observable.

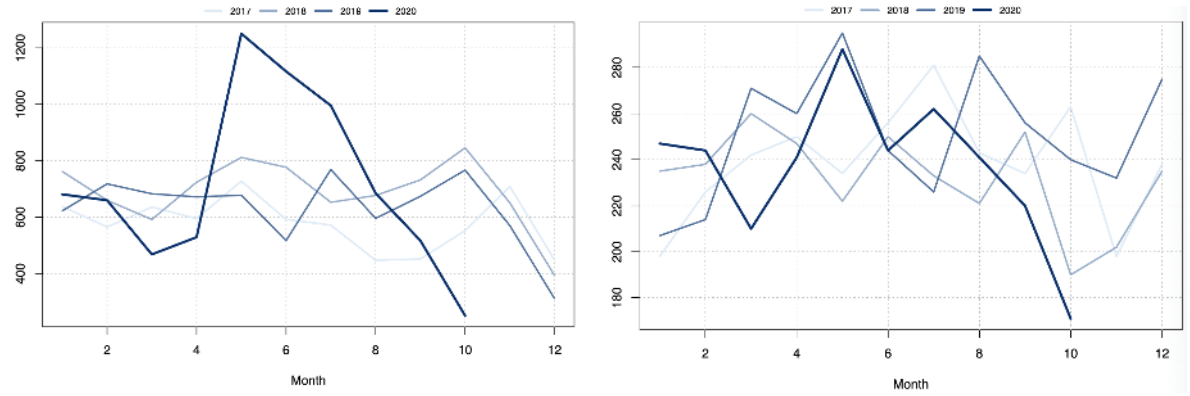
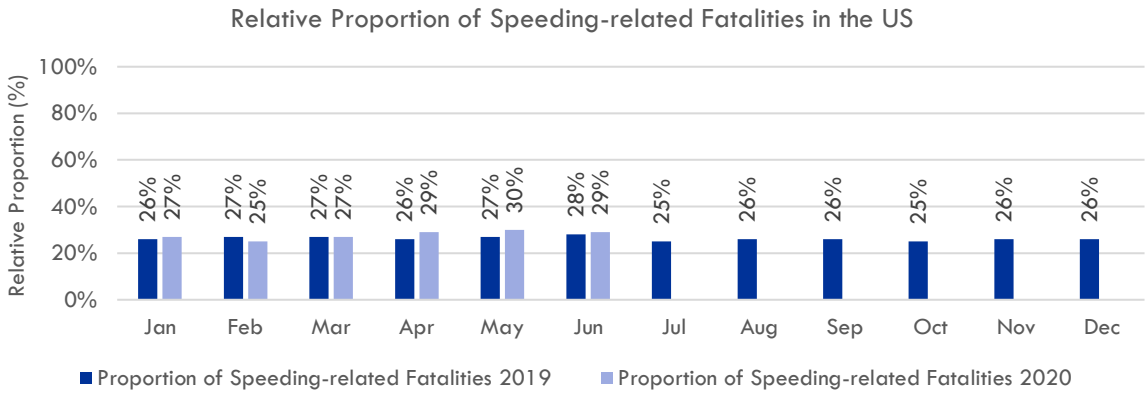


Figure 57 Monthly number of fines for speeding (left) and driving under the influence of alcohol or drugs (right) in Northern Ireland 2017-2020, Source: Vandoros & Papailias 2021

NHTSA (2020b) investigated the fatal crashes during the COVID-19 pandemic between March and June 2020 in the **USA** in greater detail and compared it with the fatal crashes of the same period in 2019. Results indicate that the share of speeding-related fatalities (proportion of all fatalities) for April to June 2020 was higher than for the same period 2019, with the largest increase in April (29% in 2020 versus 26% in 2019) and May (30% in 2020 versus 27% in 2019). In addition, passenger vehicle unrestrained occupant fatalities as a proportion of all passenger vehicle occupant fatalities increased during March to June 2020 compared to the same period 2019 with the largest increase in April (56% in 2020 versus 45% in 2019) and May (52% in 2020 versus 45% in 2019).



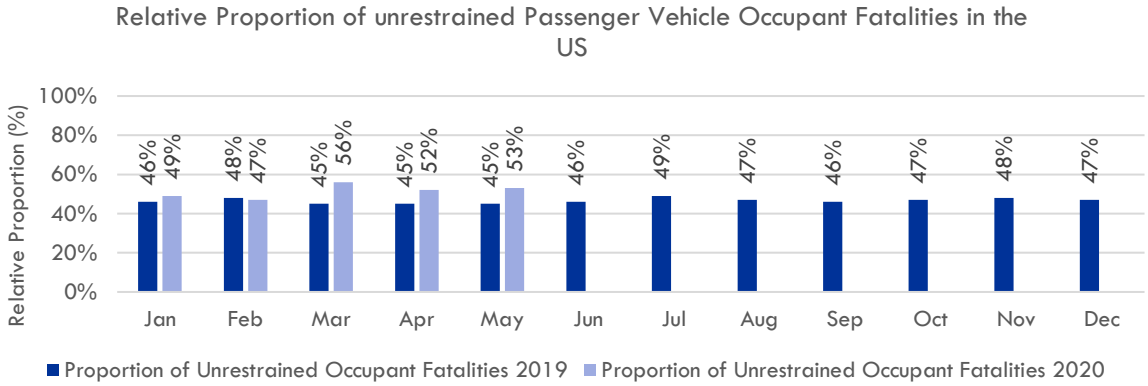


Figure 58 Relative proportion of speeding-related fatalities (above) and relative proportion of unrestrained passenger vehicle occupant fatalities (below) in the USA 2019 and 2020, Source: NHTSA 2020b

For **California**, the Economist (2021) investigated the impacts of COVID-19 and related measures on traffic collisions and deaths involving alcohol and drugs, not wearing a seatbelt, speeding and failing to stop at a signal, by analysing the development of the share of the respective collisions and deaths of all collisions and deaths over the years 2015 to 2020. They report that even as collisions declined overall in 2020 compared to 2019 (by 24%), the share of collisions involving alcohol and drugs, the share of collisions involving not wearing a seatbelt and the share of collisions failing to stop at a signal of all traffic collisions increased in 2020 compared to the years before. The same applies to the share of speeding-related deaths, which rose by 23%, a greater increase than in other types of crashes.

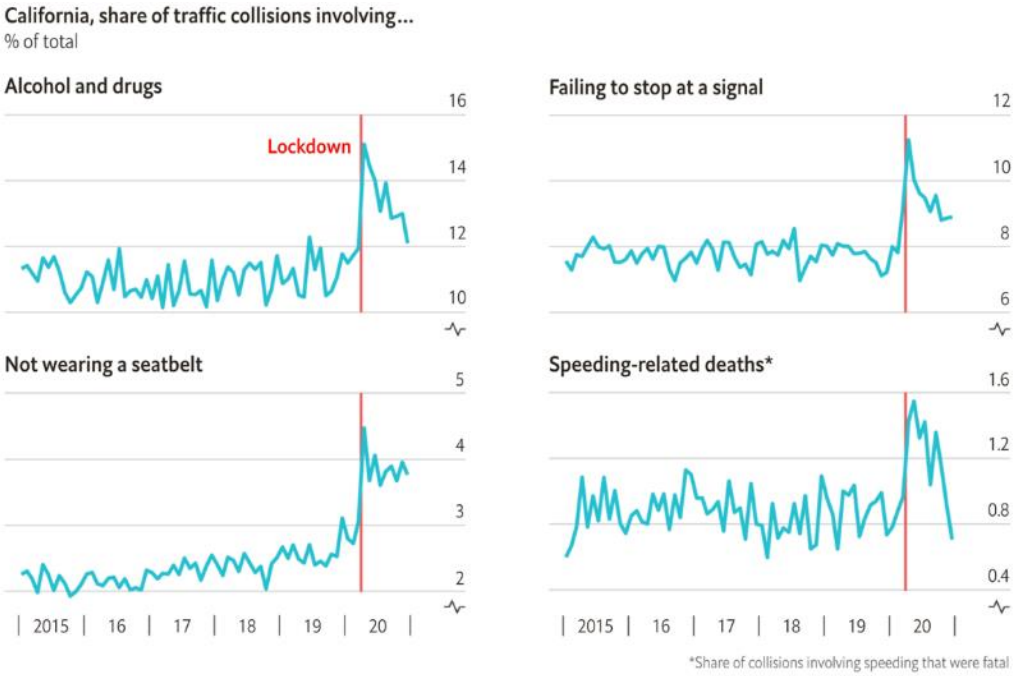


Figure 59 Development of the share of traffic collisions/deaths involving alcohol and drugs, failing to stop at a signal, not wearing a seatbelt and speeding in California 2015 to 2020, Source: The Economist 2021

For the **Netherlands,** Donkers (2021) analysed the effects of the COVID-19 related night-time curfew between 21:00 to 04:30 implemented from the government at the 23.01.2020 on the speeds of vehicles (based on Floating Car Data from HERE) and accidents in the period January to March 2021 compared to the average of the same period 2017-2019.

Results for the speeds of vehicles on different types of roads, i.e., highways and lower road functions (e.g. area access roads and access roads), indicate that the speeds rise in the last minute and hour before the curfew starts, especially at the lower road functions.

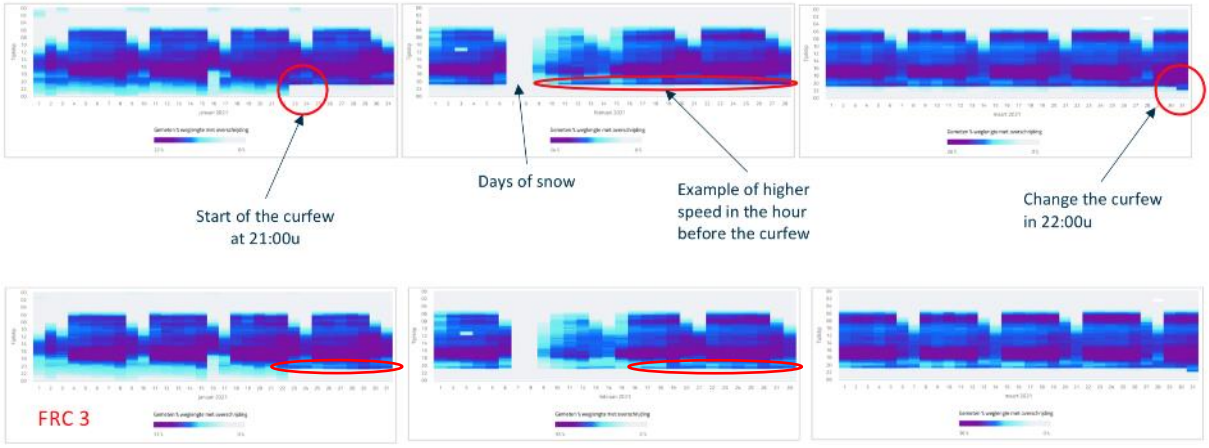


Figure 60 Speed profile of highways, area access roads and access roads (above) and of area access roads alone (below) between January and March 2021 in the Netherlands, Source: Donkers 2021

With regard to the number of accidents and victims, it is observable that the numbers of accidents were lower in the period January to March 2020 compared to the average of the same period 2017-2019. However, the hour before the curfew, i.e., 20:00 to 21:00, is an exception. Similar is true for the number of victims. Overall, results indicate that people were speeding home quickly to get home in time for the curfew, which increased the number of accidents, but especially the number of victims and created a higher risk of being a victim involved in the accident.

Figure 61 Number of accidents (left) and number of victims (right) by hour of day between 23rd January and 31st March 2020 compared to the average of the same period 2017-2019 in the Netherlands, Source: Donkers 2021

Using Floating Car Data and anonymous speed records collected by navigation systems and smartphones, Donkers & Broos (2021) investigated the share of speed limit offenders and the degree of limit exceedance of the v_{85} for all months in 2020 at arterial and collector roads in the Netherlands. Results indicate a higher share of speed limit offenders and a higher degree of limit exceedance of the v_{85} during the first wave of the COVID-19 pandemic in March and April 2020. During the summer months, after relaxations of the COVID-19 measures, the share of speed limit offenders and the degree of limit exceedance of the v_{85} decreased. For the period of the second (partly) lockdown in October to December 2020 however, no similar trend as during the first lockdown was observable and both the share of speed limit offenders and the degree of limit exceedance of the v_{85} decreased. In this regard, the authors argue that traffic intensity on arterial and collector roads during the second lockdown was higher (and mostly at their maximum capacity) than during the second lockdown and therefore possibilities for speeding were limited.

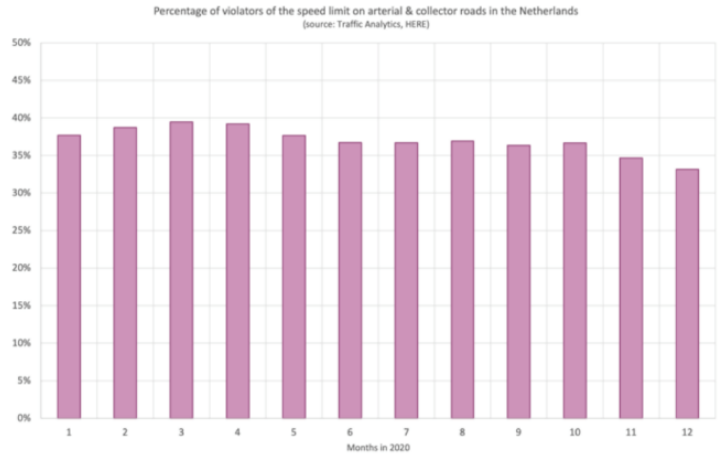


Figure 62 Percentage of violators of the speed limit on arterial & collector roads in the Netherlands 2020, Source: Donkers & Broos 2021

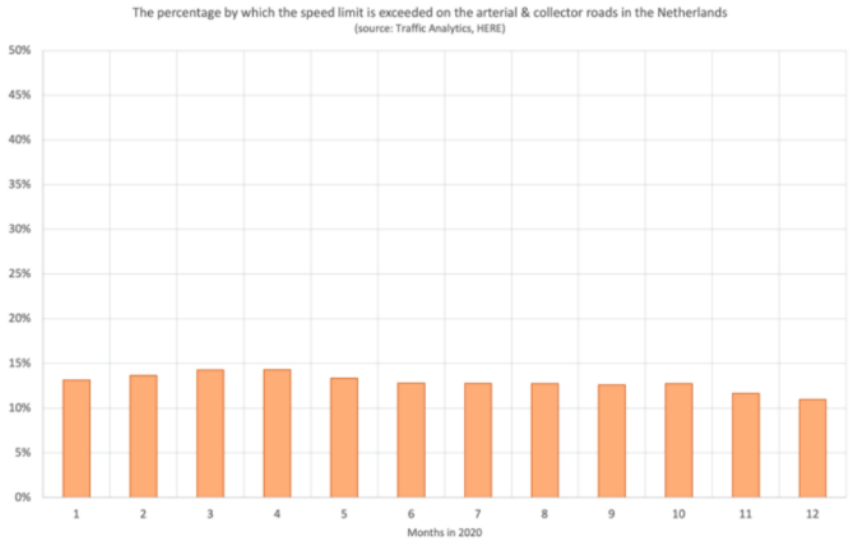


Figure 63 Percentage by which the speed limit is exceeded (degree of limit exceedance of the v_{85}) on arterial & collector roads in the Netherlands 2020, Source: Donkers & Broos 2021

For **Germany**, the German Federal Statistical Office (2021g) investigated the driver-related cause of accidents involving personal injury for 2020 compared to 2019. Results indicate that while overall the number of driver-related causes of accidents involving personal injury decreased in 2020 compared to 2019, the shares of the causes inappropriate speed, improper road use, influence of alcohol and overtaking mistakes increased slightly in 2020 compared to 2019, whereas the shares of causes like failure to yield right of way or insufficient distance decreased.

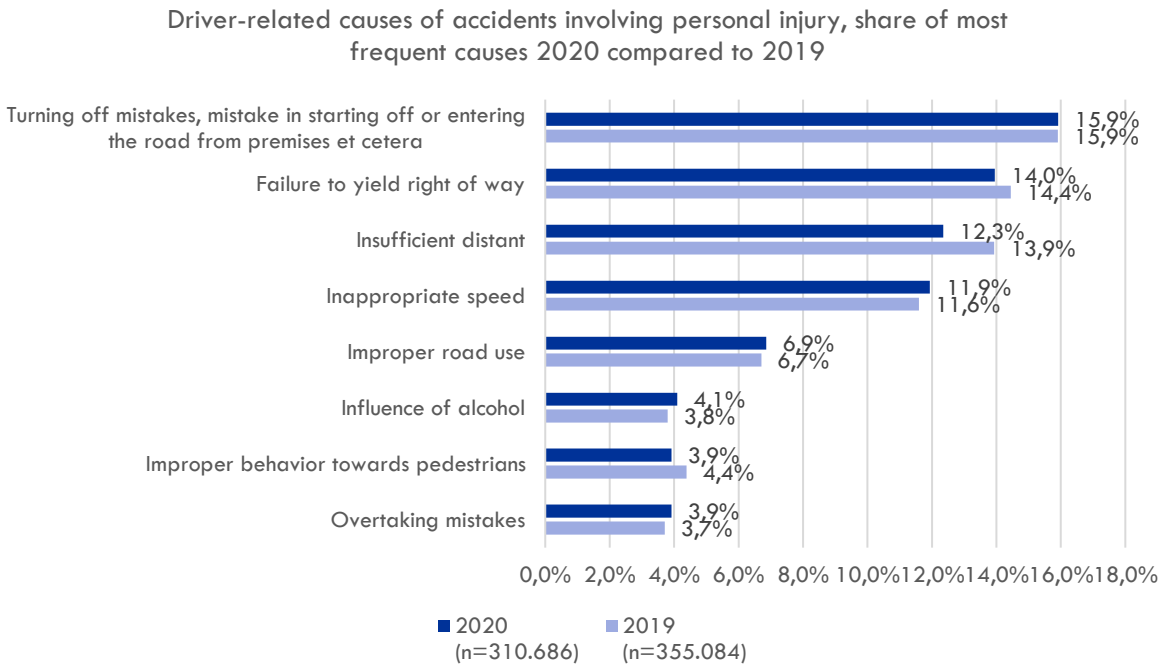


Figure 64 Shares of most frequent driver-related causes of accidents involving personal injury 2020 compared to 2019 in Germany, Source: German Federal Statistical Office 2021g

For **Switzerland,** the Swiss Federal Roads Office (2021) investigated the shares of fatalities and severe injuries by accident cause in 2020 compared to the average 2017-2019. For fatalities, a higher share of the number of fatalities caused by *speeding/inappropriate speed* was noted for 2020 (18.1%) compared to the average 2017-2019 (15.4%) – similar was also true for *distraction* (11.5% / 8.6%). With respect to severe injuries, an increase in the share due to *alcohol*, *speeding/inappropriate speed* and *distraction* in 2020 compared to the average 2017-2019 are observable, with higher increases for alcohol (10.6% in 2020 compared to 9.2% for the average 2017-2019) and speeding/inappropriate speed (12.3% in 2020 compared to 11.2% for the average 2017-2019).

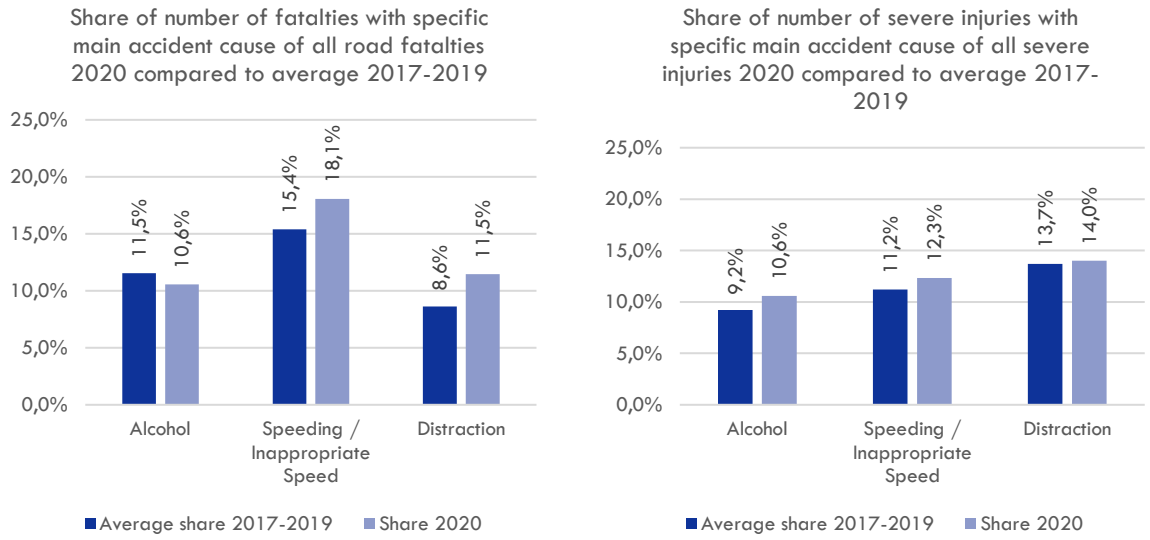


Figure 65 Share of the number of fatalities (left) and the number of severe injuries (right) with specific main accident cause of all road fatalities/ severe injuries 2020 compared to the average 2017-2020 in Switzerland, Source: Swiss Federal Roads Office – ASTRA 2021

Valentová (2021) investigated the share of drivers using the mobile phone while driving in the **Czech Republic** during the period 2014 to 2020 and reports a slight decrease from 2.9% in 2019 to 2.2% in 2020. In addition, also the number of offences for driving while using a mobile phone decreased in 2020 compared to 2019 (for both men and women).

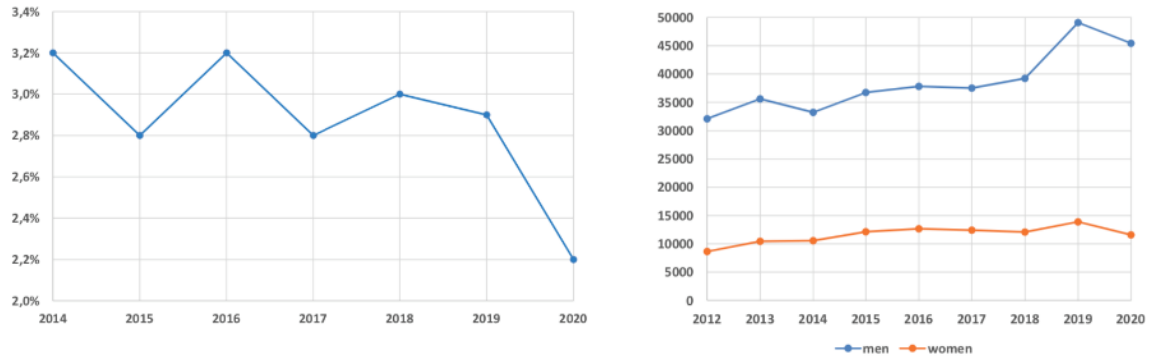


Figure 66 Development of the share of drivers using the mobile phone while driving (left) and number of offences for driving while using a mobile phone for men and women (right) in the Czech Republic, Source: Valentová 2021

Watson-Brown et al. (2021) investigated the effect of the COVID-19 pandemic and respective measures including a temporary suspension of static roadside random breath testing on the occurrence of drink driving in **Queensland**, **Australia** using three surveys with 1,193 drivers. Results indicate that overall drink driving decreased over the three survey periods due to community restrictions on socializing and travel behaviours. However, it was found that young males on restricted licenses, who are typically a high-risk cohort for such behaviours, were the more likely group of drivers to drink & drive during restrictions.

Shilling & Waetjen (2020) investigated the crash occurrence before and after the first lockdown, i.e., the *shelter in place* order in March and April 2020 in **California**, **USA**, and analysed changes in traffic speeds on highways and interstates. Results indicate a reduction of total collisions and injury/fatal accidents by about 50%. Regarding peak and average speed changes on highways and interstates, there were only small increases in peak speed and small, yet statistically significant increases in average traffic speed of about 1 to 4 mph when compared to prior the shelter-in-place-order.

Woods-Fry et al. (2020) conducted an online survey with a random, representative sample of 1,501 drivers aged 21 years or older for the **USA** and investigated the effects of the COVID-19 pandemic on risky driving behaviours. Within the survey, respondents were asked about various self-reported unsafe driving behaviours including alcohol-impaired driving, speeding, distracted driving, drug-impaired driving and restraint use, i.e., they were asked how likely they were to engage in these risky behaviours during the COVID-19 pandemic compared to their typical behaviour before the pandemic. Results indicate that the majority of drivers had not changed their behaviour and a smaller proportion of drivers also took fewer risks on the road during the pandemic. However, a notable proportion of drivers indicated that they were more likely to engage in risky behaviours during the pandemic than before: 7.6% of drivers indicated they were more likely to drive within 2 hours of consuming alcohol, and an equal proportion (7.6%) of drivers admitted to excessively speeding during the pandemic. 7.1% of drivers were more likely to not wear a seatbelt, 6.8% of drivers reported they were more likely to drive distracted, and 6.2% of drivers were more likely to drive within 2 hours of using drugs.

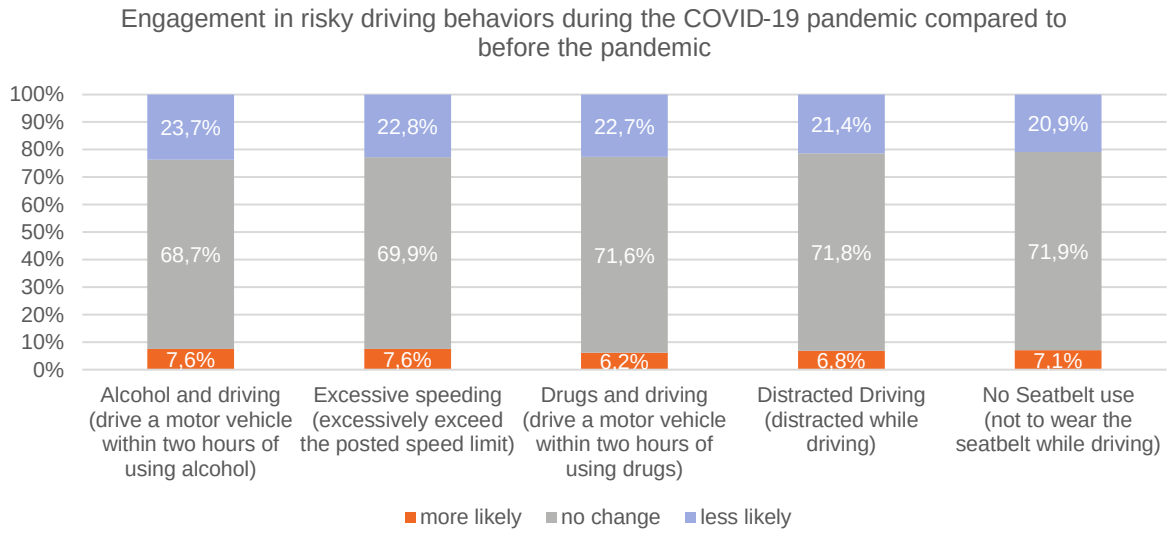


Figure 67 Engagement in risky driving behaviours during the COVID-19 pandemic compared to before the pandemic in the USA, n=1,501, Source: Woods-Fry et al. (2020)

The same survey was conducted also with 1,500 participants from **Canada** by Vanlaar et al. (2021). In comparison to the survey results for the USA, results for the Canadian participants mostly show lower proportions of drivers indicating that they were more likely to engage in risky behaviours during the pandemic than before. However, the only exception is excessive speeding: 5.5% of Canadian drivers indicated they were more likely to excessively exceed the posted speed limit during the pandemic than before.

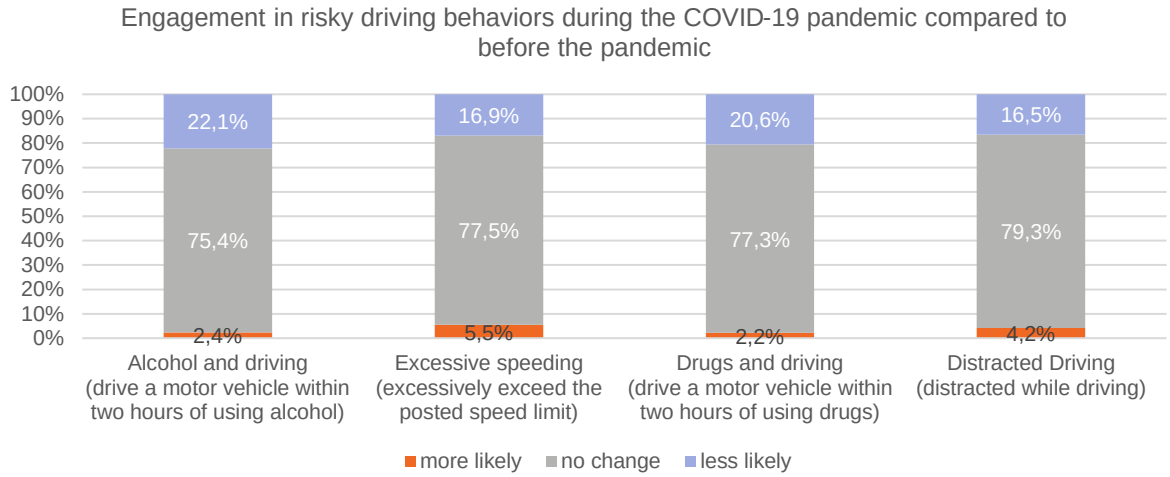


Figure 68 Engagement in risky driving behaviours during the COVID-19 pandemic compared to before the pandemic in Canada, n=1,500, Source: Vanlaar et al. (2021)

Summary of effects on risky driving behaviour

- Especially during the first wave of the pandemic in March and April 2020 an **increase of speeds** of vehicles was observable in countries in Europe (e.g. Greece, Austria, Slovakia), in North America (e.g. Canada, USA) and Asia (e.g. Japan).

- For **mean speeds**, overall, only **small increases** were observable in most countries (e.g. USA, Slovakia, Croatia), but results for Austria and the Netherlands indicate that the proportion of speeders and in particular **extensive speeders** with significant higher speeds **increased**. Speeding seems to have increased in particular before the beginning of the COVID-19 related curfews (e.g. in the Netherlands), as people were speeding home quickly to get home in time, which also increased the number of casualties during this time. In addition, the number of speed violations / speeding fines (e.g. in Canada, Northern Ireland and Croatia) but also the **share of speeding-related fatalities** (e.g. USA, Austria, Switzerland and Hungary), speeding-related serious injuries (e.g. Hungary) and speeding-related accidents involving personal injury (e.g. Germany) increased - or decreased less than for other accident causes (e.g. in the Czech Republic). However, also noticeable reductions in the share of speeding-related fatalities (e.g. in Moldova and Slovenia) were noted.

- Another risky driving behaviour that seems to have increased during the COVID-19 pandemic is **not wearing the seat belt** while driving: in the USA, the share of passenger vehicle unrestrained occupant fatalities experienced a considerable increase during March to June 2020 in comparison to the same period 2019 and also survey results indicate that some drivers were more likely not to wear a seat belt. However, for Croatia and Moldova also reductions in violations with regard to seatbelt use were observed.

- Regarding **drink driving**, data on traffic violations but also accident statistics and surveys indicate that there tends to be only a slightly influence of COVID-19. For some regions and countries, drink driving rather decreased during the first wave of the pandemic (e.g. Queensland, Australia) or for the whole year 2020 compared to previous years (e.g. in the Moldova and Hungary), whereas in other regions a (slight) increase of the share of collisions (e.g. Germany, California, USA) or severe injuries (e.g. Switzerland) due to drink driving was noted – however, for Switzerland and Moldova the share of the number of fatalities in which alcohol was the main cause decreased. Survey results also suggest that especially some drivers (presumable **young males** on restricted licenses), were **more likely** to drink & drive than before the pandemic.

- For driving while **distracted**, e.g. using a mobile phone while driving, although increases in mobile phone use were observed in some countries (e.g. Greece) and in surveys a small share of drivers reported that they were more likely to drive distracted, results on the share of fatalities related to distracted driving (e.g. for Austria and Moldova) but also on the number of offences for using handheld mobile phones while driving (e.g. for the Czech Republic) **do not seem to indicate a particular increase** of this specific risky driving behaviour during the pandemic. However, effects seem to be mixed as results for Switzerland indicate a (slight) increase in the share of the number of fatalities and severe injuries in which distraction was the main accident cause and also for Moldova and Croatia increases in the number of violations for distracted driving/ mobile phone use were noted.

3. Conclusions and recommendations

This review of available international literature on the impacts of COVID-19 on mobility, behaviour and safety served as a working document for the respective RADAR RSEG group meeting in May 2021, dealing with RADAR's Thematic Areas "TA5- Transport safety and COVID-19". Some of the current observations in the aftermath of the COVID-19 pandemic – at least for some countries – are as follows[1]:

- the number of road crashes and fatalities as well as mobility, transport volumes and the number and distance of trips decreased; occasionally, an increase of shorter trips was noted.
- the number of injuries was reduced at similar rates as kilometres driven.
- the number of fatalities was reduced less than the reduction rate of kilometres driven (hence fatality risk increased); some countries even reported an increase of fatalities on rural roads.
- a comparatively higher share of vulnerable road user travel was noted on the urban and suburban system, and the number of cyclist (but usually not pedestrian) fatalities partly increased.
- after the first lockdown, the use of public transport did not recover as fast as other transport modes.
- the impact of the 2nd lockdown on mobility was less severe than the 1st.
- average driving speeds increased slightly – whereas the share of extensive speed violations increased more substantially.
- the share of inadequate speed as prime causal crash factor increased, especially for fatal crashes.
- the share of killed car occupants not using the seatbelt increased.
- for alcohol and distraction as primary crash causes, little change was noted.

It therefore appears timely and necessary for the restoring and further decreasing of road risk levels in the Danube Area to bring forward a set of recommendations targeted at decision-makers and stakeholders at various levels in the individual countries: at national and regional level as well as in the respective road authorities.

The set of recommendations hereunder will also inform the Danube Infrastructure Road Safety Improvement Strategy (DIRSIS) and the country-specific Danube Infrastructure Road Safety Improvement Action Plans (DIRSIAP) while avoiding repeating advice already given in earlier TA Reports.

[1] The report will be further refined with information and data from the Danube Area, collected through a questionnaire sent out to RSEG members ahead of the meeting in May 2021.

RADAR project Thematic Area 5 (TA5): Transport Safety and COVID-19

RECOMMENDATIONS SHEET

Recommendations for state governments/ministries/agencies:

- *to review the default speed limit for rural roads and consider adaptations where necessary (possibly only on sub-sets of the network, e.g. roads with narrow cross-sections, or roads with vulnerable road user traffic), with a view to preventing collision forces that humans cannot survive or would cause serious injury.*
- *to take gradual steps to implement a Safe System, with emphasis on rural roads, so that they eventually become self-explaining and forgiving to human error.*
- *to provide police forces and other enforcement entities with adequate resources and legal precautions for re-instated & intensified and effective speed enforcement; this may include section (average speed) controls – also on rural roads*
- *to consider tougher legal sanctions for excessive speed violations, such as higher/ income-dependent fines, licence withdrawal, and confiscation of vehicles.*
- *to encourage the use of seatbelts in passenger cars through awareness and enforcement measures.*

Recommendations for local governments:

- *to put high priority on enforcement and educational & awareness-raising activity to curb inappropriate speeds.*
- *To consider the implementation of local safe zones (30 km/h) around educational and medical institutions, area-wide 30 km/h limits in urban areas (potentially excluding major urban thoroughfares) and other traffic calming measures*
- *to help making the increased usage levels of active mobility (walking, cycling) sustainable by providing them with safe facilities and an adequate share of road space.*
- *to set the necessary promotive steps to re-establish the modal share of public transport – by far the safest and most sustainable transport mode – at least to pre-pandemic levels.*

Recommendations for road authorities:

- *to establish an evidence base to prioritise infrastructure investments based on safety indicators: crash locations, traffic flows, speed levels, road infrastructure design & safety data.*
- *to make sure that for each road construction, reconstruction or maintenance project, the implementation of Safe System principles is considered.*

Your Road Safety is on our RADAR.

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