

Investigation of Effectiveness of the Main Regulations Countries Launched against COVID-19

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Abstract

Since the first known case of COVID-19 was identified in December 2019, nothing was able to stop corona from spreading all over the world. Therefore, Coronavirus disease cost more than four million people worldwide. Each country attempted to take necessary measures according to its own situation whereby certain policies have been announced in all nations for they have proven themselves to be effective. However - despite the expectation of having at least similar patterns in the statistics - various results arose and are unexpectedly well distinguishable regarding the number of cases.

1 Introduction

Confronted with the worldwide COVID-19 epidemic, most countries have implemented series of restrictive, sometimes intrusive policies. Decisions had to be taken under the rapidly changing epidemiological situation, despite (at least at the very beginning of the epidemic) a lack of scientific evidence on the individual and combined effectiveness of these measures.

Country policies may cause significant social, economical and political costs while affecting individuals' behaviour, mental health and social security. On this account, knowing the effectiveness of policies would allow stakeholders to judiciously and timely implement a specific sequence of key policies to combat a resurgence of COVID-19 or any other future similar respiratory outbreak. Because many countries rolled out several policies simultaneously, the challenge arises of disentangling the impact of each individual policy.

The current study aims to provide a brief overview of the effectiveness of several policies: face coverings, international travels, lockdown restrictions and vaccinations, under numerous circumstances i.e. other possible variables of the to be analysed countries.

2 Method

The website "Our World in Data"¹ collects and brings together global data sets from three data sources: specialized institutes, research articles and international institutions or statistical agencies². The main goal of the research team by sharing various data sets is "to make progress against the world's largest problems"³.

In this project we collected the data for daily reported Covid-19 cases and four policy responses to the pandemic: face coverings, Stay-at-Home restrictions, international travel and vaccination of the G20. The data is for the timeline between 1st January 2020 till 14 July 2021.

There are different levels for every policy. A high level of a policy means the regulations become stricter. We collected the level changes for every policy individually and merged with the daily cases data. Then we visualized the final data and we got a graph with dots that represents the daily cases and four horizontal lines, one for each policy. We chose a different color for every policy, green for face coverings, blue for international travel, red for Stay-at-Home restrictions and yellow for vaccination. The darker colors represent the higher levels of the policy.

We analyzed the effectiveness of the four government policies between January 2020 and July 2021 using Python. The repository can be found at <https://git.tu-berlin.de/tangchingkei/data-science-praktikum.git>.

3 Results

Figure 1 reveals the number of daily reported cases and the level of policies between February 2020 and June 2021. In April 2020 the level of travel and lockdown were increased, followed by a drop of the daily cases for a month. Between May 2020 and October 2020 lockdown was in its highest level, where it was required to stay at home. During this time, the number of cases were flattened with a minimal increase. When the lockdown level was lowered in mid October 2020, the increase of the daily case numbers continued till January 2021. In January 2021 the level of vaccination increased again and the vaccination started. After that the cases started to decrease massively.

¹<https://ourworldindata.org>.

²<https://ourworldindata.org/faqs#where-do-you-get-your-data-from>.

³<https://ourworldindata.org/about>.

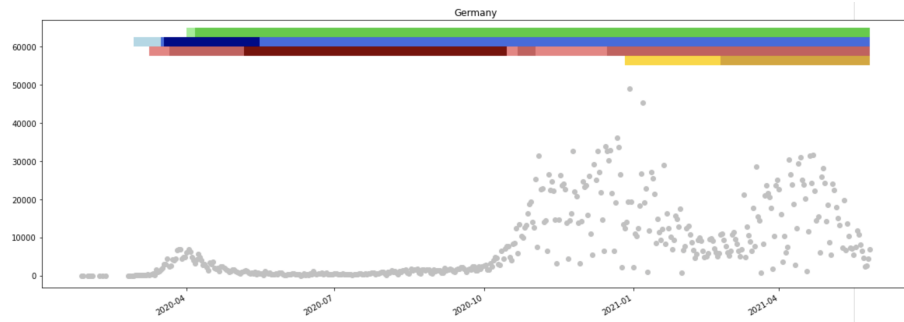


Figure 1: The trend of infection numbers in Germany

Figure 2 shows the number of daily reported cases and the level of policies between February 2020 and June 2021 in Mexico. In October 2020 the level of travel was lowered and a massive increase of the numbers started. In January 2021 the vaccination policy started and in February 2021 the cases decreased.

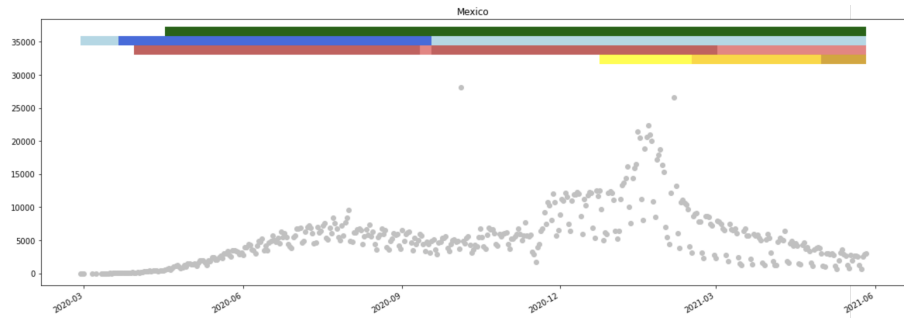


Figure 2: The trend of infection numbers in Mexico

The figure 3 is the graph for Turkey's daily cases and the level of policies between February 2020 and June 2021. Turkey hid the actual number of cases till October 2020 by counting only symptomatic patients as infected and leaving asymptomatic patients out. For reference see this link. In the end of December 2020 the cases started to decrease and in January 2021 the international travel level got higher and a nationwide complete lockdown for five days took place. In mid April 2021 the level of vaccination became higher which means everyone can get the vaccine. Right after that a massive decrease of the number of cases took place, where the cases decreased from 60,000 to 10,000 per day.

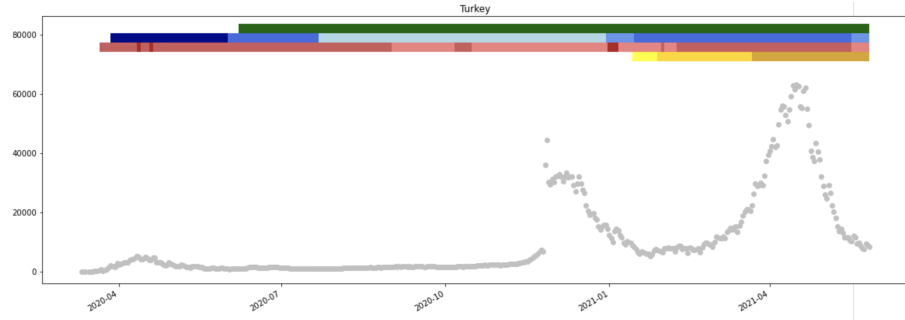


Figure 3: The trend of infection numbers in Turkey

Figure 4 is the graph to visualize the number of cases and the levels of policies in the United States of America. From the graph two minimal decrease and one massive decrease can be observed. The first minimal decline happened between April 2020 and mid June 2020, where both the level of mask and travel policy got higher and a high level of lockdown policy took place. The second minimal decrease was between mid July 2020 and October 2020. During this time, the level of the mask policy was on the highest, meaning that a face covering is required outside-the-home at all times. In January 2021 the vaccination started and the numbers decreased from 300,000 to 50,000 after that.

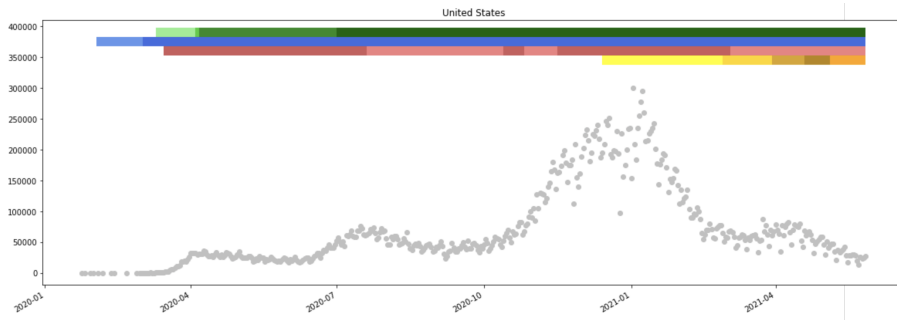


Figure 4: The trend of infection numbers in United States

Figure 5 shows the graph for the daily reported cases and the policies in Canada. The first decrease of the numbers happened after a mask policy was set in mid April 2020. In January 2021 the vaccination started and the level of lockdown got higher, which was followed by the decrease of cases for a month. In June 2021, after beginning of the vaccination policy, the decrease of numbers started.

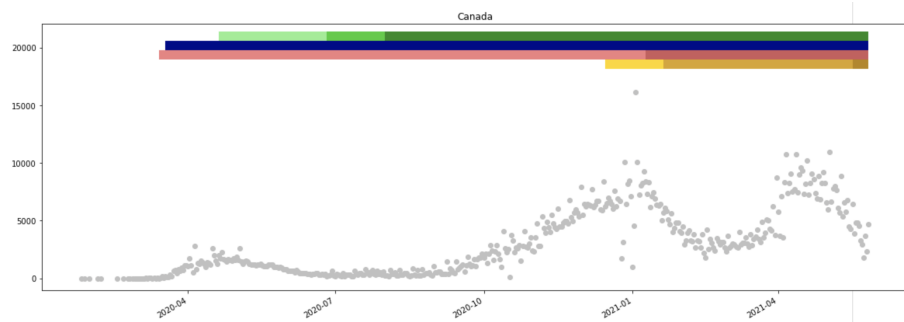


Figure 5: The trend of infection numbers in Canada

In China (Figure 6), except that the very first outbreak in the world led to the peak of infection number at the beginning of the timeline, the infection number remained flattened (fewer than 2500 cases per day) from March 2020 to July 2021. During this period all policies were implemented and sometimes adjusted, though correlations on the effectiveness of these cannot be concluded due to the stagnated numbers.

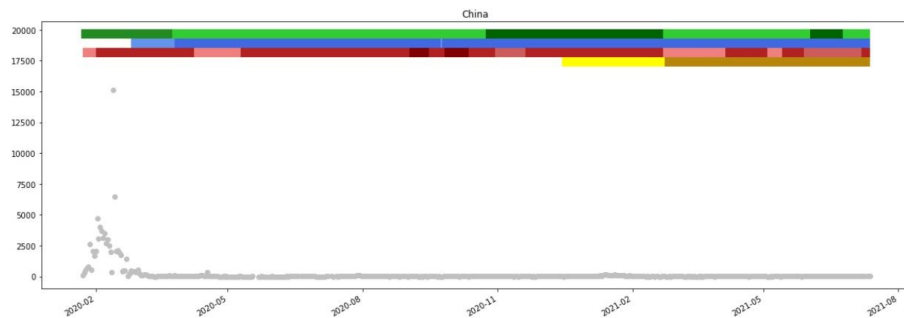


Figure 6: The trend of infection numbers in China

In India (Figure 7), the first peak (around 100,000 cases per day) occurred in mid September 2020 could be owing to the loosening of lockdown policy. The numbers then dropped for more than 50 percent although there was no strengthening of any policy. The second peak (over 400,000 cases per day) occurred in May 2021 started to fall after a continuous strengthening of vaccination. The vaccination level soon became highest and the numbers decreased afterwards to fewer than 50,000 cases in mid July 2021.

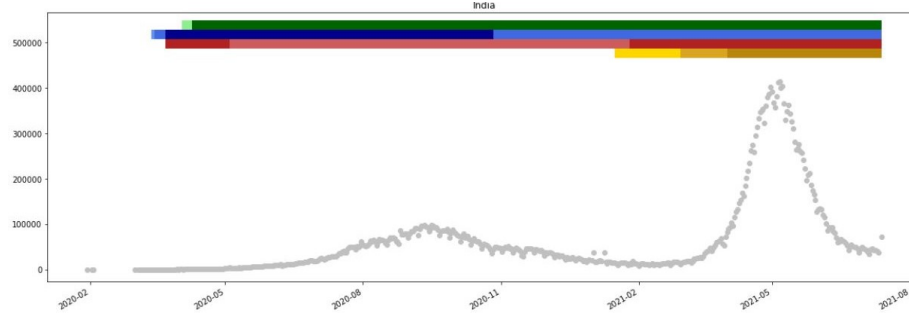


Figure 7: The trend of infection numbers in India

The trend in Indonesia (Figure 8) started to rise slowly after the relaxation of travel restriction and lockdown in August 2020 and late October 2020 respectively. Although in Feb 2021 lockdown and vaccination had been strengthened and started, the number continued to skyrocket after a slight decline between Feb 2021 and May 2021, reaching a peak of 50.000 cases per day.

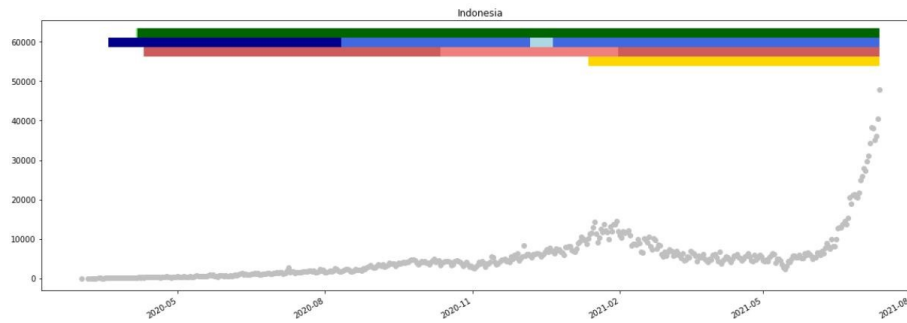


Figure 8: The trend of infection numbers in Indonesia

The first peak in Japan (Figure 9) happened in Aug 2020 was probably suppressed by the strengthening of lockdown policy. Nevertheless, the number later bounced back and reached the peak with 8000 cases per day in Feb 2021 after the relaxation of lockdown and travel restriction. The trend then declined and that could be due to the once more strengthened travel restriction. Surprisingly, the number rised again and reached another peak (May 2021) for unknown reason after falling to the bottom in March 2021. With the constantly strengthening vaccination the trend began to plummet in July 2021.

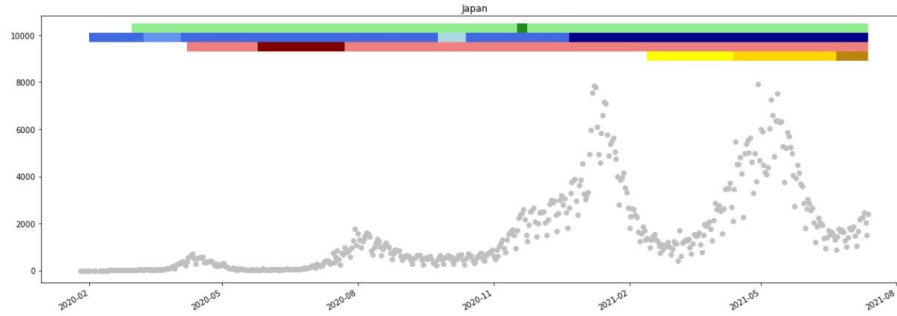


Figure 9: The trend of infection numbers in Japan

The first obvious peak (over 20,000 cases per day) in the United Kingdom (Figure 10) occurred in Nov 2020 despite the execution of stricter mask requirement policy. Right after the peak lockdown policy was slightly strengthened and that could be the reason of the slight decline around Dec 2020. The same policy relaxed and strengthened repeatedly afterwards, until Jan 2021, when travel restriction, vaccination and lockdown became stricter and the number started to plummet from the second peak (over 60,000 cases per day). In spite of having all policies strengthened to the strictest ever, the trend resurged starting from June 2021. Possible causes will be discussed in the discussion section.

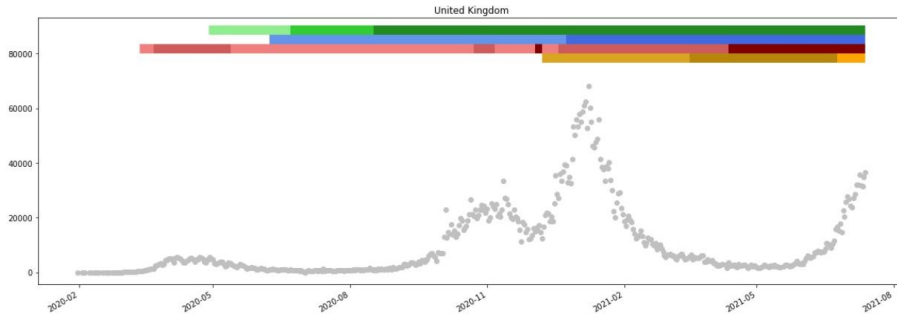


Figure 10: The trend of infection numbers in the United Kingdom

In South Korea (Figure 11), the first peak occurred in March 2020 decreased as soon as the lockdown policy started. Till August 2020, the number of cases got kept quite low. In August 2020, the cases arose slightly with the loosening of the travel restriction policy, but then the number dropped suddenly. The third peak occurred in January 2021 started to decrease when the travel restriction policy got strengthened. Although the vaccination policy started in March 2021 and got tightened in April 2021, the number of cases didn't drop at all but increased.

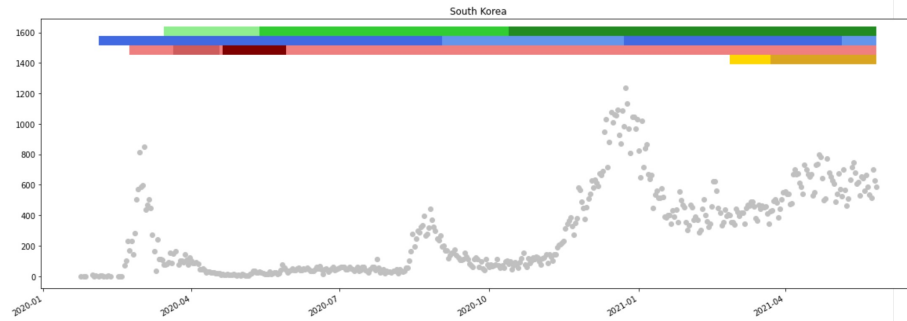


Figure 11: The trend of infection numbers in South Korea

In Russia (Figure 12), the lockdown policy started as soon as Russia had the first cases arising around March 2020. The more the cases increased, the more the policies were tightened. After the mask policy started with a higher level, the number started to decrease around May 2020 till October. As soon as the lockdown policy was loosened, the number started to increase rapidly till January 2021. In around January and February 2021, as the vaccination policy started and was more and more tightened, the number decreased quickly and then gradually.

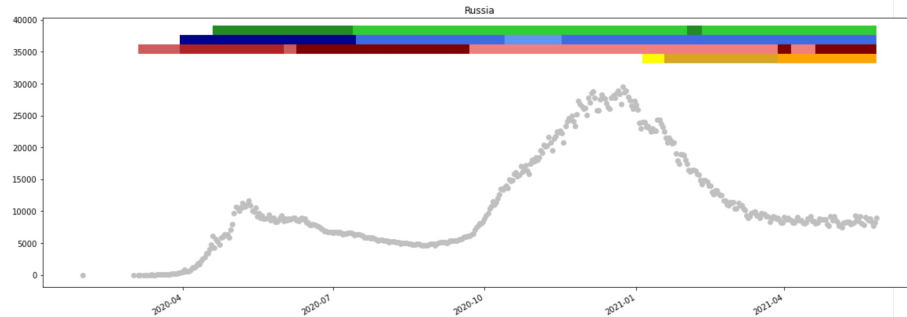


Figure 12: The trend of infection numbers in Russia

In Italy (Figure 13), the first slight peak occurred between March and April 2020 which decreased as soon as the lockdown policy was tightened and mask policy started. the number stayed quite low till October, but then the cases increased very quickly. Furthermore, the lockdown policy was loosened at the time. Then the number started to decrease for some reason and the second peak seemed to occur in January 2021 but at the time where vaccination policy started, Russia managed to keep the number of cases low.

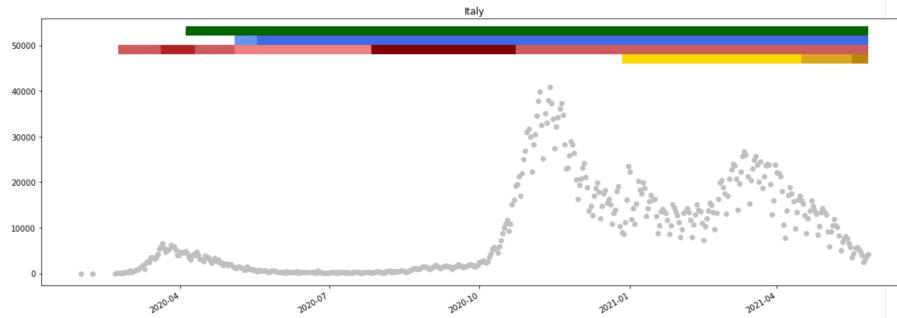


Figure 13: The trend of infection numbers in Italy

The graph for figure 14 depicts the daily reported cases in Spain which has in general three peaks. The first peak occurred in April 2020, a slight one. The strengthening of the travel restriction policy started at the same time and the number started to decrease. From July 2020, the daily reported cases kept increasing and decreasing almost consecutively, then without any pattern. The second peak occurred in November 2020 started to decrease right after the lockdown level got higher. In February 2021, the highest peak occurred but after the beginning of the vaccination policy in January 2021, the number of cases decreased very rapidly and stayed low till the end.

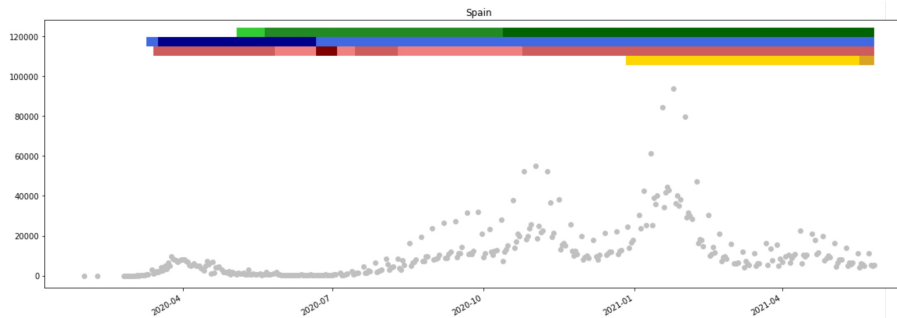


Figure 14: The trend of infection numbers in Spain

In Australia (Figure 15), there are two peaks in general. The first peak in April 2020 started to decrease when the lockdown policy began and got higher level. It must be mentioned that the travel restriction policy already started first when new cases arose and this policy was strengthened at the time of decrease of the cases. From April, there was no strengthening or loosening of travel restriction policy, but lockdown policy experienced many changes. In June 2020, the lockdown policy was loosened and the number of cases started

to increase which is the second peak in Australia. However, the second increase dropped a bit quickly when the mask by the execution of stricter face-covering policy. From the last decrease, there was no more peak in Australia although there were a bunch of changes in the four policies.

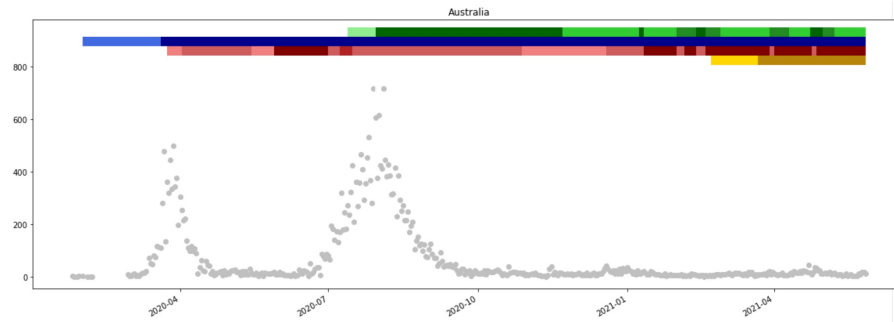


Figure 15: The trend of infection numbers in Australia

Argentina (Figure 16) had a slow start to the pandemic. Cases stagnated on a low level for about 4 months. They also implemented travel restrictions and a strict, short lockdown right away. Argentina kept a lightened lockdown and a mask mandate for the entire course of the pandemic. Daily cases stayed below 20,000 with 2 peaks in October 2020 and February 2021, until a sharp increase in cases happened in May 2021 and lasted till the end of our observation period in June 2021. Argentina started their vaccination program in January 2021 with seemingly no impact on the infection numbers.

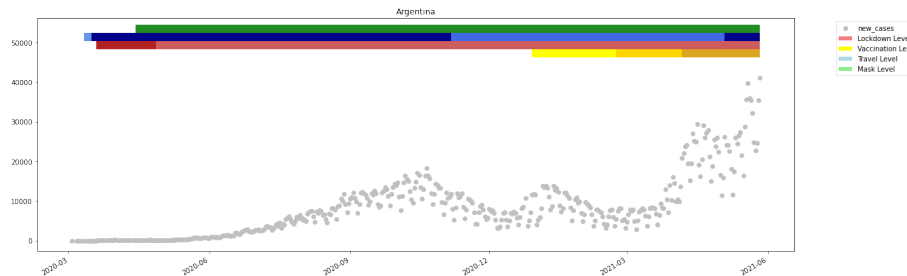


Figure 16: The trend of infection numbers in Argentina

Brazil (Figure 17) had its first peak in cases in August 2020. Followed by a short downwards trend in cases from September to November 2020 and another upwards trend which continues till the end of our observation period in June 2021. While Brazil did implement a travel restriction early in the pandemic, they did not pair it with a strict lockdown like Argentina did. Brazil saw a much

faster increase in cases after the first infections. Their light lockdown and strict mask mandate seem to have been unable to control the virus. Brazil started their vaccination program in February 2021 with seemingly no impact on the infection numbers.

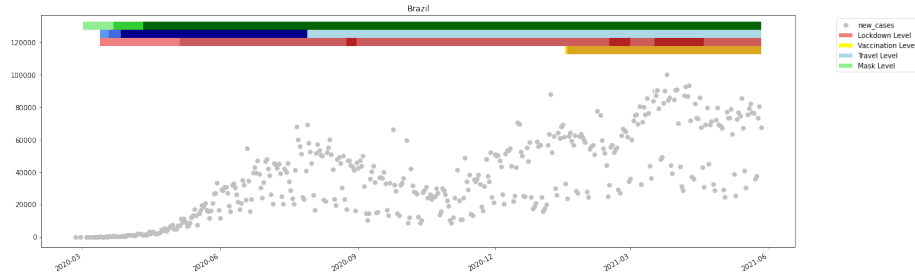


Figure 17: The trend of infection numbers in Brazil

South Afrika (Figure 18) had 2 waves of infections with very clear peaks. They implemented an early travel ban and moderate lockdown. The first peak of the infection numbers was preceded by a temporary lightening of the lockdown and numbers quickly decreased with the lockdown back in effect, without other policies changing their level. The second peak in January 2021 ended with a temporary tightening of the mask mandate and travel restrictions, which might have been a coincidence though, since the increased level of the mask mandate was only in effect for a very short time. South Afrika started their vaccination program in February 2021 and cases stayed down. This might not be related to the vaccination program though, since it mirrors the previous trend of the pandemic in South Afrika, with very clear peaks in infections numbers, followed by a timespan with low numbers.

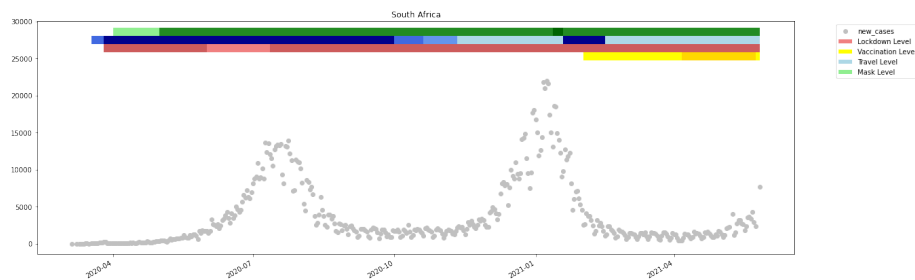


Figure 18: The trend of infection numbers in South Afrika

France (Figure 19) had a low amount of infections throughout the summer of 2020 with the first peak of infection numbers in November 2020 and a second

peak in April 2021. A strict lockdown from July 2020 to October 2020 and a strict mask mandate from August 2020 til the end of our observation period, did not stop cases from rising. France started their vaccination program in January 2021, but no clear effect on infection numbers is visible.

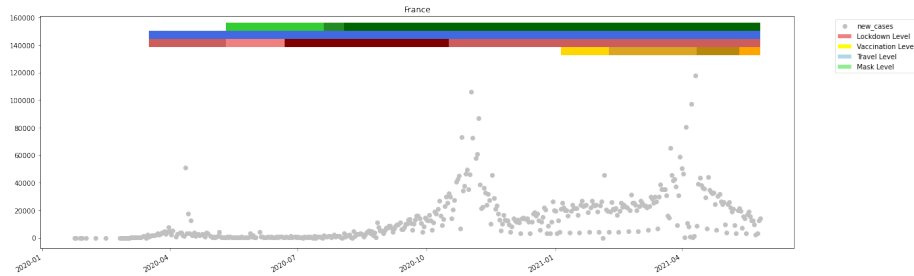


Figure 19: The trend of infection numbers in France

Saudi Arabia (Figure 20) only had one peak of infection numbers, which seemingly ended when they increased the level of their mask mandate, and cases stayed low ever since. It's notable that their travel restrictions and lockdown, which were already in effect, seemed unable to stop the first wave of infections. Therefore Saudi Arabia might be a strong case for the effectiveness of face masks. Saudi Arabia kept their mask mandate and introduced a strict lockdown for all of 2021. They started their vaccination program in February 2021. Despite this, there seems to be a slow rise in cases in May and June 2021.

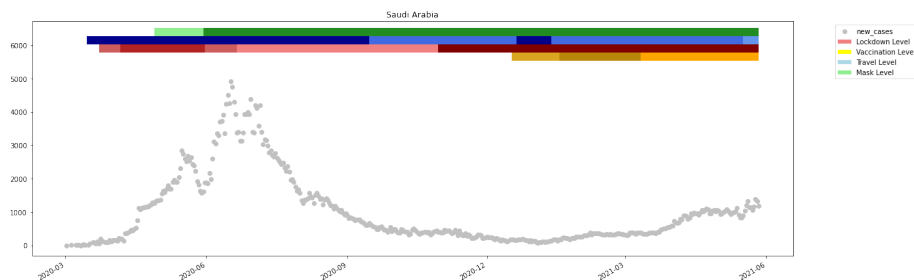


Figure 20: The trend of infection numbers in Saudi Arabia

4 Discussion

The Covid-19 infection numbers are influenced by a wide variety of factors, including the policies analyzed in this report. Every country has had a (slightly) different approach to not only the pandemic, but also the way they implement

these policies. This approach might be shaped by the overall quality of medical care, cultural differences, wealth of the country, form of government, political or social climate, and others. Since all of these factors are not included in our analysis, we can not make a clear statement on the effectiveness of individual policies, but we can make assumptions based on the examples we presented above.

Our first assumption is that an international travel ban is more effective if implemented early, as its primary use is stopping the virus from getting into the country and it seems to offer little benefit, when domestic cases are already high. A prime example for this would be Russia (Figure 12), which only implemented a travel ban after cases started to increase.

There are examples that indicate the effectiveness of masks and lockdowns, like South Afrika (Figure 18), but the effectiveness of these measures seems to vary greatly for different countries.

To make decisive statements about the effectiveness of these measures we would also need to know how well individual countries implemented them. We can assume, that countries with a more developed infrastructure have an easier time controlling their implementation of policies like a lockdown or a mask mandate, when compared to less developed countries, which might benefit more from measures like travel bans. One example here is Argentina (Figure 16).

Another general pattern that we saw was a decrease in cases during the summer. Especially for countries in a colder climate. We don't see any relation to the effectiveness of our policies though.

The effectiveness of vaccinations is also hard to judge by our data, since we only show the policy countries have for vaccinations, but not the real progress of vaccinations in the country. Also our graphs only show the total number of daily cases, but don't take into account how many of these cases showed many or no symptoms. To judge the effectiveness of vaccines it would be useful to use additional information about the severity of cases.