

University
Transportation
Research Center

Mobility Trends in New York City During COVID-19 Pandemic:

Analyses of transportation modes throughout April 2020

About the University Transportation Research Center

The University Transportation Research Center (UTRC) is one of ten original University Transportation Centers established in 1987 by the U.S. Congress. These Centers were established with the recognition that transportation plays a key role in the nation's economy and the quality of life of its citizens. University faculty members provide a critical link in resolving our national and regional transportation problems while training the professionals who address our transportation systems and their customers on a daily basis.

UTRC was established in order to support research, education and the transfer of technology in the field of transportation. The theme of the Center is "Planning and Managing Regional Transportation Systems in a Changing World." Presently, under the direction of Dr. Camille Kamga, UTRC is functioning as a consortium of eighteen major Universities throughout New York, New Jersey, and Puerto Rico. UTRC is located at the CUNY Institute for Transportation Systems at The City College of New York, the lead institution of the consortium.

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May 6, 2020
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The first case of the coronavirus was confirmed in the State of New York in New York City on March 1st, since then panic buying for food and household products was reported. On March 7th, Governor Andrew Cuomo declared a state of emergency in New York State. A second case in the State was announced on March 10th, which was the first known case in the State to be caused through community spread. On March 16th, Governor Cuomo issued an executive order to close all public and private schools throughout the State, initially ordered to last until April 1 but which was later extended. On March 22nd, the New York State stay-at-home order took effect. The coronavirus cases in New York increased massively to the point that it became the epicenter of the country.

The aggressive actions taken by the state and city governments and businesses in order to slow the spread of the coronavirus are reflected by the performance of the transportation system in New York City. Steep changes in the mobility indicators have been observed as non-essential workers were ordered to remain in their homes and to travel only when essential (summarized in the table below).

This report presents preliminary analyses of transportation-related data publicly available as of April 30, 2020 for New York City transportation systems. This report will be regularly updated as data becomes available.

Summary of Transportation Trends across Modes in NYC

Mode	Percent Change in April (or March) from 2019 to 2020
Subway	(-)93% ridership
Bus	(-)97% ridership
Metro North	(-)95% ridership
LIRR	(-)97% ridership
PATH	(-)97% ridership (includes whole of March 2020)
Traffic	+40-55% average speed, (-) 60-66% volume
Bike	+67% (March 11), significant (-) later

New Yorker's Reaction on the Novel Coronavirus

In today's world of technology, there are many ways to capture people's viewpoints during this unexpected time. The number of web search hits is one way to do this. The interest and awareness of city travelers about coronavirus has been examined by Google Trends. This can be done by searching with keywords like "Covid-19" in "New York City" with data acquired from different Google portals like Web, News, Images, Froogle, and YouTube. Figure 1 shows the result of people's interest about "Covid-19" acquired from Google Trends in the last three months. As seen, there was a huge spike in March, but then it started declining in April as information on the coronavirus pandemic became widely available.

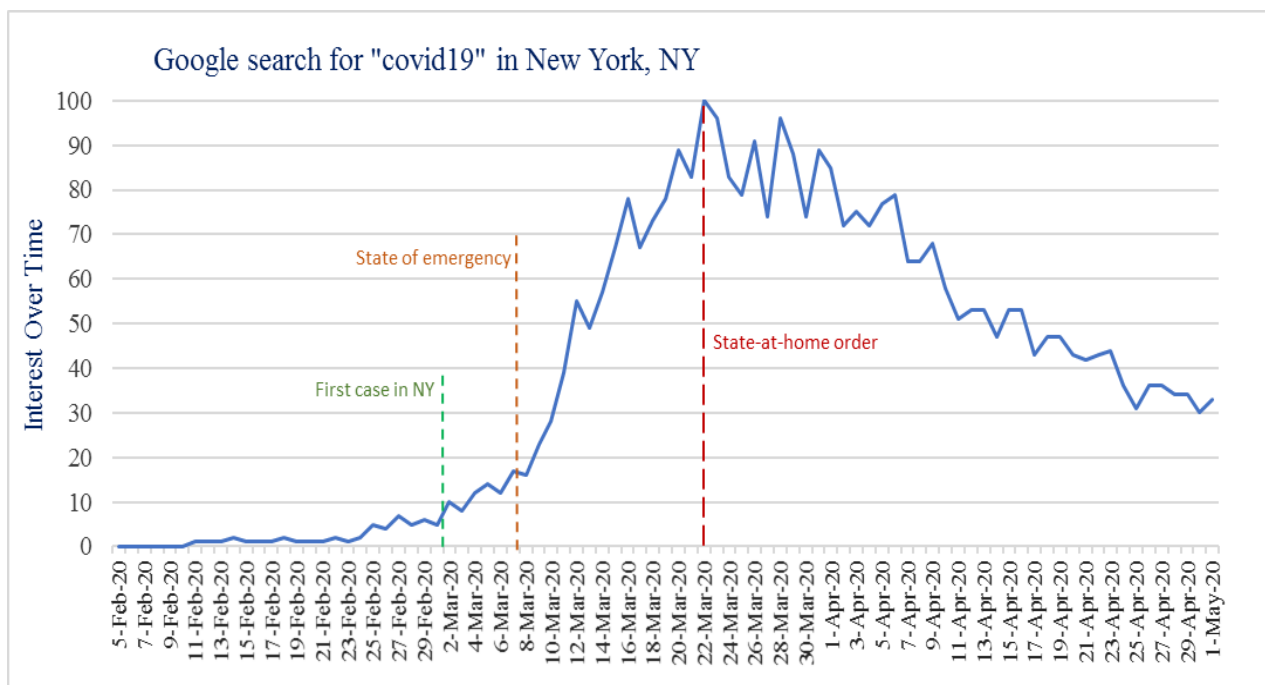


Figure 1: Interest of New Yorkers about coronavirus over the past three months (Source: Google)

Meanwhile, Apple began to report about mobility trends in many cities all over the globe during this crisis. This data was retrieved using search requests for directions on Apple Maps as a proxy for mobility. Figure 2 illustrates this trend in New York City split by three modes of transportation - driving, walking, and transit with the baseline from Jan 13th, 2020. As of April 29th, requests for transit directions from Apple Maps has plunged the most, an 84% drop since January 13th. Also, requests for driving and walking directions have declined to 44% and 67%, respectively.

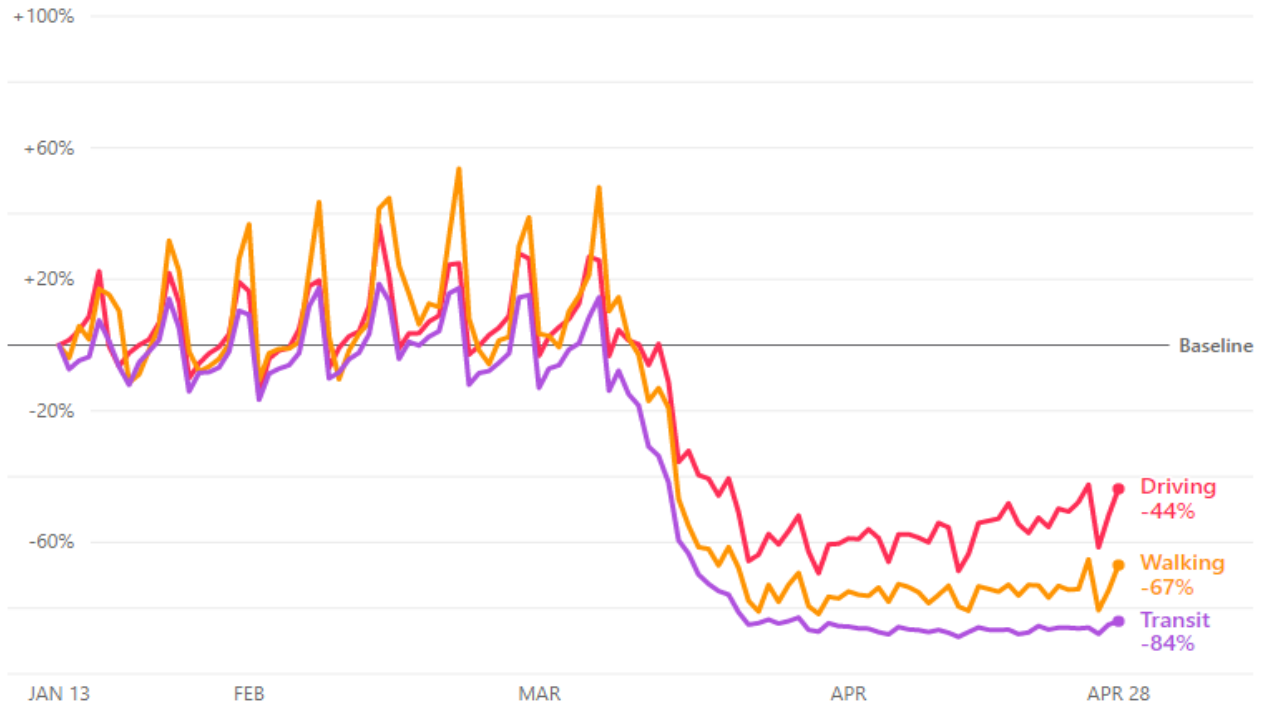


Figure 2: Requests for directions from Apple Maps (Source: Apple)

The figures below show the total number of positive cases from COVID-19 in New York City through April 29th. Figure 3 displays the cumulative number and Figure 4 illustrates a map of the positive cases per zip-code.

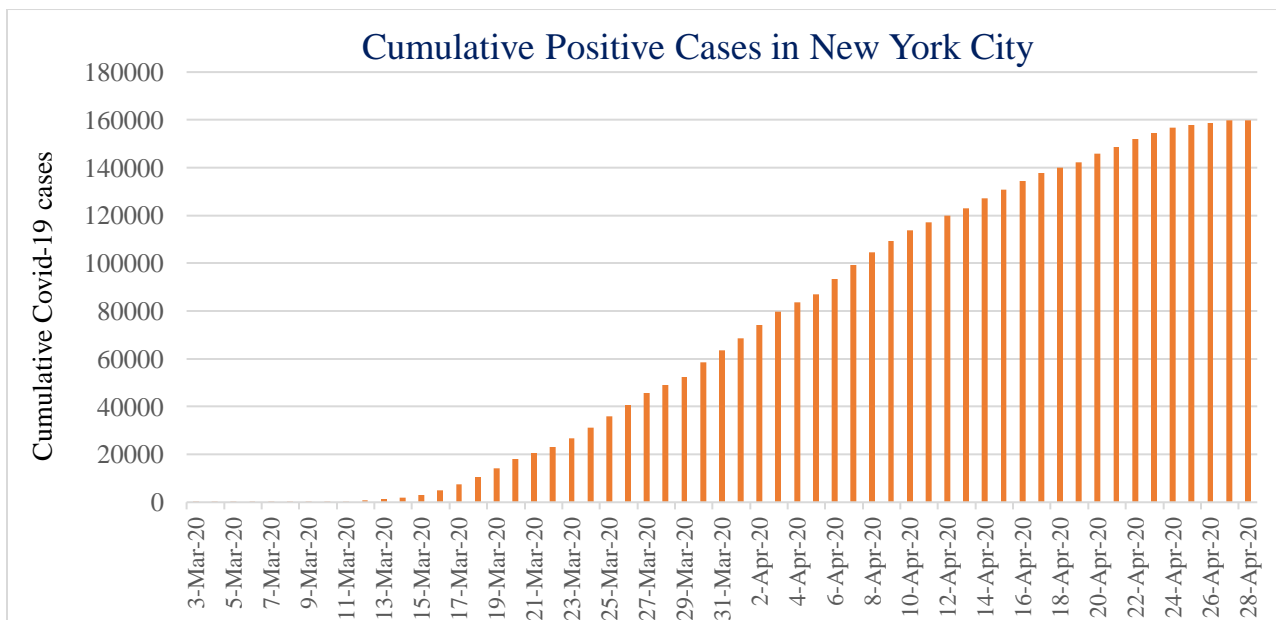


Figure 3: Cumulative COVID-19 cases in New York City (Source: NYC Health)

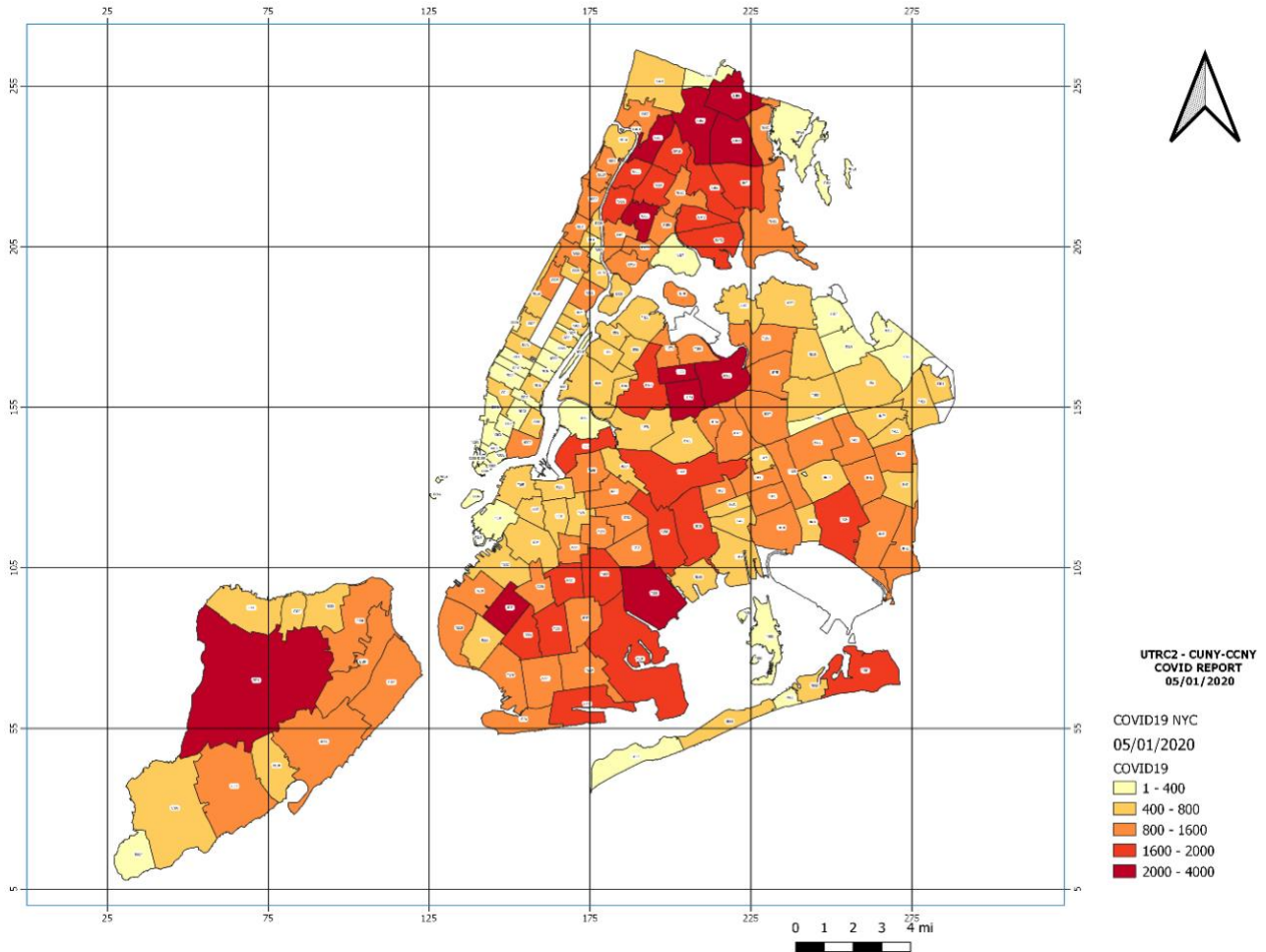


Figure 4: Total count of COVID-19 cases based on patient address by ZIP code (Source: NYC Health)

Public Transit

Public transit ridership was severely impacted by actions to slow the spread of COVID-19 cases such as school closings, the shelter-at-home order, the closing of non-essential businesses, etc. Figure 5 displays the percentage ridership declines by transit mode in New York City on March 12th, March 16th, March 23rd, April 2nd, and April 17th, compared with dates in 2019 as reported by the Metropolitan Transportation Authority (MTA). It is apparent from the graph that transit ridership dropped on all transit modes operated by MTA which include: Subway, NYC Transit Bus, MTA Bus, Metro North Railroad (a.m. peak), and Long Island Railroad (a.m. peak). The declines in public transit ridership reached more than 95% for most of the operators in April, representing the lowest ridership during this pandemic crisis.

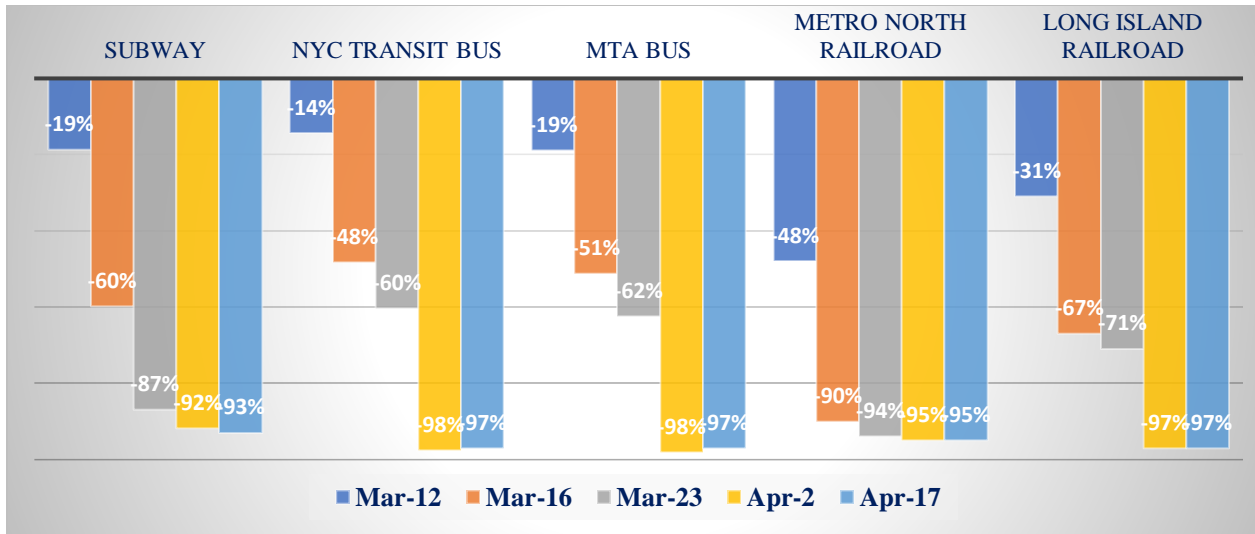


Figure 5: Transit ridership percentage reduction on March 12th, 16th, March 23rd, April 2nd, and April 17th from 2019 to 2020 (Source: MTA)

To understand the trends of subway ridership, the ridership data over time at South Ferry subway station is used for illustration. Figure 6 shows the daily turnstile entries and moving average of the mean over a seven-day rolling window at the South Ferry subway station, starting from January 1st in 2020 to April 17th in 2020. This ridership includes all turnstile entries of the subway station. The rolling average method reduces noise in time series data, enabling the ability to look at obvious trends. The subway ridership decreased gradually, then plunged suddenly in March 2020, and continued to perform with a very low ridership during April as shelter-in-place orders were mandated by state officials.

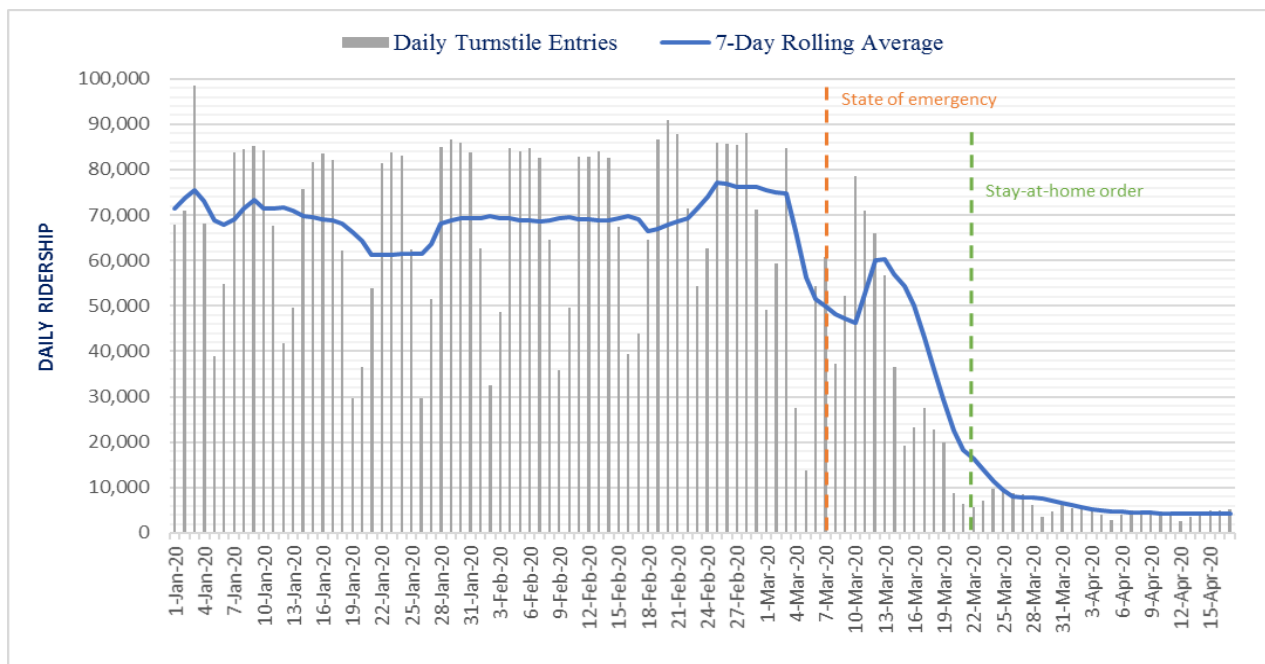


Figure 6: Daily entries and 7-day rolling average of the mean of South Ferry subway station

PATH Train

PATH train ridership has also been impacted by the COVID-19 outbreak. Figure 7 displays the average daily ridership of PATH service in February and March 2020. Here, only ridership changes for stations in New York are reported. PATH train average daily ridership plunged more than 50% at all NYC's stations over this time period. Also, the monthly subtotal of PATH train ridership in New York was reduced from 2,806,746 in February to 96,784 in March, representing a 97% decline.

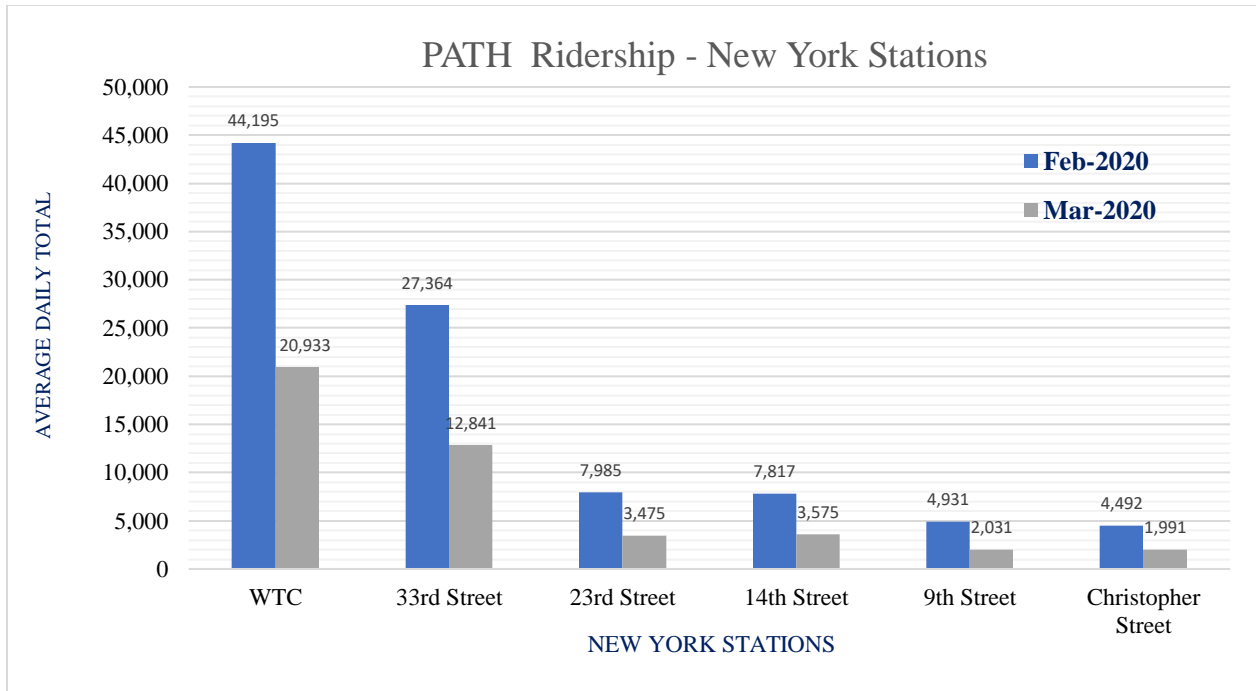


Figure 7: Average Daily of PATH ridership of New York stations in February and March 2020

Vehicular Traffic Volume

The traffic volumes on bridge and tunnel crossings in and around NYC have also seen a significant reduction. MTA's bridges and tunnels data on March 12th, 16th, 23rd, April 2nd, and April 17th showed a 9%, 21%, 60%, 65%, and 62% reduction respectively from the corresponding and similar days in 2019. The traffic volume on MTA bridges and tunnels was at its lowest values in April 2020.

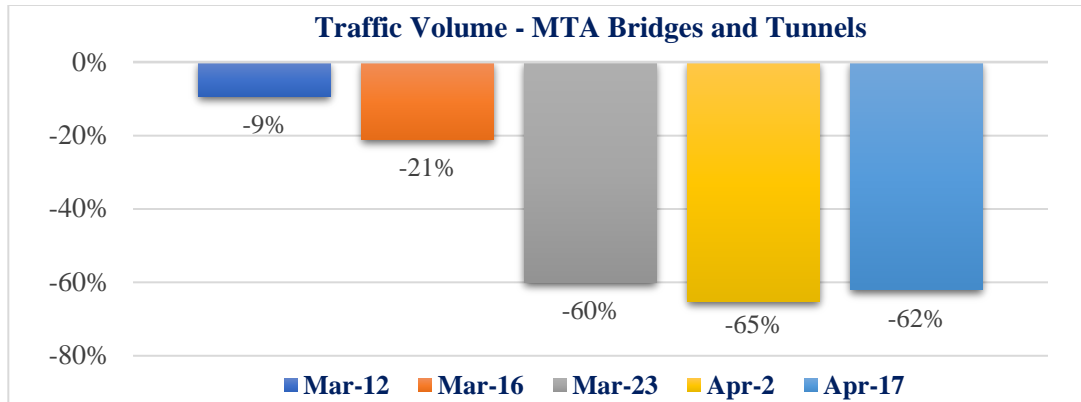


Figure 8: MTA Bridges and Tunnels percentage changes in volume on March 12th, 16th, March 23rd, April 2nd, and April 17th from 2019 to 2020 (Source: MTA)

INRIX reported on the aggregate mobility change in volume for New York City. It has reported that the personal travels in NYC dropped 66%, 63%, 62%, and 60% for the weeks of March 28-April 3, April 4-10, April 11-17, April 18-24, respectively.

Vehicular Traffic Speed

With the limitation imposed on non-essential travel, the volume of vehicles on roadways has decreased and, the speed of vehicular traffic has increased during the covid-19 pandemic. In Figure 9, the average reported traffic speed on arterial roads in all NYC's five boroughs is shown. The average speed was recorded at 5:00 PM on every Wednesday in March and April 2020. It is observable that the average speed surged gradually in the end of March and then stayed about the same level during April.

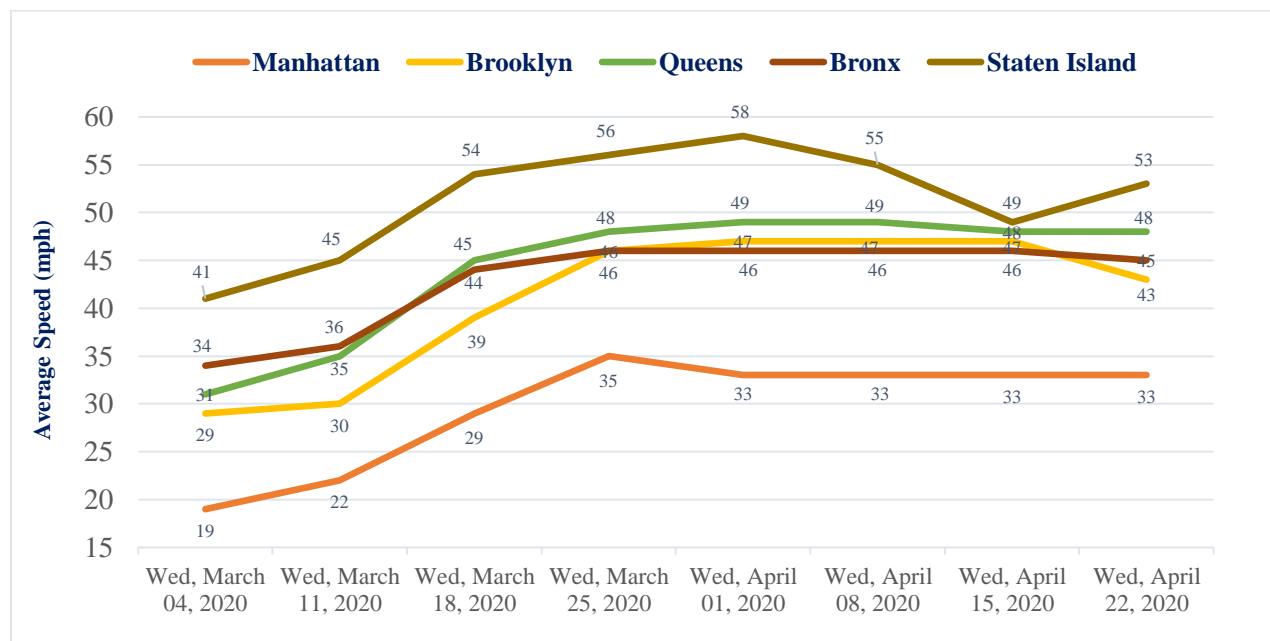


Figure 9: Average recorded speed during March and April 2020 (Source: TRANSCOM)

In Table 2, the improvements of these recorded speeds in 2020 are compared to the corresponding values in March and April 2019. One can visibly observe that from the third week of March, average speeds all boroughs have increased significantly, up to 21 MPH for some. The average speed improvement is more pronounced in Brooklyn and Queens, specifically during April.

Table 2: Speed changes (MPH) in five boroughs of New York City in March and April (TRANSCOM)

	4-Mar	11-Mar	18-Mar	25-Mar	1-Apr	8-Apr	15-Apr	22-Apr
Manhattan	-5	-2	5	11	14	14	14	14
Brooklyn	-2	-1	8	15	23	23	23	19
Queens	1	5	15	18	21	21	20	20
Bronx	2	4	12	14	16	16	16	15
Staten Island	-1	3	12	14	18	15	9	13

The improvement in average speed is attributed to the low traffic volumes on streets and highways during the coronavirus pandemic. However, such increases in traffic speed have caused some adverse consequences. A report from the city data showed that the City's automated speeding cameras have issued 24,765 tickets in March until the 27th, compared to 12,672 tickets issued daily in February, doubling the speeding tickets issued. [Source: INRIX].

Parking Violation

With congestion in cities, legal parking is sometimes limited. This forces passenger drivers and commercial operators to park illegally. Parking violation has been a major issue of managing congestion in cities like New York. During the coronavirus pandemic, there is less congestion in cities, and drivers seek to do their jobs very quickly and get back home as soon as possible. At the same time, commercial vehicles are actively delivering goods to homes and businesses. Their importance has become more noticeable during this COVID-19 pandemic as many of New Yorkers are staying home and using delivery services for their orders.

The parking violation data for passenger vehicles and commercial vehicles have been analyzed. Table 3 illustrates the number of parking violations during February and March in 2019 and 2020. In 2020, from February to March, this number is reduced by about 23% and 28% for passenger and commercial vehicles, respectively. Noteworthy, when comparing the parking violation from 2019 to 2020, the number of commercial vehicle violations has plunged about 20%. A decline in the number of violations could be due to less congestion in streets, availability of more curb parking spaces, and more lenient enforcement.

Table 3: Number of parking violations for passenger and commercial vehicles in 2019 and 2020

Parking Violation	Passenger Vehicle	Commercial Vehicle
February, 2020	855,200	195,283
March, 2020	657,057	141,338
Change (%): Feb to Mar 2020	-23%	-28%
February, 2019	610,964	158,093
March, 2019	699,562	177,079
Change (%): Feb-2019 to Feb-2020	+40%	+24%
Change (%): Mar-2019 to Mar-2020	-6%	-20%

To better grasp the trend in parking violations, Figure 10 and Figure 11 show the weekly trend by passenger and commercial vehicles from week 7 to week 13 (mid-Feb to end of March) of years 2019 and 2020. As shown, the parking violation of commercial vehicles started declining from week 9, the beginning of March.

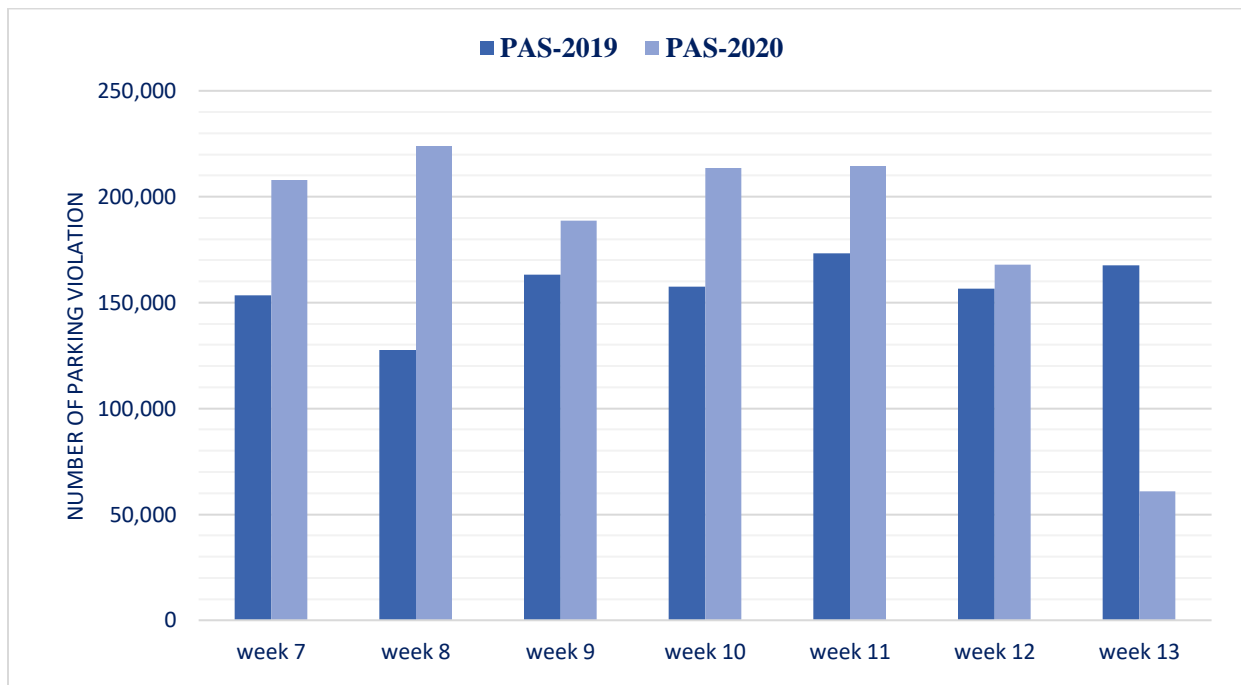


Figure 10: Number of parking violations for passenger vehicles, from week 7 (mid-February) to 13 (end of March)

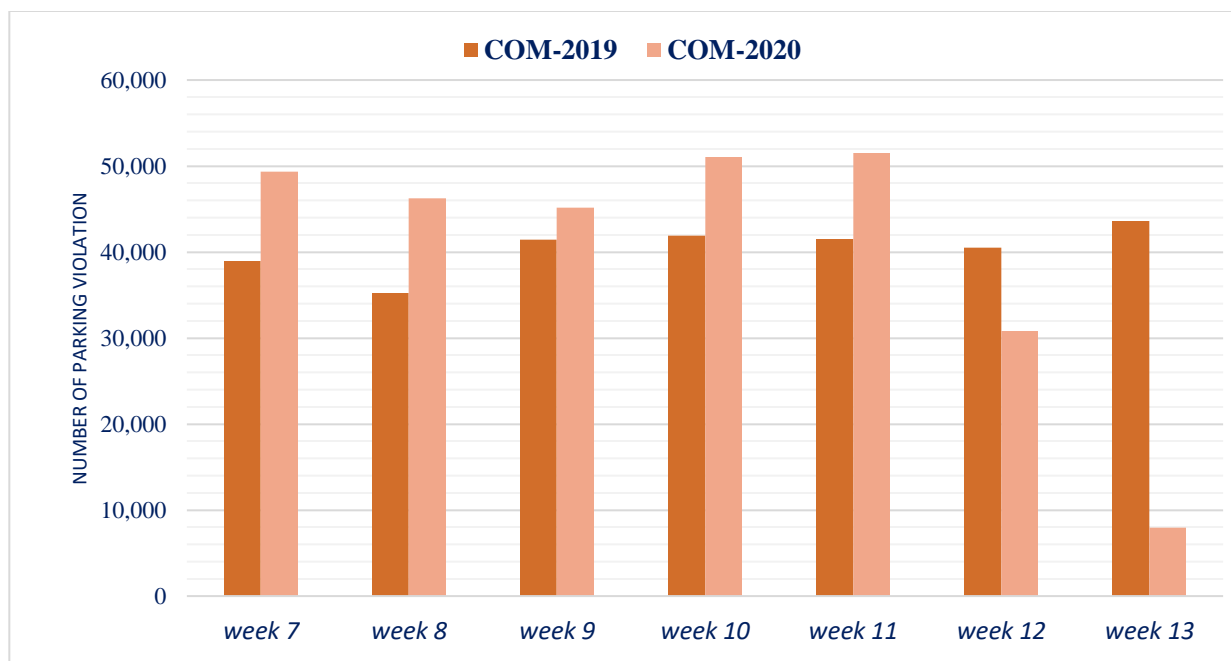


Figure 11: Number of parking violations for commercial vehicles, from week 7 (mid-February) to 13 (end of March)

Safety

Motor Vehicle Accidents

To investigate the performance of traffic safety during the COVID-19 pandemic, the number of motor vehicle crashes in New York City are analyzed and compared. In Figure 12 the total of motor vehicle crashes in New York City during February and March for 2019 and 2020 are shown. One can clearly observe that the total monthly crashes has significantly decreased from 2019 to 2020. For the months of February, the number of crashes decreased from 32,272 in 2019 to 27,631 in 2020 – a net reduction of 14%. However, such a crash reduction has reached 38% in March, falling from 35,812 crashes in 2019 to 22,228 in 2020. This is an encouraging trend for city planners aiming to reach the vision zero initiative targets. However, an important reason for this reduction is associated with low traffic volumes in New York City streets during this pandemic.

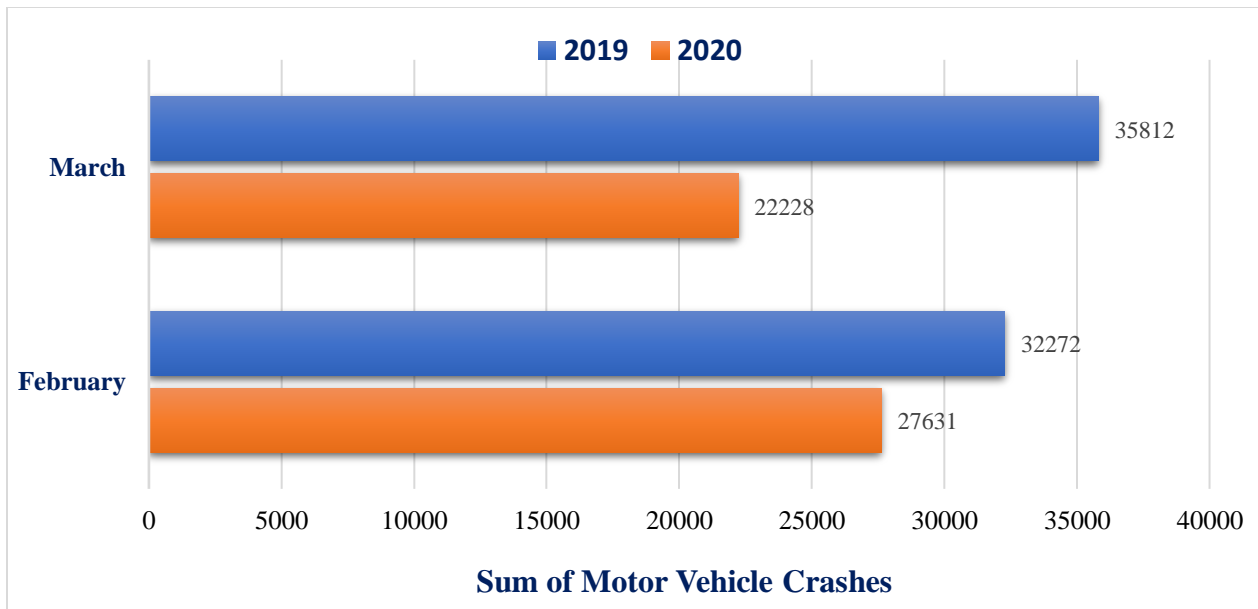


Figure 12: Sum of motor vehicle crashes during February and March in 2019 and 2020 (Source: NYC Open Data)

Roadway Incidents

In this section, the total number of incidents that occurred in the states of Connecticut, New Jersey, and New York, as reported by TRANSCOM, is presented. The total number of incidents is aggregated on a weekly basis during March and April 2020. One can visibly observe that the number of weekly incidents in the tri-state region has declined gradually. It is worth mentioning again that the full restriction was in place during the last five weeks of Figure 13.

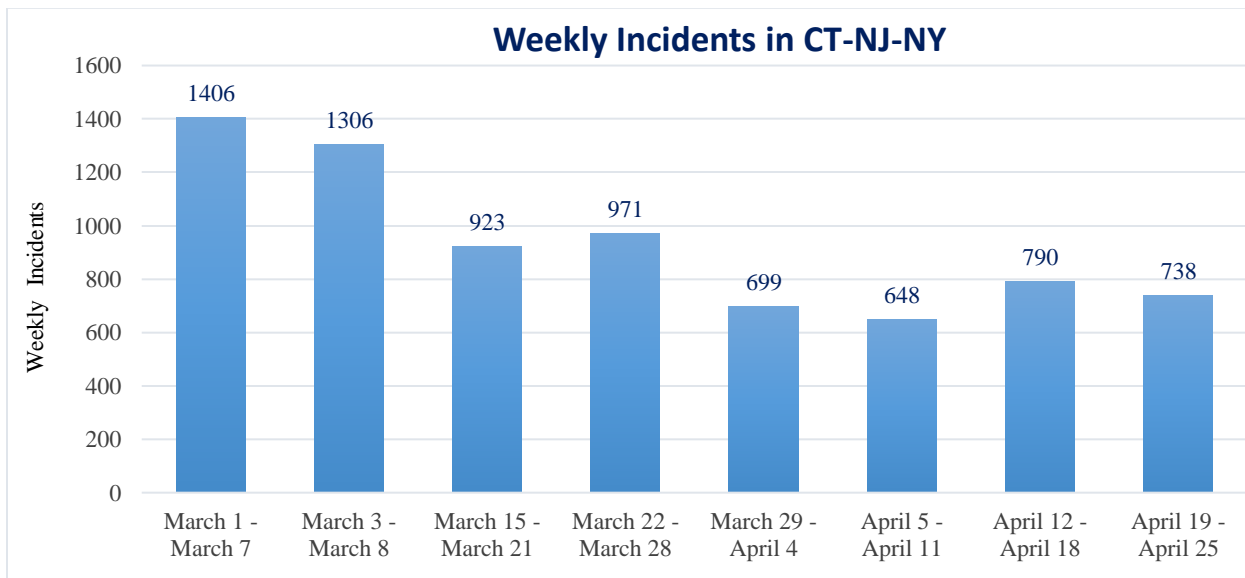


Figure 13: Total weekly incidents in March and April 2020 (Source: TRANSCOM)

Citi Bike

To understand the impact of COVID-19 on bike ridership, Citi Bike trips that were made in New York City from January 2019 to the end of March in 2020 are compared. Figure 14 illustrates the daily bike ridership (trip starts) in Manhattan, Brooklyn, and Queens. Since the ridership in Manhattan was significantly higher, the natural logarithm of the Citi Bike ridership is used to scale the data.

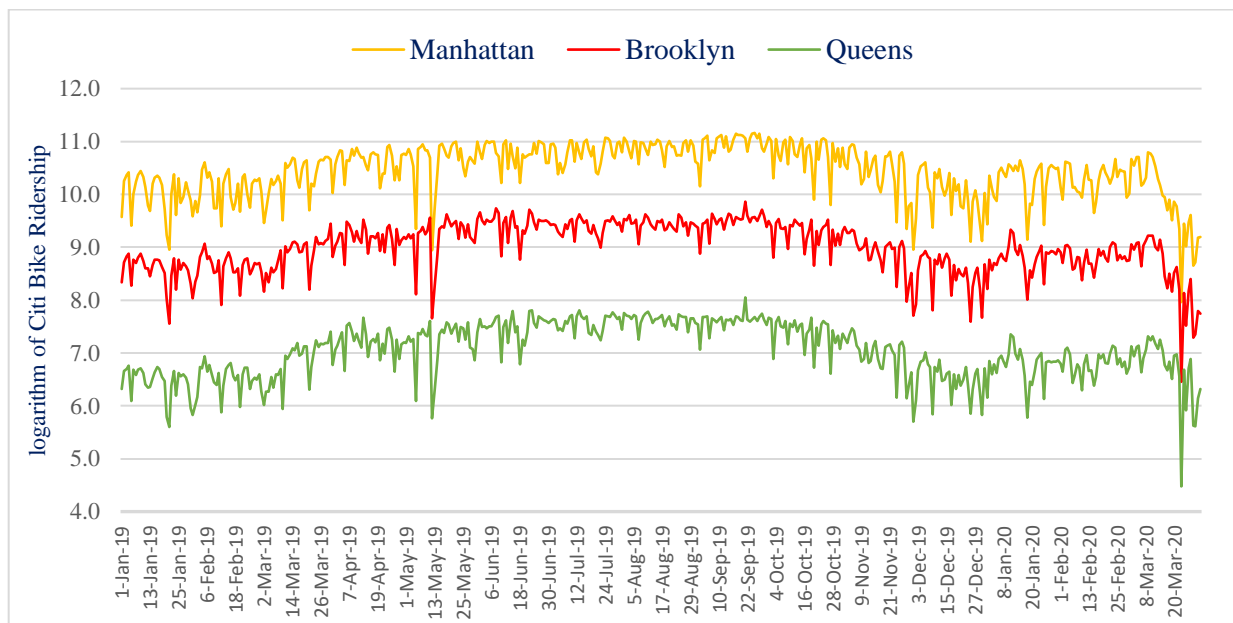


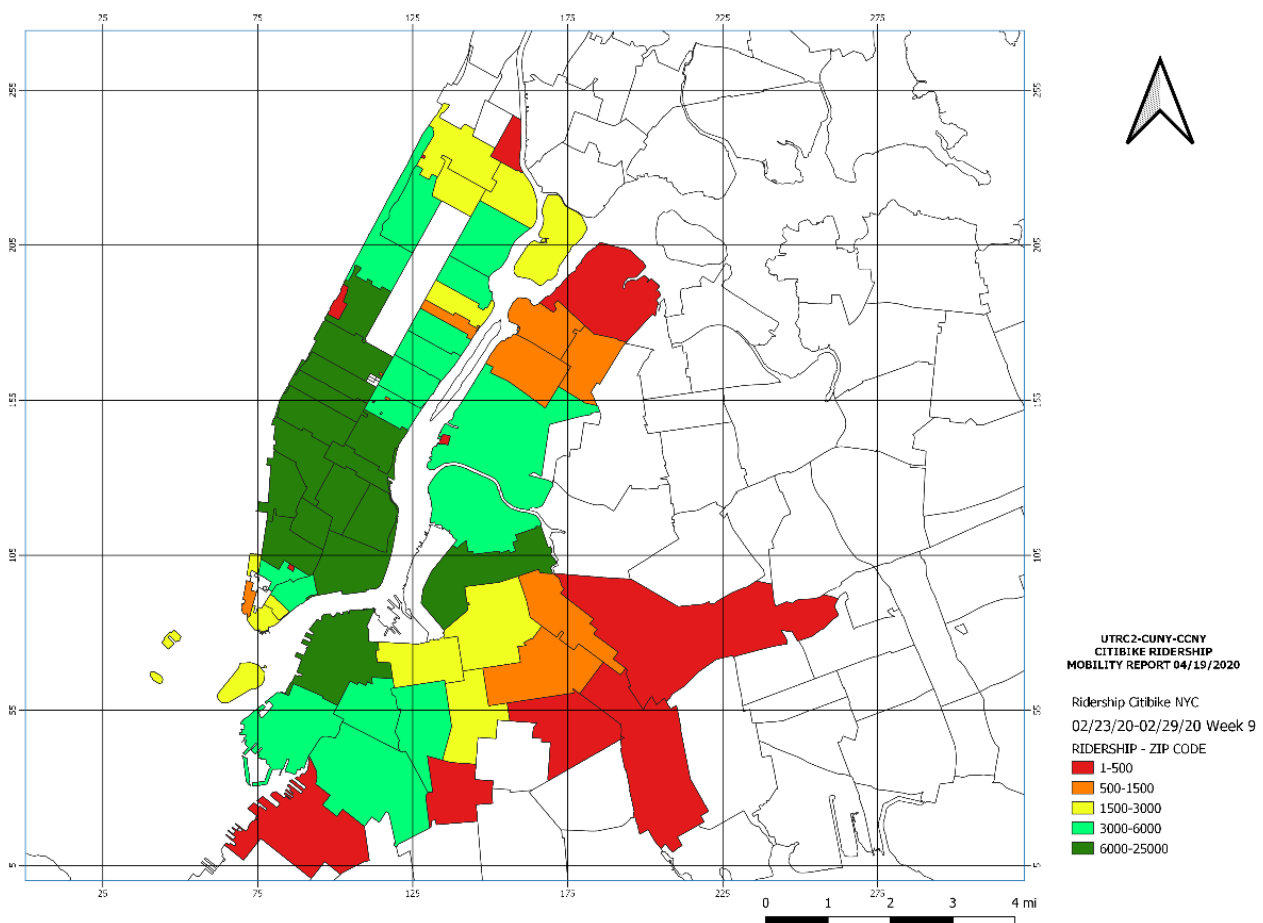
Figure 14: Semilog plot of Citi Bike trips in three boroughs from Jan 2019 to March 2020

To compare the Citi Bike ridership changes from February to March, and from 2019 to 2020, Table 4 explains the shift in the total trips during this time. The total Citi Bike trips dropped in March from 2019 to 2020. This drop is more noticeable in Manhattan as compared to Brooklyn and Queens. It is worth mentioning that the number of bike stations in Manhattan is also higher than the other boroughs. Although, the bike ridership increased from February to March in 2019 across all three boroughs, it decreased in Manhattan from February to March in 2020. The bike ridership in Manhattan is affected more during the COVID-19 pandemic.

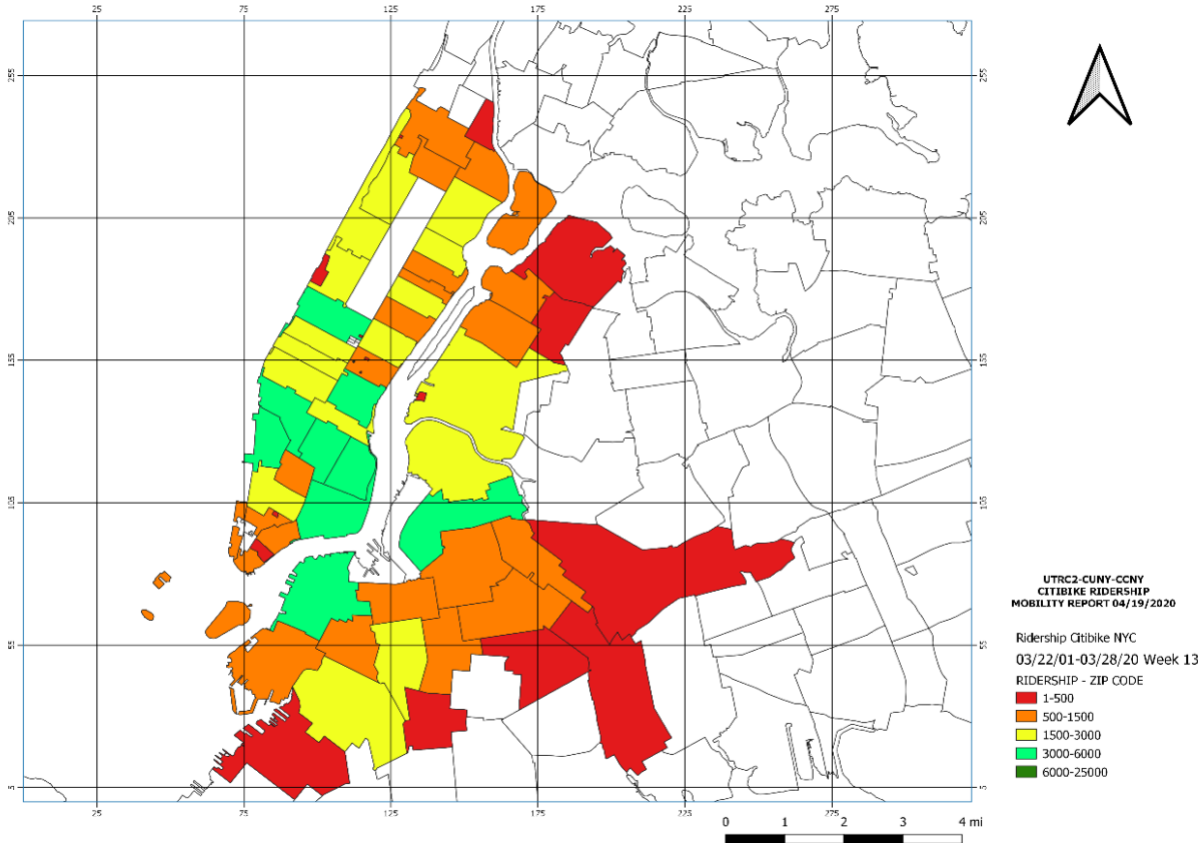
Table 4: Citi Bike monthly trips in three boroughs during February and March in 2019 and 2020

	Manhattan	Brooklyn	Queens
February, 2019	709,794	161,760	19,642
March, 2019	984,488	224,321	30,220
Change (%)	+39%	+39%	+54%
February, 2020	862,781	196,127	26,411
March, 2020	733,594	178,671	28,697
Change (%)	-15%	-9%	+9%
Feb: change from 2019 to 2020	+22%	+21%	+34%
Mar: change from 2019 to 2020	-25%	-20%	-5%

Figure 15, also shows the weekly Citi Bike ridership in New York City, aggregated at the zip-code level. The spatial and temporal maps in Figure 15 show the Citi Bike ridership for the last week of February and March in 2020. More specifically, the two maps are for: *a) February 23rd to 29th*, and *b) March 22nd to March 29th*. All bike trips less than “30 minute trip length” have been visualized in the figures. As shown in the figures in the borough of Manhattan and more specifically, Midtown Manhattan and some parts of Lower Manhattan, have the highest bike ridership. The range of ridership for these areas is between 6,000 to 25,000 trips in the last week of February, the 9th week of 2020. Also, zip-codes for Downtown Brooklyn and East Williamsburg show a high range of bike ridership. The bike ridership has decreased significantly at almost all zip-codes during the last week of March, the 13th week of 2020.



(a) From February 23rd to 29th 2020 (week 9 in 2020)



(b) From March 22nd to 28th (week 13 in 2020)

Figure 15: Citi Bike weekly ridership maps for the last week of February (a) and March (b) in 2020

Table 5 shows the number of bike trips with trips less than 30 min and those between 30 min and 60 min. A comparison of the bike trips during February and March, in 2019 and 2020, was performed. Due to COVID-19 related restrictions taking effect in March 2020, the number of bike trips with duration between 30 and 60 minutes (longer trip) increased from 77,390 trips in March 2019 to 109,955 trips in March 2020. In fact, the total number of Citi Bike trips of less than 30 minutes decreased from March 2019 to March 2020, but the ratio of longer trips has almost doubled, surging from 6.4% to 11.8%. This clearly shows that many residents have preferred to use bikes, even for longer trips, than public transit, to avoid crowded places with its perceived higher risk of transmission of the virus and to maintain social distance.

Table 5: Number of Citi Bike trips classified by trip length during February and March in 2019 and 2020

		Number of trips less than 30 min	Number of trips between 30 min and 60 min	Ratio of longer trip
2019	February	854,659	46,398	+5.4%
	March	1,208,682	77,390	+6.4%
2020	February	1,057,543	54,438	+5.1%
	March	928,303	109,955	+11.8%