

Major Project Dissertation Report on

Human Mobility Impact on COVID-19 in India

Submitted By

Pranav Bhardwaj

2K21/EMBA/33

Under the guidance of

Mr. Dhiraj Kumar Pal

Assistant Professor



DELHI SCHOOL OF MANAGEMENT

Bawana Road, Delhi 11004

Delhi Technological University

Certificate

This is to certify that Mr. Pranav Bhardwaj, Roll No. 2K21/EMBA/33 has submitted the major research project titled “Human Mobility Impact on COVID-19 in India” under the guidance of Mr. Dhiraj Kumar Pal, in partial fulfillment of the requirements for the award of Master of Business Administration (Executive) from Delhi School of Management, Delhi Technological University, New Delhi during the academic year 2022-23.

Research Supervisor
Mr. Dhiraj Kumar Pal
Assistant Professor, DSM

HoD, DSM
Dr. Archana Singh
Associate Professor, DSM

Acknowledgements

If words are a representation of token and appreciation, then let them serve as a herald for my sincerest gratitude and thanks. First and foremost, I express my profound gratitude to the Almighty for showering upon me blessings and keeping me in good spirits.

I wish to specific my deepest gratitude to my Prof. Mr. Dhiraj Kumar Pal for providing me with this opportunity to learn from his, who has worked tirelessly to ensure that this project runs smoothly at all times. I'd like to convey my gratitude to his, for serving as a mentor and providing me with unwavering support and direction. This report would not have been possible without his, contributions and words of guidance, for which I will be eternally thankful.

Subsequently, I would like to extend my honest way to my valuable circle of relatives for his or her benefits, my pals and co-workers for their hopes and idea for a success and final touch of this task.

Date: 1-May-23

Name: Pranav Bhardwaj

Roll No. : 2K21/EMBA/33

Declaration

I hereby declare that this dissertation report submitted to the “Delhi School of Management” is an original work undertaken by me and it is not submitted to any other university or institution for the award of any degree or diploma or published any time before.

Date: 1-May-23

Name: Pranav Bhardwaj

Roll No. : 2K21/EMBA/33

Abstract

The movement of people determines how quickly and where infectious diseases spread, and social patterns of movement help assess the impact of social segregation policies and improve our understanding of social behavior in this context. This study examines the relationship between human activities and the growing incidence of COVID-19 in India. In contrast, visits to parks, workplaces, and transit stations had no significant effect on changing COVID-19 conditions over time. Workplaces with segregated social systems or open spaces with minority populations are less susceptible to the spread of the virus. These findings suggest that demographic data, location data, and health model data can inform strategic decision-making during a pandemic by providing actionable insights into when and where communities may be exposed to the disease.

Mobility data was collected from Google via the WHO website and various websites. After downloading datasets from these sources, I created a Salesforce development org from my DTU email account and designed a dashboard to analyze trends in Salesforce Analytics.

I chose this topic last semester and, following the advice of the DSM faculty, I am developing/extending the same topic for my 4th semester project using the complete COVID-19 dataset.

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CHAPTER 1. INTRODUCTION - Human Mobility Impact on COVID-19 in India

1.1 About COVID

Corona virus disease / COVID-19 is an infectious/contagious disease. Basically caused by the SARS-CoV-2 virus.

Most of the general public who agreement with the aid of COVID-19 have slight to moderate signs and symptoms and recover without special treatment. However, some people become seriously ill, requiring medical attention.

Most infected people develop mild to severe symptoms of shortness of breath, & recover without the need for a specific medications. However, some people get sick and visit a medical institution. Older humans and those in poor fitness with cardio-vascular disease, diabetes, chronic respiratory ailment, or cancer are more likely to unfold critical infections. All and sundry can seize COVID-19 virus and come to be significantly ill or die at any time.

A better way to prevent disease and delay its onset is to better understand how diseases and viruses spread. Keep yourself and others safe from contamination by staying at least 3 feet away from others, wearing a tight-fitting mask, and washing your hands frequently or using an alcohol-based scrub. Get vaccinated while it's your turn and follow local advice.

The virus can be spread in small, fluid-filled debris by coughing, sneezing, talking, singing, or breathing through the mouth or nose of an infected man or woman. These particles vary from massive respiratory droplets to small aerosols. It's miles important to practice breathing habits like coughing into the naughty elbow and staying home and separating until you experience a higher level.

1.2 World Health Organization (WHO)

Founded on 7 April 1948, the World Health Organization (WHO) brings countries, partners and individuals together to improve health, make the world safer and serve vulnerable people. It is a United Nations agency that Enjoys a better quality of life. Headquarter at Switzerland, with 6 regional offices & 150 field offices worldwide.

CHAPTER 2. LITERATURE REVIEW & OBJECTIVE

2.1 Literature Review

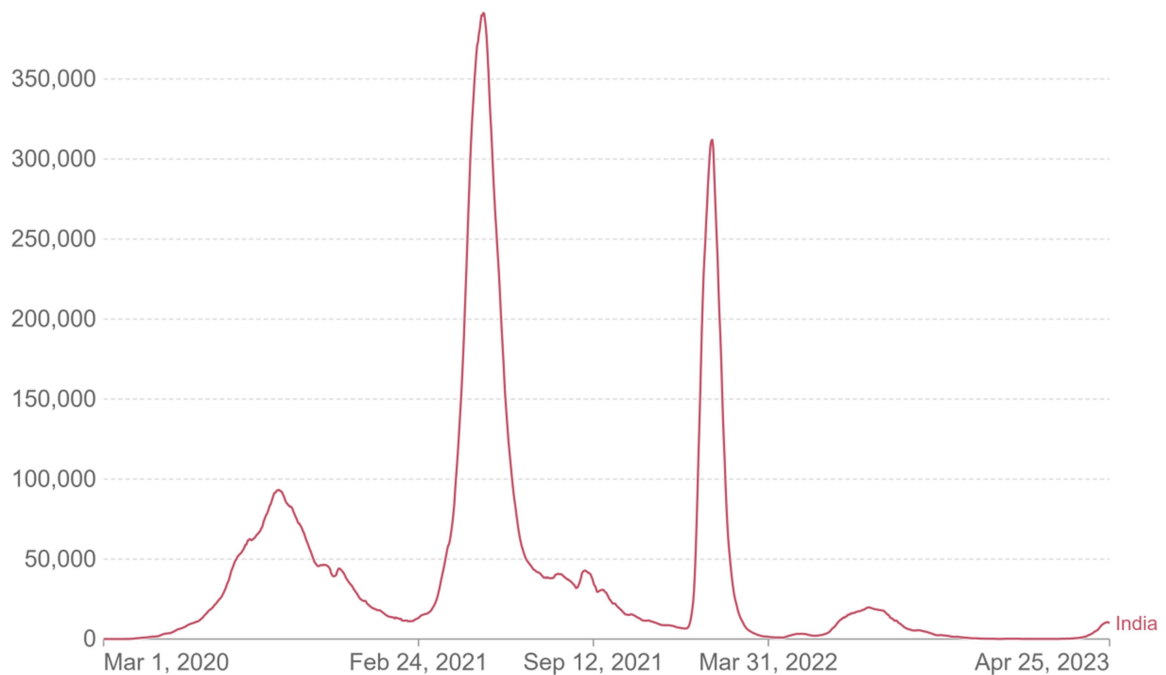
The COVID-19 pandemic has had a profound impact on global health and economies, including India. Human mobility plays a key role in the dynamics of infectious disease transmission, and therefore it is important to understand its impact on the spread of COVID-19. This literature review aims to summarize and analyze existing studies on the relationship between human mobility and COVID-19 (COVID-19 time vs. Post COVID-19 time) in India, highlight key findings and identify gaps in current knowledge. In the early stages of the pandemic, Indian authorities announced a notable shutdown on 24 March 2020, banning travel to the US and canceling global flights to prevent the spread of COVID-19. The land closure of 1.38 billion Indian plots was designed to force intervention on the grid and started in 4 phases over nine weeks (March 25-31). The first three weeks after the shutdown were very bad, almost all resources and businesses were suspended. As part of the 2nd intervention segment (April 15 to May 3), roadblocks were divided into 3 areas: purple (indicating areas of infection), orange (indicating exact infections) and green (no cases of COVID-19). In addition, in the orange and green areas of the second part, relaxation is announced, which allows the reopening of agricultural companies, banks and government institutions. 1/3 of the section (also four-17 cans) and the fourth (May 18-31) door closure were used to open up more jobs inside the orange area and restore the green area to normal. With its large population and diverse geographic and health conditions, India is facing significant challenges in controlling the spread of COVID-19. The movement of people, driven by factors such as travel, travel and population density, has been identified as an important determinant of the spread of the virus.

Understanding the relationship between human movement and COVID-19 is important for developing public health strategies and policies. This literature review provides an overview of recent research investigating the impact of human mobility on the spread of COVID-19 in India.

Daily new confirmed COVID-19 cases

7-day rolling average. Due to limited testing, the number of confirmed cases is lower than the true number of infections.

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in Data



Source: WHO COVID-19 Dashboard

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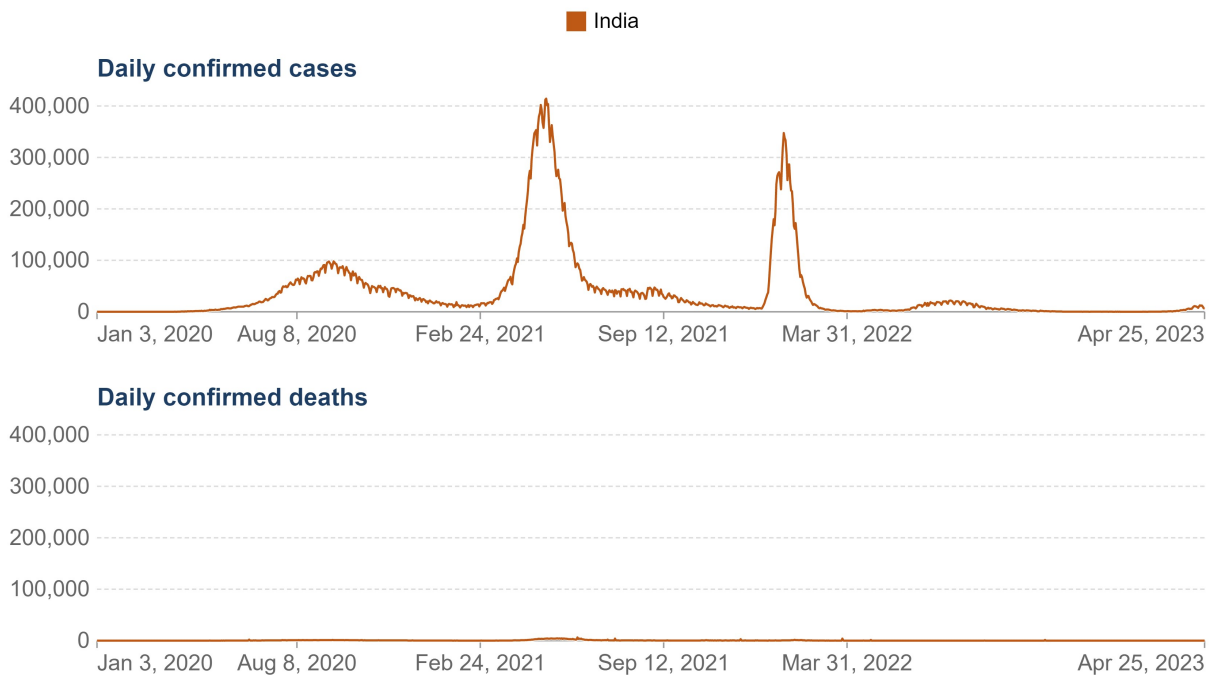
Figure 1(New Cases Trend)

During the pandemic Govt. India imposed a lockdown as soon as possible. The first lockdown was implemented on March 23, 2020, and was smoothed out according to the saturation of the coronavirus. The lockdown has clearly reduced the number of cases in India's healthcare system. In the first wave of Covid-19, India was one of the global countries that managed the situation much better than developed countries. Figure 1 shows that initially, the caseload curve flattened until August 2020. With the unblocking, the number of cases started to increase, but with social awareness, they helped people understand social distancing norms and the caseload curve flattened again.

Daily confirmed COVID-19 cases and deaths

Limited testing and challenges in the attribution of cause of death means the cases and deaths counts may not be accurate.

Our World
in Data



Source: WHO COVID-19 Dashboard

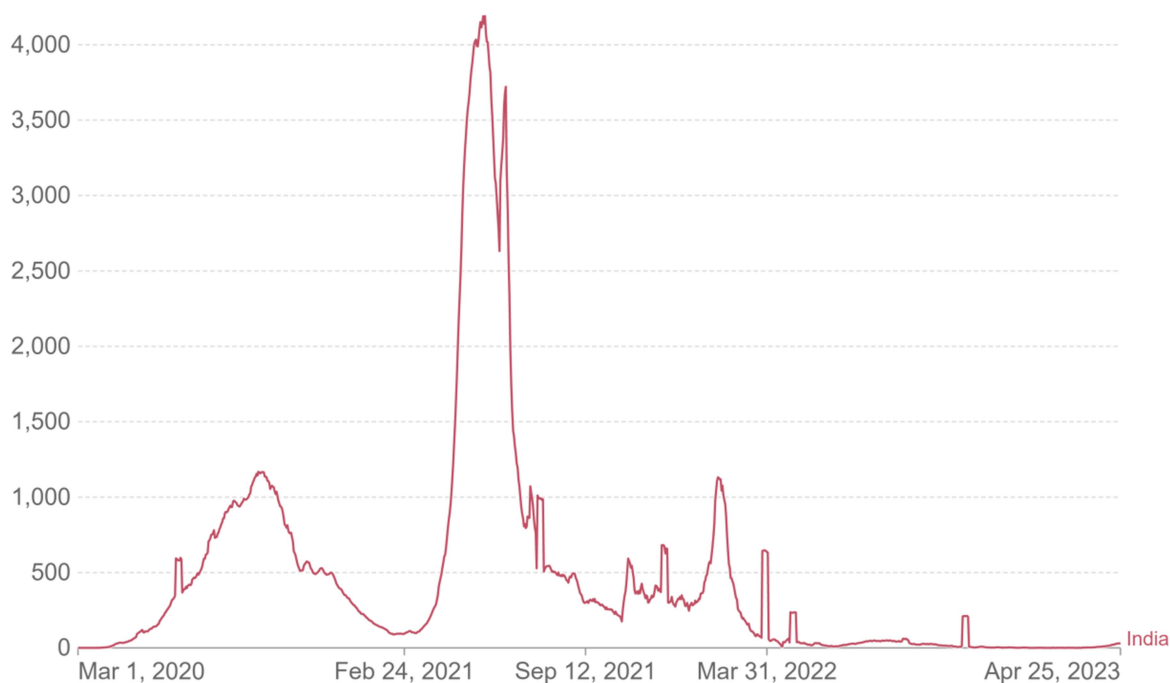
OurWorldInData.org/coronavirus • CC BY

Figure 2(Daily confirmed Cases & Deaths Counts in India)

Figure 2 shows data on daily cases reported & daily death count in India. Two different peaks are seen in the picture because two waves prevailed in India. Initially, India tackled Covid-19 with strict measures to limit the transmission of the coronavirus, and then it began to unlock the country with some relaxation and the number of cases began to rise. The second wave entered the scene around April 2021. Community transmission of covid-19 and the number of cases began to increase very rapidly and peaked around June 2021. Similarly, the number of deaths in the first wave also increased and then started to increase again in the second wave, peaking in June 2021.

Daily new confirmed COVID-19 deaths

7-day rolling average. Due to varying protocols and challenges in the attribution of the cause of death, the number of confirmed deaths may not accurately represent the true number of deaths caused by COVID-19.



Source: WHO COVID-19 Dashboard

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Figure 3(Death Trend)

Figure 3 shows the trend of deaths during the first and second waves, which are worse than the first and the COVID contamination is at its peak, because the lockdown was lifted, people started their movement and did not observe social distancing.

Electronic databases including PubMed, Google Scholar and pre-authorized databases were searched to identify studies published between 2020-2023. Search terms included "COVID-19", "SARS-CoV-2", "human mobility", "movement patterns", "India" and various combinations of these terms. Including exploring the relationship between population movements and the spread of COVID-19. Collaborative work between communication and communication in India. The reviewed literature consistently highlights the role of human mobility in the spread of COVID-19 in India. It is crucial to recognize that human mobility patterns are influenced by a variety of factors, including socio-economic differences, urbanization and government policies. The interplay

between mobility patterns, population density, and the dynamics of COVID-19 transmission needs to be further explored in order to develop targeted interventions.

Finding the gap: Before setting the goal of examining the impact of human movement on COVID-19 in India, it is important to understand the current research findings in this area. Based on the available information, the following studies can be identified:

- Limited research on certain types of movement: There is no research on the effects of certain types of movement, such as work, tourism and social media, on the spread of the virus. COVID-19 in India. Understanding the risks associated with these activities can inform interventions and lessons learned.
- Long-term effects of movement restrictions: While some research has explored the short-term effects of mobility restrictions such as curfew measures, for the spread of COVID-19 in India.
- Effectiveness of public health interventions and mobility models: More research is needed to assess the effectiveness of public health interventions Tests such as mandatory wearing of masks, testing strategies and vaccines affect the public's movement patterns and reduce the spread of COVID-19 in India.
- The differential impact of mobility in rural and urban areas: Exploring gaps in understanding differences in human mobility during the spread of COVID-19 in rural and urban areas of India. Investigating patterns of movement and effective transmission in different areas can provide valuable information for response plans.
- Analysis of Scientific Research Challenges: With the ability to monitor technology and data sources, research is needed to assess the spread of accuracy, reliability, and privacy concerns associated with COVID-19 when assessing the impact of human movement technology.
- Addressing these studies will lead to a better understanding of the relationship between population movements and the spread of COVID-19 in India, leading to the development of first-based strategies and interventions to reduce the impact of the movement on disease transmission.

2.2 Objective of the Study

The aim of the study is to understand the likely disruption of COVID-19 in India and its impact due to mobility during COVID-19 time & Post COVID-19 time. This case study covers the mobility of people's means of movement in cities or villages based on their latitude and longitude (location) captured from their smartphones provided by the Google Mobility Report.

- To examine the relationship between human mobility patterns and transmission of Covid-19 in India.
- To examine the role of intercity and international travel in the spread of Covid-19 in different regions of India.
- To analyze the impact of large-scale migration such as the movement of migrant workers on the transmission dynamics of COVID-19 in rural areas.
- To explore the influence of public transport system on the transmission of COVID-19 in India.
- To assess the long-term effects of mobility restrictions such as lockdown measures on transmission dynamics and socio-economic outcomes of COVID-19 in India.
- To provide insights that can inform targeted interventions and public health strategies to control and prevent the spread of COVID-19 in India based on an understanding of the impact of human mobility.

CHAPTER 3. RESEARCH METHODOLOGY

Data for analysis were obtained from the WHO website. The positivity ratio of the test was analyzed. The mobility of people during covid-19 was also analyzed based on data from two different sources. The data was taken from Google Maps via the WHO website. The Oxford Covid-19 tracker technique was used to find the strict index and its impact on caseload was plotted. And for better understanding and visualization, I use Salesforce Analytics as a tool.

CHAPTER 4. ANALYSIS, DISCUSSION AND RECOMMENDATIONS

4.1 Case Introduction

Migration propensity is measured in six broad categories:

1. **Accommodation:** primarily for housing.
2. **Grocery Stores and Pharmacies:** Places like grocery stores, grocery stores, farmers markets, grocery stores, drug stores, and pharmacies.
3. **Workplace:** the workplace.
4. **Parks:** Areas such as local parks, national parks, community beaches, marinas, dog parks, open spaces and community gardens.
5. **Transportation Stations:** Areas of public transport such as metro, bus, and train stations.
6. **Retail and Recreation:** Places such as restaurants, cafes, shopping malls, amusement parks and museums.

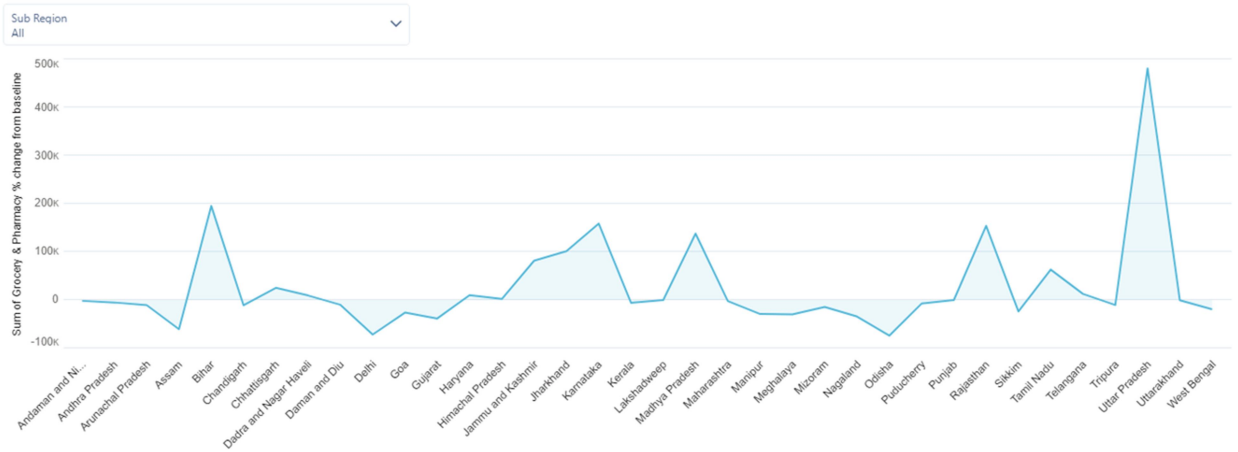
4.2 Data collection sources/techniques

Mobility data was collected from Google via the WHO website and various websites. After downloading datasets from these sources, I created a Salesforce development org from my DTU email account and designed a dashboard to analyze trends in Salesforce Analytics.

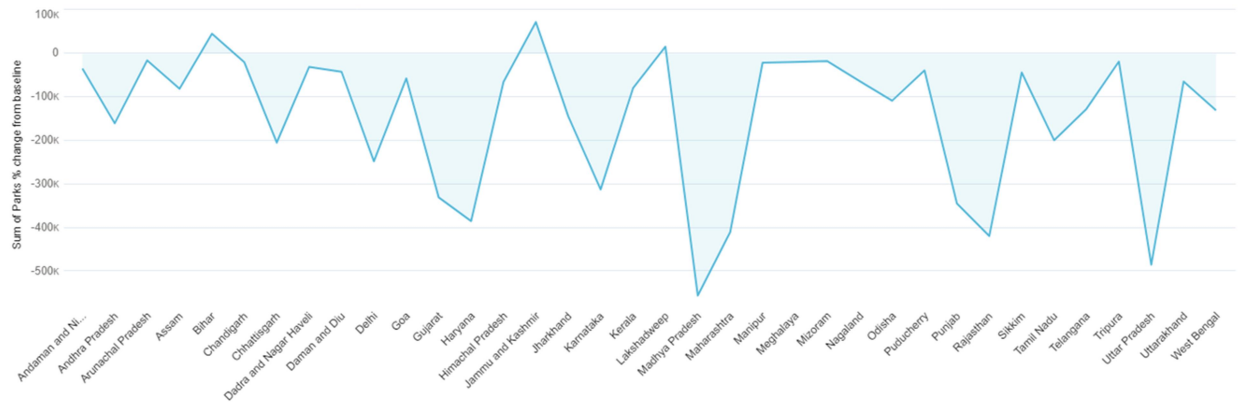
4.3 Data analysis

Below are the dashboard screenshots which I made in the Salesforce Analytics for the trend analysis.

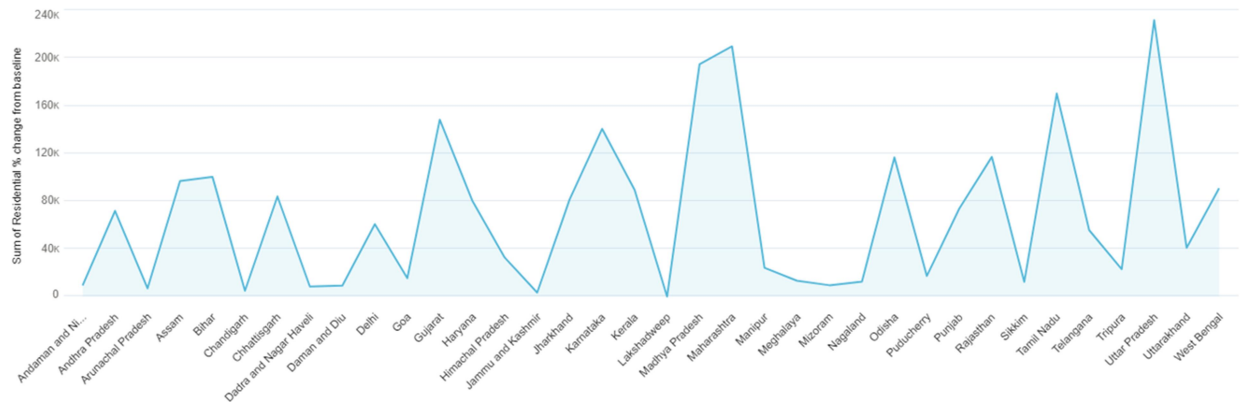
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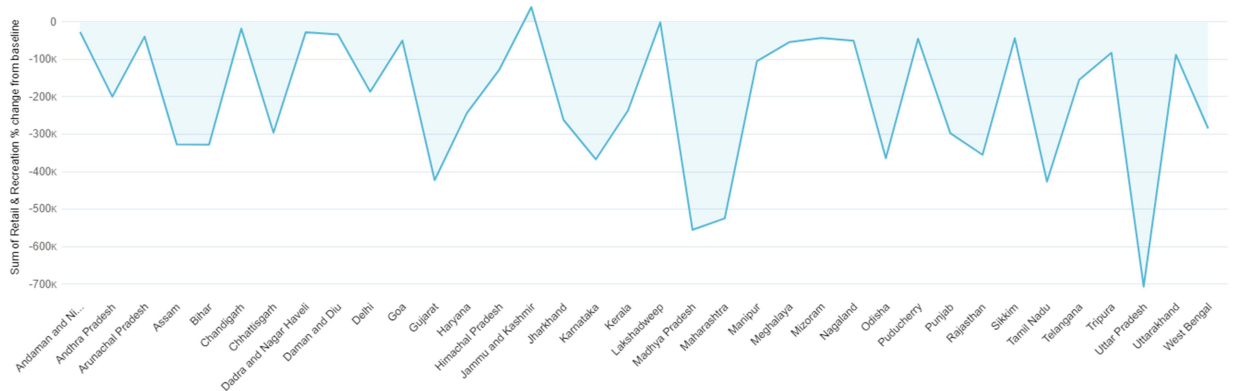
The above chart describes the change of mobility in the Grocery & Pharmacy in different States/Regions of India. We saw the high sharp edges in which state the mobility is high and few states have negative sharp edges where mobility is low.



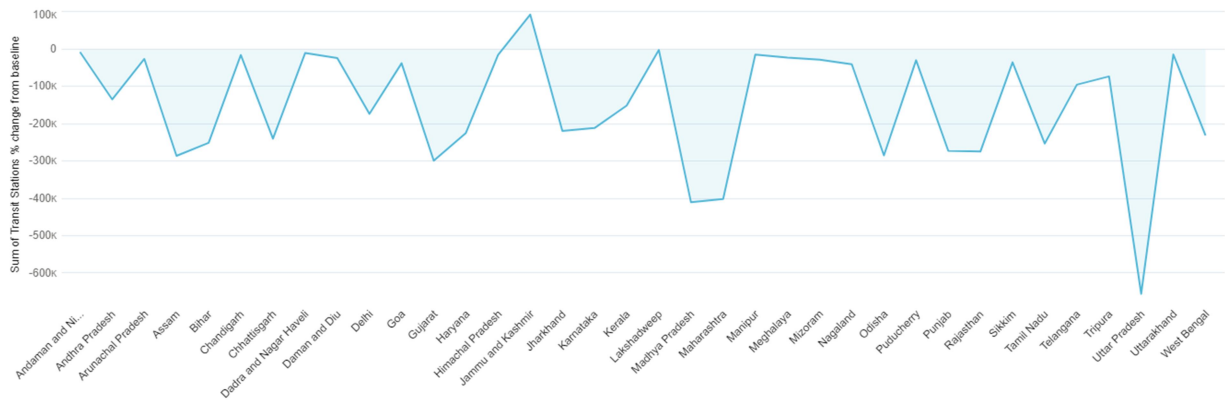
The above chart describes the change of mobility in the Parks in different States/Regions of India. Here, we saw with the sharp negative edges in most of the states so the mobility is very low.



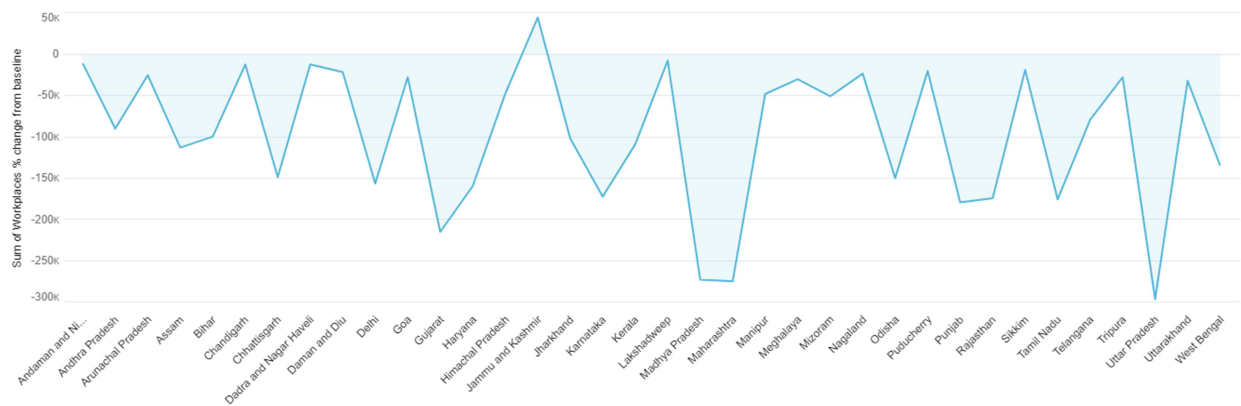
The above chart describes the change in mobility in the Residential in different States/Regions of India. We saw with the high sharp edges in which state the mobility is high during. With this we can say that people move for their residencies.



The above chart describes the change of mobility in Retail & Recreation in different States/Regions of India. Here we saw again negative sharp edges for most of the states in terms of mobility.



The above chart describes the change in mobility in the Transit Stations in different States/Regions of India. In this also, we saw negative curves for most of the states, so we can say that during this period people rarely move to transit stations.



The above chart describes the change in mobility in Workplaces in different States/Regions of India. Again we saw high sharp edges for some of the states, as during lockdown people adapt to the work-from-home facility.

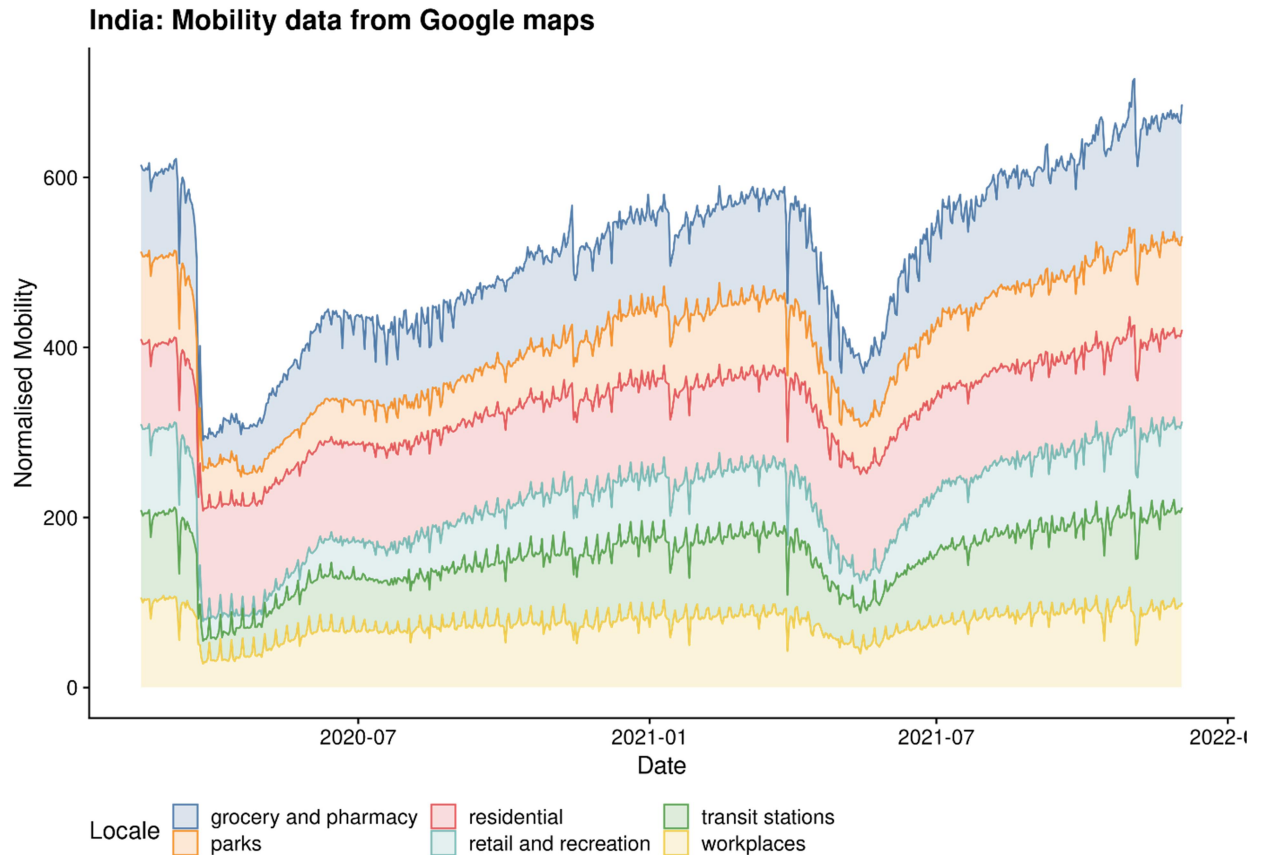


Figure 4(Mobility Graphs)

The Figure 4 shows the movement of people, the data was collected from Google maps. In this graph, the movement for local settings has been analyzed. Data was collected for the movement of people to grocery stores, residential buildings, transit stations, parks, retail and recreation, and workplaces. It was clearly observed that people traveled less from March 2020 to June 2020. This is in line with the government's movement restriction to prevent the transmission of the virus. This has a direct impact on mobility such as grocery shopping and dining out at restaurants. In general, it had a serious impact on economic activities. Even during the second blocking, the same trend was observed and the number of steps decreased, which leads to a decrease in people's physical activities.

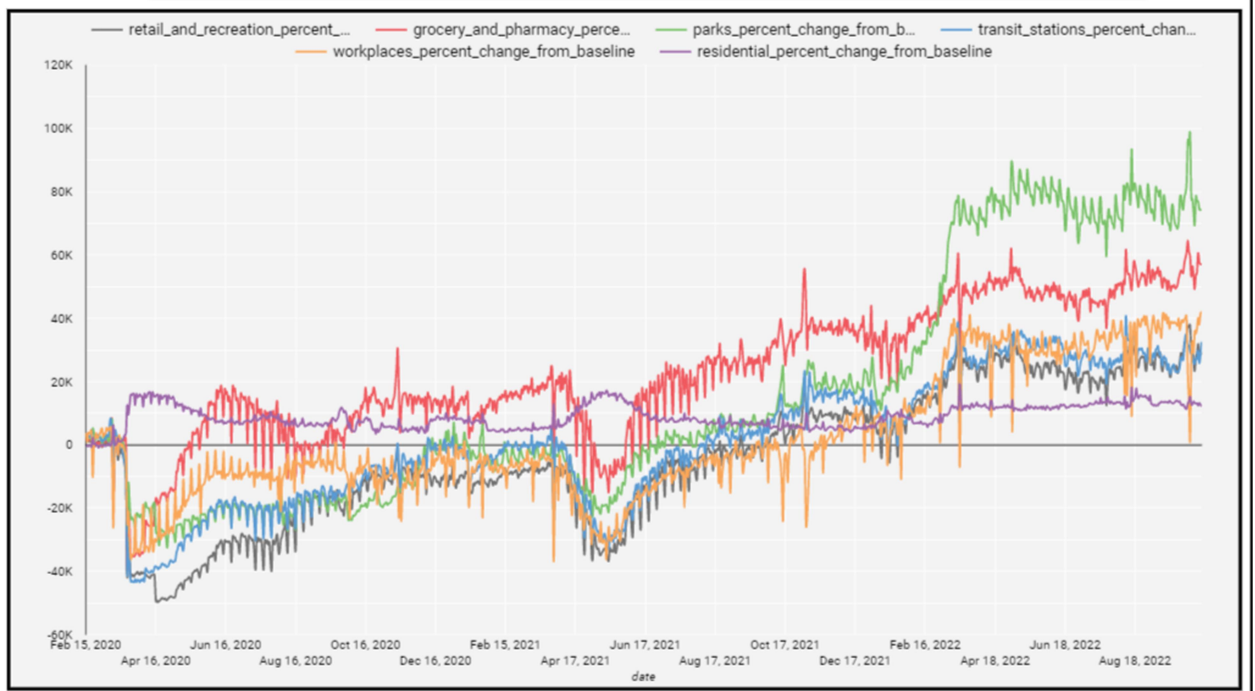


Figure 5(Comparison in all parameters of Mobility Trend)

As groups around the world respond to COVID-19, we've heard from public health officers (dear friends and loved ones) that the same type of aggregated, anonymous facts we use about goods like Google Maps can be useful because it's vital election against COVID-19.

These assessments (Mobility Community Assessments Figure 5) are intended to provide information on what has changed in response to regulations to combat COVID-19. The overview map movement has trended over the years in all classes of neighborhoods across the country: stores and leisure centers, grocery stores and pharmacies, parks, interchange stations, workplaces, and residential areas.

COVID-19: Stringency Index

The stringency index is a composite measure based on nine response indicators including school closures, workplace closures, and travel bans, rescaled to a value from 0 to 100 (100 = strictest).



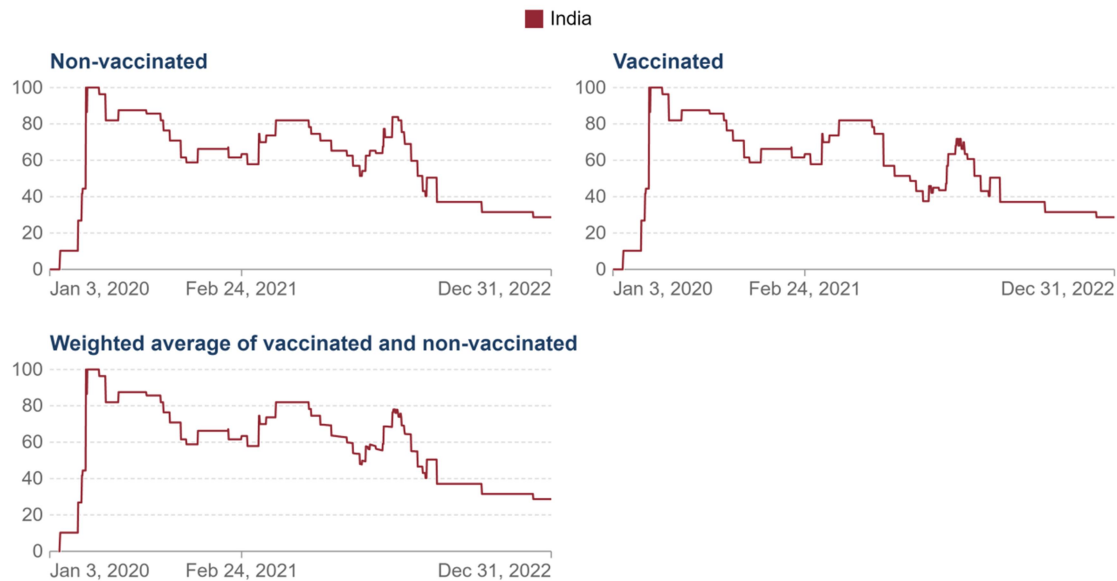
Source: Hale, T., Angrist, N., Goldszmidt, R. et al. A global panel database of pandemic policies (Oxford COVID-19 Government Response Tracker). Nat Hum Behav 5, 529–538 (2021). <https://doi.org/10.1038/s41562-021-01079-8>
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Figure 6(Stringency Index Graphs)

The graph (Figure 6) right here shows how the response of the authorities has changed over the years. It shows the Government Severity Index (SI) – a compact measure of the strength of policy responses.

COVID-19: Stringency Index

The stringency index is a composite measure based on nine response indicators including school closures, workplace closures, and travel bans, rescaled to a value from 0 to 100 (100 = strictest).



Source: Hale, T., Angrist, N., Goldszmidt, R. et al. A global panel database of pandemic policies (Oxford COVID-19 Government Response Tracker). Nat Hum Behav 5, 529–538 (2021). <https://doi.org/10.1038/s41562-021-01079-8>
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Figure 7(Stringency Index Graphs-Vaccinated/Non-Vaccinated)

This index captures the energy of "lock fashion" rules that largely constrain human behavior. By far, it is calculated using all indicators of foreclosure and foreclosure coverage, except for the index that reports public information campaigns.

The index for a given day is calculated as a rating of nine coverage points, each occupying several between zero and one hundred. A high rating indicates a strong response from the government (ie one hundred = strong response).

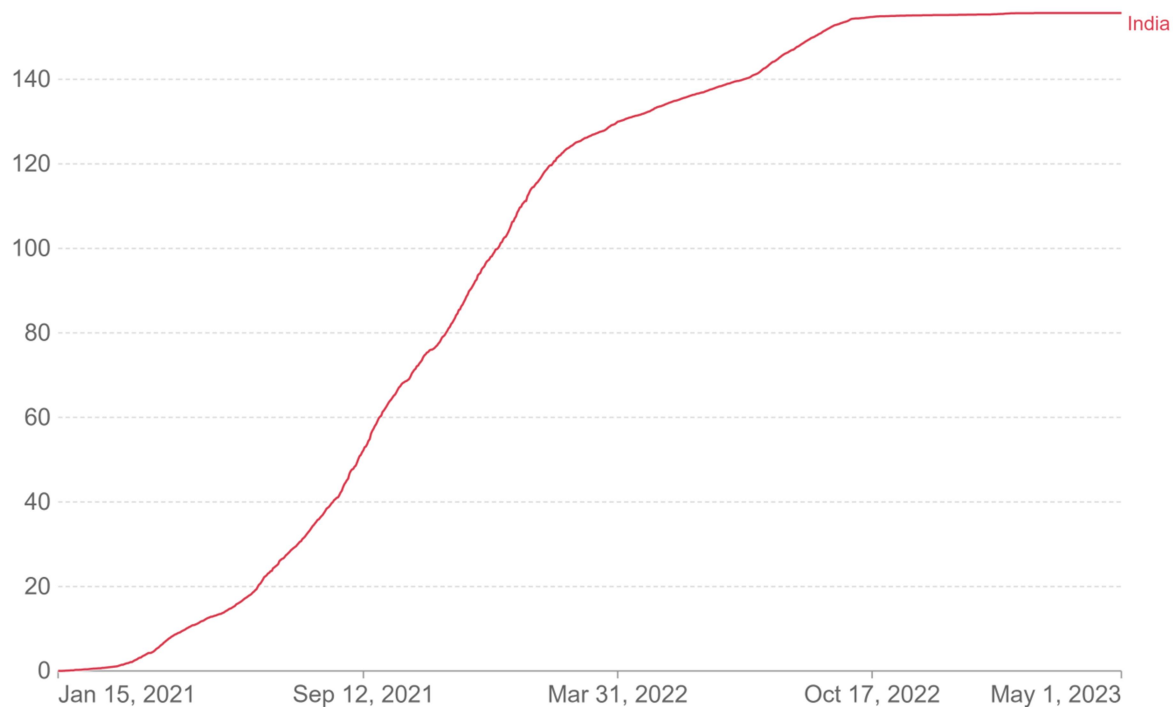
The OxCGRT challenge calculates this index using 9 unique steps, along with:

- Closure of universities and workplaces – C1 & C2.
- Restriction of public circles (gatherings & events) – C3 & C4.
- Shipping/Transport restrictions (public movements, between cities, & across borders) – C5, C7 & C8.
- Necessities for life at home – C6.
- Record presence of public info campaigns – H1.

Total COVID-19 vaccine doses administered per 100 people

All doses, including boosters, are counted individually.

Our World
in Data



Source: Official data collated by Our World in Data – Last updated 3 May 2023

OurWorldInData.org/coronavirus • CC BY

Figure 8(Total COVID-19 vaccine doses administered per 100 people)

4.4 Findings and Recommendations

Findings

First, we infer from this study that there is a direct impact on mobility due to Covid 19 waves in India. It also stagnates during the government's unblocking of policies after the first wave in March 2020, but later drops significantly again due to the second wave compared to the first wave. Human mobility has a significant impact on the transmission dynamics of COVID-19 in India. Understanding the link between mobility patterns and the spread of disease is critical to implementing effective public health interventions.

- Due to Covid-19, the highest mobility of people as shown in Figure 4 clearly showed that people usually moved outside their home only for basic things like food and pharmacy.
- Another movement noted Parks for a healthy lifestyle, and in the middle we found that people prefer to stay at home (residential) because of the fear of infection.
- Retail and Recreation you will notice on the third level from the bottom, due to Covid-19 all construction and real estate business has been suspended, as well as recreation such as the Cinema is closed until further orders.
- People preferred to travel by their own private vehicle and avoid all public transport, so the crossing station comes to the penultimate stage to maintain social distance to prevent infection.
- In the latter case, workplace mobility was very low because the Work from Home (WFH) policy was implemented by many organizations, even government institutes.

Next, we consider associations between index (via the University of Oxford) and a key outcome of interest, mobility of persons, to illustrate the potential for mixing statistics with different signatures to analyze financial, social, and epidemiological issues of hobbies.

We can analyze from the data charts that the mobility in different categories, where there are movement the COVID spread hits high a lot where as its completely opposite for low mobility categories. Additionally, it depends upon the population of a certain state.

Recommendations

- We can suggest whenever this type of situation occurs we can restrict our mobility to cut down the spread span.
- Improve monitoring and information sharing: Improve surveillance systems and data sharing mechanisms to monitor mobility patterns, identify high-risk areas, and make informed decisions regarding targeted interventions. Collaboration between public health agencies, researchers, and technology companies can facilitate data-driven strategies.
- Promote Telephone/Internet/remote work and Flexible Hours: Employers are encouraged to adopt phone/internet plans and flexible hours to reduce the need for travel and reduce office downtime. This helps limit people's movement and reduce the risk of disease transmission.
- Improve public transport safety measures: Tighten safety procedures in public transport, including air conditioning, car washes, and nasal face masks. Consider reducing the number of passengers to be able to remotely control the fuselage.
- Foster community engagement: Encourage community participation and engagement in COVID-19 prevention efforts. Empower local community leaders and organizations to disseminate accurate information, address concerns, and promote adherence to preventive measures among community members.
- Implement targeted travel restrictions: Implement travel restrictions, both domestic and international, based on the epidemiological situation in different regions. This can help reduce the spread of the virus from high-incidence areas to low-incidence areas and minimize the risk of importing new variants.

4.5 Limitations of the study

The only limitation is that the data collected is only based on the available location of smartphone users. Also not included in this study are the people who did not follow the government guidelines, for example, Aarogya Setu Mobile app that users did not install cannot be captured here, mobile location function is turned off.

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7. Figure 2 (Daily confirmed Cases & Deaths Counts in India) - <https://ourworldindata.org/grapher/daily-covid-cases-deaths?facet=metric&country=~IND>
8. Figure 3(Death Trend) - <https://ourworldindata.org/covid-deaths>
9. Figure 4 – Salesforce Analytics org
10. Figure 5(Comparison in all parameters of Mobility Trend) - <https://lookerstudio.google.com/u/0/reporting/a529e043-e2b9-4e6f-86c6-ec99a5d7b9a4/page/yY2MB?s=ho2bve3abdM>
11. Figure 6(Stringency Index Graphs) & Figure 7(Stringency Index Graphs-Vaccinated/Non-Vaccinated) - <https://ourworldindata.org/covid-stringency-index>
12. Figure 8(Total COVID-19 vaccine doses administered per 100 people) - <https://ourworldindata.org/grapher/covid-vaccine-booster-doses-per-capita>