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Mandated societal lockdown and road traffic accidents

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ABSTRACT

Background: The effect of mandated societal lockdown to reduce the transmission of coronavirus disease 2019 (COVID-19) on road traffic accidents is not known. For this reason, we performed an in-depth analysis using data from Statewide Traffic Accident Records System.

Materials and methods: We reviewed data on total 2292 road traffic accident records in Missouri from January 1, 2020 through May 15, 2020. We treated March 23 as the first day of mandated societal lockdown and May 3 as the first day of re-opening.

Results: We have found that there was a significant reduction in road traffic accidents resulting in minor or no injuries (mean 14.5 versus 10.8, $p < 0.0001$) but not in accidents resulting in serious or fatal injuries (mean 3.4 versus 3.7, $p = 0.42$) after mandated societal lockdown. Furthermore, there was a significant reduction in road traffic accidents resulting in minor or no injuries after the mandated social lockdown (parameter estimate -5.9, $p = 0.0028$) in the time series analysis. There was an increase in road traffic accidents resulting in minor or no injuries after expiration of mandatory societal lockdown (mean 10.8 versus 13.7, $p = 0.04$).

Conclusion: The mandated societal lockdown policies led to reduction in road traffic accidents resulting in non-serious or no injuries but not those resulting in serious or fatal injuries.

1. Introduction

The effect of mandated societal lockdown to reduce the transmission of coronavirus disease 2019 (COVID-19) on road traffic accidents has been identified as an important issue with direct implications for public safety (Chang and Miranda-Moreno, 2020). The Centers for Disease Control and Prevention recommended that staying home was one of the most effective strategy against acquiring and spreading COVID-19 (Travel during the COVID-19 pandemic, 2020). Vos (2020) speculated that during mandated societal lockdown, people might be more inclined to perform activities at home which would result in less car traffic and less congestion during peak hours. Vingilis et al. (2020) postulated that the adverse economic consequences of COVID-19 may improve road safety by reductions in vehicle kilometers travelled, number of higher risk drivers on roads; and travel for entertainment and leisure activities. Stavrinou et al. (2020) found a 37 % reduction in driving days per week and 35 % reduction in vehicle miles driven among adolescents during

COVID-19 pandemic. However, another report suggested that the traffic volume has decreased but the speed of traffic has increased due to lower congestion on roads in New York city (What are the impacts of the COVID-19 pandemic on our transport systems, 2020; Camille Kamga et al., 2020). Furthermore, there was no change in volume of heavy vehicle traffic and the volume may have increased to meet the supply needs (What are the impacts of the COVID-19 pandemic on our transport systems, 2020). Speeding and stunt driving may also have increased during COVID-19 pandemic (Vingilis et al., 2020).

Despite the initial expectation that road traffic accidents will decrease during the COVID-19 pandemic, the preliminary results are variable. National Safety Council reported that fatalities from road traffic accidents increased 14 % in the month of March despite mandated societal lockdown (Motor vehicle fatality rates up 14 percent in March, despite COVID-19, 2020). The estimates varied between states. Shilling and Waetjen (2020) found a 50 % reduction in total and casualty collisions in California's from March 1, 2020 to April 30, 2020

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but some regions showed very little reduction. [Oguzoglu \(2020\)](#) estimated a reduction in 200 traffic related deaths and 17,600 injuries during the months that stay-at-home orders were in place in Turkey.

Road traffic accidents are a prominent contributor to hospitalization ([Motor vehicle traffic crash statistics: New York state residents, 2020](#)) and may negatively impact the existing hospital resources directed towards COVID-19. We studied the effect of mandated societal lockdown in Missouri (described in previous publication ([Williams, 2020](#))) on road traffic accidents. Briefly, all individuals currently residing in Missouri had to avoid leaving their homes or places of residence and avoid social gatherings of more than 10 people. Any entity that did not employ individuals to perform essential worker functions needed to adhere to the limitations on social gatherings and social distancing. Any entity that employed individuals to perform essential worker functions were required to limit the number of individuals in any particular retail location. Every person had to avoid eating or drinking at restaurants, bars, or food courts and visit to people nursing homes, long-term care facilities, retirement homes, or assisted living homes unless to provide critical assistance. All state office buildings were closed to the public.

2. Materials and methods

We performed an in-depth analysis using data from Statewide Traffic Accident Records System maintained by Missouri State Highway Patrol ([Patrol MSH, 2020](#)). The state of Missouri has a population of 6,137,428 persons as of July 1st, 2019 ([QuickFacts, 2019](#)) and there are 3,326,092 vehicles registered in the state ([Total current licenses plates by type - statewide, 2020](#)). In the record system, injuries are classified on the basis of conditions at the scene of the accident except fatal injuries ([KABCO Injury classification scale and definitions, 2020](#)). If any injury resulted in death within a specified period (30 days) after the road traffic accident in which the injury occurred, the injury classification is changed to fatal injury. Serious injury is defined based on: 1/. Severe laceration resulting in exposure of underlying tissues/muscle/organs or resulting in significant loss of blood; 2/. Broken or distorted extremity (arm or leg); 3/. Crush injuries; Suspected skull, chest or abdominal injury other than bruises or minor lacerations; 4/. Significant burns (second and third degree burns over 10 % or more of the body); 5/. Unconsciousness when taken from the crash scene; or 6/. Paralysis. Minor injury is defined by any injury that is evident at the scene of the crash other than fatal or serious injuries such as lump on the head, abrasions, bruises, minor lacerations (cuts on the skin surface with minimal bleeding and no exposure of deeper tissue/muscle). We classified the severity of injury based on the injury sustained by the driver of the vehicle.

2.1. Statistical analysis

The primary analysis was based on the mean daily number difference of road traffic accidents. We treated March 23 as the first day of mandated societal lockdown and May 3 as the first day of re-opening. The March 23rd policy was made a state-wide mandate on April 5th, 2020. We used two-sample *t*-test to identify the differences before and during the mandated societal lockdown in regards to road traffic accidents resulting in minor or no injuries and those resulting in serious injuries or fatalities. We also analyzed differences in the road traffic accidents during and after the mandated societal lockdown using similar paradigm. The two-sample *t*-test method was carried out using PROC TTEST in SAS Studio software (Release: 3.8, Enterprise Edition).

In the second analysis, we used interrupted time series (ITS) to identify trends in and effect of mandated societal lockdown on road traffic accidents. First, we calculated Durbin-Watson (DW) value to see if there are autocorrelation. No autocorrelation was assumed when DW value was close to 2 and *p*-value of DW test greater than or equal to 0.05. We used autoregressive integrated moving average (ARIMA) modeling function for ITS with PROC AUTOREG in SAS Studio software (Release: 3.8, Enterprise Edition) ([Penfold and Zhang, 2013](#)).

3. Results

We reviewed data on total 2292 road traffic accident records in Missouri from January 1, 2020 through May 15, 2020. The total number of road traffic accident ranged from 5 to 38 per day. The number of serious or fatal crashes ranged from 0 to 9 per day. Among these road traffic accidents, 1809 were associated with no or minor injuries and 483 were associated with serious or fatal injuries.

The daily counts of road traffic accidents decreased during the entire period ([Fig. 1](#)). Overall, the total daily number of road traffic accidents varied from 17.9 ± 6.1 (before lockdown) to 14.4 ± 4.6 (during lockdown) and 18.1 ± 6.4 (after lockdown) per day. The daily number of serious or fatal traffic accidents ranged from 3.4 ± 1.8 (before lockdown) to 3.7 ± 2.1 (during lockdown) and 4.4 ± 2.4 (after lockdown).

There was a significant reduction in road traffic accidents resulting in minor or no injuries (mean 14.5 ± 5.5 versus 10.8 ± 3.9 , $p < 0.0001$, effect size = 0.8). There was no reduction in road traffic accidents resulting in serious or fatal injuries (mean 3.4 ± 1.8 versus 3.7 ± 2.1 , $p = 0.42$, effect size = 0.2). There was an increase in road traffic accidents resulting in minor or no injuries after expiration of mandatory societal lockdown (mean 10.8 ± 3.9 versus 13.7 ± 5.7 , $p = 0.04$, effect size = 0.6) but not road traffic accidents resulting in serious or fatal injuries (mean 3.7 ± 2.1 versus 4.4 ± 2.4 , $p = 0.30$, effect size = 0.3). After further implementation of the statewide mandate, we observed that there was a reduction in minor or no injuries during the statewide mandate (mean 13.8 ± 5.2 versus 11.3 ± 4.6 , $p = 0.03$, effect size = 0.5), but no significant change was identified between during and after the mandated societal lockdown.

There was no autocorrelation for the data in ITS analysis. There was a non-significant decreasing trend in road traffic accidents resulting in minor or no injuries prior to mandated social lockdown. There was a significantly reduction in road traffic accident resulting in minor or no injuries after mandated social lockdown (parameter estimate -5.9 , $p = 0.0028$). The trend change (parameter estimate 0.1, $p = 0.04$) also confirmed that reduction rate was significantly greater after mandated social lockdown. There was a non-significant trend towards increase over time during the mandated social lockdown. There was no significant change was identified between during and after the mandated societal lockdown. The ITS analysis did not identify any changes in road traffic accidents resulting in serious or fatal injuries.

4. Discussion

We observed that road traffic accidents resulting in non-serious or no injuries are affected by societal lockdown policies but not road traffic accidents resulting in serious or fatal injuries. The reduction in road traffic accidents resulting in minor or no injuries may be due to reduced commuting and vehicle utilization during mandated societal lockdown ([Vos, 2020](#)). The reason behind lack of reduction in road traffic accidents resulting in serious or fatal injuries during mandated societal lockdown is unclear. Potential reasons include increased speed of traffic due to lower congestion ([What are the impacts of the COVID-19 pandemic on our transport systems, 2020](#); [Camille Kamga et al., 2020](#)). Increase in speed of traffic may increase the number of serious or fatal road traffic accidents thereby nullifying the effect of reduced traffic ([Finch et al., 2020](#); [Johansson, 1996](#)). There may be other contributory factors such as greater number of drivers under the influence of alcohol and drugs ([Volkow, 2020](#)), economic pressures on drivers to save time, and changes in road safety publicity campaigns, and level of policing and the size of fines ([Aljanahi et al., 1999](#)) and increase in speed of heavy vehicle traffic without any change in volume ([What are the impacts of the COVID-19 pandemic on our transport systems, 2020](#)).

Statewide Traffic Accident Records System only archives last 12-month data and therefore a comparison with corresponding months in 2019 was not possible. The lack of corresponding data precluded us from assessing nonstationary or secular trends ([Al-Ghamdi, 1995](#); [Chamlin,](#)

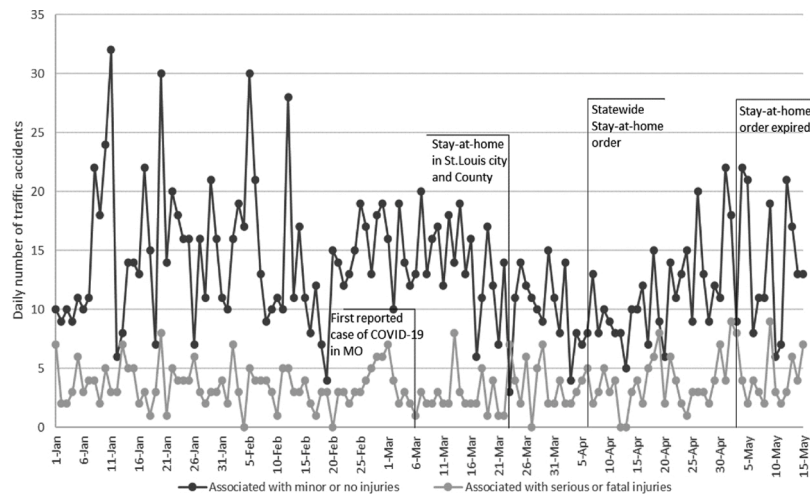


Fig. 1. The daily number of road traffic accidents associated with different types of injuries.

2016). Since the data only provides daily number of road traffic accident records, therefore, the event rate per miles driven could not be computed. We may have underestimated fatal injuries because the data was censored for analysis before 30 days after the road traffic accident for the events occurring in May. Late fatalities may be underestimated although such fatalities are unlikely to be directly related to the road traffic accident. We had also combined serious and fatal injuries so potentially fatal injuries are likely to be identified as serious injury at time of initial ascertainment. The findings are based on data from road traffic accidents that occurred within state of Missouri and may not be generalizable to other states.

5. Conclusion

The mandated societal lockdown policies led to reduction in road traffic accidents resulting in non-serious or no injuries but not road traffic accidents resulting in serious or fatal injuries. Further studies need to identify reasons for lack of reduction in serious or fatal injuries if the volume of traffic was reduced during mandated societal lockdown. National Highway Traffic Safety Administration in partnership with Federal Motor Carrier Safety Administration and the Federal Highway Administration provides the roadmap, tools, guidance, and resources for State and local governments to use in designing and applying a balanced and effective speed management program (Speeding, 2019). Understanding the various aspects of road traffic behavior and accidents such as increased speeding due to less traffic congestion may allow implementation of dedicated programs during mandated societal lockdown.

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CRedit authorship contribution statement

Adnan I. Qureshi: Conceptualization, Methodology, Writing - original draft, Supervision, Project administration. **Wei Huang:** Data curation, Writing - review & editing, Visualization. **Suleman Khan:** Data curation, Writing - review & editing. **Iryna Lobanova:** Writing - review & editing, Project administration. **Farhan Siddiq:** Writing - review & editing. **Camilo R. Gomez:** Writing - review & editing. **M. Fareed K. Suri:** Writing - review & editing.

Declaration of Competing Interest

The authors report no declarations of interest.

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