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Lockdown Dynamics and COVID-19 Transmission: A Comparative Analysis in India and Beyond

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Abstract

Similar to other nations, India has grappled with the repercussions of the COVID-19 pandemic, which originated in a Chinese city in December 2019. The impact of this contagion extends across diverse domains, encompassing the profound loss of human lives-India has already recorded over 4 lakh deaths—economic ramifications, disruptions in academic institutions, and various other sectors. This research is designed to scrutinize the influence of lockdown measures on the spread of the coronavirus, both in India and other countries. Data pertaining to COVID-19 cases and the duration of lockdowns has been compiled for India and other nations that implemented such measures before, during, and after specified dates. Employing statistical methodologies, the study draws inferences from the COVID data encompassing daily new cases, active cases, and daily death occurrences. The objective is to unravel the nuanced relationship between lockdown strategies and the trajectory of COVID-19 transmission in different countries, with a specific focus on the Indian context

Keywords: Covin-19 data, Correlation analysis, covariance, Shapiro-Wilk Test.

INTRODUCTION

The Spanish flu pandemic, also recognized as the formidable Influenza Epidemic, marked a global outbreak driven by the H1N1 influenza virus (Beach et al., 2020) This influenza scourge rapidly disseminated in 1918, spanning from January 1918 to December 1920, affecting an estimated five hundred million individuals, with a staggering 50 to 100 million fatalities, as documented by (Collier, 1974). Regrettably, this stands as the deadliest natural disaster in human history. Commencing on March 4, 1918, the Spanish influenza pandemic claimed lives across various age groups, with a particularly high mortality rate among children. The elderly were also significantly impacted. Factors such as malnutrition, overcrowding in medical facilities, and poor hygiene were exacerbated by the turmoil induced by bacterial superinfection, culminating in the demise of a majority of patients after a prolonged struggle. The 1918 Spanish flu pandemic was the inaugural event of its kind, followed by the 2009 pandemic and the most recent global health crisis, COVID-19 in 2019

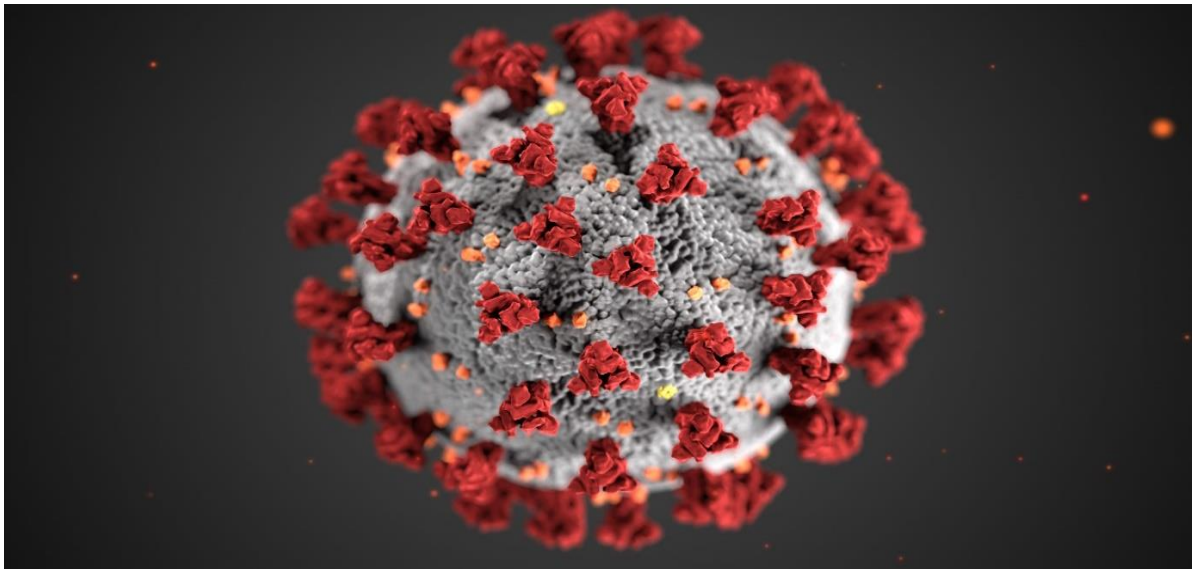
The pandemic H1N1/09 virus (Yipeng, 2014 and Christman, 2011), unlike most influenza strains, failed to infect adults over the age of 60 at a disproportionately high rate; this was an unusual and typical feature of the H1N1 pandemic. Because the virus was latent in pigs for several months due to the beginning, agricultural surveillance should be increased to prevent repeat outbreaks. "Contrary to common opinion, the new swine influenza pandemic emerged on factory farms in Mexico, apparently emerged in pigs in Asia, on the other hand, arrived in North America in an unusually human way," US agricultural officials speculated 2009. The military gives citizens in Mexico protection masks. The World Health Organization (WHO) confirmed the world's first-ever "public health emergency of international concern," or PHEIC, in late April.

The Covid-19 pandemic has harmed humanity in ways that no one could have predicted. It has changed everything about our lives. It goes without saying that such a massive public health emergency dramatically influences our society. We must recognize that public health crises are primarily a social phenomenon. However, the influence of such a severe disaster cannot be dismissed, offering a wide range of possibilities for where society will go and how it will be impacted. While it is possible to argue and expect that the covid-19 pandemic will improve societal trust and solidarity, it is also possible that it could have the opposite effect. The justifiable fear of contracting the virus has transformed our behavior and drastically affected our interactions. For the past year and a half, social gatherings and interactions have been strictly prohibited, creating an atmosphere of mistrust and distrust. Coronavirus first appeared in 2019; this virus strain is known as coronavirus 2019 or covid 19. The virus is supposed to

originate in the “Huanan seafood market in Wuhan, China.” After being imparted from animal to human, the virus can be transmitted from person to person.

The principles governing the spread of respiratory diseases, as elucidated by (Noymer and Garenne, 2000), underscore the role of respiratory droplets in transmission. Individuals afflicted with respiratory illnesses, such as COVID-19, are prone to spread the virus through coughing and sneezing, exposing those in close proximity. The swift propagation of the COVID-19 outbreak, infecting over 4 million individuals globally, has prompted the enforcement of restrictions in nearly every region, as noted by (Oxford et al., 2002). Adhering to stringent hygiene practices, particularly regular handwashing, emerges as a pivotal measure in curbing the pandemic's escalation and preventing further infections. Our research aims to comprehensively assess the impact of COVID-19 on India and the world, with a focus on understanding the dynamics of infection. Noteworthy efforts have been made globally, including the imposition of household bans, as various institutions grapple with the challenges posed by the pandemic. Scientists caution that the COVID-19 virus poses a rapid threat across age groups.

In response to the swift spread of the virus, the Indian government has implemented various measures, such as short-term lockdowns, stay-at-home directives, regular handwashing, mask-wearing, and maintaining a minimum one-meter distance. The global impact of the COVID-19 pandemic has triggered comprehensive investigations into the diverse effects of lockdowns on psychological, environmental, and economic dimensions, as illustrated by research conducted by (Atlan, 2020). Additionally, Das and Kumari (2021) conducted a statistical analysis of COVID cases in India, while S. Ahmad Alajlan et al. [9] explored the influence of lockdown policies on the proliferation of coronavirus cases in Saudi Arabia. Saleh Alrashed et al. (2021) presented findings on the impact of lockdowns on the spread of COVID-19 in the same country. The data for our study has been sourced from reputable references (Phillips, 2014).

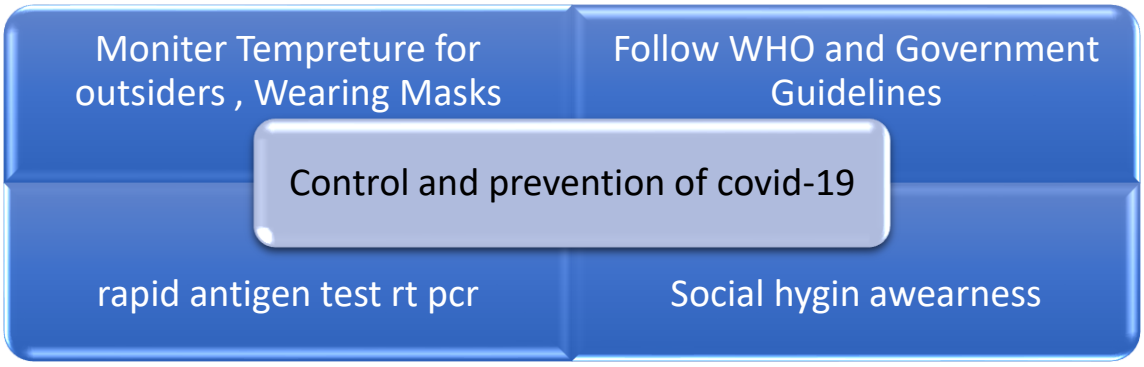


Covid 19 virus picture

Methods of Controls Covid -19

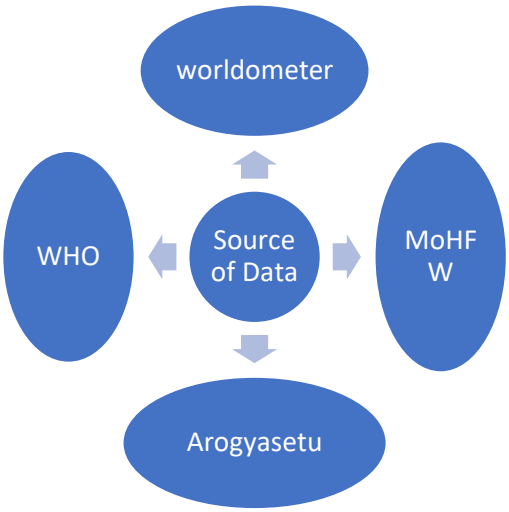
The most basic method for reducing coronavirus transmission and preventing disease is to apply the guidelines. The premier thing to remember is to scrub your hands regularly. As a result, the transmission of this virus is delayed in nations where individuals wash their hands often and observe basic hygiene standards. There is a significant level of involvement in the "stay at home" demand among reputable organizations. The COVID-19 virus, according to scientists, can quickly infect people of all ages. As a result, India's government has taken the following actions: Stay at home; Hand wash periodically; Wear the mask and keep a distance of at least one meter; wearing Mask: Face the WHO recommends masks for use in schools, workplaces, and public areas. Even though the masks are good, then it seems, respiratory viruses can easily get through the gaps, making them impossible to block out totally. Masks will filter particulates in industrial settings, but biological agents like the swine influenza have no fixed exposure limits. Almost all Indian states have imposed fines on persons who do not wear masks.

Quarantine: During the height of the pandemic fear, governments-imposed quarantines on foreign visitors suspected of being infected or having come into touch with others. If people were traveling from one state to another state for fourteen days, home quarantine is compulsory, and they have to show RTPCR reports during traveling or visiting.



Source of Data:

In this research, we have taken data from World meter and Arogyasetu. The goal of this research is to see how lockdown days affect the spread of the Coronavirus in various countries. Data on COVID-19 cases and lockdown days was collected for India and other countries that conducted lockdowns before, during, and after specific dates.



1. **Importance of Lockdown:**

Covid-19 has a direct impact on society's established norms. Schools were closed for obvious reasons; public meetings have grown rare working from home. The Covid 19 killed people all over the world. The number of people who perished in India was the same as the number of people who died in the United States. These were all highly successful efforts taken by society because people's immunity was deteriorating due to virus mutations. This research aims to learn more about the impact of lockdown days. Lockdown controlled the spreading coronavirus and protected the lives.

Figure 1: A picture of Lockdown in India

2. Methodology

The COVID-19 case data for the countries under examination was sourced from www.worldometer.com. A correlation test was performed to explore the connection between daily new COVID-19 cases and daily death cases in both India and globally. The correlation coefficient for the COVID-19 cases was calculated using a normal distribution, and the distribution's conformity to normality was assessed using the Shapiro-Wilk Test, as mathematically defined in Equation (1).

$$\square = \frac{\left(\sum_{i=1}^{n} a_i x_i\right)^2}{\left(\sum_{i=1}^{n} x_i - \bar{x}\right)^2} \tag{1}$$

$$a_i = \frac{m_v^T V^{-1}}{N}, m_v = \left(m_{v_1}, m_{v_2}, \ldots\ldots\ldots m_{v_n},\right)^T \tag{2}$$

$$N = \left\| V^{-1} m_v \right\| \tag{3}$$

Here, the symbols represent specific statistical parameters: sample is denoted by x_i, coefficients sample denoted by a_i, V is the covariance matrix of those normal order statistics, N is vector norm and sample mean denoted by $\bar{x}$.

3. Results and discussions

This study focuses on the analysis of Covid-19 cases and death rates in India and globally, both before, during, and after lockdown periods. Tables 1 and 2 are employed to facilitate this examination. The primary objective is to assess the influence of lockdown measures

on the occurrence of new Covid-19 cases and deaths. A comparative analysis is also conducted between India and the rest of the world. Several assumptions were made regarding the p-value and t-test. It was anticipated that the p-value would fall within the range of 0 to 1 before lockdown, and the t-test values were expected to be within the interval of [-2.0262, 2.0262]. Throughout the periods preceding, during, and following the lockdowns, the simplest analysis outcomes were presented with a 95% confidence level. A two-tailed statistical test was applied, and a significance level of $p < 0.05$ was determined. However, it is noteworthy that the data set utilized for the first lockdown was deemed inappropriate for normal distribution based on the Shapiro-Wilk test. The p-values for the test were 6.128e-7 (India) and 0 (world) before lockdown, 0 (India) and 0.058 (World) during lockdown, and 0.00001601 (India) and 2613e-9 (world) after lockdown. Similarly, for the second lockdown, the data set was also considered unsuitable for normal distribution according to the Shapiro-Wilk test, with respective p-values of 0 (India) and 0.4158 (world) before lockdown, 2.844e-7 (India) and 0.8408 (world) during lockdown, and 2.22e-16 (India) and 0.7971 (world) after lockdown. The correlation coefficient, ranging from -1 to 1, was utilized to determine the relationship between variables. A coefficient nearing -1 indicates a negative relationship, while a value approaching +1 signifies a positive relationship. A correlation coefficient of zero signifies the absence of a relationship. The statistical analysis encompassed the transformation of Covid-19 data. The research utilizes a dataset covering three distinct periods: 39 days preceding the initial lockdown (15-02-2020 to 24-03-2020), 60 days during the lockdown (25-03-2020 to 31-05-2020), and 60 days post-lockdown (01-06-2020 to 30-07-2020). The focus of the investigation revolves around the daily incidence of new COVID-19 cases and deaths before, during, and after the lockdown. The specific emphasis lies in assessing the impact of the implemented lockdown measures on the daily frequency of COVID-19 cases and deaths

Parameters	**Before Lockdown Period**		**During Lockdown Period**		**After Lockdown Period**	
	India	**World**	**India**	**World**	**India**	**World**
the Pearson Coefficient of Correlation (r) Daily Death	**0.7027**	**0.9655**	**0.9557**	**0.2308**	**0.5258**	**0.6783**

cases and Between Daily New COVID-19 Cases						
P-value	6.13E-07	0	0	0.058	0.00001601	2.61E-09
Covariance	12.2058	8147445.18	148912.788	4486423.72	1939829.47	29984281
Sample size (n)	39 Days	39 Days	68 Days	68 Days	60 Days	60 Days
Average Daily New Cases	13.7435897	11602.5641	2795.19	88244.17	24145.68	190962.76
Average Daily Deaths	0.28	455.65	80.01	5833.82	512	5589.65
t-test	6.0078	22.5375	26.3879	1.9267	4.7077	7.0297

Table 1: First Lockdown India Vs World

Table 1 illustrates that prior to the implementation of the lockdown, the average daily new cases stood at approximately 14. Simultaneously, the average daily death rate hovered around 0.28. Throughout the lockdown period, the number of cases per day surged to 2795, accompanied by a corresponding increase in the daily death toll. Post-lockdown, both the number of cases and deaths continued to rise. However, upon closer examination, it becomes apparent that the correlation coefficient (r) exhibited a decrease after the lockdown, indicating a discernible impact. Before the lockdown, the T-test value was recorded at 6.00, which increased during the lockdown and subsequently decreased post-lockdown. This suggests that while the lockdown did not significantly affect the number of daily cases and deaths, it did influence the daily death rate, as evidenced by the decrease in the correlation coefficient (r) post-lockdown. The calculated test statistic T equals 6.0078, placing it outside the 95% acceptance region. Examining the data in Table 1 further reveals that the average daily new cases before the lockdown were approximately 11602, with an average daily death rate of around 455. During the lockdown, the daily cases spiked to 88244, accompanied by an increase in daily deaths. Post-lockdown, both cases and deaths continued to rise. However, the correlation coefficient (r) showed an increase after the lockdown, indicating a lack of impact.

Comparing the T-test values, it is observed that before the lockdown, the value was 22.5, which decreased during the lockdown and increased post-lockdown. This suggests that the lockdown

did not significantly impact the daily cases and deaths in this scenario. Analysing the global data, it is evident that the numbers of COVID-19 cases and deaths increased worldwide before, during, and after lockdown. However, a distinctive trend is noted—while global death cases increased during the lockdown, they decreased after lockdown. This suggests that lockdown measures worldwide contributed to a reduction in daily death cases. Further analysis of the correlation coefficient (r) between India and the world indicates an increase during the lockdown and a decrease after the first lockdown in India. Conversely, the global correlation coefficient decreased during the lockdown and increased after the first lockdown. The subsequent data is derived from COVID-19 cases in India and globally, spanning periods before the second lockdown (01-02-2021 to 04-04-2021), during the lockdown (05-04-2021 to 15-06-2021), and after the lockdown (16-06-2021 to 16-08-2021). The study focuses on new daily cases and daily deaths, exploring the impact of the lockdown on these aspects of COVID-19.

Parameters	**Before Lockdown Period**		**During Lockdown Period**		**After Lockdown Period**	
	India	**World**	**India**	**World**	**India**	**World**
Pearson correlation coefficient (r) Between Daily New Cases and Daily Death	0.9405	0.4158	0.5617	0.8408	0.8234	0.7971
P-value	0	0.0007008	$2.84e^{-7}$	0	$2.22e^{-16}$	$9.10e^{-15}$
Covariance	2882194.98	92594069.5	85976080.2	344702431	2446394.32	118633077
Sample size (n)	63	63	72	72	62	62
Average Daily New Cases	29036	449358.85	236726	634938.06	42219	507382.08
Average Daily Deaths	172	9968.46	3051	12086.76	765	8605.32
t-test	21.6146	3.5711	5.6803	12.994	11.2405	10.2236

Table2: Second Lockdown India Vs World

Table 2 illustrates that, prior to the lockdown, the average daily new cases stood at approximately 29,000, with an average daily death rate of about 172. The daily cases surged to 236,726, accompanied by an increase in death cases. Subsequently, post-lockdown, the number

of cases and deaths decreased, yet a closer analysis reveals that the correlation coefficient (r) rose, indicating that the lockdown had negligible impact. The T-test value before lockdown was 21.6146, decreasing during lockdown and rising after lockdown. Consequently, the table suggests that the lockdown had minimal effect on daily cases and deaths but did influence the daily death rate, as evidenced by the post-lockdown decrease in the correlation coefficient (r), with the T-test value (21.6146) falling outside the 95% acceptance region.

Similarly, Table 2 indicates that, pre-lockdown, the average daily new cases were approximately 449,358, with an average daily death rate of around 9,968. Daily cases surged to 634,938, accompanied by an increase in death cases. Post-lockdown, both cases and deaths decreased, and a critical examination reveals a decrease in the correlation coefficient (r), indicating a significant impact of the lockdown. The T-test value before lockdown was 3.5711, increasing during lockdown and decreasing after lockdown.

Comparing the data in Table 2 for India and the world during the second lockdown, it is evident that daily Covid-19 cases and deaths increased during the lockdown and significantly decreased after the second lockdown in India. In contrast, globally, daily Covid-19 cases and deaths increased during the lockdown and decreased slightly after the second lockdown.

Further examination of the correlation coefficient (r) during the second lockdown in India reveals a decrease during the lockdown and an increase after the second lockdown. Conversely, for the world, the correlation coefficient (r) increased during the lockdown and experienced a slight decrease after the second lockdown.

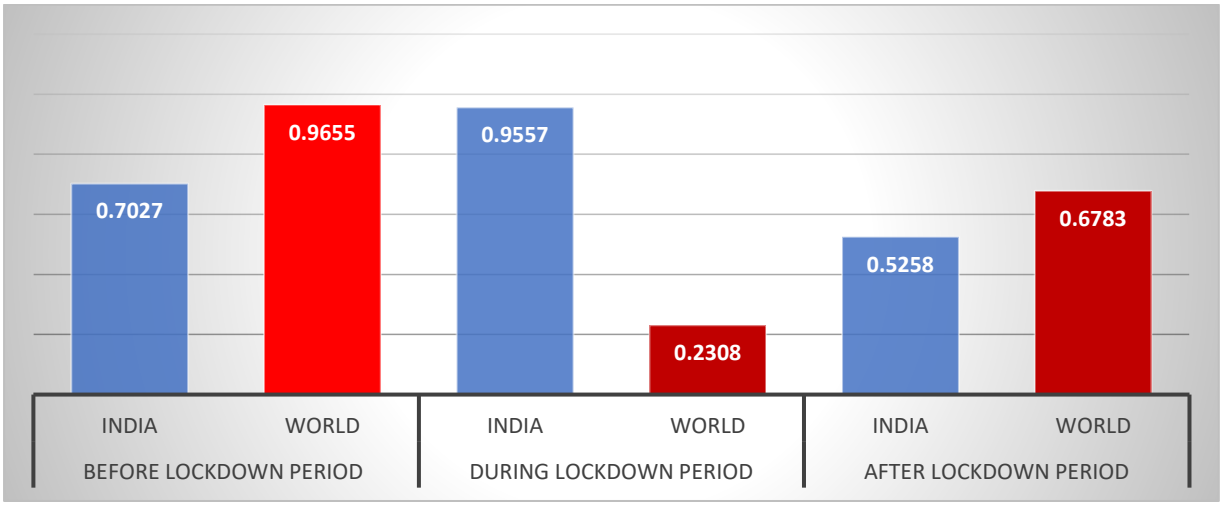


Figure 1: 1st Lockdown Period (Pearson coefficient of correlation (r) Between Daily New Cases and Daily Death)

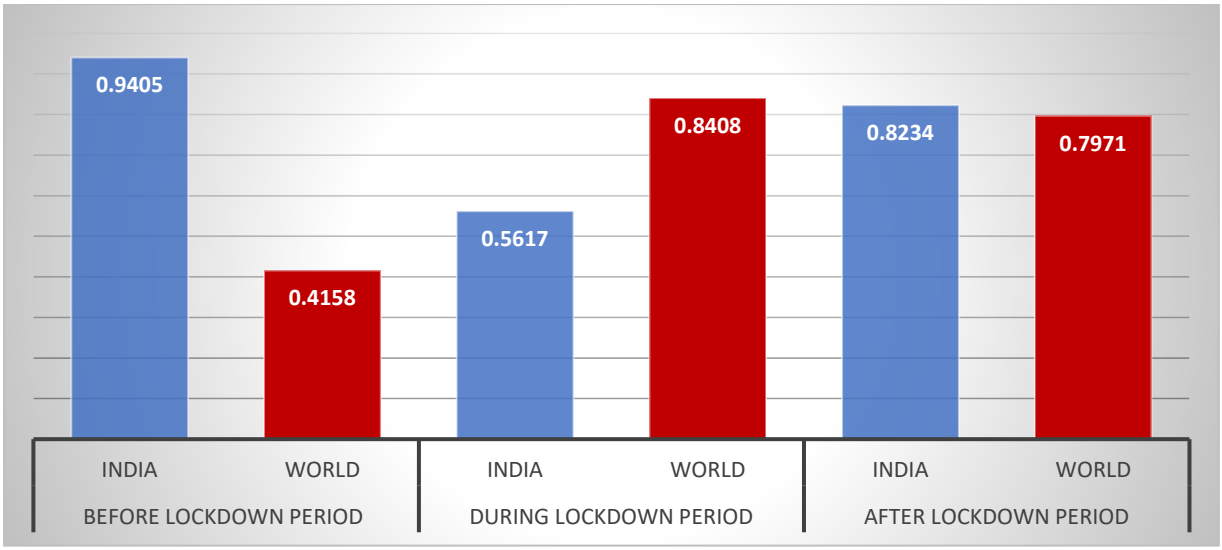


Figure 2: 2nd Lockdown Period (Pearson coefficient of correlation (r) Between Daily New Cases and Daily Death)

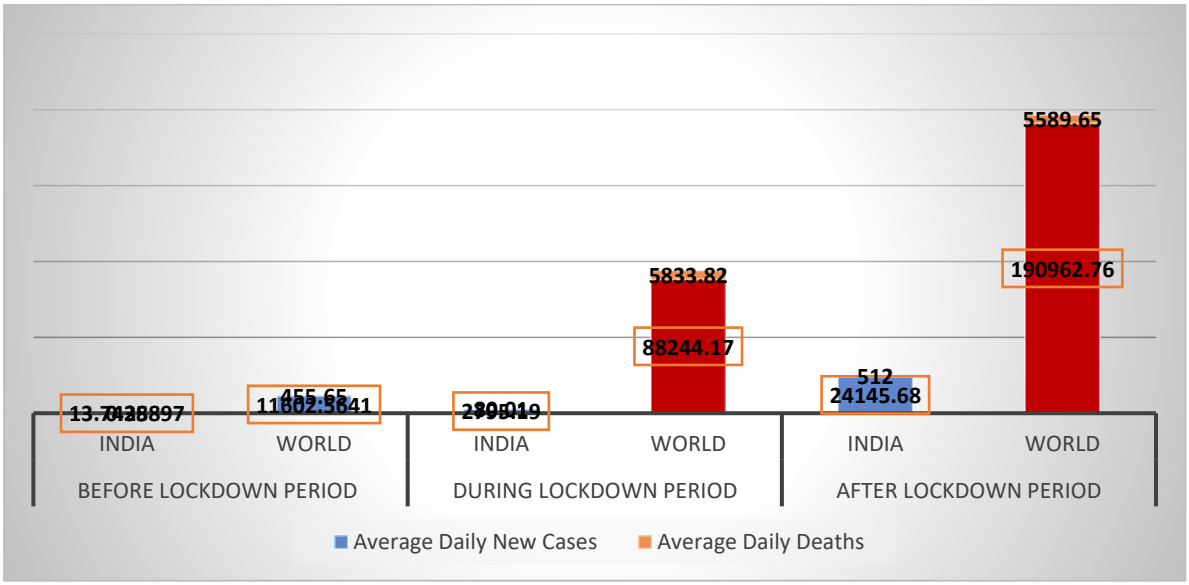


Figure 3: 1st Lockdown Daily Average new cases Vs Daily deaths

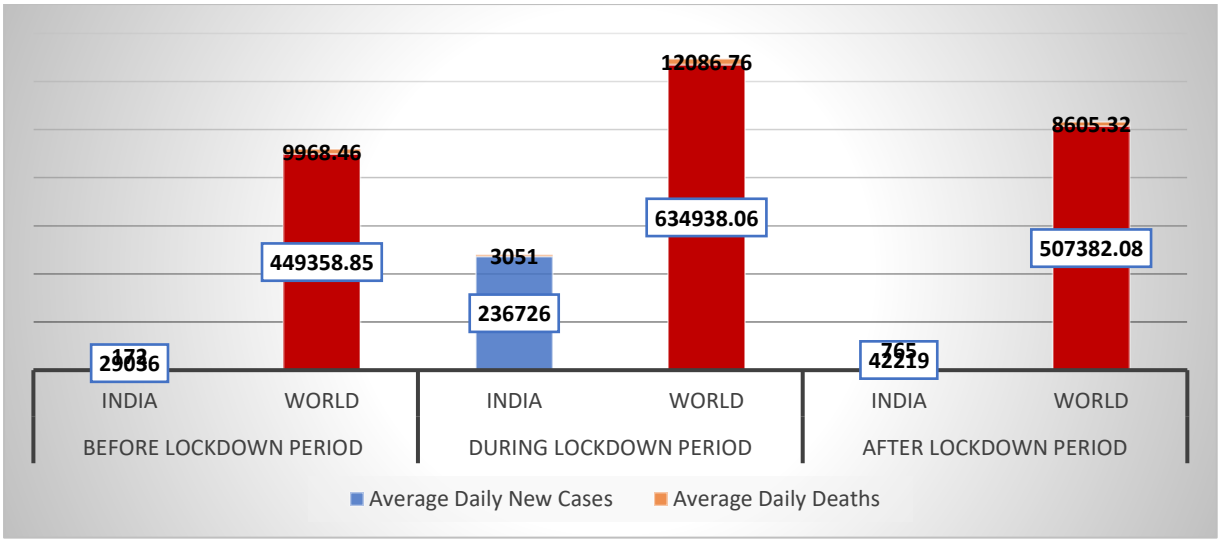


Figure 4: 2nd Lockdown Average Daily new cases Vs Daily deaths

4. Conclusion:

This research delves into the available data surrounding the COVID-19 pandemic, examining both the Indian and global scenarios. A meticulous analysis was conducted across the periods preceding, during, and following the initial lockdown in India. The first lockdown endured for 39 days (15-02-2020 to 24-03-2020), succeeded by a 60-day during-lockdown phase (25-03-2020 to 31-05-2020) and a post-lockdown period of 60 days (01-06-2020 to 30-07-2020). Throughout these phases, our scrutiny concentrated on establishing correlations between daily new COVID-19 cases and daily deaths. Our findings reveal a significant decrease in the correlation coefficient (r) between daily new cases and daily deaths after the first lockdown. This suggests that the implemented lockdown measures had a discernible impact on mitigating the virus's spread, both within India and globally. The escalating daily growth of COVID-19 cases and deaths prompted a comprehensive global response, encompassing lockdowns, quarantines, and various restrictive measures. In the second lockdown period, spanning 63 days before lockdown (01-02-2021 to 04-04-2021), during 72 days of lockdown (05-04-2021 to 15-06-2021), and 62 days after lockdown (16-06-2021 to 16-08-2021), we observed a decline in the coefficient of correlation between daily new cases and daily deaths during the lockdown. Additionally, there was a decrease in daily deaths in India, and the coefficient of correlation between daily deaths daily and new cases also displayed a global decline post-lockdown, as detailed in Table-2. This study suggests a preliminary indication that lockdowns, as recommended by the World Health Organization (WHO), play a significant role in controlling

the COVID-19 pandemic. Consequently, these lockdown measures have profound implications for the environment, the economy, psychology, and the overall spread of COVID-19.

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