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Transportation Research Procedia 00 (2022) 000–000

Transportation Research Procedia

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Transport Research Arena (TRA) Conference

Was average speed affected by the COVID-19 response measures? Findings from Athens, Greece

Eva Michelaraki[a]*, Christos Katrakazas[a], Marios Sekadakis[a], Antonis Chaziris[a], George Yannis[a]

[a]*National Technical University of Athens, Department of Transportation Planning and Engineering, 5 Heroon Polytechniou str., GR-15773, Athens, Greece*

Abstract

In the unprecedented year of 2020, the rapid spread of COVID-19 disrupted everyday activities worldwide, leading the majority of countries to impose lockdowns and confine citizens to minimize the exponential increase in cases and casualties. The aim of this study is to present a descriptive overview of average driving speed and road crash data in correlation with the COVID-19 pandemic in Athens, Greece. Results indicated that during the lockdown periods, average speeds were increased by up to 8%, compared to the period with no restrictions. The imposition of another lockdown caused significant changes in Greek driving behavior, which was also depicted in the 37% increase on the road crashes. Policymakers should focus on the reduction and enforcement of speed limits, especially within urban areas as well as the reallocation of road space to cyclists and walkers in urban areas.

Peer-review under responsibility of the scientific committee of the Transport Research Arena (TRA) Conference

Keywords: COVID-19 pandemic; response measures; average speed; road crashes; Athens; Greece.

1. Introduction

In the year 2020, the COVID-19 pandemic dominated every aspect of life globally by infecting around 100 million individuals and leading to more than 2 million casualties (Dong et al., 2020). When the spread of the coronavirus started increasing around the world, the majority of governments chose to impose lockdowns as a means of restricting non-essential civilian movements, while all recreational or religious services as well as entertainment and cultural establishments were instructed to cease operations.

* Corresponding author. Tel.: +30-210-772-1265;
E-mail address: evamich@mail.ntua.gr

Peer-review under responsibility of the scientific committee of the Transport Research Arena (TRA) Conference

Athens is the largest city and capital of Greece as well as one of the oldest recorded cities in the world. The Municipality of Athens and surrounding municipalities constitute the metropolitan area of the Attica basin, which has a population of 664,046 people and an area of 38.96 km^2. Road infrastructure consists of 868 km with more than 400 signalized intersections. As COVID-19 swept across Europe, Greece started implementing nationwide response measures to contain the virus, including restrictions on all non-essential movements, cancelation of major public gatherings and lockdown measures.

During the year 2020, COVID-19 response measures varied from country to country according to the fluctuation of number of cases and patients in the available Intensive Care Units (ICUs). The harshness of the response measures has been captured by the stringency index introduced by Hale et al. (2020), which exploits information on several indicators of COVID-19 government responses and corresponds to the strictness of government policies on the matter.

The aforementioned reasons form the motivation for the current paper, which aims at providing a detailed overview of how COVID-19 affected average speed in Athens, while accounting for the cases and casualties of COVID-19 countermeasures. This paper employs descriptive statistical approaches to fulfil its aim, and it is the first of its kind to provide a detailed overview of driving speed data and monthly crash data for a long period in Athens. In order to fulfill this aim, a descriptive exploration of 16 months (i.e. from November 2020 to February 2022) of data regarding average speed was presented in order to understand the effect of the pandemic on driving behavior. Following the effect of the pandemic on driving behavior and road safety, policy recommendations are discussed, in order to pave the way for post-pandemic safer roads.

The paper is structured as follows: initially, the literature with regards to driving behavior and road safety during the pandemic is reviewed. This is followed by an overview of the data needed for the exploratory analysis. The main part of this paper is dedicated to depicting the changes in driving behavior during end-2020 and first-2022. Finally, the results are discussed and helpful conclusions for researchers and policymakers are also provided.

2. Literature review

In order to be able to provide an overview of the effect of COVID-19 response measures on average speed in Athens, the literature was reviewed for studies correlating the pandemic and driving behavior or road safety. To begin with, descriptive evidence from Greece and Saudi Arabia with regards to COVID-19 and driving behavior was conducted and a slight increase by 6–11% in average driving speed was observed (Katrakazas et al., 2020). When a lockdown was imposed, harsh events (i.e. accelerations and brakings) per 100km were more frequent by up to 12% when compared to normal operations (i.e. before the appearance of COVID-19 pandemic). Furthermore, a full time-series modelling approach was employed by Inada et al. (2020). Using a seasonal ARIMA model and data from January to May 2020, the authors concluded that the lockdown was the crucial factor for speed-related traffic violations, which consequently led to an increase of fatal road crashes. It was further demonstrated that speeding was increased by 52% in March 2020 compared to March 2019.

Stavrinos et al. (2020), using multi-level modelling, demonstrated that after the appearance of COVID-19 driving days per week decreased by 37%, while vehicle miles driven dropped by 35%. Nevertheless, the data utilized were concerned with self-reported driving behavior and as a result a bias existed. Similarly, Roe et al. (2021) investigated the effect of the pandemic on daily driving behavior of older adults before and after the onset of very rapid increase in the total number of U.S. COVID-19 cases. Results indicated that drivers reduced the proportion of days driven as well as the length of trips they took during the pandemic compared with the same time period during the previous year. Participants managed to drive slower with fewer speeding incidents and had different trip destinations. Thus, it was revealed that older adults reduced their driving behavior when faced with a pandemic.

Another interesting study (Katrakazas et al., 2021) revealed that the significant decrease in traffic volumes led to higher speeds and more frequent harsh braking events. More specifically, speeds were increased by 2.27 km/h on average compared to the forecasted evolution, while harsh braking/100 km increased to almost 1.51 on average. Furthermore, Tucker and Marsh (2021) found that lower traffic volumes led to a reduction of drivers' ability to perceive and control their speed. The results indicated that several changes in speeding behavior have been observed. In particular, the COVID-19 stay-at-home order in Connecticut was associated with a great increase in the percentage of cars engaged in extreme speeding (i.e. more than 20mph over the posted speed limit).

Michelaraki et al. (2021) explored the impact of COVID-19 pandemic on driving behavior and mobility patterns during 2020 in four countries, namely Greece, Saudi Arabia, Cyprus and Brazil. A descriptive exploration of 12-month timeframe of data was conducted and driving or walking traffic volumes, driving behavior indicators (i.e. speeding percentage, average driving speed, harsh accelerations/100km, harsh brakings/100km, total duration, driving duration) as well as road crashes were collected and analyzed. The results indicated that speeding percentage, average driving speed, and harsh events (except for Cyprus) were increased during the lockdown period. At the same time, a reduction in traffic volumes and the total number of people walking in each country was also observed.

Moreover, Vanlaar et al. (2021) investigated self-reported risky driving behaviors, such as speeding, distraction while driving, consumption of alcohol or drugs during the COVID-19 pandemic. The majority of respondents reported that their driving behavior did not change, and most positively, a small proportion revealed that they were less likely to engage in risky driving behaviors. However, it should be mentioned that notable proportions answered that they were more likely to engage in risky driving behaviors during the pandemic, as compared to the period before the appearance of COVID-19.

In terms of road safety, the number of road crashes, injuries, and fatalities has fallen dramatically during the COVID-19 lockdown measures, particularly during the first lockdown phase. In Greece and Spain, a sharp decrease in traffic crashes, fatalities and injuries was revealed (Saladié et al., 2020; Sekadakis et al., 2021). Similarly, Carter (2020) indicated that during the COVID-19 lockdown period (i.e. from March 15, 2020 to May 16, 2020), road crashes and fatalities in North Carolina were decreased by 50% and 10%, respectively, while serious injuries were increased by 6%, compared to pre-lockdown baseline. However, on the contrary to the reduction of road crashes, another study indicated that the fatality and injury rate in Greece was increased during the same period (Sekadakis et al., 2021).

With regards to traffic exposure studies, descriptive results were presented in Saladié et al. (2020). In particular, the reduction in road crashes in the province of Tarragona was presented by comparing frequency of crashes and checking statistical significance using a chi-square test on weekdays and weekends as well as different road types. A large reduction in crashes (74% compared to February of 2020; 76% compared to 2019) was observed and was associated with the overall reduction of traffic volumes.

3. Data collection

To achieve the aim of this study, traffic data for a 16-month period from several major arterials in Athens were collected and processed. The 16-month period was considered, from 05/11/2020 to 28/02/2022. Traffic data were extracted from the Traffic Management Centre (TMC) of Athens for Kifisias, Kallirois, Alexandras, Stadiou and Mesogeion avenues. For the analysis, descriptive statistics were implemented. In order to be able to provide a holistic overview of the COVID-19 impact on average driving speed, exposure data related to road crashes were also extracted which were delivered from the Hellenic Statistical Authority (Hellenic Statistical Authority, 2022).

The main apparatus of the Traffic Management Centre consists of 576 measuring stations. In addition, 75% of these measuring stations correspond to single inductive loops and 25% of these correspond to Video-Detection loops, 210 CCTV control cameras, 24 Variable Message Signs (VMS) and connection with 850 traffic controllers.

Immediate and advance warning messages involve messages providing information to drivers about programmed (e.g. road closures, maintenance works) or unexpected incidents (e.g. broken-down vehicles, crashes). Travel-time information messages involve messages providing information to drivers about the time needed to reach specific destinations and possible traffic congestion in neighboring road sections. Public announcement messages involve messages, which do not provide any kind of traffic information to drivers, but are “soft” messages, which are used in special events such as public holidays.

For the estimation of travel times (which are displayed in case of Travel-Time Information messages), each route is split into several road sections which are identified either by the existence of critical traffic lights (in case of urban roads with signalized intersections) or by the existence of significant traffic or geometrical changes (in case of highways). Hence, in the case of urban roads with signalized intersections the identification of the critical traffic lights is of vital importance for the accuracy of the travel times’ estimation (Sermpis and Kefallinos, 2011).

The estimation of average vehicle speed for each road section was made by the use of algorithms which take into account the collected traffic data of traffic flow and also several traffic and signalization characteristics (Sermpis et al, 2006). More specifically, the travel time for each road section consists of three parts, namely; the time needed for

a vehicle to travel through the uncongested part of the road section, the time needed to travel through the congested part of the road section and the time needed to wait for the green indication. Hence, the most crucial factor is the estimation of the queue length, which splits the road section length into its congested part and its uncongested part (Sermpis and Kefallinos, 2010).

4. Methodology

In order to provide a 16-month overview of the impact of COVID-19, average speed data were presented descriptively so as to identify critical changes throughout end-2020 up to first-2022 (i.e. from November 2020 to February 2022). Comparisons were made with regards to the lockdown periods as well as periods with restrictions between the lockdown states. In addition, explanatory figures were provided in order to depict the status of driving behavior and road safety indicators in relation with COVID-19 cases and casualties.

It should be noted that Greece, and therefore Athens, put in place several measures and restrictions on movement and business activity from early-November 2020. More specifically, primary schools and special schools initially remained open, while middle and high schools switched to distance learning. On mid-November 2020, primary schools and kindergartens closed and then they switched to distance learning.

On December 2020, shops (utilizing the click away method) as well as other facilities were allowed to open, while schools and restaurants remained closed. At the end of 2020, there were nearly 140,000 cases and about 4,800 deaths in the country. On January 2021, all the measures lifted or relaxed, citing the opening of schools as reason for these measures. On February 2021, Attica was again placed in lockdown with the closure of lower schools (i.e. high schools had already been closed since early November) and retail outlets, but virus cases continued their rapid growth.

Local lockdowns were imposed in more and more local districts. On March 2021, new measures were taken, including placing all of Greece in the highest level of measures. Approximately half of the prefectures were in the deep red level (full closure of all schools and retail outlets). On early-May 2021, the lockdown ended and measures eased, and on mid-May, Greece, including islands, opened for tourists from several countries.

5. Results

5.1 Average driving speed

During the lockdown period (i.e. November-December 2020) in Athens, an overall increase in average speed by up to 8% in several major arterials in Athens was identified compared to the period after, even when the restrictions of non-essential movements were dropped. When the restrictions on non-essential movements were gradually lifted, the average speed gradually began to raise (especially in February and March 2021), but with more vehicles on city streets, drivers managed to reduce their overall average speed. Figure 1 shows evidence of average speed, especially, during and after the lockdown periods in Athens.

As shown in Figure 1, the COVID-19 pandemic has had a great impact on average driving speed. When a decrease in driving traffic volumes was observed, drivers in Athens tended to increase their average driving speed. After the end of the lockdown period (from November to December 2020), a 7% and 9% drop in average driving speed was identified in the avenue “Kifisias to Kifisia” and “Kifisias to Center”, respectively. Additionally, the second wave of COVID-19 pandemic led to a 9% decrease in average driving speed in Kallirois avenue, compared to after lockdown restrictions period. Interestingly, a significant 15% reduction in average driving speed in Stadiou avenue was observed compared to the lockdown period. What’s more, an 8% and 5% drop in average driving speed was found in the avenue “Alexandras to L. Kifisias” and “Alexandras to Center”, respectively. Lastly, when Athens began to gradually lift restrictions on movement and restart business activities, average driving speed was decreased by 5% and 4% in the avenue “Mesogeion to Ag. Paraskeui” and “Mesogeion to Center”, respectively.

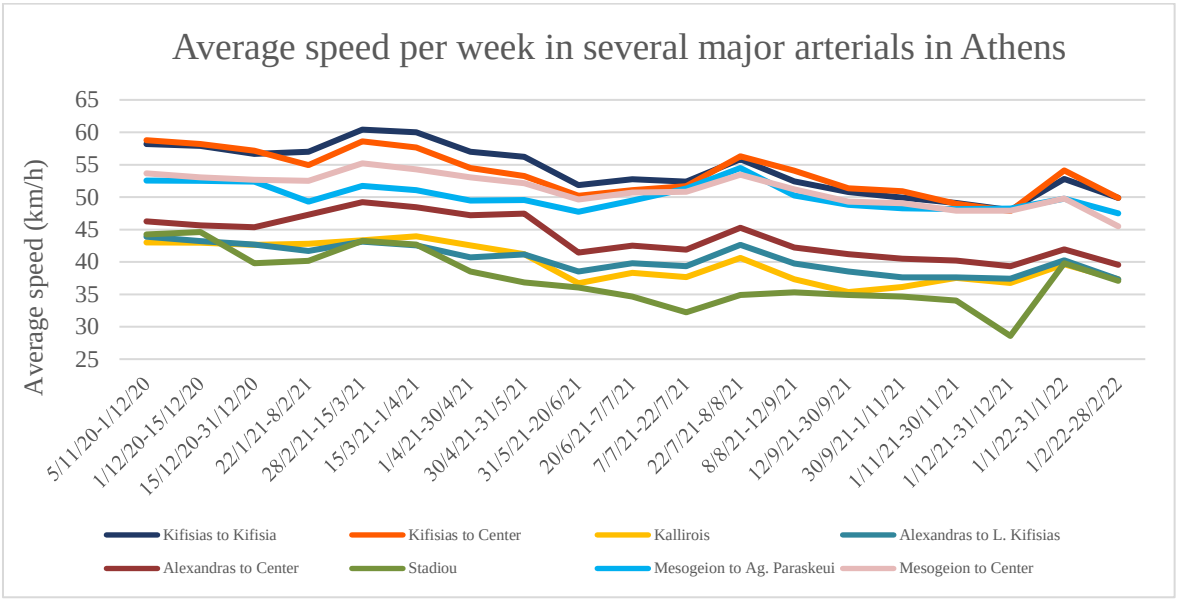
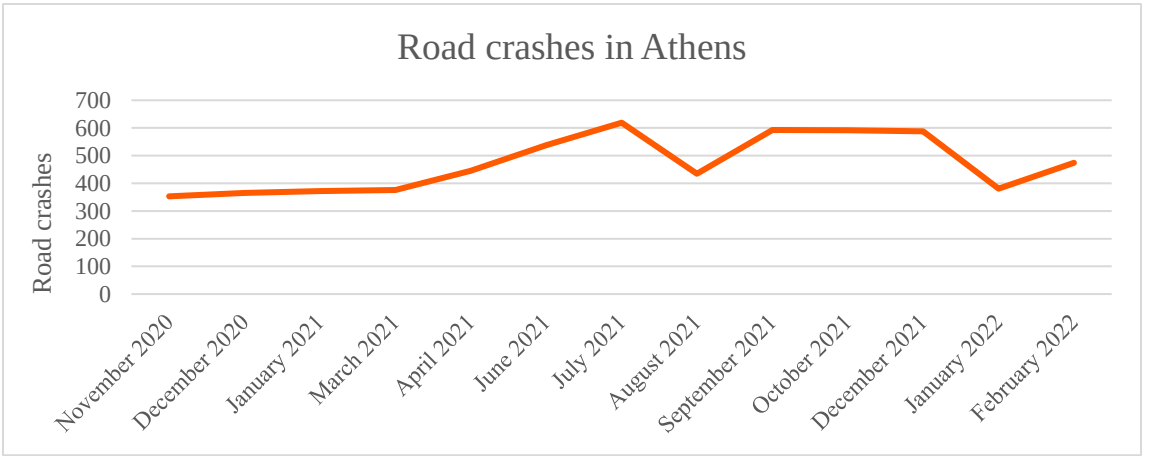


Fig. 1. Average speed per week in several major arterials in Athens
(Source: Traffic Management Centre, Data Processing: NTUA)

5.2 Road crashes

Several studies revealed that reductions in crash rates were in association with average speed enforcement, particularly in relation to fatal and serious injury crashes (Soole et al., 2013). Thus, a more comprehensive picture of the effects of COVID-19 pandemic on average speed and, therefore, road safety can be drawn from the high-quality data on total number of road crashes. Specifically, during the lockdown period (i.e. November – December 2020), a remarkable 37% increase in the total number of road crashes was observed compared to the period after the lockdown restrictions. It should be noted that monthly data for road crashes in February 2021, May 2021 and November 2021 were not available for Athens.

Figure 2 illustrates the difference in the total number of road crashes from November 2020 to February 2022 in Athens.



Data on 2/2021, 5/2021 and 11/2021 were not available

Fig. 2. Road crashes from November 2020 to February 2022 in Athens
(Source: Hellenic Statistical Authority, Data Processing: NTUA)

6. Discussion

The COVID-19 pandemic has had a great impact on the lives and health of many citizens of Athens, but it has also resulted in cleaner air and quieter streets. An overall increase in average speed during the lockdown period compared to the non-lockdown period was identified. It should be noted that the paper builds upon previous work (Katrakazas et al., 2020), which provided an overview of the effect on driving behavior and road safety during the first wave of the pandemic. The overview is similar with the current paper, which for the first time describes the effect of the pandemic using data from the largest city and capital of Greece (i.e. Athens).

The COVID-19 pandemic upset normal operations in arguably all aspects of life for citizens worldwide. With regards to transportation safety, "empty" roads have led to less risk exposure due to limited traffic flow and less fatalities from crashes, however the reduction of fatalities is not proportionate with the reduction in traffic volumes (Wegman & Katrakazas, 2021). Recent studies and reports have succeeded in identifying the quantified impact of the pandemic in safety indicator, such as crashes and fatalities as well as risk exposure in terms of modal split and traffic volumes.

For Athens, as seen in the overview of Figure 1, driving after the shock of the lockdown (November and December 2020), average driving speed pointed towards safer attitudes. With "normal" everyday life disrupted, it was evident that driving behavior would be significantly affected. The first wave of the pandemic took governments and citizens by surprise, but at present, two years into the pandemic, signs of adjustment to the new reality are becoming apparent.

Unfortunately, the positive attitudes of Greek drivers immediately after the imposition of a second lockdown, were not reflected in the frequency of road crashes. For example, crashes were increased in Athens after the second lockdown by 37% when comparing the period after the second lockdown with time spent under confinement in November and December 2020. This is in contrast with other studies regarding the effect of COVID-19 on crash frequency (Inada et al., 2020; Muley et al., 2021; Saladié et al., 2020) although previous studies used a more limited time span for their data collection. The fluctuation in crashes and injuries during the period where lockdowns are imposed or resolved is something that is expected however due to the rapid changes in social and behavioral patterns during the pandemic (Calderon & Kaufman, 2021). Nevertheless, further in-depth crash research during the pandemic in Athens is needed in order to discover contributing and causal factors that led to the crashes in question.

As it was previously demonstrated, driving speed was significantly increased during the periods when lockdowns were imposed, due to the heavily reduced traffic volumes for motorized traffic. Towards that end, the paradigm of reducing speed limits inside urban areas to 20 or 30 km/h, as declared by the Stockholm Declaration of the third global ministerial conference on road safety should be extended. With lower speeds, the risk of crashes, severe injuries and harsh events will be apprehended. Such policies have already been applied in Paris, Brussels and Bilbao and could be extended to major metropolitan areas worldwide.

Nevertheless, this paper is not without shortcomings. One limitation of the present study is that the evidence presented by the authors majorly consists of descriptive statistics and explanatory figures. Additionally, no data were available for the exposure indicator for crashes per kilometer driven. Moreover, the influence of psychological status of drivers, such as driver distraction, anger, sleepiness or fatigue were not examined in the present study, while demographic characteristics were not taken into consideration.

Future research should initially concentrate on comparing COVID-19 driving indicators from different cities or countries so as to compare and contrast different effects. In the future, real-time traffic data could allow for identification of the impact of COVID-19 pandemic on average speed and, therefore, road safety. Thus, future efforts could also implement a naturalistic driving experiment in real driving conditions. The investigation of other significant factors could be also included in the future. For instance, the presence of a passenger, the drug abuse, the alcohol consumption or the seat belt use constitute some of the high risk factors that cause road crashes. More driving behavior indicators, such as the use of mobile phone during driving or aggressiveness levels, would also assist in quantifying the effects of lockdown on driving. Finally, the development of more sophisticated models, such as Convolutional Neural Networks (CNNs) or Long Short-Term Memory Networks (LSTMs), as well as multivariate forecasting models using Vector AutoRegression (VAR) should provide more insights on the impact of COVID-19 on average driving speed.

7. Conclusions

The objective of the current research is to present a descriptive overview of average driving speed as well as road crash data in correlation with the total number of cases and casualties due to COVID-19 pandemic in Athens, Greece. Towards that aim, traffic data for a 16-month period from several major arterials in Athens were collected and processed. The 16-month period was considered, from 05/11/2020 to 28/02/2022. Traffic data were extracted from the Traffic Management Centre (TMC) of Athens for Kifisias, Kallirois, Alexandras, Stadiou and Mesogeion avenues. For the analysis, descriptive statistics were implemented. In order to be able to provide a holistic overview of the COVID-19 impact on average driving speed, data related to road crashes delivered from the Hellenic Statistical Authority were also extracted.

Results indicated that during the lockdown periods, average speeds were increased by up to 8%, compared to the period with no restrictions. The imposition of another lockdown caused significant changes in Greek driving behavior during the late months of 2020 compared to the non-lockdown period. During the lockdown period (i.e. November – December 2020), a remarkable 37% increase in the total number of road crashes was observed compared to the period after the lockdown restrictions.

With respect to traffic impact indicators, significant benefits in mobility in the center of Athens were identified, with an extraordinary rise in walking and cycling. In particular, the completion of the Athens Great Walk made the center of Athens even more attractive, improving road safety and developing a new culture for safer behavior of all road users. Stricter speed limits (20 or 30 km/h) can permanently support the establishment of residential areas and streets in which priority is given to pedestrians and cyclists. Athens should be a living example of continuous sustainable mobility and quality of life improvement. Lastly, cities must build on the successes and innovation born out of the pandemic to catalyze progress towards ensuring the right to health for all.

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