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AN EXAMINATION OF THE PREVENTION STRATEGIES IMPLEMENTED DURING THE COVID-19 PANDEMIC, THEIR IMPACT ON THE VIRUS, AND THE ECONOMY OF THE COUNTRY

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ABSTRACT

Background
An outbreak of pneumonia-like infections was triggered by a zoonotic trans- mission that occurred at a wet market in Wuhan, China. This sickness rapidly disseminated to multiple nations worldwide within a short timeframe. Subsequently, the World Health Organisation officially categorized this virus as a pandemic. As of June 2024, the virus has caused approximately 70 million deaths worldwide.

Objective
To analyze the prevention strategies implemented by the US, China, and India to curb the spread of the coronavirus infection, their effects on the virus, and the national economy.

Methods
An exploratory data analysis (EDA) using sci-analysis (Python) was con-ducted to rank the countries according to the outcomes in order to determine the optimal strategy.

Results
Levene's test results demonstrate that $P < 0.05$, indicating a difference in the variances of cases, fatalities, and the stringency index documented during the pandemic. The Kruskal-Wallis test yields a p-value of 0.0, which is below the conventional significance threshold of 0.05, indicating that the groups have distinct average ranks. This analysis reveals that India's strategy is more balanced and efficient compared to that of the US and China.

Conclusion
Amidst the COVID-19 outbreak, many nations enforced comprehensive lock- down measures, leading to a catastrophic economic downturn. Few countries prioritized protecting the economy over preserving human lives, resulting in a surplus of deaths. We must embrace an approach that prioritizes both eco- nomic activities and life-saving measures equally to prevent such scenarios in the future.

Keywords: Data Analytics, COVID-19, Pandemic, Preventive Measures, Economic Impact, Daily New Cases

1. INTRODUCTION

An epidemic is a term used to describe a highly contagious disease that has a significant and easily observable impact on the population of a coun- try. A pandemic is a highly contagious disease that quickly spreads across numerous countries and has a considerable impact on a large section of the global population [1]. After a pandemic is officially announced, it becomes extremely challenging to precisely determine the locations where the disease is spreading. It is now crucial to implement necessary control measures on a global scale in order to halt the development of the pandemic. Control measures are proactive activities performed by individuals or governmental entities to successfully halt the transmission of a disease within a certain ter- ritory [2]. On January 3, 2020, Chinese health officials declared a pneumonia outbreak in Wuhan. The virus quickly spread to most countries, infecting a substantial section of the

population. On September 28, 2020, the World Health Organization (WHO) reported nearly one million deaths worldwide [3]. The virus is typically transmitted through respiratory droplets expelled during coughing or sneezing. Due to the absence of a viable vaccine, the majority of countries have enforced lockdown measures in order to mitigate the rapid transmission of the virus [4]. Lockdowns will exert a substantial adverse effect on the overall national economy. The objective of this study is to investigate the different preventive measures implemented to control the transmission of the disease, and examine their impact on both the virus and the national economy. The findings of this study will assist us in identify- ing the optimal containment strategy for halting the transmission of diseases during a pandemic.

2. METHODS

2.1. STUDY DESIGN AND PARTICIPANTS

For this study, we examined the COVID-19 data of three countries with the largest population and highest gross domestic product (GDP). The countries being assessed are the United States of America, China, and India.

2.2. DATA SOURCES

We collected data on the preventive measures implemented by these coun- tries from COVID-19 data archives, such as Google Scholar, PubMed, and Springer. We performed a search on these sites with targeted keywords such as COVID-19, preventive measures, the implications of control measures, and the impact on the economy. We obtained further information regarding the COVID-19 prognosis from reliable sources such as the Centres for Dis- ease Control and Prevention, the Ministry of Health, and the World Health Organization.

We obtained the numerical data on COVID-19 cases, fatalities, tests, vac- cinations, stringency index, genetic sequencing, and economic data from pub- licly available online repositories such as Our World in Data [13], NextStrain [14], WorldOmeters [15], and FRED [16].

2.3. PROCEDURES

We systematically structured and integrated the numerical data acquired from many sources utilizing Microsoft Excel. The cases, deaths, stringency index, and GDP changes of the three nations were aggregated, and an ex- ploratory analysis was performed utilizing the sci-analysis module in Python.

2.4. OUTCOMES

The result is summarised, and the countries were ranked to determine the optimal strategy.

Statistical analysis

We performed the statistical analysis on COVID-19 data collected between January 2020 and December 2022. We analyzed clinical and epidemiological factors using Anaconda-packaged Python (3.11.5).

3. THEORY / CALCULATIONS

The most serious global infectious pandemic in the last century, COVID- 19, has had a considerable negative impact on practically every country's so- cial stability and economic growth in addition to causing significant deaths and illnesses worldwide [17]. There were 6,950,655 deaths and 767,972,961 confirmed cases of COVID-19 as of July 12, 2023.

3.1. UNITED STATES OF AMERICA ORIGIN

The first infection in a human was identified on January 20th, 2020, and

marked the beginning of the first wave of the infectious disease in the US. The first death occurred in February 2020. An emergency was declared in a media briefing on March 13, 2020. The second wave of infections began in June 2020, followed by the third and fourth waves in October 2020 and March 2021, respectively. By the end of 2022, about 77% of Americans had contracted COVID-19, as reported by the CDC.

1) Prevention Strategy

The United States enacted basic and less stringent regulatory protocols. Pre- ventive measures include social separation, the use of face masks, and the implementation of comprehensive hand hygiene. The United States refrained from implementing a lockdown, opting instead to put limits on public venues. The US government issued a decree on March 16, 2020, requiring a 15-day stay-at-home order [18]. The average stringency index score in the United States from 2020 to 2022 was 49.47. The process of creating vaccines and distributing them to the populace had more focus. However, several imped-iments hindered the process of vaccine development, leading to an almost year-long delay. On December 11, 2020, the FDA granted emergency use au- thorization for the administration of vaccines developed by Pfizer-BioNTech. By the end of 2022, 66,57,42,181 vaccines had been administered to the pop- ulation. Numerous testing centers were built nationwide, and self-testing kits were accessible through online sales. This facilitated the accessibility of test kits to the general populace, enabling people to undergo testing and self-isolate in the event of a positive result. There was no surveillance app to track individuals who tested positive for COVID-19.

2) Impact of preventive measures on the pandemic

COVID-19 is the most lethal pandemic in the nation's history as of January 2024, with approximately 10,34,36,829 confirmed cases and 11,93,165 fatal- ities. The single-day tally of 56,50,933 cases was the highest recorded on January 16, 2022. Overall, 9.7% of the infected are over 70, while 15.4% are over 65. The median age of those affected is 38.3. The highest reported number of fatalities in a single day was 23,312 on January 17, 2021. That represents 1.46% of the cases that were recorded that day.

3) Impact of preventive measures on the economy

Gross Domestic Product (GDP) provides a straightforward and precise mea- sure of the economic consequences of the pandemic. The US economy had a severe recession in 2020, marking one of its most significant downturns to date. Commodities are strongly preferred over services due to the strong demand. During the second quarter of 2020, the United States had a signif- icant increase in its trade deficit, while its Gross Domestic Product (GDP) dropped by 8.9 percent, marking the largest decline in over 70 years. Figure 1 depicts the fluctuation in the Gross Domestic Product (GDP) of the United States from 2013 to 2022.

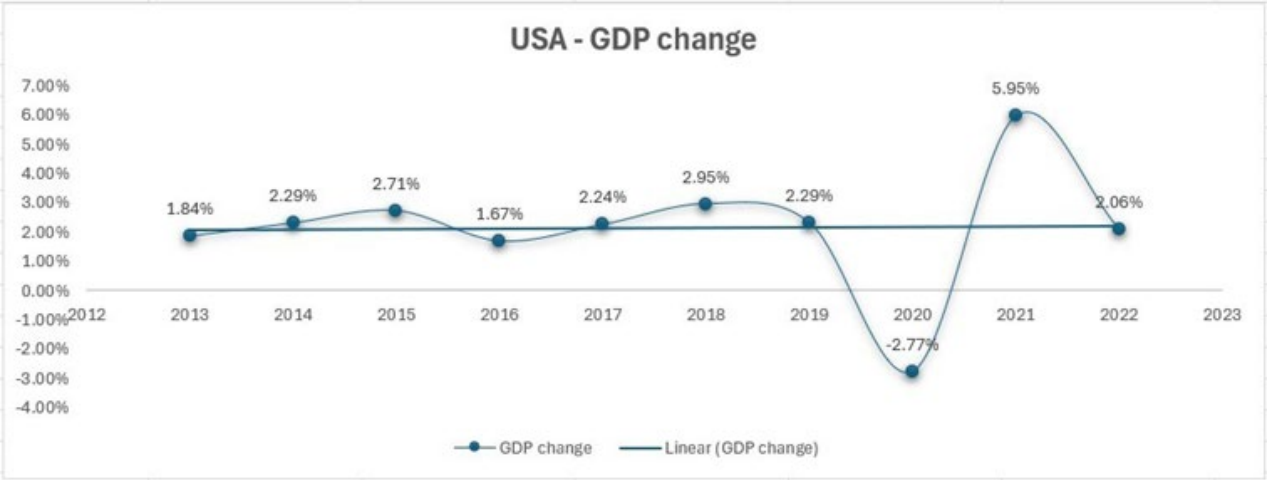


Figure 1 USA: GDP change

3.2. CHINA

1) Origin

In December 2019, the CDC in Hubei Province, located in central China, identified instances that had symptoms similar to pneumonia but lacked a clear and apparent etiology. The Wuhan Municipal Health Commission iden- tified the illness as "pneumonia resulting from the novel coronavirus" [19].

2) Prevention Strategy

The Chinese enforced a rigorous ”Zero-COVID” policy, prohibiting anyone from exiting their premises if the area is classified as a high-risk zone [20]. The aim was to efficiently control the illness and decrease the mortality rate. China has implemented various preventative measures, such as the closure of markets and educational institutions, suspension of public transportation, trains, airports, and major highways, travel restrictions, patient isolation and monitoring of close contacts, mandatory face mask usage, and the ces- sation of all non-essential businesses, including manufacturing facilities. The lockdown was enforced in regions with a significant incidence of infection. Preventative measures and the enforcement of lockdowns effectively reduced disease transmission and prevented a massive outbreak.

The average score of the stringency index in China from 2020 to 2022 is 73.58. The emergency use authorization for the COVID-19 vaccine was issued on July 2, 2020. Vaccination for people at high risk began before the end of 2020. China commenced screening for individuals entering the country at border checkpoints, alongside screening patients at healthcare facilities and living in risky zones. China swiftly established national nucleic acid ampli- fication testing (NAAT) laboratories around the country. As of February 14, 2020, around 12,777 of these had been established. China established a significant number of mobile laboratories to improve everyday testing capac- ity. The close contact detector app was built to track individuals who tested positive for COVID-19.

3) Impact of preventive measures on the pandemic

The Lancet Infectious Diseases commended China’s efforts in managing the pandemic in one of its reports. The statement asserts that China has suc- cessfully and swiftly managed to control the COVID-19 pandemic, while the rest of the world continues to struggle with it. The reference is cited as [21]. As of January 2024, there were 9,93,65,162 confirmed cases and 1,22,271 deaths. The infected population has a median age of 38.7, with 10.64% of individuals being above the age of 65 and 5.9% being above the age of

70. The highest number of infections were detected on December 25, 2022, with a weekly count of 40,47,54,477 and an average daily count of approx- imately 5,78,22,211. During the week of December 25th, 2022, there were 5,849 recorded deaths, marking it as the week with the highest mortality rate documented. Throughout that week, the daily average of deaths was 835. It constitutes roughly 0.014% of the cases recorded on every single day of the week.

Impact of preventive measures on the economy

In the year 2020, the rate of growth of the GDP dropped from 6.0 percent to 2.2 percent. Because of the unprecedented pandemic, international trade, investment, production, and consumer demand were all hampered consid- erably. Based on the data supplied by the World Bank, figure 2 depicts the fluctuations that occurred in China’s Gross Domestic Product (GDP) between the years 2013 and 2022.

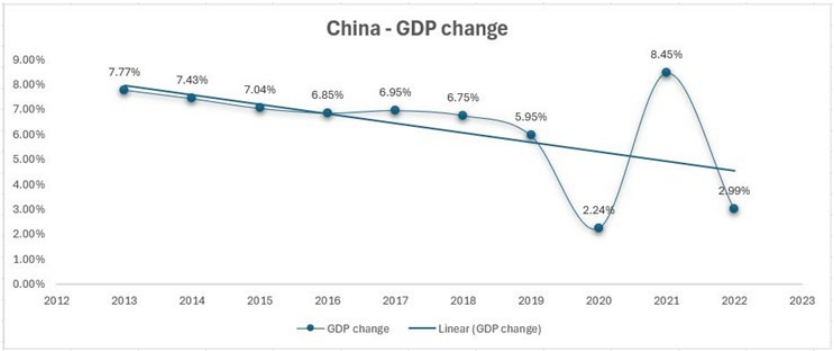


Figure 2 China: GDP change

3.3. INDIA

1) Origin

Kerala, a state located in the southern region of India, documented the initial case of COVID-19 infection in January 2020. The initial recorded fatality took place in March 2020. This marks the beginning of the first wave. The onset of the second wave occurred in February 2021.

2) Prevention Strategy

India adopted a strategy involving careful monitoring of the pandemic's de- velopment and executing appropriate responses. India formed committees to oversee the issue and intensified measures to curb the spread. Subse- quent to the initial identification of the disease in Kerala, aircraft travel was promptly suspended, and international borders were closed [22]. On March 22, 2020, the state instituted a one-day Janata curfew. A nationwide lock- down was implemented in India from March 25 to May 31, 2020 [23]. The Indian authorities executed a thorough approach during the initial lockdown phase, encompassing preventive measures such as isolation, social distancing, staying at home, wearing face masks, and utilizing hand sanitizers.

The lockdown was gradually rescinded in regions where the disease had been controlled. India implemented targeted lockdown measures in areas experiencing swift illness transmission. These actions include the closure of educational institutions, such as schools and colleges, as well as the shut- down of marketplaces. Moreover, there were restrictions on domestic travel, heightened congestion on public transit, bans on public gatherings, and the closure of houses of worship, including temples, churches, and mosques [24]. The mean score of the stringency index in India from 2020 to 2022 is 59.7.

The vaccine program began in India in February 2021. In 278 days, India accomplished the vaccination of almost 1 billion individuals. India conducted tests on individuals who had traveled internationally, had interactions with COVID-19 patients, or had signs of severe acute respiratory diseases. In- dia has rapidly constructed swab collection facilities nationwide. India has established mobile swab collection facilities to enhance the daily testing ca- pacity. The Arogya Setu application was developed to monitor individuals who tested positive for COVID-19.

3) Impact of preventive measures on the pandemic

By December 25, 2022, there were a total of 4,46,77,106 confirmed cases and 5,30,693 deaths. The infected population has a median age of 28.2, with 5.9% of individuals above the age of 65 and 3.4% above the age of 70. On May 9th, 2021, we detected the highest number of infections, with a weekly count of 27,38,957 and an average daily count of approximately 3,91,279. During the week of May 23rd, 2021, there were 28,982 recorded deaths, marking it as the week with the highest mortality rate documented. Throughout that week, the daily average of deaths was 4,140. It constitutes roughly 1.56% of the cases recorded on every single day of the week.

4) Impact of preventive measures on the economy

India experienced a decline of 3.1% in its growth rate in the year 2020. The World Bank's updated forecasts for 2021 are the most pessimistic since 1990 [25]. The launch of the economic package in mid-May led to a further reduction in India's GDP predictions, indicating a significant recession with negative values [26]. Figure 3 depicts the fluctuations that occurred in India's Gross Domestic Product (GDP) between the years 2013 and 2022.

4. RESULTS

1) Case analysis

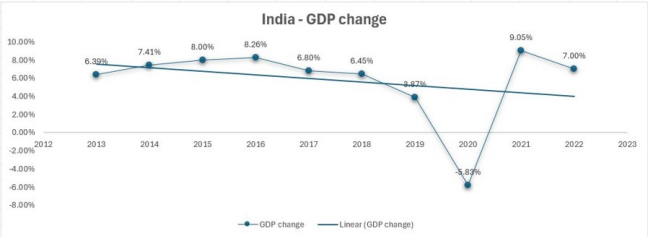


Figure 3 India: GDP change

According to Levene's test, the groups have unequal variance and no matching means ($P < 0.05$). Figure 4 presents an examination of COVID-19 instances documented in the United States, China, and India. The quantile chart on the right shows that the US has a steeper slope than the other groupings, indicating more volatility. We used the Kruskal-Wallis test over the one-way ANOVA because equal variances were not met. The Kruskal- Wallis test's p-value is 0, below the 0.05 significance threshold. Thus, we may reject the null hypothesis that all groups have the same average ranks. India has the lowest mean compared to the US and China.

Figure 5 shows the overall statistics of cases recorded in the US, China, and India.

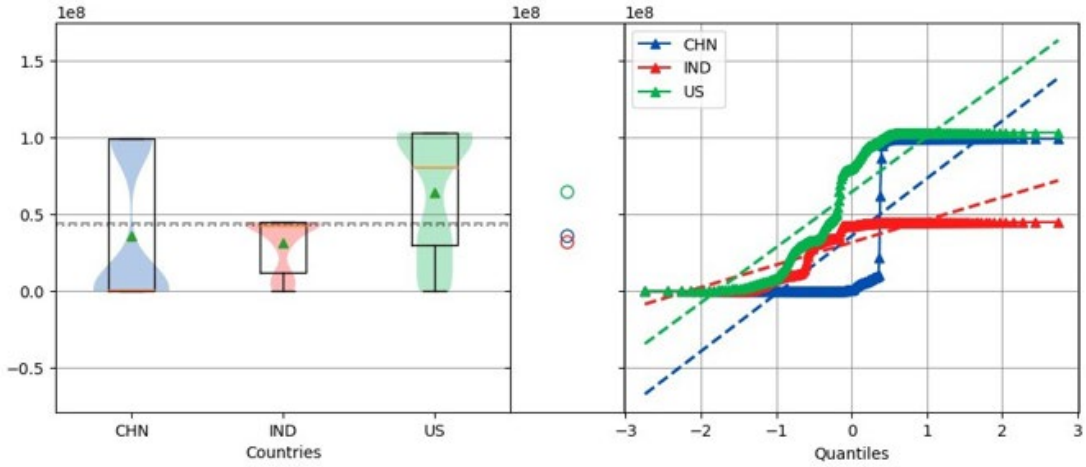


Figure 4 Analysis of the cases recorded between 2020 and 2024

```
Overall Statistics
------------------

Number of Groups =  3
Total            =  687
Grand Mean       =  44152502.5342
Pooled Std Dev   =  36534832.2881
Grand Median     =  43079188.0000


Group Statistics
----------------

n             Mean          Std Dev       Min           Median        Max           Group
-------------------------------------------------------------------------------------------
229           35933832.0786 46591274.1754 14411.0000    1109144.0000  99365162.0000CHN
229           31870604.8996 16896543.9160 2.0000        43079188.0000 45040752.0000IND
229           64653070.6245 39346434.2142 9.0000        80626043.0000 103436829.0000US


Levene Test
-----------

alpha   =  0.0500
W value =  39.6660
p value =  0.0000

HA: Variances are not equal


Kruskal-Wallis
--------------

alpha   =  0.0500
h value =  101.7426
p value =  0.0000

HA: Group means are not matched
```

Figure 5 Overall statistics of the cases recorded between 2020 and 2024

2) Fatality analysis

According to Levene's test, the groups have uneven variance and means ($P < 0.05$). Figure 6 presents an examination of COVID-19 mortality rates documented in the United States, China, and India. The right quantile chart shows a steeper slope for the US, indicating more volatility. The Kruskal- Wallis test yields a p-value of 0, below 0.05. Therefore, we reject the null hypothesis. China has the lowest figures compared to the US and India.

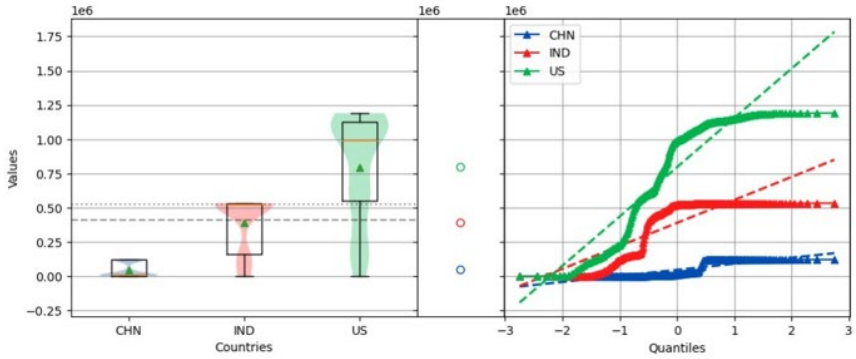


Figure 6 Analysis of the fatalities recorded between 2020 and 2024

Figure 7 shows the overall statistics of fatalities recorded in the US, China, and India.

```
Overall Statistics
------------------

Number of Groups =  3
Total            =  687
Grand Mean       =  411196.1092
Pooled Std Dev   =  251962.3122
Grand Median     =  523843.0000


Group Statistics
----------------

n             Mean          Std Dev       Min           Median        Max           Group
-------------------------------------------------------------------------------------------
229           47747.0218    52775.0592    361.0000      15273.0000    122271.0000   CHN
229           389841.7773   196680.9767   0.0000        523843.0000   533622.0000   IND
229           795999.5284   385987.5735   0.0000        989129.0000   1190579.0000  US


Levene Test
-----------

alpha    =  0.0500
W value  =  108.0096
p value  =  0.0000

HA: Variances are not equal


Kruskal-Wallis
--------------

alpha    =  0.0500
h value  =  406.2206
p value  =  0.0000

HA: Group means are not matched
```

Figure 7: Overall statistics of the fatalities recorded between 2020 and 2024

3) Stringency analysis

Figure 8 presents the examination of the COVID-19 stringency index documented in the United States, China, and India. Levene's test produces a P value of 0.022, which is below the significance level of 0.05. This sig- nifies that the groups exhibit heteroscedasticity and lack equal means. The Kruskal-Wallis test indicates P<0.05. Consequently, we reject the null hy- pothesis. Among the three nations, China has the highest standard deviation of 36.47 when compared to the United States and India.

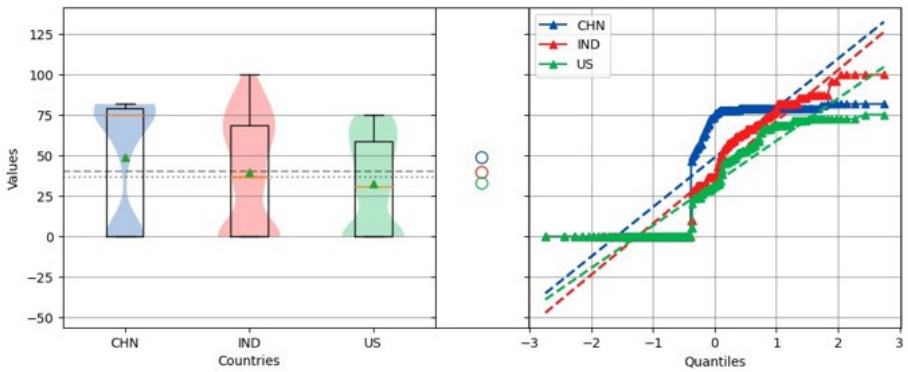


Figure 8 Analysis of the stringency index recorded between 2020 and 2024

Figure 9 shows the overall statistics of stringency index recorded in the US, China, and India.

```
Overall Statistics
------------------

Number of Groups =  3
Total            =  687
Grand Mean       =  40.4403
Pooled Std Dev   =  32.9222
Grand Median     =  37.0400


Group Statistics
----------------

n            Mean         Std Dev      Min          Median       Max          Group
-------------------------------------------------------------------------------------
229          48.7676      36.4723      0.0000       75.4600      81.9400      CHN
229          39.6194      33.6315      0.0000       37.0400      100.0000     IND
229          32.9338      28.1124      0.0000       30.7600      75.4600      US


Levene Test
-----------

alpha   =  0.0500
W value =  3.8096
p value =  0.0226

HA: Variances are not equal


Kruskal-Wallis
--------------

alpha   =  0.0500
h value =  41.2935
p value =  0.0000

HA: Group means are not matched
```

Figure 9 Overall statistics of the stringency index recorded between 2020 and 2024

4) GDP analysis

Figure 10 illustrates the examination of GDP fluctuations observed in the United States, China, and India. Bartlett's test yields a p-value of 0.3409, exceeding the significance threshold of 0.05, indicating that the groups pos- sess identical variance and comparable means. We performed the one-way ANOVA test as it met the prerequisite of homogeneity of variance. The p-value for this one-way ANOVA test is 0.6717, exceeding the conventional significance threshold of 0.05. We can affirm that all groups possess a same average rank, without rejecting the null hypothesis. Among the three countries, India's mean value is 0.0350, which is close to the grand mean of 0.03 than that of the United States and China.

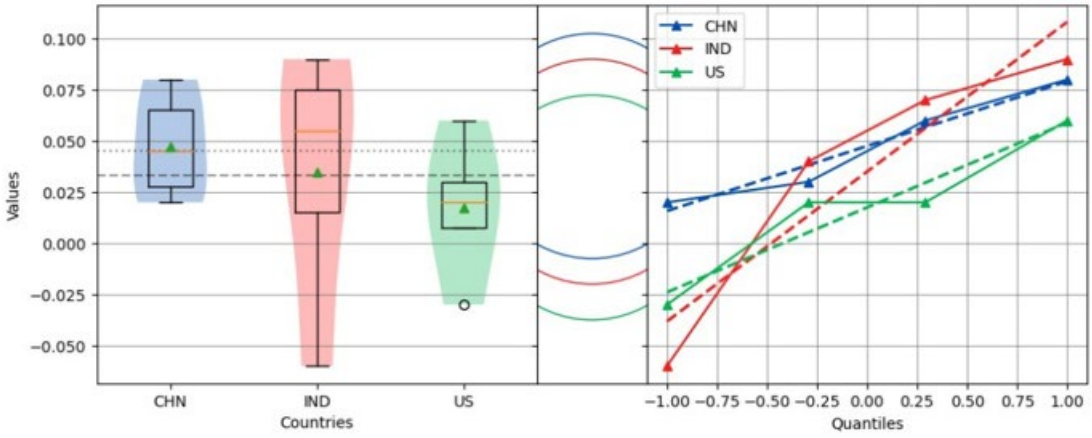
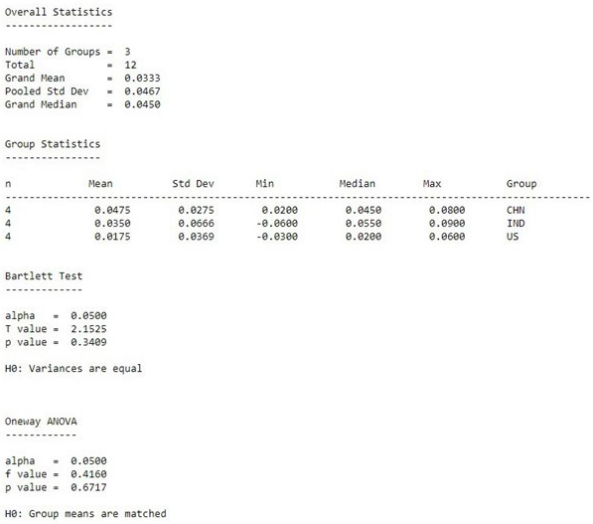


Figure 10 Analysis of the GDP change recorded between 2020 and 2022

Figure 11 shows the overall statistics of GDP change recorded in the US, China, and India.



Overall Statistics

Number of Groups	3
Total	12
Grand Mean	0.0333
Pooled Std Dev	0.0467
Grand Median	0.0450

Group Statistics

n	Mean	Std Dev	Min	Median	Max	Group
4	0.0475	0.0275	0.0200	0.0450	0.0800	CHN
4	0.0350	0.0666	-0.0600	0.0550	0.0900	IND
4	0.0175	0.0369	-0.0300	0.0200	0.0600	US

Bartlett Test

alpha	0.0500
T value	2.1525
p value	0.3409

H0: Variances are equal

Oneway ANOVA

alpha	0.0500
f value	0.4160
p value	0.6717

H0: Group means are matched

Figure 11 Overall statistics of the GDP change recorded between 2020 and 2022

5. DISCUSSION

We lack a comprehensive model to accurately forecast the result of a pandemic. Viruses undergo evolutionary changes, and facilitating their transmission raises the likelihood of genetic mutations and the potential for another surge in infections. To effectively manage an infection which has a higher fatality rate, it is advisable to promptly implement stringent measures instead of relying on herd immunity to naturally stop the spread.

6. CONCLUSION

Based on a worldwide agreement, the majority of individuals desire their governments to give priority to preserving lives rather than focusing on economic restoration. The US effort to halt the spread of the epidemic was insufficient when contrasted with the strategies employed by China and India. The number of fatalities caused by inadequate planning and careless strategies exceeds the global average of deaths resulting from the COVID-19 pandemic. Simultaneously rigorous lockdown measures may induce signifi- cant stress within the populace. The ”Zero-COVID” policy enacted by China may have received global appreciation; yet, it has profoundly impacted the economy. An efficient strategy necessitates a balanced approach that period- ically assesses the situation, taking into account both lives and livelihoods, as exemplified by India, and this strategy can be replicated in future pandemics.

7. DATA AVAILABILITY STATEMENT

The data supporting this study’s findings are available from the corresponding author upon reasonable request.

8. CREDIT AUTHORSHIP CONTRIBUTION STATEMENT

Santosh C J: Conceptualization, Methodology, Formal analysis, Investigation, Resources, Writing- Reviewing and Editing. Dr. Anurag Shakya: Supervision

9. DECLARATION OF COMPETING INTEREST

The authors declare that they have no known competing financial in- terests or personal relationships that could have appeared to influence the work reported in this paper

CONFLICT OF INTERESTS

None.

ACKNOWLEDGMENTS

None.

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