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## How COVID changed the transportation landscape of NYC

#### Introduction

The COVID-19 pandemic forever changed the landscape of not just New York, or just the United States, but of the entire world. As cities came to a standstill, bustling urban centers transformed in ways that will likely have lasting impacts. One of the most significant transformations was in transportation patterns, especially in urban areas previously known for heavy traffic congestion, packed sidewalks, and high numbers of traffic-related fatalities. Before COVID-19, New York City’s streets were crowded with vehicles, pedestrians, and cyclists alike, creating a complex and often hazardous transportation environment. However, as lockdowns were imposed, traffic levels plummeted as people stayed indoors. At the same time, the city saw a surge in walking and cycling as residents sought outdoor exercise, fresh air, and safer alternatives to public transportation. These shifts in travel behavior not only reshaped the way people moved around but also had immediate effects on traffic-related incidents. A notable outcome of these shifts was the emergence of new trends in car accidents and pedestrian fatalities, which persist to this day and reflect how the pandemic’s influence on urban transportation has not entirely faded.

Historically, there has been extensive research into road safety and accident trends; however, most of this research focuses on the pre-pandemic period. What remains less understood is how these trends have evolved in the wake of COVID-19, especially as cities attempt to adjust to the changing needs of their residents. This research paper seeks to address this gap by employing data science techniques to analyze crash and fatality data specific to New York City. The goal is to explore how car accidents and pedestrian fatalities have shifted in response to the pandemic's lasting impacts on transportation behavior. In doing so, this research aims to provide crucial insights for urban planners, policymakers, and public safety officials tasked with creating safer, more adaptable streets. These insights are particularly relevant in a time when urban spaces are experiencing an uptick in non-motorized transportation, including biking and walking (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7964246/). In any city, it is now more important than ever to identify potential vulnerabilities within transportation systems. With this understanding, cities like New York can take proactive steps to mitigate crashes and make their streets safer, more accessible, and more enjoyable for all residents and visitors.

This study is guided by a central question: how have the patterns of car accidents and pedestrian fatalities shifted in comparison to pre-pandemic levels? The analysis will delve into a range of factors to gain a comprehensive understanding of these changes. By examining shifts in transportation modes and the frequency, severity, and nature of incidents before, during, and after the pandemic, this research seeks to uncover the nuanced ways in which the pandemic reshaped urban transportation safety. Moreover, a significant component of this study involves exploring the underlying factors influencing these trends, such as changes in traffic volume, alterations in commuting behaviors, potential risk factors, and modifications to infrastructure, like expanded bike lanes and open streets programs. By understanding these driving forces, the study aims to uncover the specific elements that have contributed to observed changes in accident rates and fatalities.

Additionally, this research will assess whether certain areas, demographic groups, or times of day have experienced notable changes in accident and fatality rates in the post-COVID era. This analysis is vital, as different parts of the city or different populations may face unique risks and challenges that have evolved since the pandemic began. For instance, lower traffic volumes might have made certain intersections safer, while others could have seen increased risks due to higher cycling rates. By analyzing these dynamics, the study will provide a nuanced view of where and how the most significant changes have occurred. Lastly, the findings will inform considerations for future urban planning, road safety policies, and traffic management strategies in New York City. These insights aim to support efforts to design a city that prioritizes the safety and well-being of all its inhabitants. In the end, this research aspires not only to enhance road safety in New York but also to offer a framework that other urban areas can adopt as they navigate the ongoing impacts of COVID-19 on transportation and public safety.

#### Literature Review

The literature on road safety and traffic accidents in New York City is extensive, particularly concerning trends before the COVID-19 pandemic. Many studies have examined the dynamics of traffic incidents in urban settings, highlighting factors such as road design, traffic volume, pedestrian behavior, and the implementation of safety measures like Vision Zero. Vision Zero, a program aimed at eliminating traffic fatalities and severe injuries, has been a focal point of New York City’s road safety strategy since 2014. Hu & Cicchino (2018) evaluated the early impact of Vision Zero on traffic fatalities in New York City and found mixed results; while traffic deaths overall had decreased, pedestrian fatalities remained a significant issue, especially in densely populated areas. This highlighted the challenges of implementing broad safety policies in a city with complex, high-density traffic environments.

Mueller et al. (2020) expanded on this by examining the interactions between urban infrastructure and safety outcomes, specifically focusing on cycling and pedestrian crashes. They emphasized the importance of proper urban design and traffic calming measures, such as bike lanes and speed-reducing street features, in reducing injuries. Their findings showed that, although cycling was encouraged as a sustainable and safe mode of transportation, the infrastructure was often inadequate to fully protect cyclists in crowded urban environments. Research by DiMaggio et al. (2019) similarly noted that while Vision Zero policies had a positive impact on reducing motor vehicle collisions, areas with high pedestrian density continued to experience elevated risks, highlighting the need for targeted interventions in neighborhoods with unique traffic patterns. These studies underscore the complexity of traffic safety in an urban setting like New York, where the sheer volume and diversity of road users necessitate multi-faceted safety approaches.

However, these pre-pandemic studies did not account for a disruptor like COVID-19, which profoundly altered urban mobility patterns and presented new challenges and opportunities in traffic safety research. The pandemic led to sudden changes in transportation behavior, prompting researchers to investigate how lockdown measures impacted traffic incidents. During the initial stages of the pandemic, there was a significant decrease in road traffic, as stay-at-home orders and restrictions on movement drastically reduced the number of vehicles on the roads. Shilling and Waetjen (2020) found that overall traffic volume plummeted during the lockdown, leading to fewer accidents; however, they observed a paradoxical increase in the severity of crashes. This phenomenon was likely due to an increase in reckless driving behavior; as roads emptied, some drivers took advantage of reduced congestion to engage in speeding and other dangerous driving practices.

In a related study, Barnard et al. (2020) observed similar trends, reporting that while the frequency of incidents decreased, the fatality rate per mile traveled rose, suggesting a shift in the nature of urban driving. This shift was attributed to fewer vehicles sharing the road, which allowed for higher average speeds and riskier behaviors. Additionally, Dumbaugh et al. (2021) documented how COVID-19 fundamentally altered the transportation landscape, with more people turning to walking and cycling as safer alternatives to public transportation. Public transit usage saw a sharp decline due to concerns over virus transmission in crowded, enclosed spaces, which further emphasized the need for safe, pedestrian-friendly streets and infrastructure that could accommodate increased foot and bicycle traffic. These early studies highlight initial pandemic trends, but much of this research is limited to the first year of COVID-19 and has not yet fully delved into the long-term post-pandemic impacts on traffic safety.

As the pandemic unfolded, new behaviors in transportation emerged, raising questions about whether these changes would be temporary or would persist into the future. Early findings suggest that some shifts, such as increased cycling and walking, may continue post-pandemic, underscoring the need for adjustments in urban planning and safety measures. There is a notable gap in the literature concerning post-pandemic trends in crash and fatality data in New York City. While Vision Zero initiatives were thoroughly examined pre-pandemic, research into how the pandemic permanently altered traffic behaviors, road safety, and accident severity is sparse. For example, Sharifi et al. (2022) conducted a study examining pandemic-era shifts in traffic safety across multiple cities but lacked a focused analysis of how these shifts have specifically played out in New York City post-lockdown.

Current studies have yet to explore whether new behaviors—such as increased walking and biking or changes in driver habits—have continued and what these shifts mean for road safety. For instance, with more people now working remotely or on flexible schedules, rush-hour traffic patterns may be permanently altered, potentially leading to less congestion during traditional peak hours but higher traffic volumes at other times. Moreover, the role of law enforcement and traffic monitoring has evolved, as highlighted by reports from the New York City Department of Transportation (NYC DOT, 2021). Changes in traffic enforcement during COVID-19, such as reduced ticketing and fewer DUI checkpoints, impacted how strictly traffic laws were adhered to, potentially contributing to shifts in driver behavior. This period also saw a rise in automated enforcement tools, such as speed cameras, in response to reduced police presence on the streets.

These shifts indicate a need for future research to investigate whether these new patterns in mobility and enforcement have led to lasting changes in both driver and pedestrian behavior, with significant implications for public safety policy. The interplay between pandemic-driven behavioral changes and pre-existing safety initiatives like Vision Zero presents a complex, evolving landscape for transportation in New York City. As the city continues to adapt to a post-pandemic reality, urban planners and policymakers will need to consider how to build on both the successes and the challenges highlighted by these recent studies. In particular, they must assess whether current infrastructure and enforcement measures are sufficient to address the needs of a city where pedestrian and cycling traffic has taken on new importance, and where traditional driving patterns may have been permanently disrupted.

#### Research Question

This research aims to fill the gap in the literature by utilizing data science methods to analyze post-COVID crash and fatality trends in New York City. The COVID-19 pandemic brought about unprecedented shifts in urban mobility patterns, disrupting typical traffic flows and altering the use of public transportation, personal vehicles, and non-motorized modes of travel like walking and cycling. These changes have had a lasting impact on traffic safety dynamics, creating a critical need for studies that investigate how these shifts have influenced crash and fatality trends in one of the most densely populated and complex transportation environments in the world. Previous research has primarily focused on pre-pandemic traffic patterns, examining factors such as road design, traffic volume, and pedestrian behavior, and assessing the efficacy of safety initiatives like Vision Zero. However, these studies did not anticipate the profound changes brought about by a global health crisis, and as a result, there remains a significant gap in understanding how traffic safety has evolved in the post-pandemic context. This study seeks to address this gap by employing advanced data science techniques to gain new insights into post-COVID traffic trends in New York City.

To achieve this objective, the study will apply a combination of machine learning models, statistical analysis, and geospatial tools. Machine learning models will allow for the identification of complex patterns within crash data that traditional analysis methods may overlook, such as changes in crash severity and frequency in specific areas. These models can also detect shifts in driver and pedestrian behaviors, helping to determine whether trends seen during the pandemic—such as increased speeding due to reduced traffic volume—have continued, diminished, or evolved in new ways. Statistical analysis will be used to rigorously quantify changes in crash and fatality rates compared to pre-pandemic baselines, and to test hypotheses about the factors driving these changes. Additionally, geospatial tools will enable a detailed examination of spatial variations in traffic incidents, providing insights into how different neighborhoods have been impacted by the pandemic. By mapping crash and fatality trends, the study will highlight areas where traffic safety concerns have increased or decreased, and explore the influence of local infrastructure, land use, and demographic characteristics on post-pandemic traffic outcomes.

In undertaking this analysis, the research aims to contribute to the growing body of knowledge on the post-pandemic safety landscape and offer practical insights to inform urban planning and road safety policies in New York City. Understanding how the pandemic has reshaped traffic safety is essential for developing targeted interventions that address the unique challenges of the post-COVID environment. For instance, if the analysis reveals that pedestrian and cyclist fatalities have increased in certain areas due to higher levels of non-motorized travel, this information can guide infrastructure investments that prioritize the protection of vulnerable road users. Furthermore, insights from the study could inform the allocation of law enforcement resources, by identifying areas where changes in traffic enforcement strategies may be warranted based on observed shifts in driver behavior.

In addition to informing immediate safety interventions, this research has broader implications for urban planning and transportation policy. As cities worldwide grapple with the long-term effects of the pandemic, findings from this study can provide a model for understanding and responding to similar shifts in other urban contexts. By demonstrating the application of data science methods to complex, real-world transportation challenges, the study will also highlight the potential for these techniques to play a central role in future traffic safety research. Ultimately, the goal of this research is to support New York City’s ongoing efforts to improve road safety and enhance the quality of life for its residents, by providing a data-driven understanding of the city’s evolving transportation landscape in the wake of COVID-19.

#### Data and Methods

The methodology for this study will involve a comprehensive data-driven analysis of crash and fatality data in New York City, focusing specifically on the post-COVID-19 period. The primary data will be sourced from the publicly available dataset, the New York City Open Data Portal (https://data.cityofnewyork.us/browse?q=VZV), which provides detailed records of motor vehicle collisions maintained by the NYPD. Additional data will be drawn from NYC Department of Transportation (DOT) reports, which offer insights into traffic fatalities, serious injuries, and Vision Zero progress. These datasets will cover the period from 2014 to 2023, enabling an analysis of crash and fatality trends across pre-pandemic, during-pandemic, and post-pandemic timeframes.

The data analysis will include several key approaches. Descriptive statistics will first be used to summarize the data, providing a broad overview of crash rates, fatalities, and injury patterns over time. Time-series analysis will then be employed to identify trends and shifts in crash and fatality rates, particularly around key moments such as the onset of lockdowns and the city’s reopening. A geospatial analysis using GIS tools will be conducted to identify accident "hotspots" and observe any changes in the geographic distribution of crashes or fatalities. To further understand the predictors of crashes and fatalities, machine learning models such as logistic regression and random forests will be applied. These models will help identify which factors (e.g., traffic volume, driver behaviors, and infrastructure) have had the most significant influence on crash severity and pedestrian deaths, both before and after the pandemic. Hypothesis testing will also be used to statistically evaluate changes in accident rates across different periods.

For this study, Python and R will be used for data cleaning, statistical analysis, and machine learning. Libraries such as Pandas, Scikit-learn, and Stats models will facilitate data manipulation and predictive modeling. GIS software, such as QGIS or ArcGIS, will be used to conduct geospatial analysis and create visual representations of accident data, while tools like Tableau or Matplotlib will help visualize the trends and results in easily interpretable formats. To ensure the validity of the findings, techniques such as cross-validation will be employed to evaluate the performance of the machine learning models, and sensitivity analyses will be conducted to assess the robustness of the results across different data assumptions. Ethical considerations will also be maintained throughout the study, ensuring that any sensitive information is anonymized, although the data being used is publicly available and free from personally identifiable information. This multi-faceted approach will provide a thorough and robust analysis of how traffic accidents and pedestrian fatalities have evolved in New York City post-COVID, offering critical insights for urban planning and public safety policy.

#### Statistical Methods

The datasets that I chose to analyze for this paper all come from the NYC department of transportation. They are the Crashes, Persons, and Vehicles databases from the motor vehicle collisions databases. I started by importing all 3 databases into jupyter notebook. Each database was millions of rows and almost a gigabyte large in text format, so this process took quite awhile. Once all the data was imported, I needed to convert the crash date data into datetime objects in case I wanted to do a datetime analysis. Once the data was filtered to only show records between 2017 and 2024, I merged all the databases together on the Collision ID column. Once all the data was merged together an info was taken for more information on the new table:

A screenshot of a computer screen

Description automatically generated

I also removed some columns from all 3 databases that were not relevant to my analysis, such as victim name, street information, and some car information columns (at this point I also saved the newly created dataframe to a new CSV, because constantly reading these 3 massive databases over and over again was taking forever). I did some initial data exploration in a few ways: firstly, I created a line graph to visualize crash trends over time:

### **A graph with a line going up Description automatically generated**

As well as analyzing crash severity by borough:

A comparison of a graph

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Though at this stage in the process I have no begun the analysis in earnest, I anecdotally thought it was interesting that staten island has such a high ratio of injuries per crash compared to the other boroghs. It was at this point that I decided to begin looking into covid vs pre covid differences. Using a line chart, you can see the stark drop off when the pandemic started, and where it began to once again pick up.

A graph with numbers and lines

Description automatically generated with medium confidence

The crash factor analysis that I did shows how different contributing factors lead to crashes, both before and after the pandemic.

A graph with red squares

Description automatically generated

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