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## **Mobility Trends during the COVID-19 Virus Pandemic**

### **Abstract**

The Coronavirus Pandemic (COVID-19) has a significant impact on countries around the world and many states have introduced restrictions to transport. This includes keeping essential transport moving, for example to transport medical supplies and other essential goods. Many countries have closed their borders and imposed curfews in sharp reductions in transport demand also on regional and continental level. Public transport but also shared mobility services are vectors for distribution of the virus, on the other hand, they are severely impacted by travel bans and individual concerns in order to avoid public gatherings leading to reduced travel and transport demand. Different countries have dealt with these challenging circumstances in different ways - and, in some cases, the directives vary from city to city. Cities in developing countries and emerging economies face bigger challenges than ever before. At the beginning of the Coronavirus Pandemic (COVID-19) google maps started to collect detailed statistics on the movement of people using location data from mobile devices. The paper analyzes the data obtained and shows the results for various areas of movement such as shops, recreation areas, parks, public transport and other. A comparison was made of the collected data in the Republic of Croatia, which had a solid measures, Italian Republic which had many affected during the pandemic and Kingdom of Sweden which had very mild measures during a pandemic. Therefore, a study was made on how measures affected the mobility of people in individual countries with different measures.

**Keywords:** pandemic, restrictions, public transport, statistics

## 1. Introduction

In the Chinese city of Wuhan, an outbreak of the new coronavirus broke out, which quickly spread to other Chinese provinces and around the world. After that, the World Health Organization officially confirms that it is a new coronavirus SARS-CoV-2, and the disease it causes is called COVID-19. On 17 March 2020, European Union Member States agreed to implement coordinated measures at the external borders in line with the Commission's recommendation of which some remain in force until writing this paper.

How effective these policies have been in reducing people's movement can be seen from the data that Google and Apple present in their COVID-19 mobility reports. Using anonymous data provided by apps like Google Maps, the company has created a regularly updated dataset that shows how people's movements changed during a pandemic.

Studies identified by this search concluded that the reduction in travel had a positive effect on the reduction in COVID-19 transmission. However, the only studies that used data to reach this conclusion were done using data from China; therefore, empirical evidence on the effectiveness of social distancing is still needed to understand its effect on the transmission of COVID-19. [1]

Paper present data in the charts below to make it easier to see changes over time in a particular country, and how certain policies could have influenced behaviour in communities. This mobility data may provide helpful insights to local governments and health authorities and may also be used as a foundation for new public policies by showing the change in volume of people driving and walking in their communities.

## 2. Methodology and resources

The study was made on how measures affected the mobility of people in individual countries with different measures. To tackle the pandemic, countries around the world have implemented a number of strict policies, including "locking in" at home, school and workplace closure, cancellation of events and public gatherings, and public transport restrictions. We can learn about this from the data that Google and Apple presents in community mobility report. United Nations and other organisations sources and categorized the data into the following categories [2]:

- ◇ Social distancing
- ◇ Movement restrictions
- ◇ Public health measures
- ◇ Social and economic measures
- ◇ Lockdowns

Table 1. Policy measures considered in the analysis

Category	Measure	Description
Social distancing	Limit public gatherings	Cancelation of public events. Limit to the number of people that can meet in public and private spaces.
	Public services closure	Public services and facilities are closing access to the public. In some countries, services are available online.
	Changes in prison policies	Change in policies around prisons to mitigate the spread of the disease. This may include early release but also suspension of day-release programs, suspension of visits.
	Schools closure	Authorities have closed schools.
Lockdown	Partial lockdown	Partial lockdown includes: 1. The population cannot leave their houses apart for specific reasons that they have to communicate to the authorities. 2. All stores that are not related to alimentation or pharmacies are not open.
	Full lockdown	Full lockdown includes: 1. The population cannot leave their houses apart for specific reasons that they have to communicate to the authorities. 2. All non-essential services closed and production stops.
	Lockdown of camps	Limitations to the population living in camps and/or camp like conditions.

Google released community mobility reports that show movement trends by region, across different categories of places. For each category in a region, reports show the changes in two different ways. Compares mobility for the report date to the baseline day. Calculated for the report date and reported as a positive or negative percentage.

These community mobility reports aim to provide insights into what has changed in response to policies aimed at combating COVID-19. The reports chart movement trends over time by geography, across different categories of places such as retail and recreation, groceries and pharmacies, parks, transit stations, workplaces, and residential.

*Table 2. Description of mobility reports categories*

Category	Description	Data Source
Retail and recreation	Restaurants, cafes, shopping centres, theme parks, museums, libraries, and movie theatres.	Google
Grocery and pharmacy	Grocery markets, food warehouses, farmers markets, specialty food shops, drug stores, and pharmacies.	Google
Parks	National parks, public beaches, marinas, dog parks, plazas, and public gardens.	Google
Transit stations	Public transport hubs such as subway, bus, and train stations.	Google
Workplace	Places of work.	Google
Residential	Places of residence.	Google
Driving	Driving mobility of Apple users	Apple
Walking	Walking mobility of Apple users	Apple

### 3. Research results

Using anonymous data provided by apps like Google Map, the company has created a regularly updated dataset that shows how people's movements changed during a pandemic. This Google data set measures the number of visitors to certain categories of places on a daily basis and compares this change to the starting day before the outbreak. Baseline days represent the normal value for that day of the week, which is given as the average over five weeks from January 3 to February 6, 2020.

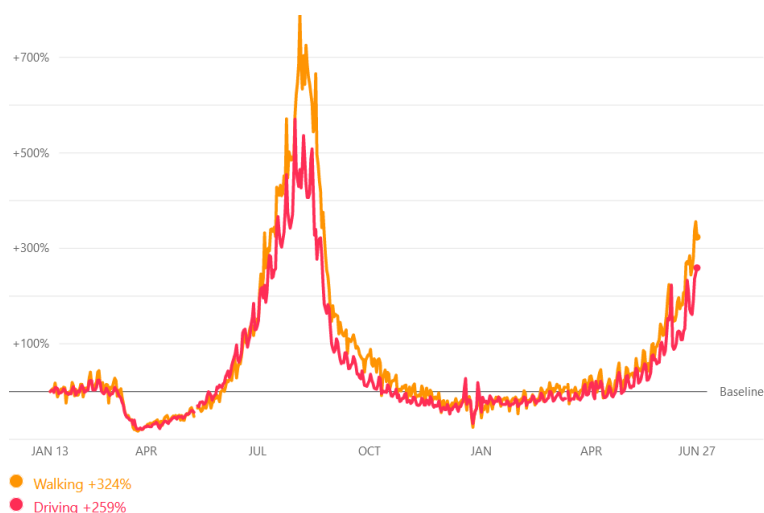
Apple released a series of mobility data related to the COVID-19 pandemic. Data are collected from requests for instructions in Apple Maps and are provided nationwide, as well as for the selection of major cities around the world. Apple has released time series data for countries and cities for each of the two modes of movement: driving and walking.

To make this easier to understand, we converted the raw data, from January 13, 2020 to June 27, 2021, to the current average of seven days as shown in the data in the following graphs.

#### 3.1. Mobility Trends in Croatia

The chart shows the relative volume of requests for driving and walking in Republic of Croatia, compared to the base volume of January 13, 2020. In a part of the country, on March 14, 2020, preventive measures will be introduced and on March

19, 2020, the implementation of measures to close most stores and cancelling public events across the country began. On March 21, 2020, the National Headquarters issued a decision to strictly limit detention on the streets, squares and other public places, as well as a decision to suspend public transport in order to prevent an increase in the number of infected people. Intercity lines for trains and buses are also being cut off.



*Figure 1. Mobility Trends Report from Croatia*

*Source: [7]*

The graph shows the largest decline in mobility on March 23, 2020, and the reason is the ban on leaving the place of residence or permanent residence. By the decision of the National Headquarters on April 27, 2020, the first phase of easing pandemic protection measures in order to partially start the economy came into force. This enables the work of all business entities that perform the activity of trade, except those that perform trade activities, except for those who operate shopping centres.

The third phase of easing epidemiological measures began on May 11, 2020, so schools were opened for some students, and after almost two months, shopping malls, cafes and restaurants began to operate. This establishes a long-distance road, rail and domestic air transport of passengers, as well as open bus and train stations for long-distance traffic.

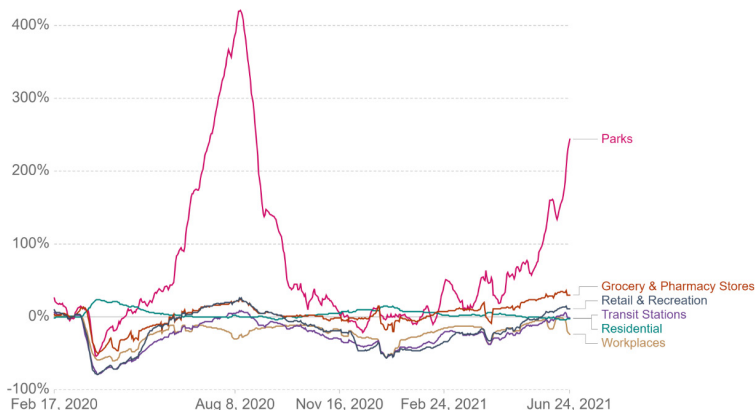


Figure 2. Community movement on specific locations in Croatia

Source: [9]

Previously mentioned reduction of epidemiological measures leading to increased mobility of driving and walking which reaches its maximum in August 2020 due to the large number of tourists. At the end of September and the beginning of October 2020, the number of infected people will increase, so measures will be reintroduced, such as the suspension of classes in schools and colleges, restaurants and cafes will be closed, and restrict the public events, which leads to a sharp decrease in mobility shown in the chart.

### 3.2. Mobility Trends in Italy

Italian Republic on March 4, 2020 takes measures against the spread of coronavirus; restrictions on sports competitions, teaching activities, school trips, the operation of shopping centres. A few days later, on 8, March 2020 restricted the entry and exit in the area of northern Italy.

Public events have been cancelled and a number of new measures have been introduced to limit the spread of coronavirus.

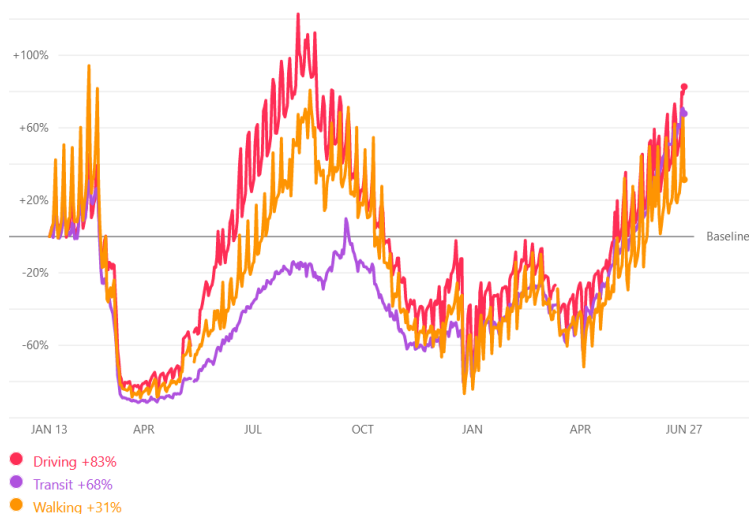


Figure 3. Mobility Trends Report from Italy  
Source: [7]

After the introduction of the measures, a significant decline in mobility is visible and reaches a minimum after the government on March 11, 2020 banned almost all commercial activities except supermarkets and pharmacies, and on March 21, 2020 closed all irrelevant businesses and industries and restricted the movement of people.

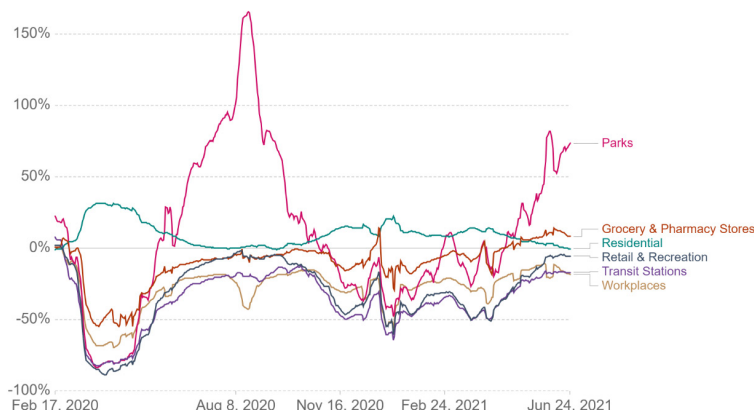


Figure 4. Community movement on specific locations in Italy  
Source: [9]

On April 26, the prime minister announced the so-called “Phase 2” in which movement by region was still prohibited, while movement between municipalities was allowed only for work and health reasons, as well as for visits to relatives. Moreover, it allowed the reopening of closed factories, but schools, bars, restaurants and barbershops were still closed. On May 18, most businesses could reopen, and free movement was granted to all citizens within their region; movement in the regions is still prohibited for irrelevant reasons. On June 3, free movement was restored throughout the national territory, ending the de facto blockade that began in March.

### 3.3. Mobility Trends in Sweden

Sweden is exceptional compared to most other countries in the world, in its quite different response to the COVID-19 outbreak by relying on individuals acting responsibly and adhering to public recommendations. This outlier position has led to international attention and debate. While several other countries have adopted quite drastic policies to stop infectivity at a larger scale, Sweden has adopted a route of less restrictive social distancing policies and mild recommendations following the Coronavirus epidemic. [4]

Sweden’s strategy to manage the spread of Covid-19 did not include any form of locking, unlike the approach adopted by most other countries. Instead, the strategy is largely based on strong recommendations for society. Although Sweden did not have any form of locking, the Covid-19 pandemic over a relatively short period of time brought about changes in society, significantly disrupting daily life.

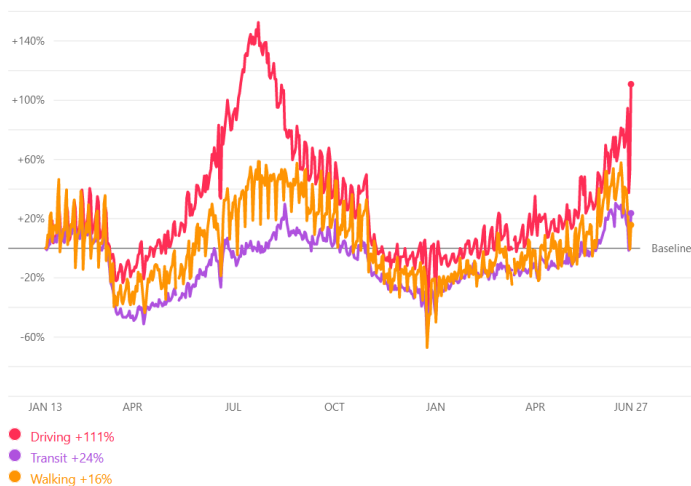


Figure 5. Mobility Trends Report from Sweden  
Source: [7]



By the summer of 2020, primary schools and kindergartens had not been closed, neither had shops nor restaurants as long as guidelines were followed. During the spring of 2020, all education in upper secondary schools and higher education institutions switched to online learning, and public gatherings were limited to a maximum of 50 people. Despite this relatively soft approach, the pandemic affected people's daily lives, and affected proper mobility and travel behaviour.

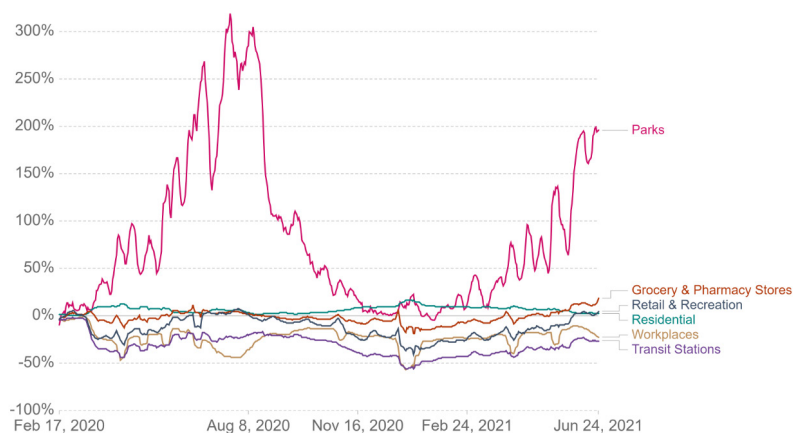


Figure 6. Community movement on specific locations in Sweden

Source: [9]

Public transportation in Sweden was operating and the borders to most EU countries remained open. Swedish spent less time home compared to other Europeans during the COVID-19 crisis. In Sweden, most policy measures announced by the authorities were mainly recommendations. Anyone that was displaying the COVID-19 symptoms was asked to stay home, but other members of their family were not restricted from going to school or showing up for work.

There are clear reductions in four of these categories, “retail”, “grocery”, “transit stations” and “workplace” Exceptions are for “parks” and “residential” activities. The ‘parks’ activity was continuously increasing throughout the period. [2]

The mobility indicator is a data product that aggregates data on the position of a mobile phone on standardized spatial and temporal granulations, thus enabling easier comparison of mobility patterns in different European countries. Comparison is made in the table below of the collected data in the Republic of Croatia, which had a solid measures, Italian Republic which had many affected during the pandemic and Kingdom of Sweden which had very mild measures during a pandemic.

Table 3. Review of absolute and relative changes in visits by category

Category	Country	Observed period		Absolute Change	Relative Change
		Feb 17, 2020	Jun 24, 2021		
Retail Recreation	Croatia	11.14%	+1.81 %	+19%	11.14 %
	Italy	2.00%	-5.43%	-7.43 %	-371 %
	Sweden	4.71%	+8.71 %	+218%	-3.33 %
Grocery & Pharmacy Stores	Croatia	3.67%	29.86%	+26.19 %	+714 %
	Italy	0.67%	8.14%	+7.48 %	+1,121 %
	Sweden	-3.33%	18.57%	+21.90 %	+657 %
Public transport stations	Croatia	6.33%	-2.00%	-8.33 %	-132%
	Italy	7.67 %	-16.86 %	-24.52 %	-320 %
	Sweden	-4.33 %	-26.29 %	-21.95 %	-507 %
Parks and outdoor spaces	Croatia	26.33 %	243.86 %	+217.52 %	+826 %
	Italy	22.67 %	73.43 %	+50.76 %	+224 %
	Sweden	-10.00 %	195.71 %	+205.71 %	+2,057 %
Workplace	Croatia	1.00 %	-23.86 %	-24.86 %	-2,486 %
	Italy	0.67 %	-18.29 %	-18.95 %	-2,842 %
	Sweden	-4.33 %	-22.57 %	-18.24 %	-421 %
Residential	Croatia	-1.67 %	-2.43 %	-0.76 %	-46 %
	Italy	-1.00 %	-0.29 %	+0.71 %	+71 %
	Sweden	1.33 %	2.29 %	+0.95 %	+71 %

The results suggest that mobile phone mobility data recorded only a small component of social remoteness-related behaviours that reduced virus transmission in the early stages of a pandemic. The absence of a strong correlation between mobility and case growth after the initial phase of a pandemic suggests that other factors at the individual level, such as wearing a mask or maintaining distance even when meeting individuals, are likely to be more important than mobility itself.

## 4. Conclusion

Although pandemics are rare in modern history, some studies on the effects of epidemics on mobility were conducted before the outbreak of Covid-19 and also found a drastic decline in mobility.

The analysis suggests that lockdown have the strongest causal impact on increasing presence at home and reducing visits to workplaces, public transport hubs, grocery, pharmacies, open public spaces. The impact of public services closure and schools closure is significant but of a smaller magnitude.

Results indicate that the most effective COVID-19 policies for reducing mobility are the public services and facilities closures, the partial lockdown and the full lockdown. Schools closure seems to reduce significantly the visits to workplaces and public transport hubs and increase the presence at home. Finally, the analysis indicates that the cancelation of public events and the changes around prisons have no statistical significant effect on community mobility as measured in mobility reports.

The crisis also provides opportunities for more sustainable transport. Avoiding public transport and declining demand for roads have seen a decline in public transport sponsorship, as has car traffic elsewhere. Long-term changes in teleworking or virtual mobility can result in temporal changes, including less frequent travel. Improving the accessibility of cycling and walking could improve traffic safety, health and the environment.

For future research, these study will play an important role in further influencing mobility trends.

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