

Assessing the Road Safety Implications of COVID-19 Mobility Restrictions: A Case Study from Bangladesh

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Abstract

This study examines the impact of the COVID-19 lockdown on road accident trends in Bangladesh, leveraging data from the Accident Research Institute (ARI), Bangladesh Road Transport Authority (BRTA), Dhaka Metropolitan Police (DMP), and the Directorate General of Health Services. The analysis covers the period from January 2016 to December 2020, with a specific focus on the first lockdown phase in 2020. Monthly and annual accident patterns, vehicle-specific involvement, and accident severity data reveal a significant decrease in road accidents during the lockdown, particularly in April and May, correlating with restricted traffic movement. Comparisons between road accident fatalities and COVID-19-related deaths highlight that despite limited mobility, road accidents remained a persistent concern, with a notable number of fatalities even amid pandemic restrictions. Analysis across regions also shows that highway areas and the Dhaka Metro experienced higher accident rates, with specific vehicle types contributing significantly to these incidents. Findings underscore that while the lockdown reduced accident rates, fundamental traffic safety issues persist, requiring a reassessment of existing policies. This study provides insights into the influence of mobility restrictions on road safety. It offers recommendations to enhance road safety measures, reduce accident frequency, and address implementation gaps in Bangladesh's traffic safety framework.

Keywords: *Traffic crashes; COVID-19; Mobility; Vehicle types; Road safety*

1 Introduction

Road traffic injuries pose a significant global issue in the mainstream field of public health, and the problem has been estimated to claim about 1.3 million lives, together with 20-50 million road injuries annually, the majority of which take place in low and middle-income nations (WHO, 2020). The COVID-19 crisis was an entirely new stressor to international human mobility without precedent in modern times. The mobility restrictions and nationwide lockdowns caused apparent readjustment of traffic flows and road safety markings (Shilling & Waetjen, 2020). Recorded declines in road-traffic related injuries were also observed in several countries, such as the United States, Italy, and India. Declines in vehicular activity were experienced at the same time. On the other hand, some reports recorded paradoxical increases in crash severity, which are explained by a more risky driving behavior on mostly uncongested roads (Qureshi et al., 2022; Shaik et al., 2022; Saladi et al., 2020). Most of the studies that have been carried out on the impact of COVID-19 on road safety in high-income nations possess a severe knowledge gap within lower-income settings. The consequence of these mobility limitations is also the least studied in South Asia. The COVID-19 lockdown provided a special point of intervention in a country that was already experiencing a critical road safety situation in Bangladesh because of a deficiency in infrastructure, lack of enforcement, and mixed traffic directions (Enam et al., 2023; Shaik et al., 2021). Even though lockdowns prevented people to move, there are some initial indications that road traffic fatalities did not decrease proportionally to the decrease in traffic on the road (Gupta et al., 2022; ITF, 2020). The research in Dhaka-Aricha and Jamuna Bridge corridors demonstrates that buses and trucks are the vehicles that, in most cases, cause the death accidents, and pedestrian involvement is the highest (Ahmed et al., 2013; Rahman et al., 2021). Simple crashes and fatality in Bangladesh have increased in a statistically significant way during the COVID-19 disruption. However, in Bangladesh, the road crash deaths showed a significant variation statistically during the COVID-19 interruption. During the first national lockdown in Bangladesh from March – May, 2020, a total of 806 people died in road crashes during the first lockdown from March–May, 2020, compared to 667 COVID-related deaths in the same period (DGHS, 2020). Between 2016 and 2020, Bangladesh had more than 16,000 road accidents, and about 2020 alone experienced about 26% of the accidents despite the COVID-19 lockdown. According to the study, more than 7,000 people died in 2020, and the nature of the problem worsened because of poor infrastructure and regulators (Pervez et al., 2021), which shows that the problem of road safety was pressing even in the context of a pandemic. Shaik et al. (2021) found that during the COVID-19 lockdown in Bangladesh, the government mobility restrictions (suspension of transport, curfews) were enforced, but around 4.5% of people traveled individually daily due to livelihood purposes. Although the traffic was reduced but road crashes and fatalities increased, mainly due to high-speed, reckless driving on empty roads (Enam et al., 2023). However, there is a limited understanding of how mobility restrictions affected road crashes during the COVID-19 period. The main goals of the research are to estimate the effects of mobility restrictions on road trends due to COVID-19 and to understand the temporal and vehicle-specific changes in the frequency and severity of crashes in the light of the data collected by Accident Research Institute (ARI), Bangladesh

Road Transport Authority (BRTA), the Dhaka Metropolitan Police (DMP), and the Directorate General of Health Services (DGHS) on the first lockdown in Bangladesh in March-May 2020. An approach using a flexible design that involves time trends, individual-vehicle characteristics, and severity of accidents is reported. The lack of knowledge depends on the low- and middle-income countries (LMICs) and fulfils the knowledge gap by evaluating whether pre-existing traffic-safety vulnerabilities were revealed because of the pandemic. The knowledge acquired in the course of this study is to be used in policy formulation toward addressing the issue of road safety in the post-pandemic reality of the country.

2 Data Collection and Methodology

2.1 Study Area and Period

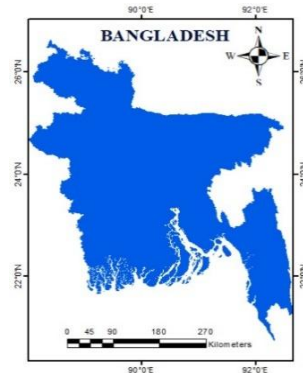


Figure 1. Study area

This study focuses on the entire geographical boundary of Bangladesh. The analysis explores 5 years from January 2016 to December 2020, especially emphasizing the first nationwide lockdown phase during March–May 2020.

2.2 Data Sources

This research obtained information from various governmental and institutional sources. Accident Research Institute (ARI), BUET, provided complete traffic-crash records using the MAAP5 software. The Bangladesh Road Transport Authority (BRTA) also supplied the data regarding vehicle registration, classification, and issuance of licenses. The records of accidents obtained were localized records of accidents under the Dhaka Metropolitan Police (DMP). Pandemic-related statistics, such as COVID-19 cases, recoveries, and deaths, were taken from the Directorate General of Health Services (DGHS). These datasets, in combination, allowed studying both traffic accidents and their interaction with COVID-19 pandemic-related public-health indicators widely in Bangladesh.

2.3 Data Processing

Over 16082 reports of road accidents were extracted and manually processed from the Accident Research Institute (ARI) and Dhaka Metropolitan Police (DMP) databases. The data were sufficiently assessed, scrubbed, and matched because of the software constraints present in the Microcomputer Accident Analysis Package (MAAP5) and the issue of underreporting. The verified data were systematically organized and statistically analyzed to identify temporal patterns, regional variations, and severity distributions of road accidents.

2.4 Analytical Framework

Descriptive and comparative trend analyses were performed using Microsoft Excel and SPSS Statistics to evaluate how COVID-19 mobility restrictions influenced road accidents in Bangladesh. The analysis was conducted in the major phases, including temporal analysis and vehicle-wise and severity classification.

- 1) Temporal analysis: Before the pandemic and lockdown period, road crash trends monthly and annually were identified.
- 2) Vehicle wise distribution analysis: Data were disaggregated and analyzed based on vehicle type (bus, truck, microbus, motorcycle).
- 3) Accident severity classification: The monthly distribution of traffic severities (injuries and fatalities) to identify patterns in accident severity.

It provided a comparative evaluation of COVID-19 mortality and road-accident death during the lockdown using temporal and vehicle-specific analysis of the accident data to elicit the impact of movement restrictions on the population-health outcomes.

3 Results and Discussion

3.1 Annual distribution of accidents

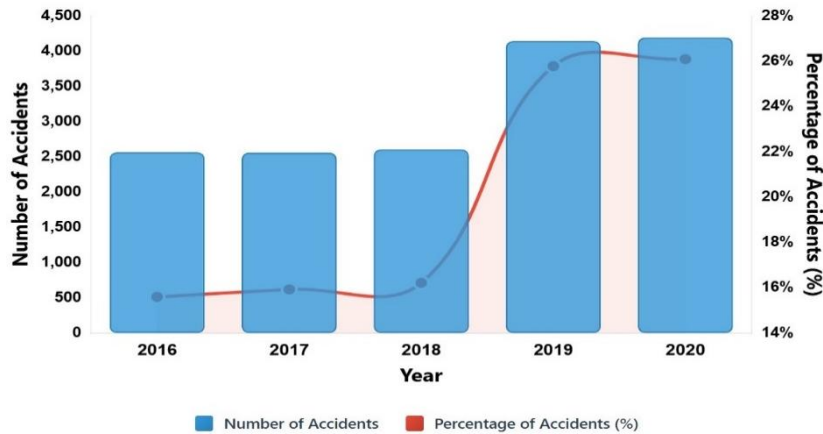


Figure 2. Annual distribution of accidents

Figure 2 indicates strong time variability in the frequency of road accidents shown in the yearly states of the distribution presented in these figures. From 2016 to 2018, the number of accidents stayed rather stable, with between 2,500 and 2,700 happening each year, representing a baseline condition with minimal year-to-year differences. However, this stability was disrupted in 2019, when accidents rose to 4,200 cases, a staggering 58.5% increase, which continued into 2020 with 4,250 incidents. The proportional analysis further emphasizes the severity of this crisis, revealing that 2019 and 2020 collectively accounted for 51.48% of all recorded accidents during the entire five-year period, while the earlier three years contributed approximately equal proportions of 16% each. The rate of reduction was narrowly measured at 0.03 % between 2016 and 2017, but the subsequent years witnessed a sharp 9.88% increase, which reflects a positive growth trend despite policy and enforcement efforts. The highest accident was recorded in 2019 (25.79 %) and in 2020 (26.10 %), the latter particularly being impressive in view of the COVID-19 lockdown throughout the country during the study period. Such evidence demonstrates that despite lower rates of mobility, the road-safety issues were not overcome. The minimum accident share in 2017 (15.93%) also underlines the erratic nature of the change in accidents per year. The average 3,217 accidents annually highlight the remaining issue in this matter of public safety, which instead should dwell on structural, behavioral, and enforcement-related reasons which suggesting that effective interventions must address multiple dimensions of road safety infrastructure, traffic management, and regulatory frameworks to achieve fruitful improvements in Bangladesh's road safety outcomes.

3.2 Vehicle types total accident distribution pre and during COVID-19

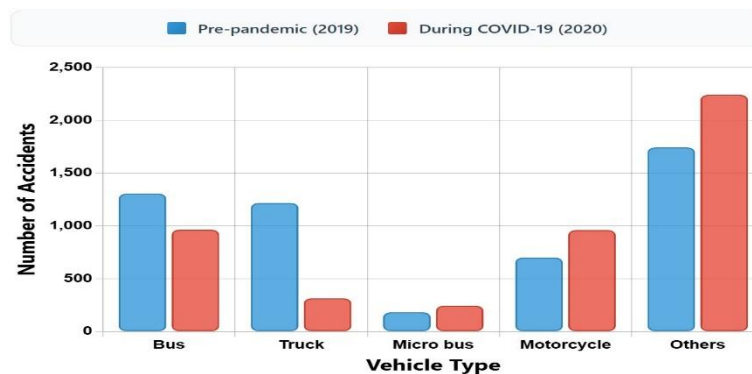


Figure 3. Vehicle type total accident distribution pre and during COVID-19

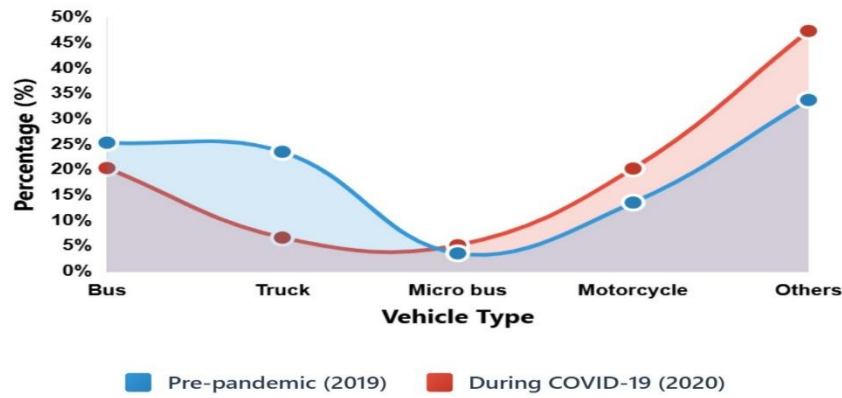


Figure 4. Vehicle type total accident distribution (%) pre and during COVID-19

Figure 3 and Figure 4 reveal that the total number and percentage distribution of vehicle type-specific accidents in 2020 during the COVID-19 pandemic, compared to the pre-pandemic year 2019. The comparison shows a radical change in the situation with road safety in Bangladesh during the pandemic period. Before COVID-19, the buses and the trucks were maximum involved vehicle types, with total involvement of 1,306 and 1,218, respectively. These figures indicate a severe reduction in commercial transport related accidents, with a reduction of 74 percent (1,218 to 315) in the case of truck accidents and 26 percent (1,306 to 965) in the case of bus accidents. Such declines are due to freight limitations, lockdowns, and decreased vulnerability to society in terms of transportation needs. The less socially distant personal travel, such as motorcycle, microbus, and Others, experienced significant increases: 37 percent (701 to 961), 34 percent (183 to 245), and 29 percent (1,743 to 2,241), respectively. It indicates the shift in the mode of travel toward individual, socially distanced means of transportation. The percentage of accidents involving trucks of total accidents fell by 16.9 percent to 6.7 percent, and buses by 0.7 percent to 20.4 percent, whereas those involving others rose by 22.5 percent to 47.4 percent as the prevailing category. The motorcycle accidents in the context of the COVID-19 pandemic show that the total number of accidents was 701 (pre-pandemic) and 961 (pandemic), 13.6 percent to 20.3 percent, almost the same as buses in relative share of crashes. Such an increase in two-wheeled crash events reflects a mode swing towards motorcycling mode, possibly because of increased demand in more flexible and low-contact travel modes and reduced fear of COVID-19 virus spread. Whereas the total number of accidents reduced by 8.2 percent (5,151 to 4,727), this masks the structural redistribution of road risk between commercial to personal, and informal transport. This modal risk redistribution indicates the way the COVID-19 pandemic redrew the picture of road transport operations in Bangladesh. This evidence shows that there is an urgent need to design specific safety measures, infrastructure improvement, and policing measures with regard to risky types of vehicles during times of crisis related mobility reconfiguration.

3.3 Monthly distribution of traffic injuries

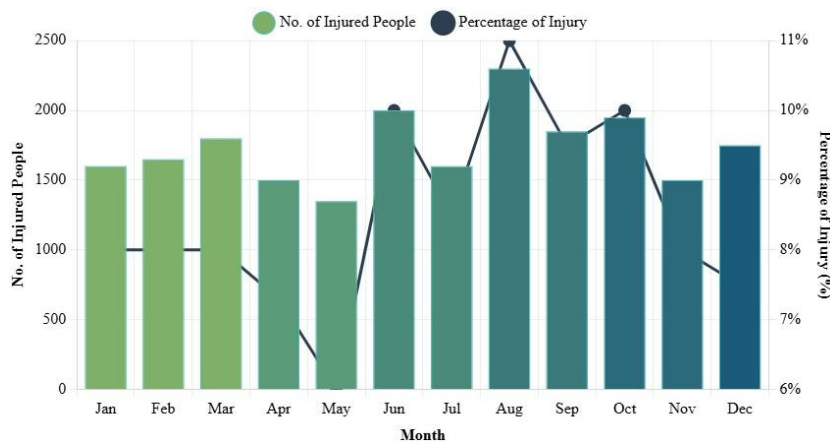


Figure 5. Monthly distribution of injured people and injury percentage

An aggregated analysis of road accident injury data between the years 2016 and 2020 is shown in Figure 5. shows a significant change month-to-month. The largest number of injuries was reported in August (2,371) and made up

11 % of the overall number, which can be taken as a relatively large increment of injuries due to heavier traffic during holidays, festivals, or bad weather conditions. August is therefore a sensitive duration of time in the witnessing of traffic safety enforcement due to the increased risk of injuries. On the other hand, the lowest number of reported injuries was persistent in May (1,309), which is only 6 % of the total and potentially can be connected to decreased mobility during Ramadan or early monsoon. Importantly, the number of injuries per month did not drop below 1,000, which showed the presence of a high base in the number of road traffic injuries in Bangladesh. The five-year average shows that 1,732 people were injured on average a month, and there was a fairly consistent distribution in January, February, July, and December (all of 8 %), whereas March, May, September, and October were lower by a variance of 7 % to 9 %. Such consistently large figures of injuries remind us that road traffic events in Bangladesh are not causal and seasonal but a persistent health issue in the country. Evidence-based strategies can be established based on the temporal consistency of injury rates, as can be seen in this dataset. By identifying August as the most dangerous month, the authorities can increase their access to traffic, strengthen their public education, and raise their emergency preparedness capabilities in the medical field. At the same time, the high injury level during the whole year dictates the need for a year-round road safety, not one-off and temporary.

3.4 Monthly distribution of traffic fatalities



Figure 6. Monthly distribution of fatalities and injury percentage.

The monthly distribution of people killed in road accidents during 2016–2020 is shown in Figure 6. Reveals critical seasonal patterns and insights into Bangladesh's road safety situation. In this course of five years, the overall death toll was 19,207, with most of them varying between 1,271 and 1,988 each month. The maximum percentage of mortalities, 10 % of the total, remained in June and August, which were the months of monsoons and contained all the concomitant hazards of slippery roads, low visibility, and high travel demand during the period of festivals. There have been no signs of stabilizing up to 2020, when, after strict mobility control in March-May, a sharp decline in road deaths was reported, but a slight weakening of the lockdown in June 2020 led to a significant increase in unregulated traffic. Without proper enforcement, such a sharp switch, joined with an increase in private vehicle use, could have led to the faster fatality rate witnessed during the two months of June-August, despite the fact that public transport use reduced. On the other hand, April and May showed the lowest deaths per 100k of 7 % which ties with the closure of schools as well as low traffic load. On the one hand, there was a stable fatality rate of 8 % in January, February, March, September, October, November, and December, which indicated the presence of a stable, continuous, and year-round risk because of the structural and behavioral shortcomings, and not a seasonal turn only. These results are in line with the trends in India and Spain, where stringent lockdowns slightly lowered the amount of traffic, but later measures recorded an increase in the severity of crashes as a result of more dangerous driving on less-crowded roads (Gupta et al., 2022; Saladié et al., 2020). The trend highlights the importance of location-specific safety measures, especially in the recovery phase of post-lockdown, monsoon months, and festivals. Secondary actions like road repairs, sensitization of people, and tighter control of traffic are necessary in order to decrease the mid-year rises in fatalities.

4. Conclusions and Recommendations

The proposed research carries out a micro analysis of the impact of COVID-19-related mobility restrictions on road safety in Bangladesh, which occurred during the lockdown stage of 2020 (March-May, 2020) and in the 2016-2020 period. The major conclusion can be made that, despite the substantial decline in the aggregate vehicle activity during the lockdown, the safety outcomes were uneven and short-term. The rate of accidents related to buses reached the single-digit numbers (6 and 12, respectively) in April and May 2020, which cannot be compared with the pre-pandemic rates of 78 and 79. Conversely, accidents involving motorcycles rose to 961 in 2020 as compared to 701 in 2019, indicating a possible change in the direction of two-wheeler use, which is probably due to the flexibility of use and possibly their supposedly low risk of influencing viruses. This notwithstanding, 806

individuals died in road accidents during the first lockdown, which is higher than the number of people who succumbed to COVID-19 in the same duration (667), thus pointing to the enduring and deadly aspect of traffic accidents even under a public health emergency. Seasonal periods also give information that August had always had the highest injury rate (2,371 injuries that were 11 % of all injuries), and June and August had the highest number of fatalities, which were 10 % of all fatalities. It was during these months that there were monsoon conditions and increased demand for travel. On the opposite end, May had the least injury and fatality, which were highly linked to the Ramadan observation and restriction of mobility. The study shows that mobility and road safety have a complex relationship. Traffic was reduced during the COVID-19 lockdown lowered some crashes involving public vehicles, but structural weaknesses, poor enforcement, and riskier driving on less crowded roads, especially affecting two-wheeler vehicles, offset these gains. Despite the now restricted mobility, the number of road accidents and collisions by privately owned vehicles increased, thus compounding the current safety issues. Data-derived responses, whether methodological or policy-based, are inevitably needed to address the current issues of road safety. The most promising strategy is the introduction and coordination of the integrated policies that integrate crisis-response mobility, mode-specific measures, enforcement, and robust infrastructure. In the case of future crises, priority should be given to the development of specific traffic control procedures, mechanisms of speed control, special emergency lanes, and quick reaction forces. At the same time, the implementation of spatio-temporal analyses is promoted to outline dangerous areas and guide the planning of long-run data-based safety plans.

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