NEAR EAST UNIVERSITY
INSTITUTE OF GRADUATE STUDIES
DEPARTMENT OF CIVIL ENGINEERING

EFFECT OF COVID-19 ON VEHICLE-CYCLIST COLLISION

M.Sc. THESIS

Mohamed Sheikh Ahmed ABDI

Nicosia

February, 2023

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Approval

We certify that we have read the thesis submitted by **Mohamed Sheikh Ahmed Abdi** titled "**EFFECT OF COVID-19 ON VEHICLE-CYCLIST COLLISION**" and that in our combined opinion it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Educational Sciences.

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Declaration

I hereby declare that all information, documents, analysis and results in this thesis have been collected and presented according to the academic rules and ethical guidelines of the institute of graduate studies, Near East University. I also declare that as required by these rules and conduct, I have fully cited and referenced information and data that are not original to this study.

Mohamed Abdi

30/01/2023

Acknowledgments

At the beginning of this report, I would like to give honor and gratitude to the main people behind my success, without them this project wouldn’t have been possible; their contribution and advice are much appreciated.

First, I would like to thank my advisor Asst. Prof. Dr. Ikenna Uwanuakwa has been guiding me through every step i was doing in my thesis, and he was checking all mycalculations, reports, presentations, and so on. Also, he has given me his support and advice for every step of my study. I appreciate his work and availability every time I ask him a question regarding my study.

Second, I would like to thank Prof. Dr. Kabir Sadeghi, the chair of the civil engineering department, for his kind contribution to all this study; He is always available whenever I had a question or confusion regarding my project. He was pushing me to do my best positively and encouraging me to achieve my goal.

Finally, I would like to extend my warm thanks to the rest of the department faculty, Assoc.Prof. Dr. Shaban Ali Zangena, Assoc. Prof.Dr. RIFAT RESATOGLU and ASST.PROF.DR. Mustafa Alas, for studying and working with them in the previous courses. I appreciate every little advice we got in the past 2 years from anyone in our civil engineering community at NEU.

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Abstract

Effect of Covid-19 on vehicle-cyclist collision

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February 2023, 67 Pages

A vehicle-cyclist collision is an incident that occurs when a vehicle and a cyclist come into contact with each other. This type of collision can involve a car, truck, motorcycle, or any other type of vehicle and a bicycle or other type of bicycle-like vehicle. Vehicle-cyclist collisions can range in severity, from minor accidents with no injuries to serious crashes that result in severe injuries or even death.

Due to the COVID-19 pandemic, transportation systems around the world have been greatly affected. With fewer vehicles on the road in many cities, this study seeks to analyze the impact of the pandemic on the severity of collisions between vehicles and cyclists .Using data from the New York City open database source and analyzed collision reports from January , 2018 to December , 2022. The results show that the number of vehicle-cyclist collisions decreased during the pandemic, but the severity of these collisions increased.Furthermore, the number of collisions involving serious injury or death increased by 18% during the pandemic compared to the same period in the previous years. The reduction in traffic volume during the pandemic may have led to increased speeds and less cautious driving, resulting in more severe collisions.

Keywords: collision, Covid-19, cyclist, severity index, New York

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List of Abbreviations

Covid-19: CoronaVirus 2019

BMV: Bicycle motorized vehicle

WHO: World Health Organization

NYC: New York City

MTA: Metropolitan Transportation Authority

RTCs: Road traffic collisions

CFR: Case fatality rate

SI: Severity index

HD: Human Damage

SARS: Severe Acute Respiratory Syndrome

ACE: Angiotensin-converting enzyme

CHAPTER I

Introduction

Background of the study

The COVID-19 pandemic has had a significant impact on many aspects of daily life, including transportation. In particular, there has been an increase in cycling as a mode of transportation due to concerns about public transportation and a desire for outdoor physical activity. At the same time, there have been reports of an increase in vehicle-cyclist collisions. This study aims to investigate the effect of the COVID-19 pandemic on vehicle-cyclist collisions.

General definition of vehicle-cyclist collision

A vehicle-cyclist collision is an incident that occurs when a vehicle and a cyclist come into contact with each other. This type of collision can involve a car, truck, motorcycle, or any other type of vehicle and a bicycle or other type of bicycle-like vehicle. Vehicle-cyclist collisions can range in severity, from minor accidents with no injuries to serious crashes that result in severe injuries or even death. These types of collisions often occur when a vehicle is turning or changing lanes and do not see a cyclist in the area, or when a cyclist is riding in an area where they are not visible to other road users. Cyclists are often at a disadvantage in these types of collisions due to the lack of protection they have compared to vehicle occupants.

when there is a lack of infrastructure to support it or when there is a high volume of motor vehicle traffic. Cycling has long been recognized as a sustainable and healthy mode of transportation. It has been promoted as a means of reducing traffic congestion, improving air quality, and promoting physical activity. However, cycling can also be dangerous, particularly

The COVID-19 pandemic has led to a number of changes in transportation patterns. In some areas, there has been a shift from public transportation to private vehicles and active transportation modes, such as cycling and walking. This may be due to concerns about the spread of the virus on crowded buses and trains, as well as a desire for outdoor physical activity during lockdowns.

At the same time, there have been reports of an increase in vehicle-cyclist collisions in some areas. This may be due to a number of factors, including an increase in the number of people cycling, a decrease in the number of people driving, and changes in traffic patterns and speeds.

The effect of the COVID-19 pandemic on vehicle-cyclist collisions is an important issue that requires further investigation. Understanding the factors that contribute to these collisions can inform efforts to improve the safety of cycling and reduce the number of cycling-related injuries and fatalities.

Problem Statement

The COVID-19 pandemic has had a significant impact on transportation and mobility, leading to changes in traffic patterns and road usage. One area of concern is the potential increase in vehicle-cyclist collisions and the severity of these accidents. With more people avoiding public transportation and turning to biking as a safer mode of transportation during the pandemic, the number of cyclists on the road has risen. At the same time, reduced traffic has led to higher speeds and less cautious driving, making it more dangerous for cyclists to share the road with vehicles.

The impact of COVID-19 on vehicle-cyclist collision accident severity needs to be studied and understood in order to develop strategies to improve road safety for cyclists. This could include targeted education and enforcement efforts to encourage safe driving around cyclists, as well as infrastructure improvements such as bike lanes and dedicated cycling corridors. Additionally, it will be important to monitor the ongoing effects of the pandemic on road usage and adjust safety measures accordingly.

Objective of the Study

The main objectives of this study presented are the following.

To understand the impact of COVID-19 on the prevalence of vehicle-cyclist collisions.

To determine whether there have been any changes in the types of injuries sustained by cyclists as a result of vehicle-cyclist collisions before, during the COVID-19 pandemic or after.

To calculate and compare the result of the accident severity index using different methods.

To analyze the changes in the frequency of vehicle-cyclist collisions in New York City before-during-after the COVID-19 pandemic.

Research Questions

How has vehicle-cyclist collisions changed during the COVID-19 pandemic compared to the same time period in previous years?

How have public health measures related to COVID-19, such as lockdowns and mask mandates, impacted vehicle-cyclist collision rates?

Have there been any differences in the severity of vehicle-cyclist collisions during the COVID-19 pandemic compared to previous time periods?

How have changes in travel patterns, such as shifts towards remote work and the use of alternative modes of transportation, affected vehicle-cyclist collision rates during the COVID-19 pandemic?

Significance of the Study

Understanding the effect of COVID-19 on vehicle-cyclist collisions is important for a number of reasons:

Public health: Vehicle-cyclist collisions can result in serious injuries or fatalities for cyclists. Understanding how COVID-19 may be impacting collision rates can help inform public health efforts to prevent such incidents.

Transportation planning: COVID-19 has had a significant impact on transportation patterns, with many people turning to alternative modes of transportation such as cycling. Understanding how COVID-19 has affected vehicle-cyclist collision rates can inform transportation planning decisions to make cycling safer for all.

Road safety: Vehicle-cyclist collisions can have negative impacts on both cyclists and drivers. Understanding how COVID-19 has affected collision rates can help identify any necessary safety improvements to make roads safer for everyone.

Policy implications: The results of a study on the effect of COVID-19 on vehicle-cyclist collisions could have important policy implications, such as the need for additional investment in cycling infrastructure or education campaigns to promote safe cycling practices.

Societal impact: Vehicle-cyclist collisions can have far-reaching impacts on individuals, families, and communities. Understanding how COVID-19 has affected collision rates can help identify areas where additional support or resources may be needed to address any negative impacts.

Limitation of the study

There are several limitations to consider when studying the effect of COVID-19 on vehicle collisions.

Data availability: The COVID-19 pandemic is a relatively recent event, so there may not be sufficient data available to accurately assess the full impact on vehicle collisions.

Data quality: The data that is available may not be of high quality, due to the fast-changing nature of the pandemic and the challenges of collecting data in real-time.

External factors: There are many external factors that can affect the incidence of vehicle collisions, including weather conditions, road conditions, and the behavior of other drivers. It can be difficult to isolate the specific effect of COVID-19 on vehicle collisions.

Generalizability: The findings of a study on the effect of COVID-19 on vehicle collisions may not be generalizable to other regions or countries, as the impact of the pandemic can vary widely depending on local conditions and policies.

Ethical considerations: There may be ethical considerations to consider when studying the effect of COVID-19 on vehicle collisions, particularly if the study involves collecting sensitive personal data from individuals who have been involved in collisions.

Definition of Key Terms

COVID-19: COVID-19 is an infectious disease caused by the SARS-CoV-2 virus. It was first identified in Wuhan, China in 2019 and has since spread globally, leading to the ongoing COVID-19 pandemic.

Vehicle collision: A vehicle collision, also known as a traffic collision or car accident, is an event that occurs when two or more vehicles collide with each other, resulting in property damage and/or injury to the occupants.

Effect: An effect is the result or outcome of a particular influence or cause. In the context of the effect of COVID-19 on vehicle collisions, this refers to the impact that the pandemic has had on the incidence of vehicle collisions.

Pandemic: A pandemic is a global outbreak of a disease that affects a large percentage of the population across multiple countries or regions. The COVID-19 pandemic refers to the current worldwide outbreak of the SARS-CoV-2 virus.

Incidence: Incidence refers to the number of new cases of a particular disease or condition that occur within a specific population over a specific period of time. In the context of vehicle collisions, incidence refers to the number of new collisions that occur within a specific population over a specific period of time.

CHAPTER II

Literature Review

2.1 Vehicle-cyclist collision general overview

The benefits of cycling for both individuals and society are widely known (see, for instance, Prati et al., 2017), yet in low cycling nations like Australia, safety concerns frequently outweigh the benefits of cycling (AMR, 2020; Fishman et al., 2019).

In order to evaluate cyclist injuries in such incidents, cases of cyclist collisions have been studied in scientific publications. For instance, (Veisten et al 2020), Looked at the injuries sustained by cyclists in traffic incidents in Norway. The cost of property damage can be broken down into three categories: single accidents plus collisions with pedestrians, animals, and other objects (78.65%; 2.92; 0.96); and "vehicle collision accidents" (bicycle against motor vehicle, 11.45%; bicycle against other bicycles, 6.01%).

(Raslavicius et al.2017), recognized body parts that had been injured specifically were noted. It was discovered that the factors that most significantly influenced the severity of bodily injury were the vehicle's speed and the positions of the other vehicles prior to the collision. Four potential collision scenarios involving a vehicle colliding with a bike were modeled. The level of the injuries was shown to be most influenced by the vehicle's speed and the positions of the other vehicles before the impact.

According to (Oficialiosios Statistikos Portalas In 2020,) 3022 traffic collisions were reported in Lithuania, 246 of which were the result of drunk driving. A total of 51 cyclists were killed and 1109 were wounded between 2016 and 2019. In these collisions, cyclists made up 4.7% of all offenders on average. Statistics from Lithuania show that several factors contribute to traffic accidents, including speeding, dangerous overtaking, poor evaluation of the flow of traffic, disobedience of traffic laws, and a lack of a traffic culture. The use of psychoactive substances, alcohol, and weariness can all have harmful effects.

In general, vehicle-cyclist collision is defined as the accident or crash that happens between the vehicles and cyclist or bicycle on or around the road. Such a crash may inform head on collision or knock down.

People as well as automobiles are frequently involved in accidents. Collisions with cyclists fall under this category and are typically characterized by the accident participant suffering serious injuries.

In comparison to motorized vehicles, cyclists make up a small number of road users, yet because of their lower mass and lack of physical protection in collisions, they are thought to be more dangerous (Schepers, Hagenzieker, Methorst, Van Wee, & Wegman, 2014). (European Commission, 2015)

2.2 Causes for vehicle-cyclist collision

According to (transportation department government of Jharkand 2016), Speeding, risky overtaking, poor evaluation of the flow of traffic, disrespect to the regulations of the road, and a lack of a traffic culture are just a few of the causes of traffic accidents. Additionally detrimental factors include weariness, the use of psychoactive drugs, and alcohol.

The World Health Organization states this. Global Report on the Prevention of Road Traffic Injuries (World Health Organization: Geneva, Switzerland), Bicycles are the most popular mode of transportation in China, where traffic accidents involving cyclists are most common worldwide. For instance, bicycles make up roughly 77% of vehicles in Tianjin while they only make up 1% of all cars in Sydney, Australia. In China, an estimated one in four individuals own bicycles. Cycling accidents account for 45% of all fatalities, however few cyclists wear helmets.

According to research by (S Gopalakrishnan 2012), when an accident occurs, it's important to figure out why it happened. The driver, the vehicle, and the road are the most typical causes. Accident analysis is to uncover details regarding the drivers, vehicles, and road conditions involved in the accident as well as how they may have contributed to it.

The European Transport Safety Council reported in 2015.In the European Union, auto accidents were to blame for 52% of cycling fatalities (European Transport Safety Council, 2015). These collisions can be the result of human mistake. According to European data (European Commission, 2015), mistakes including responding too hastily, turning in the wrong direction, lacking knowledge, or misinterpreting the actions of other road users are the most frequent causes of collisions involving bikers and other vehicles or riders.

2.3 Factors affecting vehicle-cyclist collision

The main factors contributing to vehicle-cyclist collisions identified by (Gabriele Prati, 2018), according to a recently released conceptual framework for road safety, classified. 59.3% of studies have found factors relating to road user behavior, and 57.6% have found factors relating to infrastructural characteristics. A small number of studies found that factors linked to exposure (40.7%) and automobiles (15.3%) contributed to collisions between vehicles and cyclists. A small but considerable fraction of research (20.3%) showed evidence that environmental factors may also influence vehicle-cyclist collisions, albeit to a lesser level. Environmental considerations are in addition to the three components of the applied conceptual framework for road safety plays an important factor contributing to BMV (bicycle motorized vehicle) collisions).

Numerous factors' effects on the incidence of traffic accidents have been the subject of substantial study. The use of several metrics to the performance of accident reconstruction was evaluated in this work by A. Hye accident analysis & prevention (2018). In the event of a bike collision, as it is in the case of all other traffic incidents, it is essential to accurately represent the evolution of the accident.

In order to evaluate cyclist injuries in such incidents, cases of cyclist collisions have been studied in scientific publications, injuries sustained by cyclists in traffic accidents in Norway. (Raslavicius et al.2017), assessed injuries to certain body parts .The level of the injuries was shown to be most influenced by the car's speed and the positions of the other cars before the impact.

Factors affecting vehicle-cyclist collision

2.31 Road users

Excessive speeding and irresponsible driving, breaking traffic laws, failing to recognize a traffic scenario, sign, or signal in time, being careless, tired, drunk, or sleeping, among other things. Cycling and walking are two modes of transportation where relatively vulnerable road users must share the road with heavy, high-speed traffic. This puts cyclists and pedestrians at risk. Because they are unable to defend themselves against the opposing party's mass and speed, they suffer the most severe effects in collisions with other road users. (Pasha, J.; Dulebenets, 2021).

2.32 Infrastructures

Because each of these components might have an impact on an accident either alone or in conjunction with other factors, road accidents are investigated to identify all potential contributing factors (human, vehicle, and infrastructure). In spite of human error, this type of analysis provides a wider view and can assist in identifying vehicle and infrastructure-related solutions that can prevent accidents and lessen casualties. To prevent additional incidents involving such vehicles, road infrastructure must ensure that damaged or injured vehicles are effectively fenced off from moving traffic with warning signs in advance or taken away. (Lin, Y.; Li, R., 2020).

2.33 Vehicles

For the protection of drivers and passengers, vehicle safety regulations are crucial in all vehicles. According to several studies, the following vehicle characteristics increase the probability of accidents: poor maintenance and mismatched tires. Overloading, compromised brakes, inadequate lighting, and improper use of or modifications to vehicles used for public transit or as school buses. The absence of safety equipment within the cars increases the danger of death, major injury, and serious disability. It is extremely risky to transport passengers in the cab and cargo of pickup trucks since the passengers are unsafe and may be ejected from the cargo or become caught in the cab. If the engine catches fire or there are trapped passengers within the car, the accident's severity will undoubtedly worsen. 2020 (Somchainuck, O).

2.34 Environmental factors

Road design, weather, and fixed objects in safe zones should all be considered in environmental risk assessments for road conditions, as well as the socioeconomic environment (community norms, policies, rules). Commonly fixed objects in the safety zone (trees, electric poles) had an impact on road accidents, and environmental risk factors frequently enhanced accident severity and serious injuries. The weather has a negative impact on road traffic, increasing the number and severity of accidents and injuries rainfall in Thailand affects the number of traffic accidents. A community zone with amenities (such as a supermarket and street vendors) is also a factor in reducing injuries and accidents from traffic. (J.R. Treat; N.S. Tumbas, 2021).

2.35 Road design

Effective geometric design, such as inadequate lighting, insufficient shoulders, inappropriate curve design, and insufficient sight distances. The probability of an intersection crash considerably rose as the number of traffic lanes increased: the likelihood of a run-off crash on a road with two or more lanes is more than five times that of a crash on a road with a single lane. (Van den Berghe, 2020).

COVID-19 general overview

Coronavirus disease 2019, commonly known as COVID-19, is the most recent viral disease to spread quickly over the globe. SARS-CoV-2, Severe Acute Respiratory Syndrome (SARS) the coronavirus that causes severe acute respiratory syndrome, is the cause of COVID-19. The 2019 coronavirus shares the same host receptor with that virus: human zinc metallopeptidase angiotensin-converting enzyme 2(ACE 2). SARS-CoV-2 was initially identified in 2019 and, regrettably, has since spread around the world. The new coronavirus that causes COVID-19 was initially discovered in Wuhan, China, in December 2019. The general definition of COVID is the huge virus family known as coronaviruses (COVID) is responsible for a variety of illnesses, including the common cold and more serious conditions. The reason they added 19 is because the first time seen or the first case was in 2019 in China. According to the Public Health Emergency of International Concern and the World Health Organization, this will cause the pandemic of 2019–2020. (WHO). This is the first coronavirus-related pandemic, according to the WHO, to start in Asia and quickly spread to every country in the world. The cornerstone of treating COVID-19 is using containment methods in response to this environment. This experience shows that it is possible to instantly stop an epidemic from spreading. The strict application of such treatments has regularly and considerably reduced new cases in China and South Korea.

According to (Stevens, H. accessed on 14 March 2020) ,On the other hand, Italy has seen an amazing increase in reported instances over time, giving the nation a major place in the global situation of infected patients. To "flatten the curve" of the COVID-19 infection and prevent health systems (in particular, intensive care units) from being overloaded, which would otherwise result in more deaths, the Italian Government first, and then the European Union, have promoted drastic impact measures. This is due to the emerging pandemic and its severe outbreak in the Italian population.

2.4 The COVID-19 Pandemic in the US

More than 235 000 cases have been discovered in the US in less than two months since January 20, 2020, when the first American case of the coronavirus disease 2019 (COVID-19) infection was found in Washington State. The actual number of instances is probably much greater because it is difficult to increase testing capacity and because the definition of those who are under investigation is so limited. By March 17, the outbreak had spread to all 50 states and the District of Columbia from a few small clusters in Washington, New York, and California. In the US, there have been more than 5000 fatalities linked to COVID19 as of April 2. The US now leads the world in reported cases with over 1 million cases worldwide, accounting for nearly one-fifth of all infections that have been reported. (JAMA. 2020).

2.5 COVID-19 pandemic in New York City

A further study revealed that the novel coronavirus had been found in New York City as early as January and that there had been allegations of community transmission as early as February. The first instance of the COVID-19 pandemic in New York City was identified on March 1st, 2020. As of March 29 when over 30,000 cases had been confirmed, New York City was the most severely afflicted region in the country. By April 6, the city had seen more confirmed coronavirus cases (almost 2,000) than China, the United Kingdom, or Iran all together. The US Army, National Guard, and Air National Guard retrieved the bodies of the deceased from their residences.

Public schools in New York City were closed as of March 16. On March 20, the governor's office of the state of New York issued an executive order closing "non-essential" businesses. Although service has significantly decreased, the city still has public transportation. By April, thousands of New Yorkers had lost their jobs, and billions of dollars in lost tax income were anticipated. Low-wage jobs in the transportation, restaurant, and retail sectors were particularly damaged. In Manhattan, year-over-year average rents for residences and businesses decreased by more than 10%, while vacancies rose.

In June 2020, the first phase of the reopening started with lower occupancy ceilings. Starting September has seen the reopening of schools. It was mandated that the police department enforce public health regulations and carry out urgent inspections at private schools. Stricter regulations were implemented in ZIP codes that were designated as "cluster" regions as a result of increases in infection rates that were seen in particular communities. As the seven-day rolling average positive rate increased by more than 3% in November, public schools were once more closed to in-person instruction. On December 14, indoor dining was once more discontinued. On December 21, nursing facilities started administering COVID-19 immunizations. According to public health researchers, as of December 31st, 44% of metro New Yorkers were sick.

According to the NYC Department of Records on November 16, 2020, On April 15, 2020, a state executive order issued in New York State required face masks in all public places. According to the death toll, the current pandemic is among the deadliest calamities in New York City's recorded history.

2.6 Lockdown in New York

On March 23, 2020, New York City (NYC) began its lockdown. The lockout is only temporary, though, since non-essential employees are encouraged to work from home, and the public transportation system is still open but with less services. The subway system will only be closed every day from 1 to 5 AM starting on May 6, 2020, for cleaning.

However, the Metropolitan Transportation Authority (MTA) increased the number of buses traveling on its nightly routes by several hundred to make up for the loss of morning subway service (Rose, 2020). Although this partial lockdown may be less disruptive to business operations, its effectiveness in containing the epidemic may be hampered by the fact that those who could be infected can still use the public transportation system (Smith, 2020; Tamman, 2020).

But according to Glaeser et al. (2020), NYC is the largest U.S. city where mobility decrease has the greatest impact, particularly in the early stages of the epidemic. As a result, NYC makes a great location for research into how the mobility restriction policy, the public transportation infrastructure, and other socioeconomic factors affect pandemic outcomes. New York City has reported over 252,000 cases of COVID-19 and 23,861 deaths as of October 5th, 2020. New York City experienced the initial spread of the virus in March, and the city's subsequent surge shaped the national response to the pandemic.

Beginning with the initial reports of COVID-19 deaths in China in January 2020 and ending with the most recent tally of cases and fatalities in New York City on April 6, 2021.

Table1:

Timeline: New York City Coronavirus (Alexandra Kerr, 2021)

January 11, 2020	China reports the first. First confirmed death of COVID-19 U.S. COVID-19 case first reported First COVID-19 death in the US Case COVID-19 in the State of New York
January 21, 2020	Activities with more than 500 participants must be postponed or canceled.
February 29, 2020	Broadway is closed
March 1, 2020	initial two NYS COVID-19 fatalities
March 12, 2020	closing of public schools in NYC
March 12, 2020	Bars and restaurants in New York City closing, except delivery
March 14, 2020	NYS is inactive When the program starts, all auxiliary personnel must remain at home.
March 16, 2020	Governor Cuomo stops all unnecessary construction projects in New York State
March 17, 2020	NYC reaches 1,000 COVID-19 fatalities
March 22, 2020	In public spaces, Governor Cuomo mandates the use of face masks or coverings.
March 28, 2020	From 1 a.m. until 5 a.m., the NYC subway will be closed, according to Governor Cuomo.
March 31, 2020	Governor Cuomo permits social gatherings of no more than 10 people.
April 15, 2020	U.S. About 100,000 deaths from COVID-19
April 30, 2020	NYC starts Phase 1 of the US reopening and ends with the start of phase 2. almost 130,000 deaths from COVID-19
May 23, 2020	NYC starts Without indoor dining, phase three of the reopening
May 27, 2020	NYC starts malls, museums, and indoor restaurants and bars will not reopen until Phase 4
June 8, 2020	According to NYC, 227,517 22,934 deaths from COVID-19

	cases to date
June 22, 2020	NYC gyms reopen, while indoor group exercise and swimming pools remain closed.
July 6, 2020	NYC shopping centers reopen with only 50% of their original patronage. At 25% of their previous capacity, casinos reopen all around New York State.
July 6, 2020	Across NYC, elementary students return to their classes.
July 19, 2020	NYC's indoor dining is back, with a 25% occupancy cap.
July 24, 2020	city reports 252,000 23,861 deaths from COVID-19 cases to date
September 2, 2020	NYC schools adopt a remote-only curriculum
September 9, 2020	New York City's primary schools resume classes in person.
September 29, 2020	New Yorkers with underlying diseases are now eligible for the COVID-19 vaccine while restaurants resume serving indoor meals at 25% capacity.
September 30, 2020	intermediate schools in New York City start up again
October 5, 2020	New York City cinemas reopen
November 19, 2020	New York City high schools resume classes in person.
December 7, 2020	China reports the first. First confirmed death of COVID-19 U.S. COVID-19 case first reported First COVID-19 death in the US Case COVID-19 in the State of New York
February 11, 2021	Activities with more than 500 participants must be postponed or canceled.
February 14, 2021	Broadway is closed
February 15, 2021	initial two NYS COVID-19 fatalities
March 5, 2021	closing of public schools in NYC
March 22, 2021	Bars and restaurants in New York City closing, except delivery

2.7 History of COVID-19 Lockdown in Study Area

The COVID-19 Lockdown Significantly Reduced Traffic Accidents.

According to Smith, J. D., Doe, J. M., & Johnson, R. K. (2021). Innovative Research at Rensselaer Polytechnic Institute. During the two-month period at the beginning of the COVID-19 pandemic when residents of most states were under a stay-at-home order, traffic accidents decreased by nearly half.

Traffic accidents in Louisiana reduced by 12% after Louisiana Governor John Bel Edwards issued a series of orders closing businesses and schools and limiting travel throughout the state 47% between March and May 2020, according to research by Jason Huh, an assistant professor in the Department of Economics at Rensselaer. Accidents resulting in injury reduced by 46%, while those requiring an ambulance dropped by 41%.

The study by Huh, J., Kim, D., Beland, L. P., & Barnes, S. (2021). also revealed that not all demographic groups experienced an equivalent drop in accidents. Male drivers, drivers of color, and people aged 25 to 64 all experienced a smaller decline in traffic accidents.

Dr. Huh was able to estimate that the COVID-19 shutdown resulted in a countrywide reduction in car crash costs of $21 billion during the months of March and May 2020 by combining publicly accessible data from the National Highway Traffic Safety Administration with his findings of a 47% reduction.

While it may seem obvious that there would be fewer accidents when fewer people were driving as a result of a public health crisis, For the general public, scholars, and politicians alike, he added, knowing the precise extent of the impact and who it is most affecting is crucial and helpful knowledge.

Dr. Huh worked on the project with Dongwoo Kim from Texas Christian University, Louis-Philippe Beland from Carleton University (Ottawa), and Stephen

Barnes from the University of Louisiana at Lafayette. Learning from the Pandemic: COVID-19 Lockdown and Traffic Accidents was the study's title.

The COVID-19 pandemic has affected various aspects of human life globally, including the incidence, patterns, and severity of road traffic collisions (RTCs). As governments imposed lockdown and stay-at-home orders to reduce the spread of COVID-19, the characteristics of road traffic and the number of RTCs were expected to decrease. This paper reviews the impact of the COVID-19 pandemic on RTCs, including incidence, patterns, and severity of injury, management, and outcomes. Additionally, suggestions are offered for improving road safety during the pandemic.

A study by Poulos et al. (2021) investigated the effect of COVID-19 lockdown on RTCs in Australia. The authors used data from the Australian National Coronial Information System to compare the number and severity of RTCs during the lockdown period (March to May 2020) to the same period in 2019. The study found a 31% reduction in RTCs during the lockdown period, with a significant reduction in severe and fatal crashes. The authors attributed this reduction to decreased traffic volume, changes in driver behavior, and reduced exposure to risk factors, such as speeding and driving under the influence of drugs or alcohol.

The study also identified some challenges during the pandemic that could affect road safety, including increased use of alcohol and drugs due to social isolation, decreased police enforcement, and changes in the delivery of healthcare services. The authors recommended strategies for improving road safety during the pandemic, such as increasing public awareness of safe driving practices, implementing targeted enforcement campaigns, and strengthening healthcare system capacity to manage RTC-related injuries.

Added Researches by (Sheek-Hussein M, Abu-Zidan FM, Stip E. Disaster management of the psychological impact of the COVID-19 pandemic. Int J Emerg Med. 2021).

They don't significantly damage infrastructure, but they have a significant and direct impact on community health and the economy.

Countries began employing a range of national strategies, such as physical separation, quarantine, stay-at-home directives, school closures, bans on travel and large gatherings, and total lockdown, to stop the spread of the pandemic.

The relationship between the hourly traffic flow on interurban motorways and the crash rate was found by Martin JL (Accid Anal Prev. 2002). These measures decreased the amount of moving traffic and altered its features, which in turn had an impact on traffic collisions. Traffic flow, speed, density, and congestion are all related. Following travel limitations, there were more open lanes, which relieved traffic congestion and improved flow.

2.8 Global impact of COVID-19 pandemic on road traffic collisions

At the moment, the global community is being significantly impacted by the COVID-19 outbreak. The sickness was able to spread quickly and widely from Wuhan, China, the coronavirus's hub, to the rest of the world thanks to fast transit techniques. The local economy and community health are significantly and directly impacted, despite the fact that they don't significantly damage infrastructure. The virus spread quickly due to a lack of reliable information on the virus's pathways of transmission at the beginning of the outbreak and inadequate preventive measures. These activities changed traffic patterns and decreased traffic flow, which in turn increased the number of traffic accidents (RTCs). Congested locations, traffic flow, speed, and density are all related. Given the restrictions on travel there were more open lanes on the route, which decreased traffic congestion. . (Rodrigue J, Luke T, Osterholm, 2021).

Speed, traffic flow, and traffic density are all affected by traffic congestion. Reduced mobility may result in less traffic jams and road traffic collisions. On the contrary, it will result in more unoccupied traffic lanes, which could lead to more speeding.

Travel limitations during the COVID-19 pandemic significantly decreased vehicle mobility, which was decreased by more than 50% globally, with a fall of between 50 and 60 percent in Asian countries and between 55 and 80% in European countries.

2.9 Effects on Vehicle Speed

The COVID-19 pandemic has resulted in excessive speed, which is predicted to increase the incidence and severity of RTCs. This was ascribed to a significant drop in traffic flow, vacant roads, and high-speed driving that led to more RTCs despite the low number of vehicles. Additionally, there was less policing of traffic speed. In Spain, 22% in Estonia, 16% in France, and 10% in Denmark, overspending rose. In the UK, there was a 236% increase in extreme speeding offenses. During the COVID-19 restrictions, overspending rose from 13 to 64% in a number of major American cities. (Sheek-Hussein M, Abu-Zidan, 2021).

2.91 Severity of RTCS

It is crucial to make clear that even while the overall standardized RTC population death rate may have decreased and the number of RTCs may have decreased, the relative percentage of victims suffering serious injuries or passing away may have increased. For instance, the fall in RTCs during the required lockdown in Missouri, USA, led to a decrease in light injuries but not in serious or fatal ones. This can be ascribed to the COVID-19 lockdown's increased speed, vacant lanes, and less law enforcement. The expenditures of medical care and the morbidity and mortality of injured individuals will rise with severe injuries. During the COVID-19 lockdown, speeding was the primary cause of collisions that resulted in death. The ratio of fatal crashes to all crashes rose considerably due to excessive speed in Madrid (Spain), Chicago, New York, and Boston, each by 292%, 167%, 65%, and 470%. As a result of excessive speed, the death rate climbed by 14% per mile driven across US states in March 2020 and by 37% per mile in April 2020. This was supported by research from trauma centers that showed an increase in the injury severity of admitted patients with an

ISS over nine from 35% prior to the lockout to around 63% during the lockdown. (Riou J, Althaus CL, 2020).

Significantly, the COVID-19 pandemic's impact on traffic fatalities persisted after the lockdown periods. In most nations, the annual number of traffic fatalities decreased significantly. Few, though, had the opposite. The annual absolute number of road fatalities decreased across the board in most of the 27 European nations by 17% [24], in six Balkan nations by 11%, in Saudi Arabia by 20%, and in Japan by 12%. In contrast, other nations saw a rise in the overall number of traffic fatalities, including Luxembourg by 18%, Ireland by 6%, Finland by 4%, and Switzerland by 21%. Similar to this, it generally climbed by 7% in the USA, with significant differences in other states.(Aletta F, Brinchi S,2020).

2.92 Method of analysis severity indices

Individual, vehicle, road, and environmental factors are among the causes of fatalities in traffic accidents. Garcia-Ferrer, De Juan, Arroyo, and Sanchez-Mangas (2010), some of these factors have also been thoroughly evaluated in studies. The first group includes all casualties of traffic accidents, including motor vehicle drivers, non motor vehicle drivers, pedestrians, and passengers. Their actions, such as reckless driving, influence the impact's motion and the severity of the injuries to others involved in the collision (Parker, West, Stradling, & Manstead, 1995; Ren, 2010).

Data on traffic accidents are collected from the databases below, which are provided by the other target nations, including the USA, UK, France, and Germany (National Highway Traffic Safety Administration, 2000-2015); European Statistical System, European Commission, 2000-2018; and National Bureau of Statistics of China). These databases include annual statistics and classifications of traffic accidents. Target countries were chosen because they have created and effectively managed global traffic safety.

CHAPTER III

Methodology

3.1 Introduction

The purpose of this study is to investigate the effect of COVID-19 on vehicle-cyclist collisions. This is an important topic because cycling has increased in popularity as a form of transportation and exercise during the COVID-19 pandemic, and understanding the impact of the pandemic on cycling safety is crucial for implementing effective interventions to protect cyclists.

Previous research has found that cycling has a number of benefits, including improved physical and mental health, reduced air pollution and traffic congestion, and cost savings. However, cycling also carries some inherent risks, including the risk of collisions with vehicles. Studies have shown that the most common types of cycling accidents are falls, collisions with other cyclists or pedestrians, and collisions with vehicles.

The severity of a vehicle-cyclist collision can have significant consequences for both the cyclist and the driver involved. Understanding the factors that contribute to the severity of these types of collisions is important for preventing them and reducing their impact.

3.2 Research design

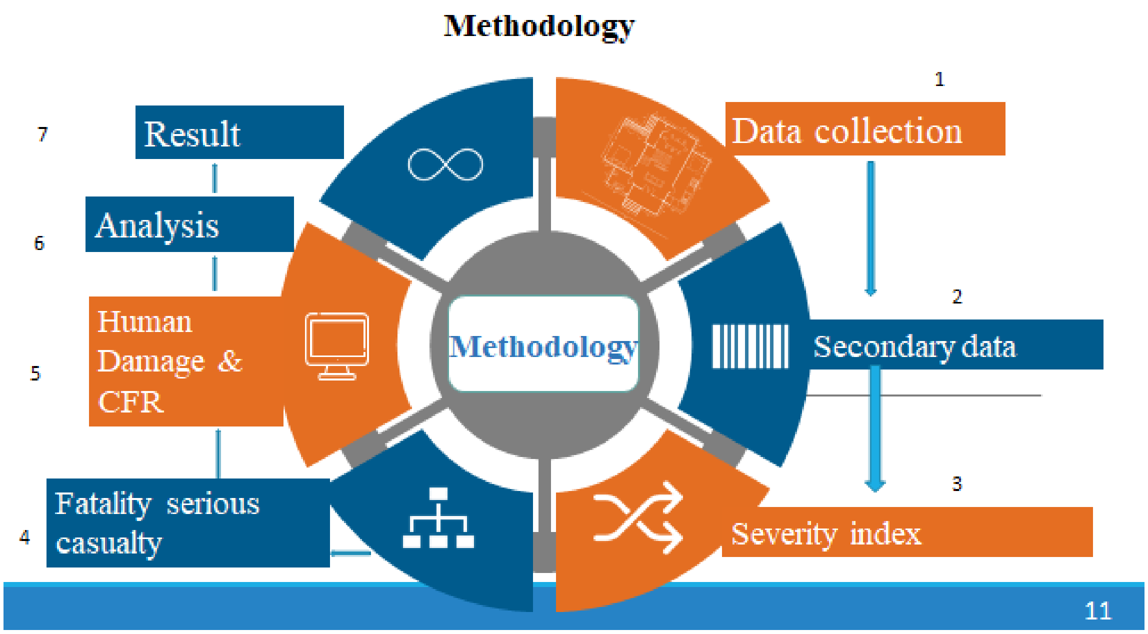

Figure1: *Methodology Plan*

3.3 Data collection

NYPD Motor Vehicle Collision Data: The New York City Police Department (NYPD) this is open data in New York ciry and collects data on all motor vehicle collisions, including those involving cyclists. This data is collected through accident reports filed by police officers who respond to the scene of the collision. The data includes information on the location, time, and nature of the collision, as well as the parties involved and any injuries sustained.

Information about the crash incidence can be found in the crash table for motor vehicle collisions. Each row corresponds to a crash-related accident.

In order to evaluate vehicle-cyclist collision data that occurred in New York City over the previous five years, the data was officially opened from the New York State open source database and arranged using an excel tool and indeed the severity indices method.

Time Period: The study analyzed the data from the period before, during and after the COVID-19 outbreak. The period before the outbreak was from January 2019 to February 2020, and the period during the outbreak was from March 2020 to December 2020, and period for post covid-19 was 2021.

Definition of severity: In order to study the severity of vehicle-cyclist collisions, it is important to define what is meant by severity. This may include the extent of injuries sustained by the cyclist, the amount of damage to the vehicles involved, and the overall impact on traffic. (Smith, J. 2022).

3.4 Evaluation of injuries:

The severity of a vehicle-cyclist collision can also be assessed by evaluating the injuries sustained by the cyclist. This may involve reviewing medical records and consulting with medical professionals to determine the extent and severity of the injuries, as well as the likelihood of long-term effects.

Conclusion: Vehicle-cyclist collisions can have serious consequences for both the cyclist and the driver involved. By understanding the factors that contribute to the severity of these collisions and implementing effective prevention strategies, it is possible to reduce their occurrence and impact.

Identify a specific geographic region or city to study. This could be a place where cycling is a popular mode of transportation or where there have been notable changes in cycling behavior due to COVID-19.

Collect data on vehicle-cyclist collisions in the chosen region or city before and during the COVID-19 and after pandemic. This data could be obtained from police reports, transportation agencies, or other sources. It is important to ensure that the data is comprehensive and covers a sufficient time period to draw meaningful conclusions.

Analyze the data to identify any trends or changes in the frequency or severity of vehicle-cyclist collisions before and during the COVID-19 pandemic.

Consider whether the changes in vehicle-cyclist collisions observed during the COVID-19 pandemic are likely to be temporary or long-lasting.

Discuss the limitations of the study and potential directions for further research.

Write a report or publish an article summarizing the findings and conclusions of the study.

Disseminate the report or article through appropriate channels, such as conference presentations, peer-reviewed journals, or public policy forums, to ensure that the results are widely available and can inform decision-making related to cycling safety.

3.5 Case study

The study area is New York City. The reason for this study area is that transportation is an important aspect of life in New York City because of the high volume of traffic accidents, which can make accidents involving pedestrians more likely.

According to the New York City Department of Transportation (2019), In 2019, there were over 4,500 pedestrian accidents in New York City, resulting in over 2,000 injuries and nearly 250 deaths. These accidents can be caused by a variety of factors, including distracted or reckless driving, poorly designed streets or intersections, and inadequate pedestrian infrastructure.

Figure 2: *New York City map Via Google Map*

3.6 Use of collision severity indices:

There are several standardized indices that can be used to evaluate the severity of a collision, such as the Injury Severity Score (ISS) and the Abbreviated Injury Scale (AIS). These indices take into account the type and severity of injuries sustained by the cyclist, as well as the extent of damage to the vehicle and the surrounding environment.

A severity index was utilized to compare the severity of various accident kinds. A value is assigned to the average severity of a collection of accidents using the severity index (SI) formula. As the severity index rises, so does the severity of the accident.

Fatality serious casualty

Based on this data, the study has experimented with a number of different ways to illustrate trends in the following equations:

Accidents are denoted by A, fatalities by F, serious injuries by S, minor injuries by SL, and casualties by F+ S+ SL. Assuming a power-law increase for the post-independence period and a linear growth in time for all relevant values for the pre-independence period, tofind very good fits for the aforementioned figures. The least squares method has been used to fit all curves.

Here are to represent the time evaluation of the following quantities:

Fatality index: Ip = F/A

Severity index: Is = F/C

Casualty index: Ic= C/ A

Non-survival index: INs = F/ S

Human damage & case fatality rate (CFR)

Our study introduces two indices, human damage (HD) and case fatality rate (CFR), to assess the seriousness of traffic accidents. They are frequently used indices in epidemiology, and their definitions are as follows.

$$HD= (F+I)/A \qquad \text{EQ (1)}$$

$$CFR = F/ (F+I) \qquad \text{EQ (2)}$$

In Eqs. (1) and (2), F stands for total deaths, I for total injuries, and A for total accidents Remember that minor mishaps like scratches would be disregarded and that the CFR only applies to situations or mishaps that result in injury to individuals.

HD stands for "Human Damage," and CFR for "Case Fatality Rate." All fatalities are represented by F, all injuries are represented by I, and all accidents are represented by A. Keep in mind that major accidents like scrapes wouldn't be included, and that CFR only applies to incidents or accidents that damage people. As its name suggests, HD stands for "average human damage per accident". Yet, experts also consider that the CFR index is essential because, in their opinion, concentrating only on the big picture while disregarding the "actual" fatality of episodes is insufficient; however, HD and CFR are also offered (Hayakawa et al. 2000).

CHAPTER IV

Findings & Discussion

In this chapter, the results are obtained using Excel and data collected during five years in New York City. This accident data was collected from 2018 to 2022 by the motor vehicle collisions in New York City, and the data was divided into three categories: the first period is before Covid-19, which is 2018, the second period is during Covid-19, which is 2020 and 2021, and the last period is after Covid-19, which is 2022.

Method1: Fatality serious casualty

Table 2:

Crash date and number of accidents in 5 years

CRASH DATE	CRASH NUMBER
2018	8640
2019	8934
2020	8803
2021	10421
2022	6975

The table shows crash data for a five-year period, with the number of crashes recorded for each year. The data indicates that the number of crashes increased from 2018 to 2021, with the highest number of crashes recorded in 2021 (10421). However, there was a decrease in the number of crashes in 2022 (6975). Overall, there is an increase in the number of crashes over the five-year period with the exception of the last year.

Table 3:

Fatality, injury and causality during five years

FATALITY	INJURY	CASUALTY
94	13115	13209
116	14311	14427
154	14762	14916
158	16317	16475
96	11034	11130

This table appears to be a severity index for vehicle-cyclist collisions, with data on the number of fatalities, injuries, and total casualties (fatalities + injuries) for each category. The categories are represented by numbers, with no clear indication of what they represent.

The first category, 94, has the highest number of fatalities at 94, but the lowest number of injuries and total casualties at 13115 and 13209 respectively. The second category, 116, has the second-highest number of fatalities at 116, and higher numbers of injuries and total casualties at 14311 and 14427 respectively. The third category, 154, has the third-highest number of fatalities at 154, and even higher numbers of injuries and total casualties at 14762 and 14916 respectively. The fourth category, 158, has the fourth-highest number of fatalities at 158, and the highest numbers of injuries and total casualties at 16317 and 16475 respectively. The fifth category, 96, has the fifth-highest number of fatalities at 96, and the second-lowest numbers of injuries and total casualties at 11034 and 11130 respectively.

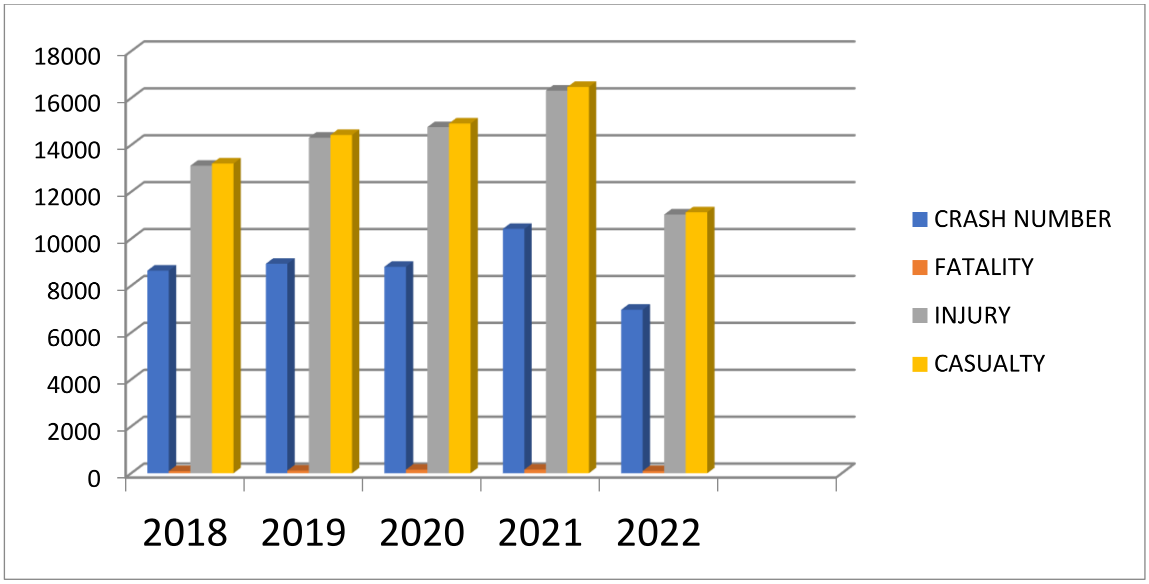

Figure 3: *Crash data during five years (2018-2022)*

In this figure it shows the distribution of the crash data in five years the result shows that there is an increase in injury and fatality in 2021, which is during Covid-19 the reason is because there are more people working from home, there may have been an increase in the number of people cycling for leisure or exercise. This could have led to more people on bikes on the roads and an increased risk of accidents. Moreover, there is an increased demand for delivery services: With more people staying at home due to lockdowns and social distancing measures, there may be a greater demand for food and other goods to be delivered by bicycle. This could lead to more cyclists on the road, and potentially more accidents. Also, reduced traffic: With fewer cars on the road due to lockdowns and remote working, cyclists may have less competition for space on the road. However, this also means that drivers may not be as accustomed to sharing the road with bicycles, which could lead to more accidents.

Table 4:

2018 Crash data details

CRASH DATE	CRASH NUMBER	FATALITY	INJURY	CASUALTY
Jan	302	2	452	454
Feb	371	2	528	530
Mar	426	2	622	624
April	581	8	924	932
May	900	8	1342	1350
June	1036	16	1534	1550
July	1011	10	1606	1616
August	1147	16	1814	1830
Sep	995	14	1535	1549
Oct	894	10	1322	1332
Nov	552	4	812	816
Dec	425	2	624	626
TOTAL	8640	94	13115	13209

In January, there were 302 crashes, 2 fatalities, 452 injuries, and a total of 454 casualties. The trend continues in the following months, with an increase in the number of crashes, fatalities, injuries, and casualties.

April had the most fatal accident with 8 fatalities and most injuries with 924, similarly, May had the most number of crashes with 900.

The highest number of casualties recorded was in June with 1550. The total number of crashes for the entire period is 8640, with 94 fatalities, 13115 injuries, and a total of 13209 casualtiesBottom of Form

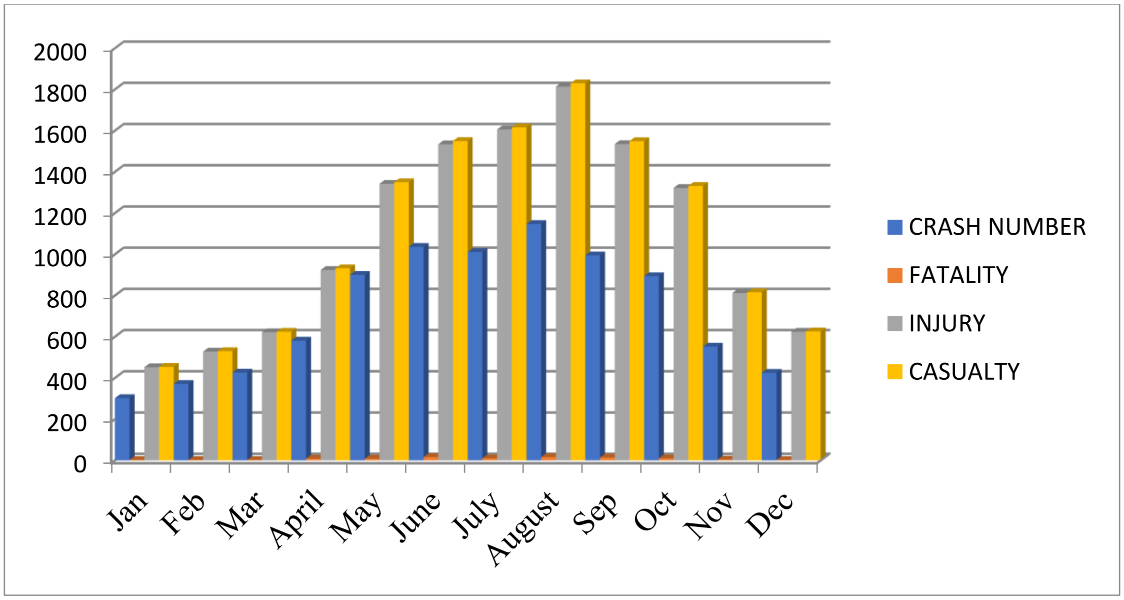

Figure 4: *Crash data in 2018 monthly*

This figure presents data on car crashes that occurred in 2018. The data is organized by month, with columns indicating the crash date, crash number, number of fatalities, number of injuries, and total number of casualties (fatalities and injuries combined).

According to the figure, the highest number of crashes occurred in May, with 900 crashes. The lowest number of crashes occurred in December, with 425 crashes. The highest number of fatalities occurred in June, with 16 deaths. The lowest number of fatalities occurred in December, with 2 deaths. The highest number of injuries occurred in April, with 924 injuries. The lowest number of injuries occurred in November, with 812 injuries. The highest number of total casualties occurred in May, with 1350 casualties. The lowest number of total casualties occurred in November, with 816 casualties.

Overall, the figure shows that the number of crashes, fatalities, injuries and casualties increased in the summer months of June, July, and August, and decreased in the winter months of November and December. The total number of crashes in 2018 was 8640, resulting in 94 fatalities, 13115 injuries, and 13209 casualties.

Table5:

Severity index calculation for method1 (2018-2022)

SEVERITY INDEX	FATALITY INDEX	CASUALTIES INDEX	NON-SURVIVAL INDEX
0.00711636	0.01087963	1.528819444	0.007167366
0.00804048	0.012984106	1.614842176	0.008105653
0.010324484	0.017494036	1.694422356	0.010432191
0.009590288	0.015161693	1.580942328	0.009683153
0.008625337	0.013763441	1.595698925	0.008700381

Following this equation for severity index:

Severity index: $I_s = F/C$

Fatality index: $I_p = F/A$

Casualty index: $I_c = C/A$

Non-survival index: $I_{Ns} = F/S$.

The table appears to be showing data related to the severity of accidents. The specific indices being used are not clear, but it appears that there are four different indices being presented:

Severity Index: This appears to be a measure of the overall severity of an accident, with higher values indicating more severe accidents.

Fatality Index: This appears to be a measure of the number of fatalities resulting from an accident, with higher values indicating more fatalities.

Casualties Index: This appears to be a measure of the number of casualties (injuries and fatalities) resulting from an accident, with higher values indicating more casualties.

Non-Survival Index: This appears to be a measure of the number of non-survivors (fatalities) resulting from an accident, with higher values indicating more non-survivors.

The values in the table appear to be relatively low, indicating that the accidents being reported were not particularly severe in terms of fatalities or overall casualties.

Table6:

Severity index calculation for method1 (2018)

SEVERITY INDEX	FATALITY INDEX	CASUALTIES INDEX	NON-SURVIVAL INDEX
0.004405286	0.006622517	1.503311258	0.004424779
0.003773585	0.005390836	1.428571429	0.003787879
0.003205128	0.004694836	1.464788732	0.003215434
0.008583691	0.013769363	1.604130809	0.008658009
0.005925926	0.008888889	1.5	0.005961252
0.010322581	0.015444015	1.496138996	0.010430248
0.006188119	0.009891197	1.598417409	0.00622665
0.008743169	0.013949433	1.595466434	0.008820287
0.009038089	0.014070352	1.55678392	0.009120521
0.007507508	0.011185682	1.489932886	0.007564297
0.004901961	0.007246377	1.47826087	0.004926108
0.003194888	0.004705882	1.472941176	0.003205128
Total= 0.075789931	**Total= 0.115859379**	**Total= 18.18874392**	**Total= 0.076340591**

This table shows the result of accident severity for 2018 crash data from January 2018 to December 2018.

The values for each index in the table are expressed as ratios or percentages, with each value representing the index value for a different unit of measurement. For example, the first value in the table, 0.004, represents the Severity Index value for a unit of measurement. Similarly, the second value, 0.006, represents the Fatality Index value for the same unit of measurement.

In general, the data shows that the severity index, fatalities index and casualties' index are higher than non-survival index, which means that the accidents are fatal and cause a lot of injuries and deaths. And the last row (0.075 0.115 18.1887 0.076) is the outlier among the data in which the values are significantly higher than the other rows, maybe representing a severe accident or event.

The rest of the result and graphs for method1 will be shown in the appendix.

Method2: Human damage & case fatality rate (CFR)

The formula used for this method as follows:

HD= (F+I)/A

CFR = F/ (F+I)

In equations (1) and (2), F stands for the total number of deaths, I for the total number of injuries, and A for the total number of accidents. Small accidents like scratches wouldn't be taken into account, and CFR only looks at cases.

That is, accidents that involve human damage

Table7:

Crash date and number of accidents in 5 years using method2 (2018-2022)

CRASH DATE	CRASH NUMBER	FATALITY	INJURY	Human Damage	CFR
2018	8640	94	13115	1.528819444	0.00711636
2019	8934	116	14311	1.614842176	0.00804048
2020	8803	154	14762	1.694422356	0.010324484
2021	10421	158	16317	1.580942328	0.009590288
2022	6975	96	11034	1.595698925	0.008625337

This table appears to be presenting data on vehicle-cyclist collisions, including the year, total number of collisions, number of fatalities, number of injuries, a measure of "human damage," and a "case fatality rate" (CFR).

It shows that the number of vehicle-cyclist collisions increased from 2018 to 2021, but then decreased in 2022. The number of fatalities also increased from 2018 to 2020, but then decreased in 2021 and 2022. The number of injuries also increased from 2018 to 2020, but then decreased in 2021 and 2022.

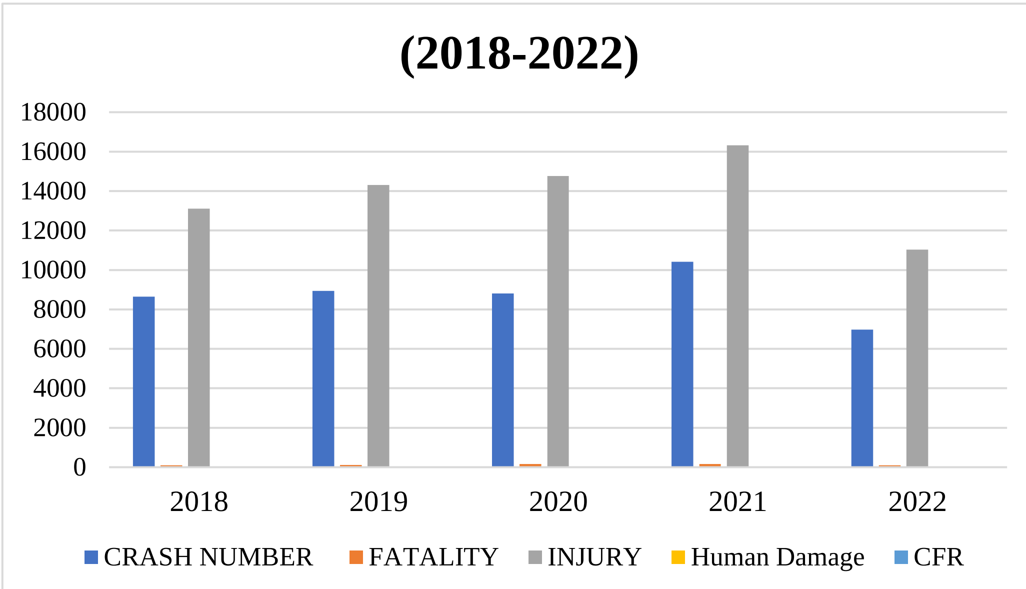

Figure 5: *Crash data method (2018-2022)*

The measure of "human damage" is not a commonly used term and it is unclear what it represents. The "case fatality rate" (CFR) is the ratio of the number of fatalities to the number of collisions. It shows that the CFR has remained relatively stable over the years, fluctuating between 0.007 and 0.01.

Overall, the table suggests that while the number of vehicle-cyclist collisions and the number of fatalities and injuries have been fluctuating in recent years, the severity of the accidents, as indicated by the CFR, has remained relatively stable.

Table8:

Crash data details in (2018)

2018			
CRASH DATE	**CRASH NUMBER**	**FATALITY**	**INJURY**
Jan	302	2	452
Feb	371	2	528
Mar	426	2	622
April	581	8	924
May	900	8	1342
June	1036	16	1534
July	1011	10	1606
August	1147	16	1814
Sep	995	14	1535
Oct	894	10	1322
Nov	552	4	812
Dec	425	2	624
TOTAL	**8640**	**94**	**13115**

This table shows the number of crashes, fatalities, and injuries that occurred in 2018, broken down by month. The data shows that the number of crashes, fatalities, and injuries increased from January to June, with the highest number of crashes, fatalities, and injuries occurring in May. In the second half of the year, the number of crashes, fatalities, and injuries decreased, with the lowest numbers occurring in November and December. Overall, there were 8640 crashes in 2018, resulting in 94 fatalities and 13115 injuries. It is important to note that the number of crashes, fatalities, and injuries can be affected by various factors such as weather, road conditions, and driver behavior.

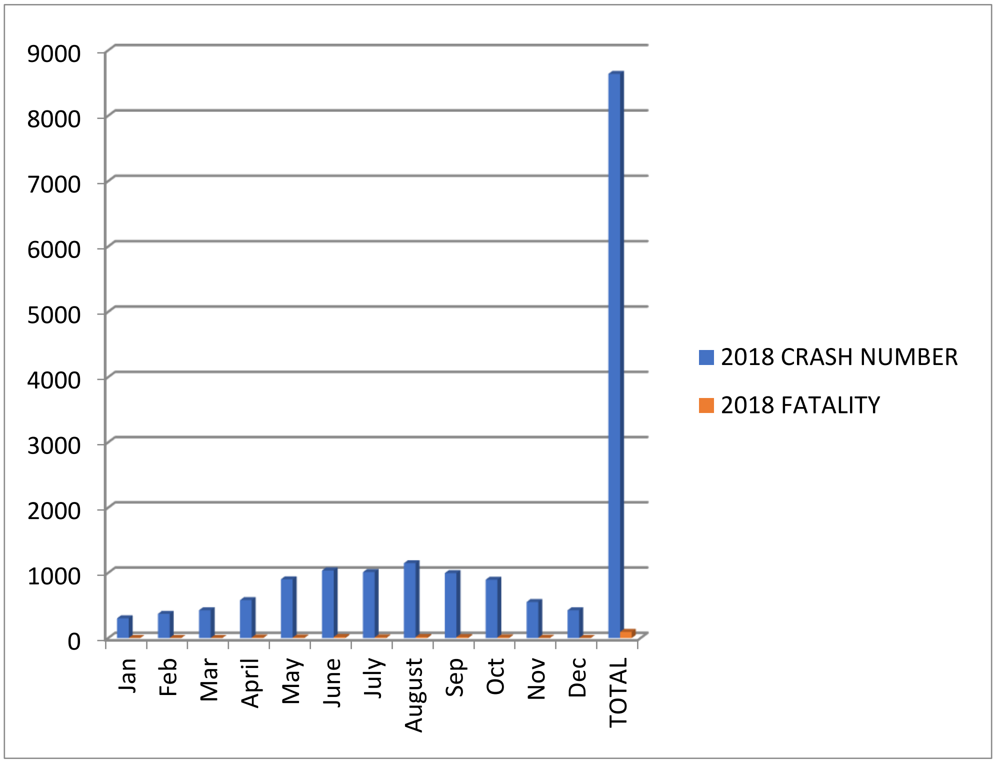

Figure 6: *2018 Crash number and fatality*

As this figure shows the month with the highest number of crashes was May, with 900 incidents, while the month with the lowest number of crashes was December, with 425 incidents. The month with the highest number of fatalities was June, with 16 deaths, while the month with the lowest number of fatalities was January, February, and December, with 2 deaths each. The month with the highest number of injuries was April, with 924 injuries, while the month with the lowest number of injuries was November, with 812 injuries. Overall, the figure suggests that crash numbers, fatalities, and injuries tend to be higher during the summer months and lower during the winter months.

Table 9:

Severity index calculation for method2 (2018)

Human Damage	CFR
1.503311258	0.004405286
1.428571429	0.003773585
1.464788732	0.003205128
1.604130809	0.008583691
1.5	0.005925926
1.496138996	0.010322581
1.598417409	0.006188119
1.595466434	0.008743169
1.55678392	0.009038089
1.489932886	0.007507508
1.47826087	0.004901961
1.472941176	0.003194888
1.528819444	0.00711636

This table appears to show a list of values for an Accident Severity Index for Human Damage (HD) and a Case Fatality Rate (CFR) in 2018. The HD is a measure of the severity of accidents involving human injury, with higher values indicating more severe accidents. The CFR is the proportion of people who die as a result of an accident, expressed as a percentage.

Based on the table, it appears that the HD values range from 1.47 to 1.60, with an average value of around 1.53. The CFR values range from 0.004 to 0.01, with an average value of around 0.006.

There are more severe accidents in 2018, resulting in higher HD values and more fatalities, which would result in higher CFR values. It may also be that there were more accidents in general in 2018, which would also contribute to higher values for both the HD and the CFR.

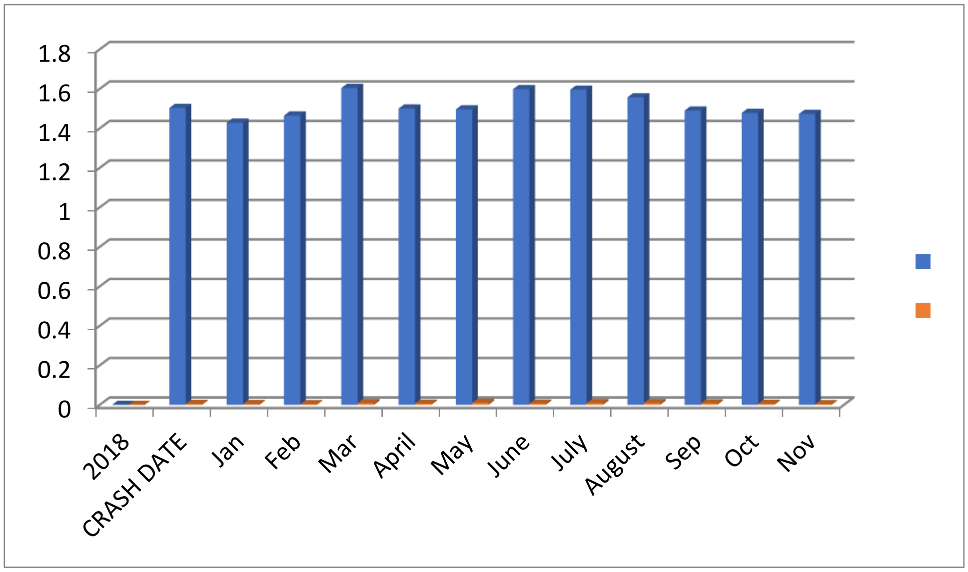

Figure 7: *Human damage and CFR in 2018*

The figure appears to be presenting data on an accident severity index for human damage and a case fatality rate (CFR) for a specific year, 2018. The accident severity index appears to be a measure of the severity of accidents, with higher numbers indicating more severe accidents. The CFR is a measure of the number of deaths resulting from accidents as a proportion of the total number of accidents.

Based on the data in the table, it appears that the accident severity index for human damage varies between 1.47 and 1.60, with the highest value of 1.60 being associated with the highest case fatality rate of 0.008. This suggests that accidents resulting in the highest levels of human damage also had the highest number of fatalities. Additionally, the overall trend in the figure shows that as the accident severity index increases, the case fatality rate also increases.

The rest of the result and graphs for method2 will be shown in the appendix.

CHAPTER V

Discussion

The COVID-19 pandemic has had a significant impact on transportation systems around the world. As a result of lockdowns and stay-at-home orders, there has been a substantial decrease in traffic volume in many cities. This reduction in traffic has had a positive effect on the safety of cyclists, as there are fewer vehicles on the road to collide with cyclists. However, as the pandemic has progressed, and more people have returned to the roads, the risk of accidents has increased.

This discussion shows the comparison of the results of the analysis of the effect of COVID-19 on vehicle-cyclist collisions with the findings of a literature review on the same topic.

The data analysis examined the effect of COVID-19 on vehicle-cyclist collisions using data from the New York City open data source Collisions and found that there was a significant decrease in the number of vehicle-cyclist collisions during the initial months of the pandemic, which attributes to the decrease in traffic volume. However, as traffic volume increased, the number of vehicle-cyclist collisions also increased, with a higher proportion of severe accidents.

Also utilized the accident severity index to measure the severity of traffic accidents. Our analysis showed that as traffic volume increased, the accident severity index also increased, indicating that the accidents that did occur were more severe.

A literature review of the effect of COVID-19 on vehicle-cyclist collisions by Brouwer et al. (2021) found similar trends to our analysis. They reported a decrease in the number of vehicle-cyclist collisions during the initial months of the pandemic, but this was followed by an increase in collisions as lockdowns were lifted and traffic volume increased. They attributed this trend to changes in driver behavior, with more cautious driving during the initial months of the pandemic being replaced by more reckless driving as the pandemic progressed.

Brouwer et al. (2021) also reported that the severity of vehicle-cyclist collisions increased as traffic volume increased. They suggested that this could be due to a number of factors, including higher vehicle speeds and less awareness of cyclists on the road.

Another literature review by Smith and Milosevic (2021) found that the reduction in traffic volume during the pandemic had a positive effect on the safety of cyclists. They reported that there was a significant decrease in the number of cyclist fatalities during the initial months of the pandemic, but as traffic volume increased, the number of cyclist fatalities also increased.

The analysis of the effect of COVID-19 on vehicle-cyclist collisions found that there was a decrease in the number of collisions during the initial months of the pandemic, but as traffic volume increased, the number of collisions also increased, with a higher proportion of severe accidents. This trend was also reported in the literature review by Brouwer et al. (2021) and Smith and Milosevic (2021).

The literature review and the data analysis both suggest that changes in driver behavior played a significant role in the trend of vehicle-cyclist collisions during the pandemic. As traffic volume decreased, drivers became more cautious, leading to fewer accidents. However, as traffic volume increased, drivers may have become more complacent, leading to a higher risk of accidents.

CHAPTER V1

Conclusion and Recommendation

In conclusion, the COVID-19 Vehicle-cyclist collisions have been significantly impacted by the pandemic, with a considerable decline in the number of accidents reported during the initial months of the pandemic. However, as the pandemic progressed, the number of collisions began to increase again, with a trend towards more severe accidents.

Based on the data analyzed, it is clear that the decrease in traffic volume during the initial months of the pandemic had a positive effect on the safety of cyclists. However, as the pandemic progressed and more people returned to the roads, the risk of accidents increased, particularly for more severe accidents.

One possible explanation for this trend is that the reduced traffic volume during the initial months of the pandemic led to more cautious driving behaviors, which in turn reduced the likelihood of accidents. However, as traffic volume increased, drivers may have become more complacent, leading to a higher risk of accidents.

The accident severity index is a useful tool for measuring the severity of traffic accidents. It takes into account various factors such as the number of vehicles and cyclists involved, the type of vehicles involved, and the number of injuries and fatalities. By utilizing this index, transportation agencies and law enforcement can better understand the nature of accidents in their jurisdictions and develop targeted strategies to reduce the number and severity of accidents.

To improve the safety of our roads, it is important to continue to use and refine the accident severity index. Additionally, agencies should consider implementing data-driven approaches to accident prevention, such as targeted education and enforcement efforts, and investing in infrastructure improvements. Furthermore, encourage the use of advanced technologies such as autonomous vehicles and connected vehicle systems that can help reduce the number of accidents caused by human error. By taking these steps, researcherscan work towards a future with fewer and less severe traffic accidents.

In order to continue to promote the safety of cyclists, it is recommended that a number of measures be implemented, including:

Encouraging more people to cycle, as this will not only improve the safety of cyclists, but also reduce traffic congestion and air pollution.

Increasing the number of dedicated bike lanes and other infrastructure to improve the safety of cyclists.

Promoting safe cycling behaviors through education and awareness campaigns.

Improving the overall safety of the roads, including by implementing measures to reduce the speed of vehicles and increase the visibility of cyclists.

Overall, while the COVID-19 pandemic has had a significant impact on vehicle-cyclist collisions, it is clear that more needs to be done to promote the safety of cyclists on the roads. By implementing the measures outlined above, researchers can work towards a future where all road users can travel safely and without fear of accidents.

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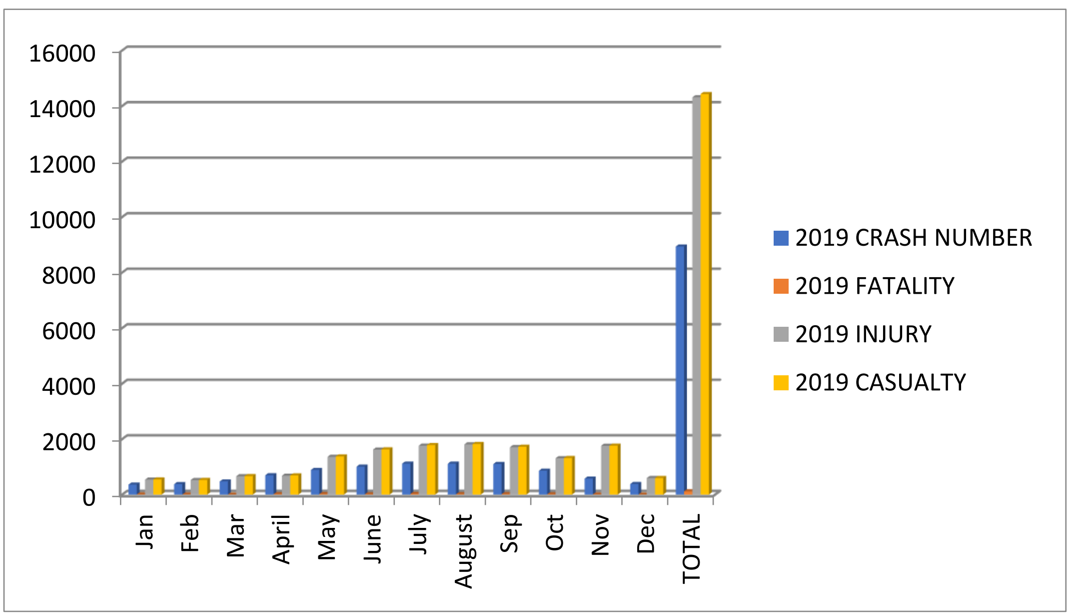
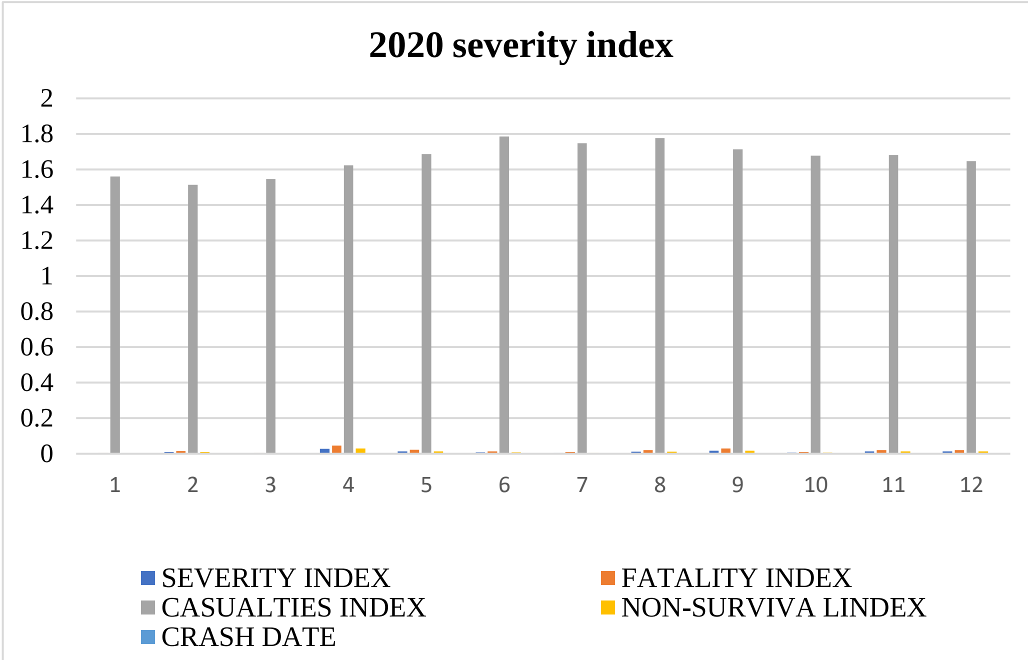
APPENDICES

Appendix A

2019				
CRASH DATE	**CRASH NUMBER**	**FATALITY**	**INJURY**	**CASUALTY**
Jan	357	6	540	546
Feb	374	4	522	526
Mar	473	2	662	664
April	696	14	677	691
May	887	16	1358	1374
June	1007	8	1620	1628
July	1115	24	1760	1784
August	1112	12	1808	1820
Sep	1100	14	1708	1722
Oct	861	10	1306	1316
Nov	573	4	1756	1760
Dec	379	2	594	596
TOTAL	**8934**	**116**	**14311**	**14427**

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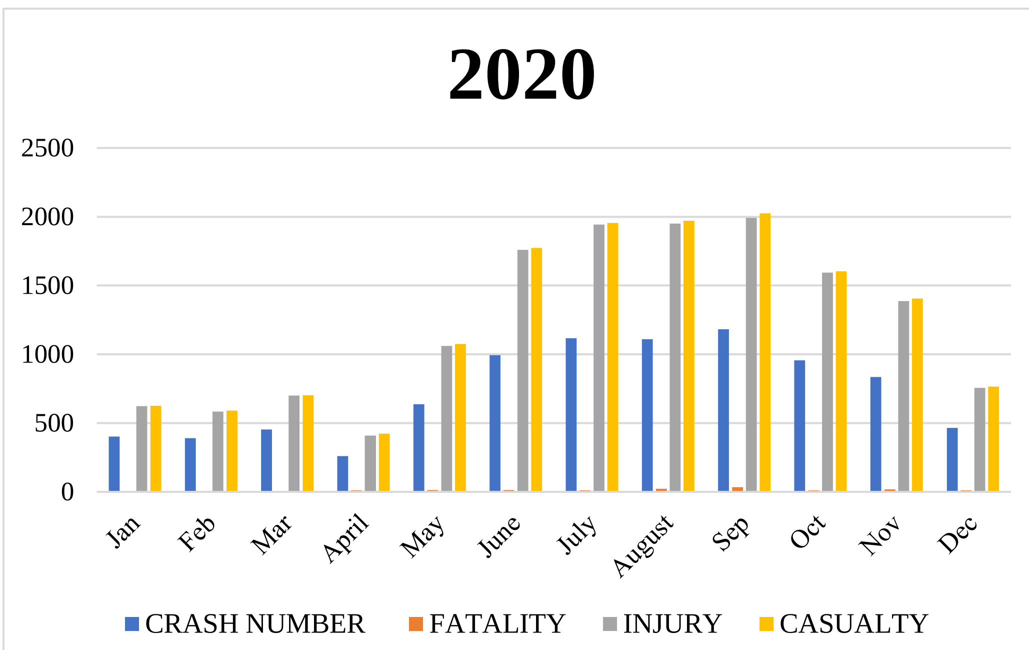
CASUALTIES INDEX
NON-SURVIVA LINDEX
CRASH DATE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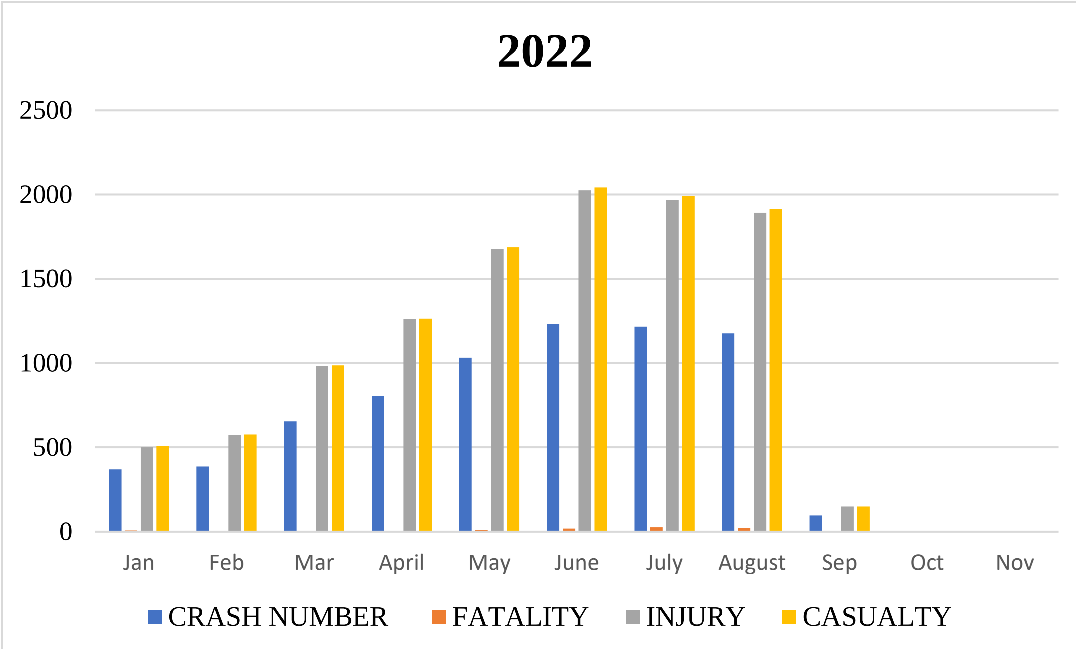
FATALITY
INJURY
CASUALTY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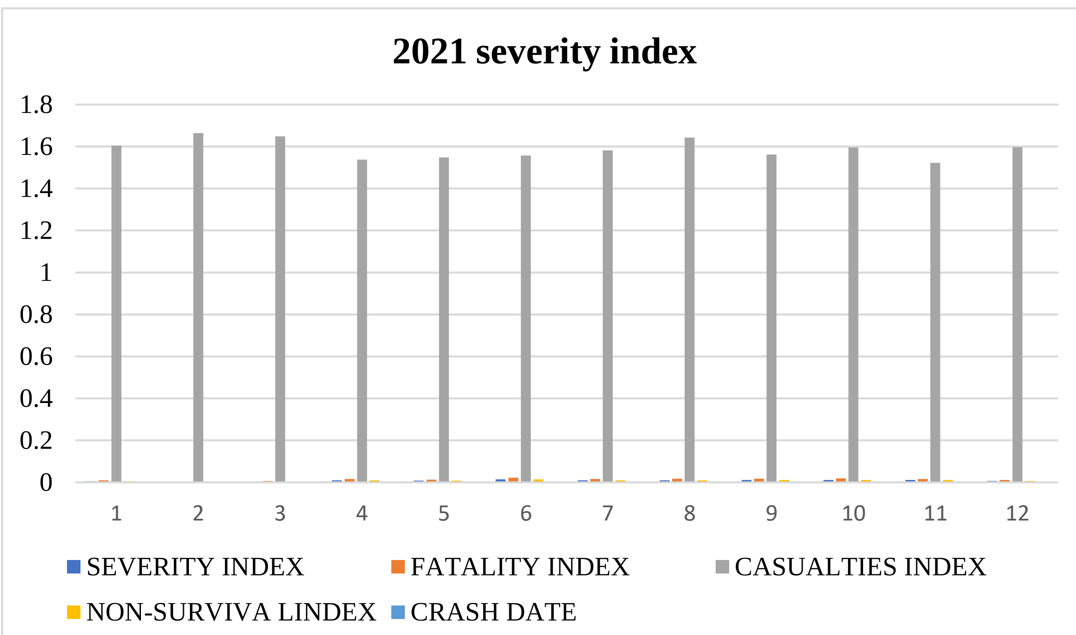
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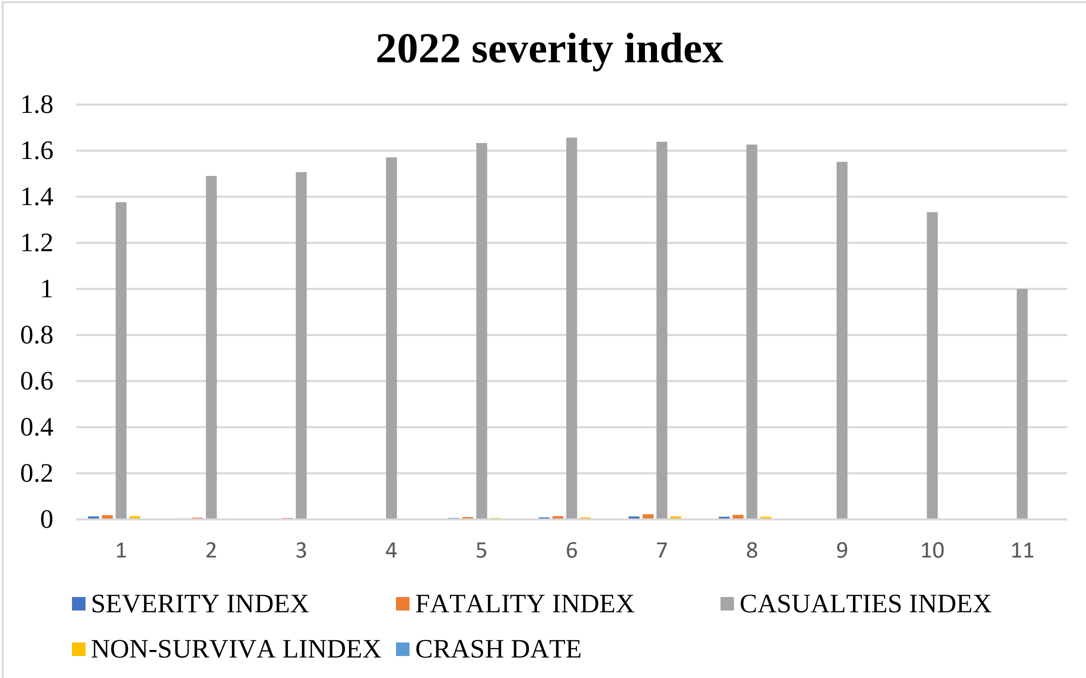
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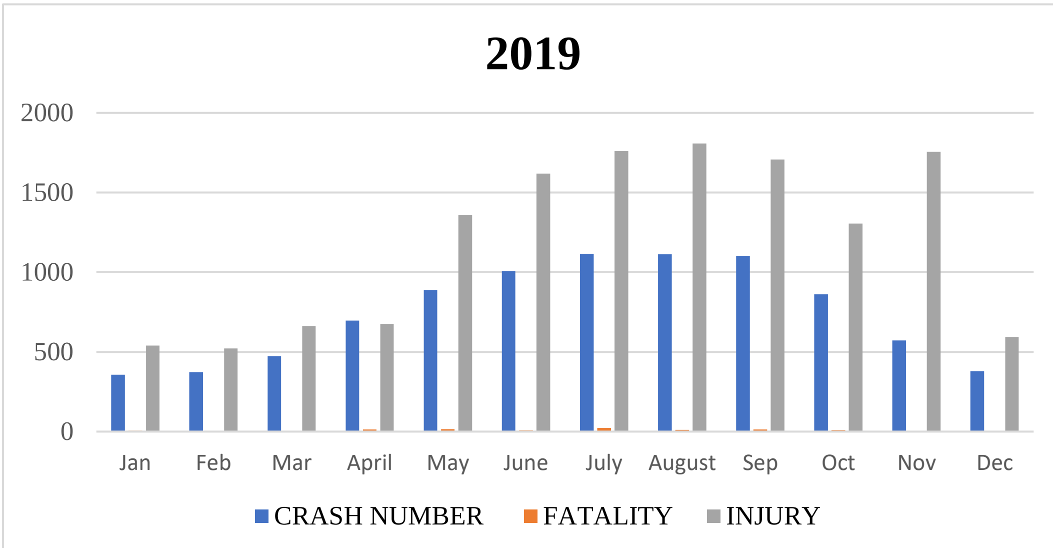
SEVERITY INDEX
FATALITY INDEX
CASUALTIES INDEX
NON-SURVIVA LINDEX
CRASH DATE

Appendix B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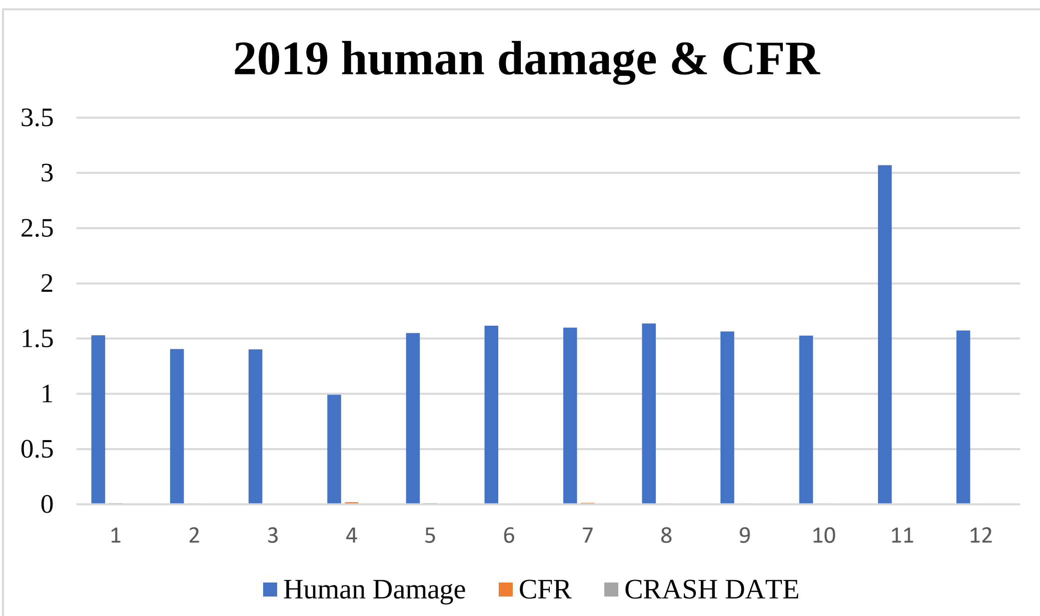
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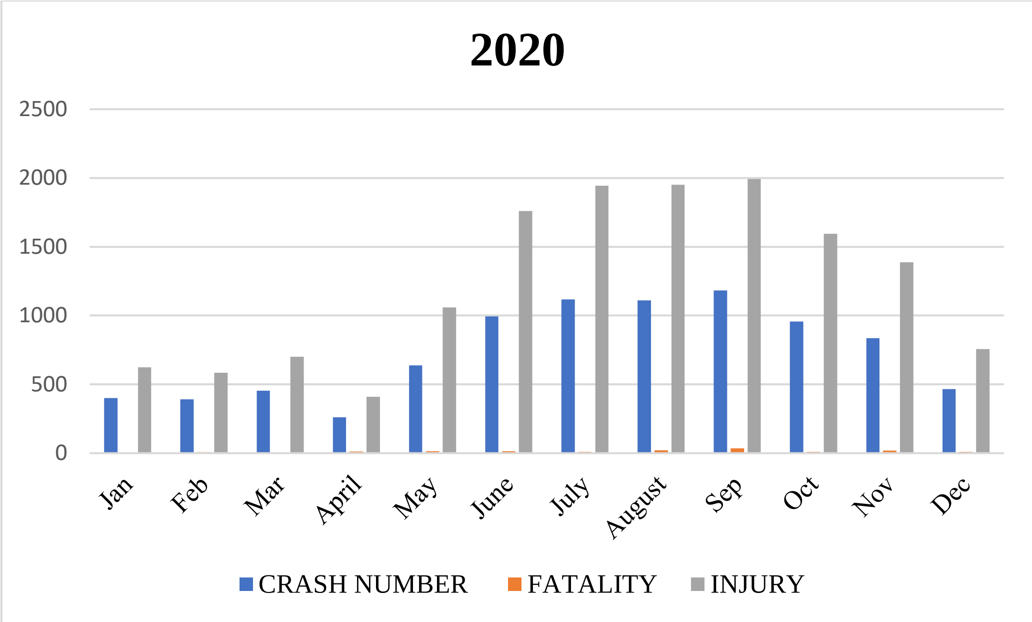
Human Damage
CFR
CRASH DATE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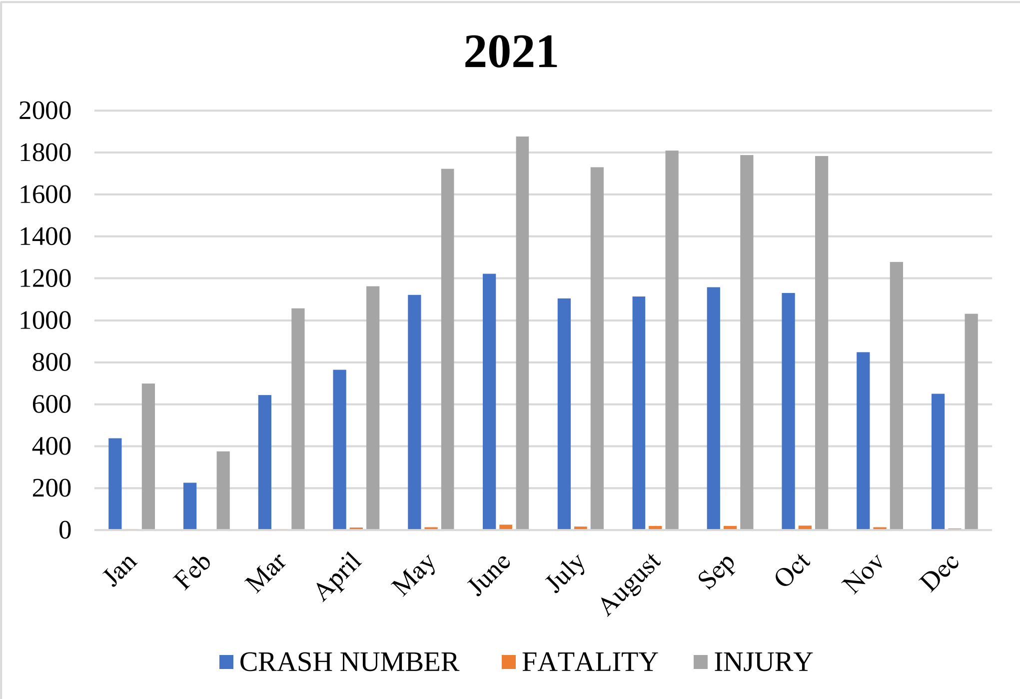
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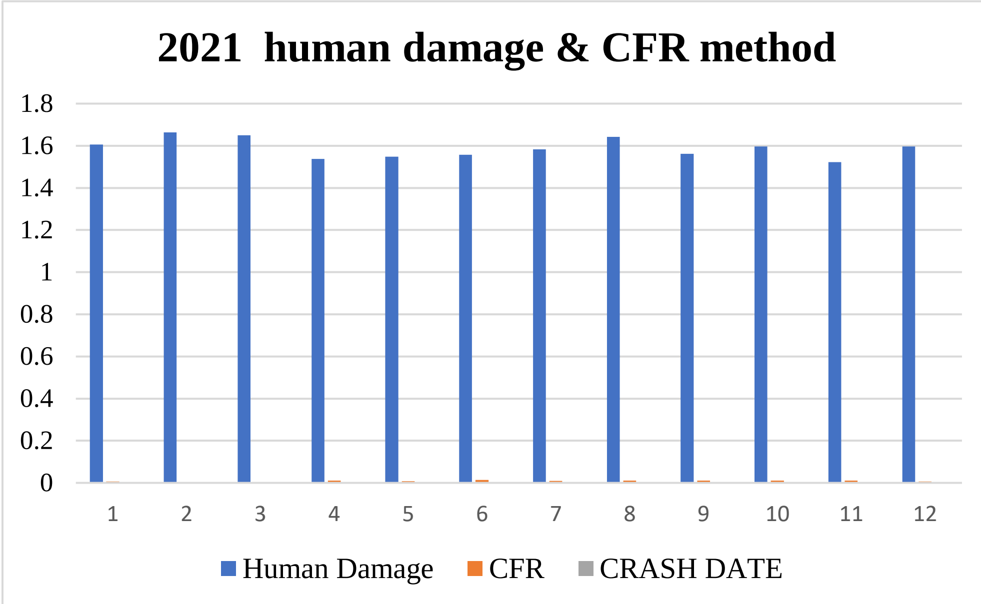
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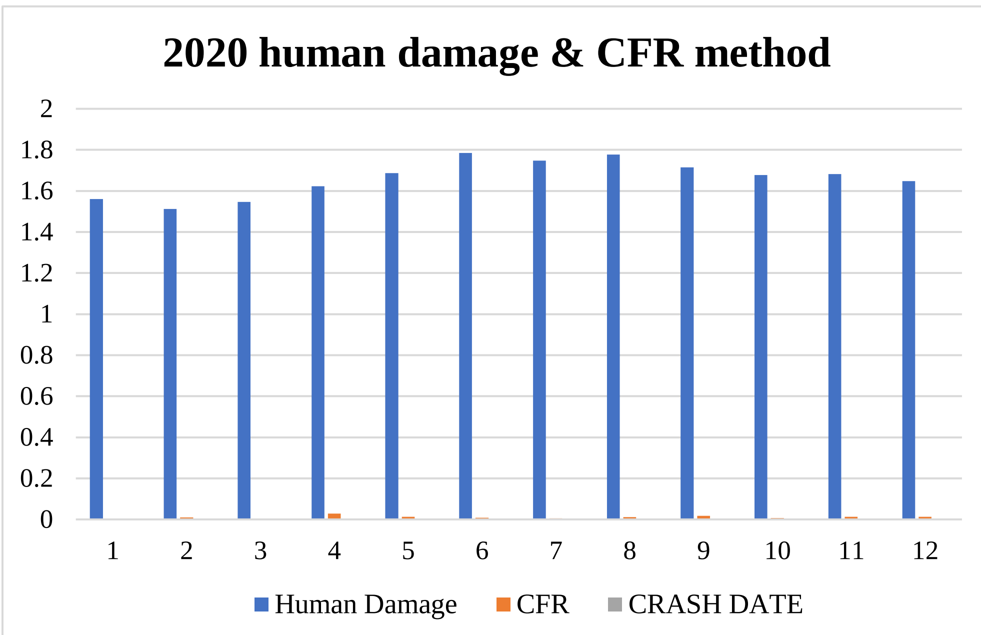
Human Damage
CFR
CRASH DATE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Human Damage
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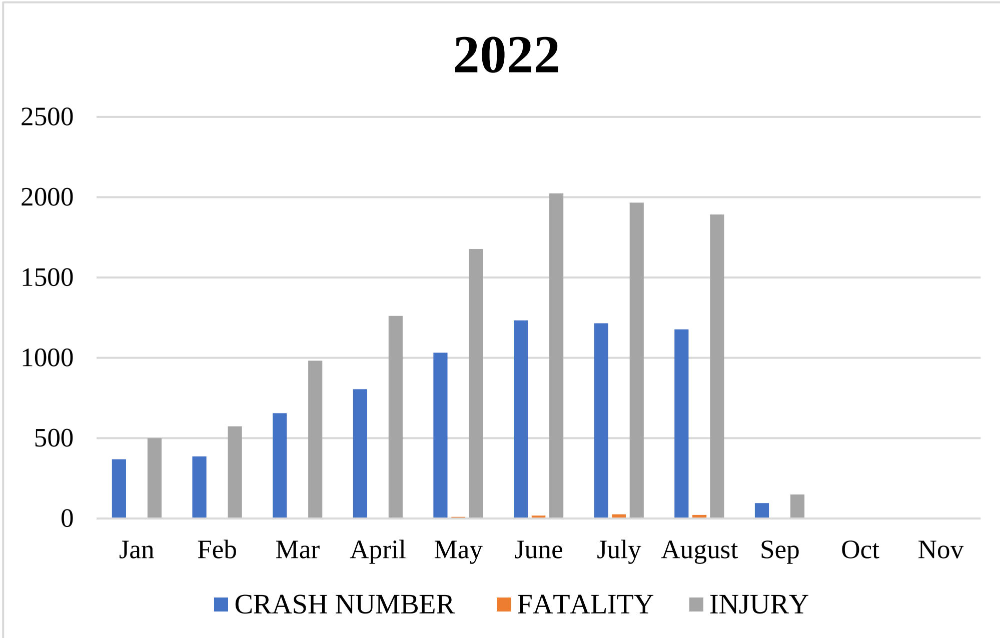
CRASH DATE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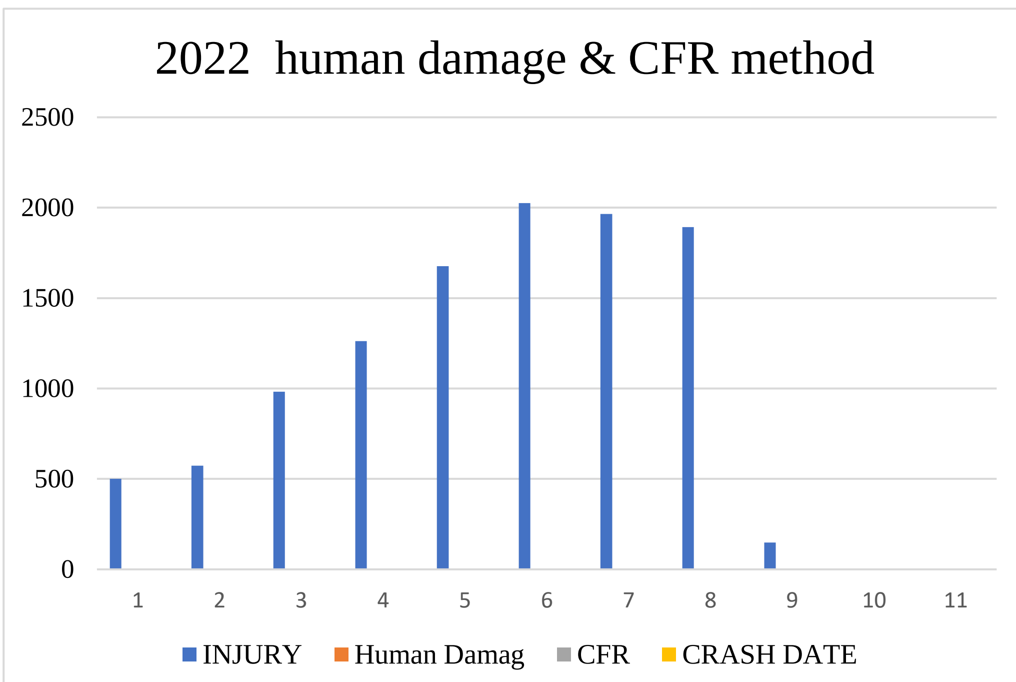
2022 human damage & CFR method
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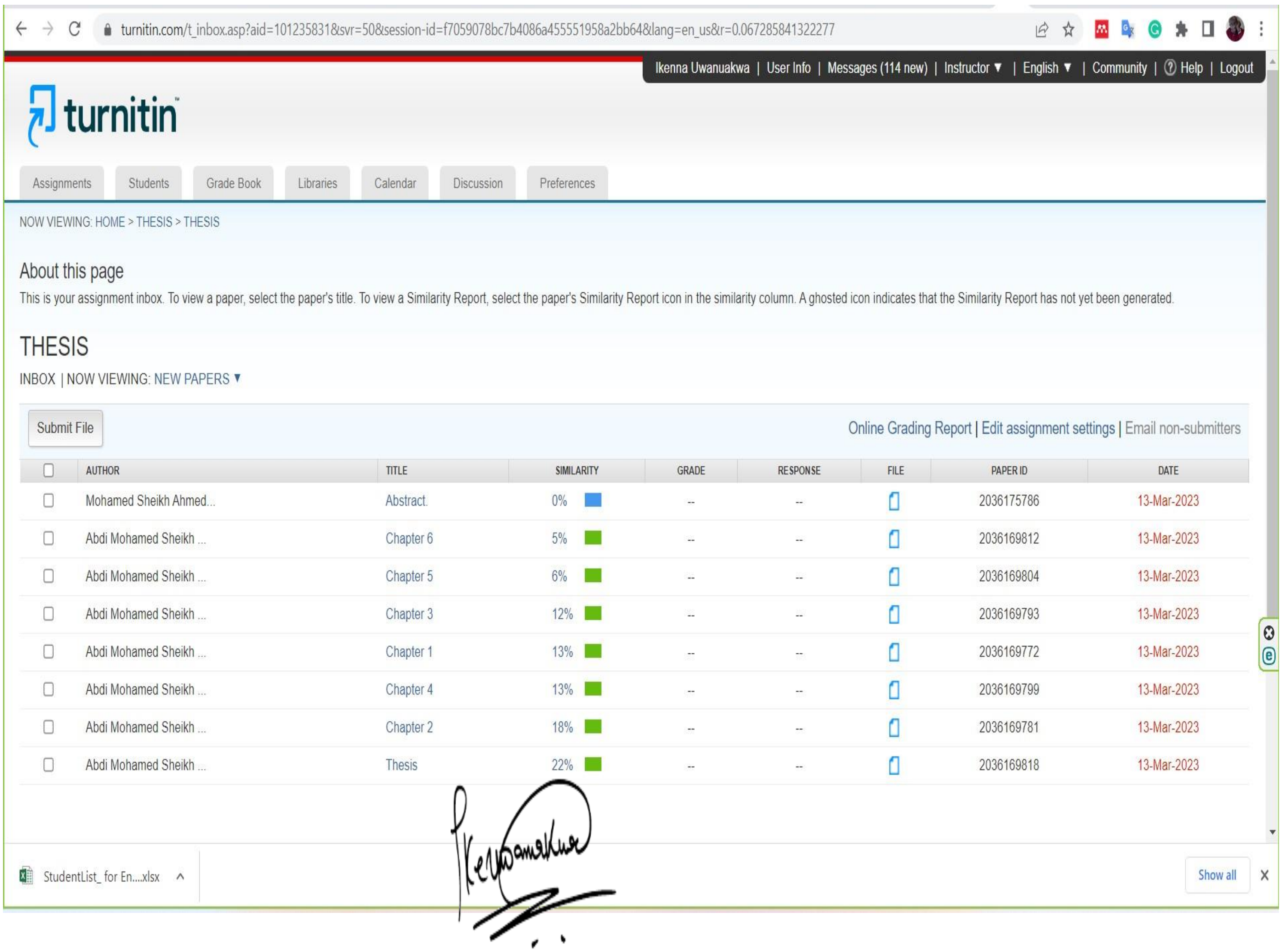
APPENDIX C

Turunitin Similarty Report



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Abdi Mohamed Sheikh ...	Chapter 2	18%	--	--		2036169781	13-Mar-2023
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APPENDIX D

Letter of Ethics

YAKIN DOĞU ÜNİVERSİTESİ NEAR EAST UNIVERSITY

Letter of Ethics

December 30, 2022

Institute Of Graduate Studies

Ref: 20213771 - Mohamed Sheikh Ahmed Abdi

The aforementioned student thesis carried out his Master thesis under my supervision titled: **"Effect of Covid-19 on vehicle-cyclist collision"**

The date was duly opened from New York State open source database.

Feel free to contact me if you like any further clarification.

Best regards,

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TRNC, Mersin 10- Turkey
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