

# Death Rate Comparison Between Five Asian Countries Due to COVID-19

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## ABSTRACT

Corona Virus Disease-19 (COVID-19) is a highly infectious disease caused by coronavirus 2 (SARS-CoV-2). It had a catastrophic effect on the world and also led to nearly 6.9 million deaths worldwide. This compelled the World Health Organization (WHO) to declare it as a global pandemic disease. The study was done based on secondary data collected from the WHO's official website. This study has demonstrated the effect of vaccination on the COVID-19 death rate in Sri Lanka during the highest pandemic period of 1<sup>st</sup> March 2020 to 28<sup>th</sup> August 2022 and also a comparison of the death rate of selected five Asian countries during the period of 1<sup>st</sup> March 2020 to 23<sup>rd</sup> May 2023. COVID-19 death rate of selected countries can be used to compare the severity of the outbreak, health barrier system, number of vaccinated people, citizen's immunity level and age factor, etc. The Analysis of Variance (ANOVA) indicated that at least a mean death rate was different between the selected 5 countries ( $p$ -Value=0.036<0.05). Furthermore, Fisher's least significant difference method showed the same pattern of death rate trend observed between the countries Philippines, South Korea, and Sri Lanka, and also similar pattern of death rate trend was not observed between the countries India and China. According to the Chi-Square test of independence, it was found that those who had been vaccinated at most one injection had a major chance of facing death during the severe pandemic period( $p$ -value=0.0085<0.05). So, it is also important to inject the recommended number of vaccinations.

**Keywords:** ANOVA, Immunity, WHO, Chi-Square, Pandemic, Vaccination

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## I. Introduction

Corona Virus Disease (COVID-19) is a pandemic disease caused by Coronavirus 2 (SARS-CoV-2) which highly spread across borders and has created a pathetic health and economic problem worldwide (African, Covid-, and Programme 2023). Considering the death rate and spreading ability of the Coronavirus, COVID-19 was declared a global disease by WHO on the 11<sup>th</sup> of March 2020. The vast outbreak of this disease from Wuhan City in Hubei Province of China to the rest of the world has created a massive death rate worldwide (Amaratunga et al. 2020). To control this pandemic outbreak, the public is encouraged to vaccinate in the number of doses approved by the WHO. For that reason, several vaccines have been introduced by different countries from 2020 to 2023 (Nagy and Alhatlani 2021). COVID-19 death rate depends on the severity of the outbreak, the health barrier system, the number of vaccinated people, citizen's immunity level, age factor, etc. (Fountoulakis et al. 2020). This study will determine whether there is an association between vaccination and death rate and will check the independencies of death rates between the selected five Asian countries.

## II. Methodology

The study was done to compare the COVID-19 death rate between five selected Asian countries such as Sri Lanka, India, Philippines, South Korea, and China during the period of 1<sup>st</sup> January 2020 to 23<sup>rd</sup> May 2023 as the death rate was considered as a measurement of the Catastrophic effect of COVID-19 and, also this study will check the relationship between vaccination and the death rate in Sri Lanka during the highest pandemic period of 1<sup>st</sup> March 2020 to 28<sup>th</sup> August 2022.

### 2.1 Source of data

The study was conducted using secondary data collected from the WHO's official website(WHO 2023 2021). All the updated data has been stored and can be downloaded in comma-separated values (CSV) file format from WHO's website. The secondary data in CSV files which were used in this study contains the number of deaths and corresponding days.

## 2.2 Development of the design of the study

Initially, the software R Studio was used to extract and combine the relevant data from different CSV files for this study. To find the death rate, the population details of each of the five countries were collected. According to the survey in 2020, it was censused as India had a population of 1.40 billion, China had a population of 1.411 billion, South Korea had a population of 51.84 million, the Philippines had a population of 112.2 million, and Sri Lanka had a population of 21.92 million (World Bank 2020).

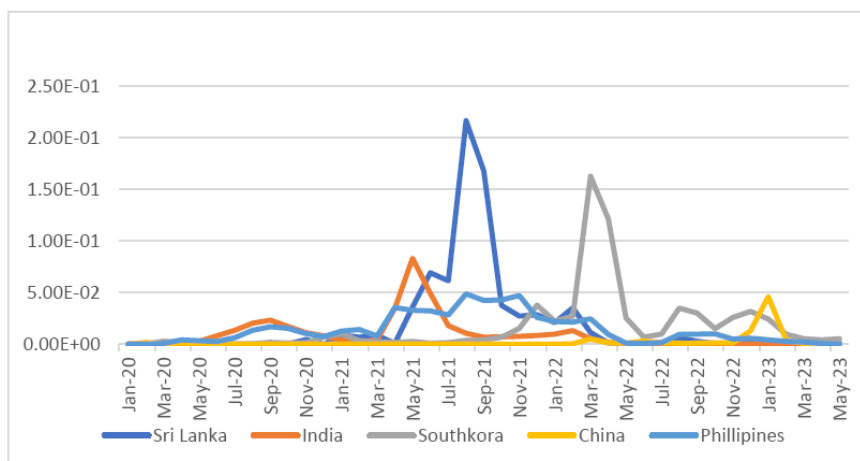


Figure 1: Interface showing the Death Rate per 1000 population in a month of Five selected Asian Countries

The death rate was calculated by using equation (1) (Dr. Bill Spears 2024) from the extracted and processed data done by R software. In this equation, the total population used to calculate the death rate of the five countries.

$$Death\ Rate = \frac{Number\ of\ death\ recorded}{Total\ population} \times 1000 \quad (1)$$

Analysis of Variance (ANOVA) and Fisher's Least Significant Difference (LSD) method were done respectively by using the statistical software R studio to check the mean comparison of death rates between the selected five countries. In ANOVA, the null hypothesis was taken as there was no significant difference between the death rate of the countries, and the alternative hypothesis was taken as there was a significant difference between the countries.

The chi-square test of independence was done by using the software R Studio to check the association between vaccination and the death rate in Sri Lanka. Here, the null hypothesis was taken as there is no association between the vaccination and death rate, and the alternative hypothesis was taken as there is an association between the vaccination and death rate.

The contingency table was produced according to the information given by the epidemiology unit of Sri Lanka. According to the given information in the cumulative infected cases from 1<sup>st</sup> March 2020 to 21<sup>st</sup> August 2022, 8% had received only one dose, 1% had died even though they were vaccinated and 91% died who had not taken a single dose of vaccination (Economynext 2022).

## III. Results and Discussion

According to Figure 1 shown above, it is clearly visible that the death rate fluctuated within the period from Jan 2020 to May 2023. Death rate is the ratio between the number of deaths to total population size. The death rate depends on the country's population size but comparing the mean difference using death rate rather than comparing the number of deaths in each country will give the exact result as the death rate can be considered as a common parameter for each countries (LEVCHUK and SHEVCHUK 2021). The following graphs show how the number of deaths varied from Jan 2020 to May 2023 in selected five countries.

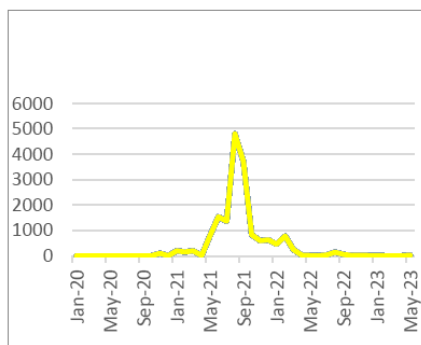


Figure 2: Interface showing the Number of Deaths in Sri Lanka

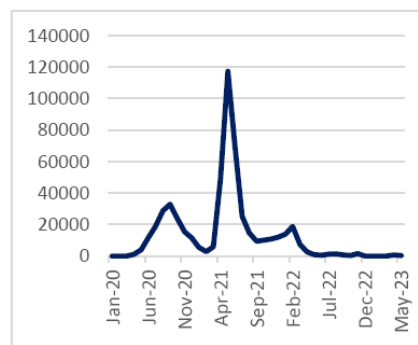


Figure 3: Interface showing the Number of Deaths in India

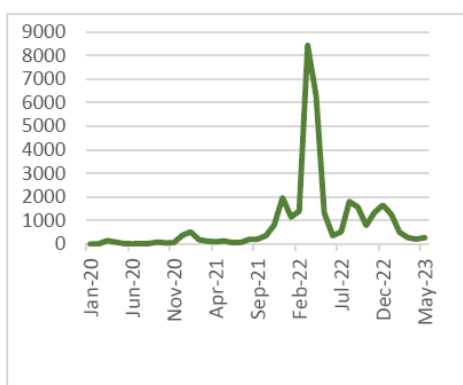


Figure 4: Interface showing the Number of Deaths in the South Korea

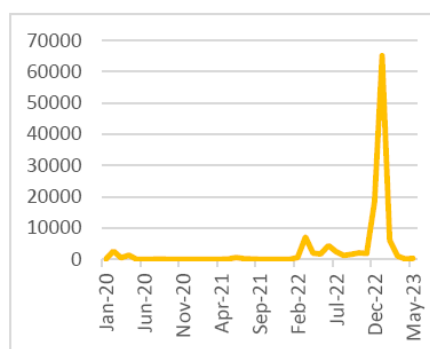


Figure 5: Interface showing the Number of Deaths in China

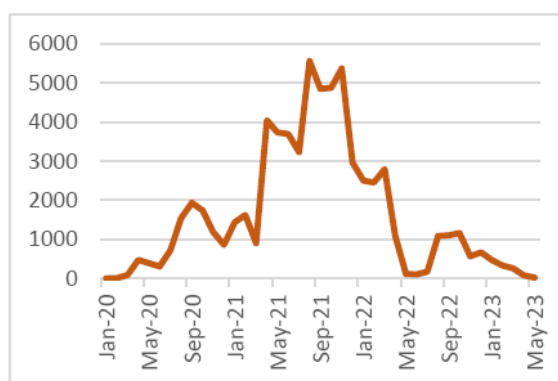


Figure 6: Interface showing the Number of Deaths in the Philippines

The number of deaths fluctuated during the period from April 2021 to April 2022 in Sri Lanka, during the period of May 2021 to May 2022 in India, from April 2020 to April 2023 in Philippines, during the period of September 2022 to January 2023 in China and during the period of October 2021 to January 2023 in South Korea. It was not possible to predict the effect of COVID-19 using the above graphs as fluctuation in death happened in different period and population size also differs between the mentioned countries. In this study independencies of death rate were checked between five selected countries.

As per the results of the R output, there is a significant difference between the selected countries ( $0.0358 < 0.05$ ) as shown in Table 1.

Table 1: ANOVA table of the five independent variables

	DF	Sum of Squares	Mean Squares	F-value	Pr(>F)
Country	4	7.100e-09	1.776e-09	2.627	0.0358 *
Residuals	200	1.352e-07	6.760e-10		
Signif. codes:		0 '****' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1			

As the next step, Fisher’s LSD was used to check the comparison between the independence of the death rate of the countries. Fisher’s LSD is a comparison technique that was found by Fisher in 1935 (Salkind 2012). According to Fisher’s LSD, the below output in Table 2 was produced by R.

Table 2: Fisher’s LSD comparison and Grouping of each country

Country	Death Rate	Grouping using Fisher’s LSD
Sri Lanka	1.857005e-05	a
South Korea	1.638305e-05	a
Philippines	1.638305e-05	a
India	9.213379e-06	ab
China	2.090479e-06	b

Groups and Range

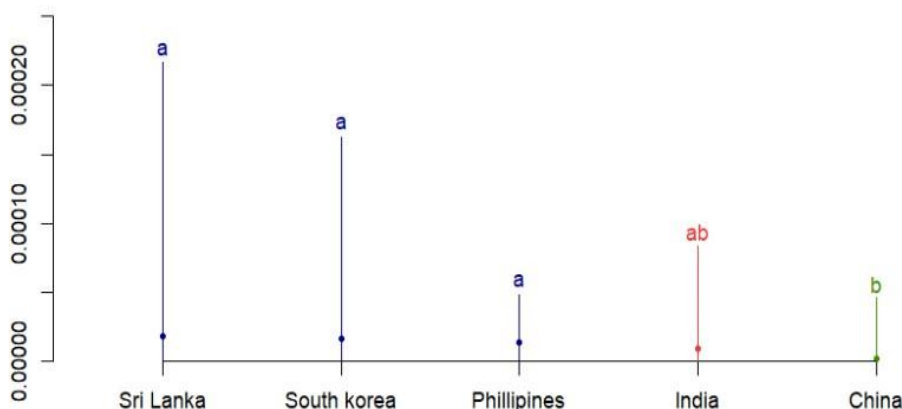


Figure 7: Visualization of the LSD’s grouping between the selected five countries

It is clearly visible from the above Figure 6, that Sri Lanka, South Korea, and the Philippines show the same death rate pattern during the period from 1<sup>st</sup> January 2020 to 23<sup>rd</sup> May 2023 as it is denoted with the same alphabet “a”.

India and China show a different death rate pattern during the period from 1<sup>st</sup> January 2020 to 23<sup>rd</sup> May 2023.

Table 3: R output of chi-squared test with Yates’ continuity correction

Pearson's Chi-squared test with Yates' continuity correction
X-squared = 6.795, df = 1, p-value = 0.009141

The chi-squared test is commonly used to check the independence or association between the two qualitative variables (Mindrila and Balentyne 2013). From the result above which is depicted in Table 3, it is concluded that there is an association between the vaccination and death rate during the highest pandemic period of 1<sup>st</sup> March 2020 to 28<sup>th</sup> August 2022 as p-value (0.009141<0.05). Furthermore, it was investigated to check whether the most influential qualitative variable in the chi-square test was in the above result. The plot below shows how the residuals were been in the chi-square test. The blue in color circle shows the highest significant association was there between the number of deaths and persons who were only vaccinated once.

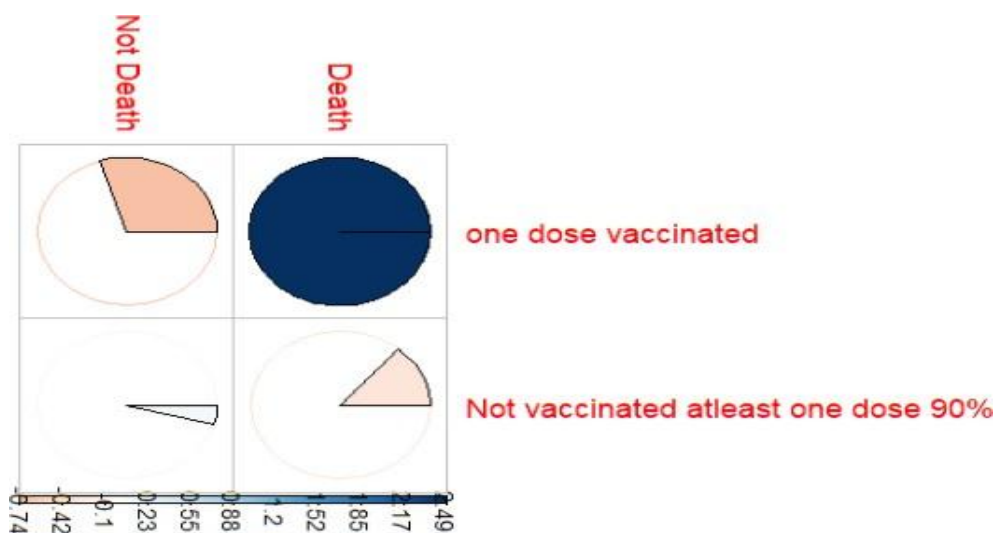


Figure 8: Visualization of the correlation plot of person residuals

#### IV. Conclusion

The effect of the COVID-19 created extreme chaos all over the country worldwide. This research has evolved the idea of finding out the death rate pattern between the selected five countries. COVID-19 death rate depends on the severity of the outbreak, the health barrier system, the number of vaccinated people, citizen immunity level, age factor, etc. As per the results, within five countries, COVID-19 has created the same effect on the countries Sri Lanka, the Philippines, and South Korea, and created different effects in India and China separately. Using this method, it is possible to compare the death rate pattern between any of the countries worldwide. The same grouped countries could create precautions activity in advance to avoid the severe outbreak of Coronavirus and save lives from death in the future by looking at the factors that are common for them. Also, from this study, it was found that those who had been vaccinated with one injection had a major chance of facing death during a severe pandemic period. So, it is also important to inject the recommended number of vaccinations.

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