



Research on COVID-19 and vaccination

Krisanat Anukarnsakulchularp

Master of Business Analytics

Kumar Vatsal

Master of Business Analytics

Xiyun Zhou

Master of Actuarial Studies

Xinyu Hu

Master of Applied Economics and Econometrics

Report for
Monash University

26 May 2022

Subject ETC5513

Group Name

Quad Squad

☎ (03) 9905 2478
✉ questions@company.com

ABN: 12 377 614 630

1 Introduction

Since the first outbreak of Covid-19 in late 2019, there have been more than 500 million confirmed cases. To curb the spread, governments around the world had taken several measures like imposing restrictions on travelling, lockdown, and introducing social-distance.

To bring this pandemic to an end, a large share of the world needs to be immune to the virus. The safest way to achieve this is with a vaccine. Vaccines are a technology that humanity has often relied on in the past to bring down the death toll of infectious diseases.

Fortunately in 2021, COVID-19 vaccines were introduced, it would require an incredibly-high vaccination rate to reduce the spread of the virus. Although the vaccines are not able to prevent infection, yet they are efficient at keeping the mortality rate low. “You may wonder if the vaccine is so effective, why are we still having a growth in the infection rate.”

We collected data from a public data base in github [COVID-19 data](#). In this report, we focus on overall COVID-19 analysis and explore the relationship between the pandemic and the vaccination by the world range.

The packages we will be using in this analysis are **tidyverse**, **readr**, **kableExtra**, **bookdown**, **bookdown2**, and **ggplot2**

2 Research questions :

- 1)The overall analysis of COVID-19.
- 2)The Effects of government policies on the spread of COVID- 19 worldwide.
- 3)How do positive cases change relate to vaccination?
- 4)How do death rates from COVID-19 differ between people who are vaccinated and those who are not?

2.1 The overall analysis of covid-19

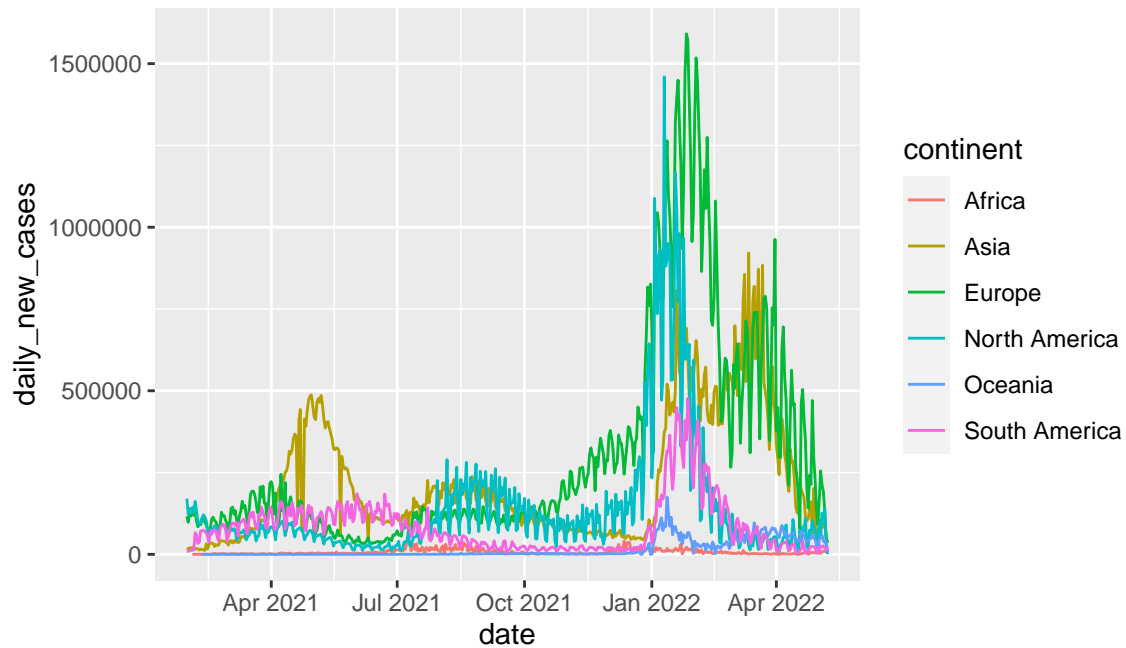


Figure 1: COVID-19 Daily new cases

The line chart 1 indicate from January 2021 to May 2022, the daily new cases show an upward trend. There are 3 times breakout in most regions, which occurs in the May 2021, August 2021, and February 2022. Especially in the past few months, the average daily cases reach to the highest point. Some countries in Europe and North America region have more than 1 million new cases every day. And European countries always have the highest daily cases in this period.

Table 1: Countries with Highest Average Daily Cases

location	average daily cases
United States	120485
India	70729
France	56649
Germany	50097
Brazil	46861

Table 1 list the top 5 countries with the highest average daily cases. The average daily cases are more than 1 million in United State. In the following, the countries in the table will be utilised to examine the relationship between vaccination and daily new cases.

The overall of graph 2 show a decline trend of average daily deaths attributed to COVID-19. The North America area has the greatest daily deaths in early 2021, and then the number of deaths

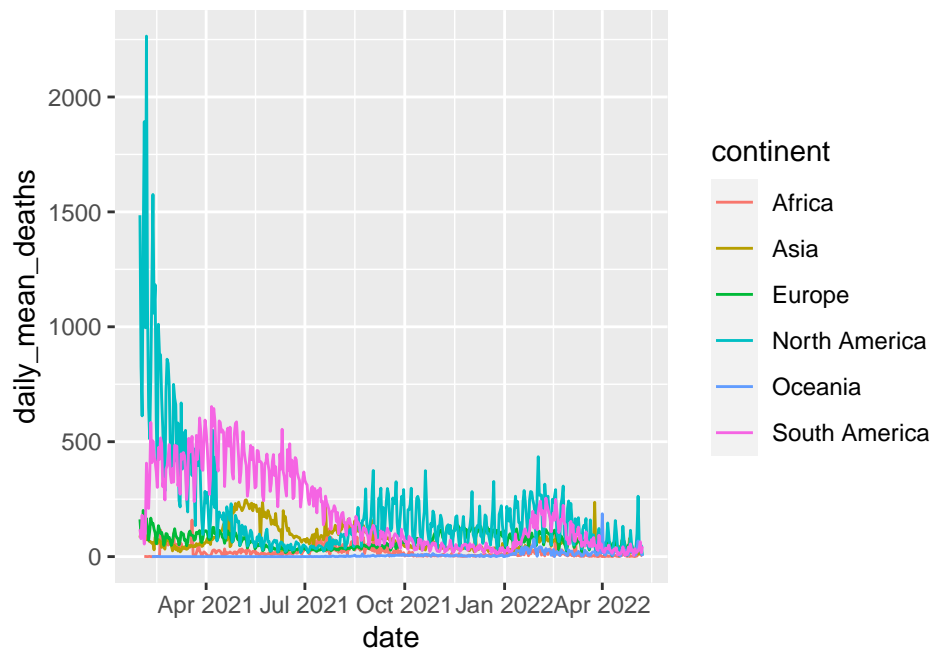


Figure 2: Average daily deaths attributed to COVID-19

drops dramatically beginning in May 2021. After October 2021, the average daily death toll in North America never exceed 500.

Table 2: COVID-19 Highest Average Daily Deaths Countries

location	average daily deaths
United States	1200.9892
Brazil	977.8126
India	797.7945
Russia	662.3771
Mexico	396.0946

Table 2 list the top 5 countries with the highest average daily deaths caused by COVID-19. In the following, the countries in the table will be using to analyse the relationship between vaccination and daily deaths.

The barplot 3 shows the fully vaccination rate by regions. Except Africa region, the fully vaccinated rate over 50% in other continent. According to the research Idris and Adebisi (2022), at the end of December 2021, only 7 African countries with relatively smaller populations (Seychelles, Mauritius, Morocco, Tunisia, Comoros, Botswana, and Cape Verde) met the 40% target. The African continent's fundamentally deficient health systems are undoubtedly leading to insufficient COVID-19 vaccination capability.

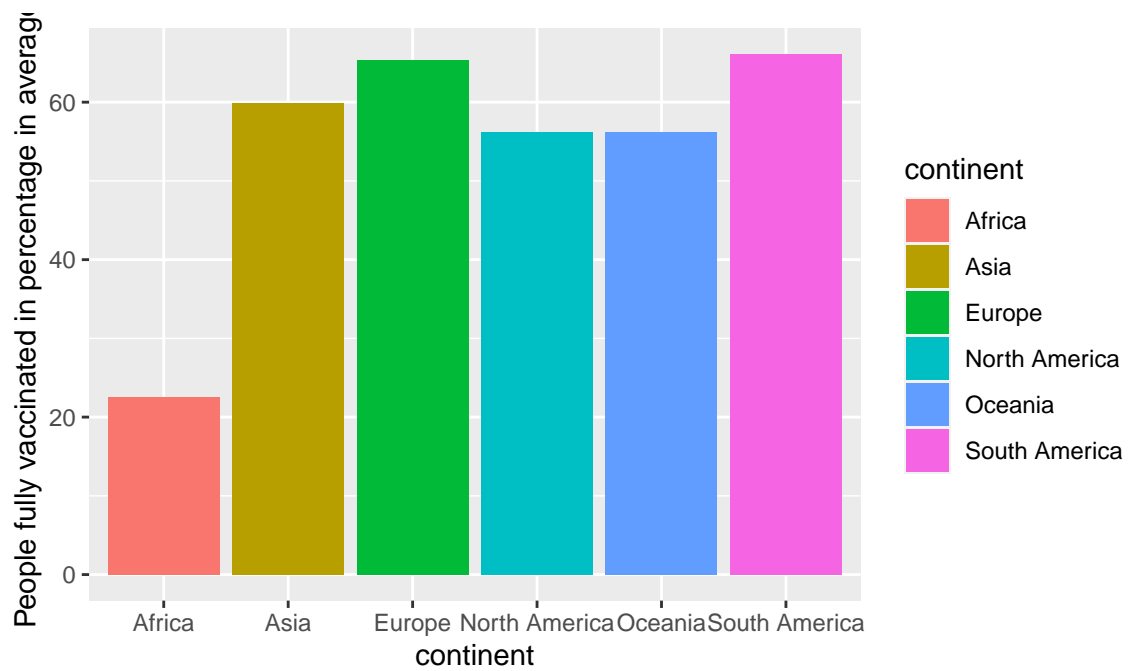


Figure 3: *People fully vaccinated in percentage by region*

How do positive cases change relate to vaccination?

top 5 countries with highest daily new cases

Table 3: top 10 countries with highest daily cases

location	mean_daily_cases	mean_new_vax
United States	120484.50	460807.1
India	70728.59	2008029.1
France	56648.85	114807.6
Germany	50096.89	138850.6
Brazil	46861.09	372419.6
South Korea	39991.02	102166.7
United Kingdom	38446.46	110154.3
Italy	30754.16	102214.1
Russia	29094.76	203228.0
Turkey	27831.21	119240.3

Trend of trend of new cases vs fully vaccinated

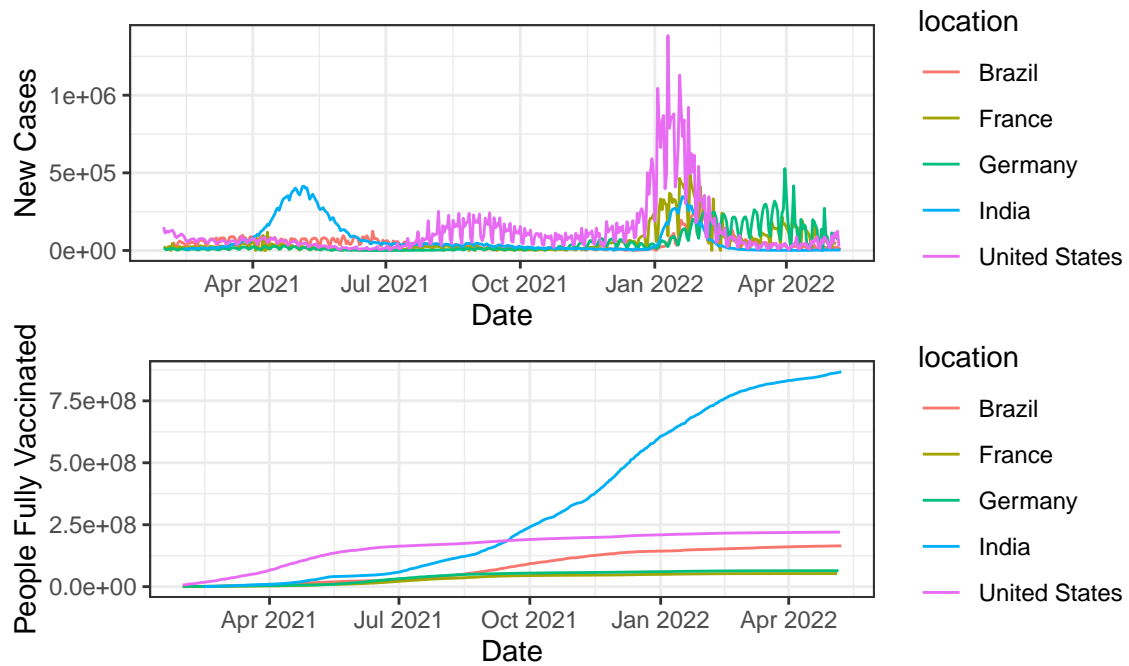


Figure 4: trend of new cases vs fully vaccinated

Trend of trend of new cases vs fully vaccinated

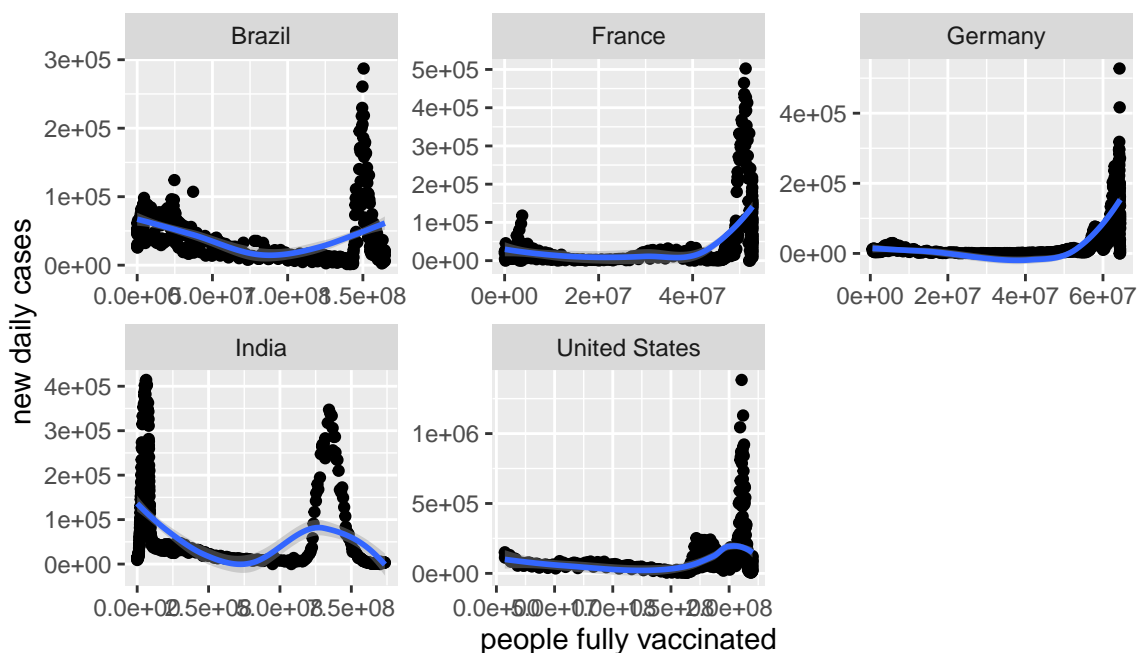


Figure 5: correlation between new cases vs fully vaccinated

We sorted out countries by the order of mean new daily cases, referring @ref(tab: table3), the table showcases top 10 countries with highest mean value of daily cases, our research onward will be based on the top 5 countries, US, Brazil, India, Germany, France. From table 3, United States has the highest daily cases and India did the best in terms of vaccination.

Line chart 4 showcases the trend of new cases and fully vaccinated people from 2021 to latest data, and from the line chart, there is no corresponding effect between them. Lipsitch and Dean (2020) mentioned that the effectiveness of vaccination varies within different conditions of health, however, both direct and indirect protection reduce virus symptoms generally.

Plot chart 5 was generated to explore the relationship between vaccination and new cases, with vaccination on the x-axis, daily cases on the y-axis. The graph did not show a significant correlation between them; a smooth line was added to overview general movement. The graph further proves there is no expected higher vaccination with lower infections in the top 5 countries. Chen et al. (2021) discussed how mutations reduce the effectiveness of vaccination in terms of infection protection, and the research team mentioned we need to develop a vaccine to deal with predicted mutations.

How do death rates from COVID-19 differ between people who are vaccinated and those who are not

Research Question 3

Table 4: Average daily vaccinations and deaths for the countries with highest death rates.

location	average_vaccinations_per_day	average_deaths_per_day
United States	1135290	1246
Brazil	934008	847
India	4057187	657
Russia	434410	472
Mexico	444551	407

Table 4 shows the average daily vaccinations and deaths for the countries with highest death rates. We can see that **United States** has the highest deaths per day of 1264 while **India** has the highest average vaccinations per day of approx 4057187.

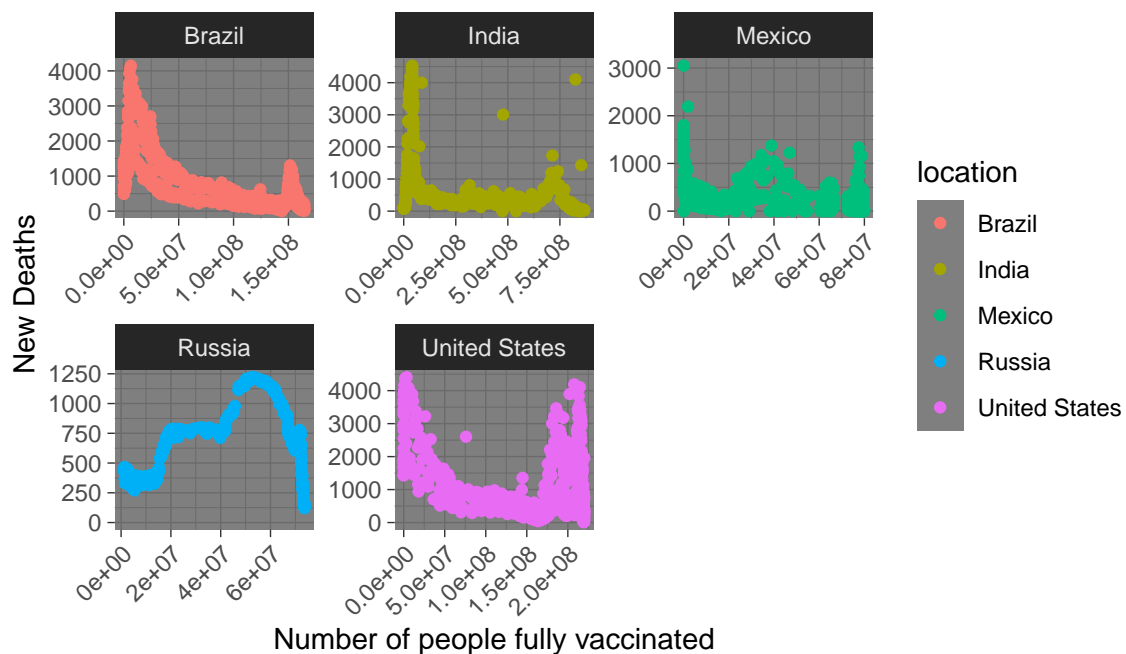


Figure 6: Relationship between new deaths and vaccination status

From the figure 6 we can clearly see that in countries like Brazil, India and Mexico, there is a clear effect of vaccinations on the death rates. The death rates in the third wave (second peak of the graph) have fallen to around 25% of what they were in the second wave (first peak of the graph).

For the countries like Russia and United States the case is a little different as the vaccinations have increased but the number of deaths due to COVID-19 have remained constant or have increased. This

may be due to many reasons such as the vaccine that was being used in the particular country, the immunity of the individual at the given location and the other Comorbidities they had. Also, the vaccine was designed using the first strain of COVID-19 virus and mutations caused in the virus might have affected the efficacy of the vaccine.

A research published Rustagi et al. (2022) also confirmed that double vaccination against COVID-19 will decrease the death rate by 74.89 %

3 CONCLUSIONS

Globally, after the continued decline observed since the end of March 2022, new daily COVID-19 cases have stabilized in the latest weeks. And the number of new daily deaths continues to decline.

The vaccination seems to not affect the spread of the virus due to mutation. From the findings above it is clear that vaccination against COVID-19 is not the sure shot method to prevent the disease but it is still one of the best and safest way to prevent the spread of a pandemic like this.

References

- Chen, J, K Gao, R Wang, and GW Wei (2021). Prediction and mitigation of mutation threats to COVID-19 vaccines and antibody therapies. *Chemical science* **12**(20), 6929–6948.
- Idris, AG and Adebisi (2022). Why many African countries may not achieve the 2022 COVID-19 vaccination coverage target. *Tropical Medicine and Health*.
- Lipsitch, M and NE Dean (2020). Understanding COVID-19 vaccine efficacy. *Science* **370**(6518), 763–765.
- Rustagi, V, M Bajaj, Tanvi, P Singh, R Aggarwal, MF AlAjmi, A Hussain, MI Hassan, A Singh, and IK Singh (2022). Analyzing the Effect of Vaccination Over COVID Cases and Deaths in Asian Countries Using Machine Learning Models. *Frontiers in Cellular and Infection Microbiology* **11**.