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THE EFFECTIVENESS OF MOVEMENT CONTROL ORDER (MCO) PHASES IMPLEMENTATION IN MALAYSIA

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ABSTRACT

The COVID-19 cases have taken its strike since December 2019 in Wuhan, China and then has spread to other countries. Malaysia was not excluded from this pandemic, in which the first case of COVID-19 was discovered on 25th January 2020. The disease has caused a pandemic outbreak ever since, driving many countries to close international gateways and implement lockdowns and many studies have been trying to model and forecast the rising number of Covid-19 cases worldwide. This study aimed to prove the effectiveness of Movement Control Order (MCO) phases implemented in Malaysia. From 8 MCO phases implemented in Malaysia, 5 of the MCO phases were taken into consideration for this study. Line plots were used to observed the pattern, increasing (+) or decreasing (-) number of cases for each MCO implementation. The before and after trends for each phase were recorded and tabulated. Using the Wilcoxon Signed-rank test with Binomial probability calculation showed the p-value=0.001< α=0.05 obtained. Hence, supported the hypothesis that MCO implementation reduces the number of positive cases in Malaysia. In conclusion, the implementation of lockdown would 'flatten the curve' of the daily COVID-19 cases, resulting in better control over the spread of the COVID-19 virus in Malaysia.

Keywords: *Covid-19, Movement Control, MCO, National Lockdown, Wilcoxon Signed-rank Test*

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1. Introduction

The month of December 2019 will be etched in history as the world was confronted with a lethal disease viral pandemic. The last time the world responded to a global epidemic was the 1918-1919 influenza pandemic where there was no access to vaccines and the number of infections was increasing from the current scale of this COVID-19 pandemic (Ferguson, *et al.*, 2020). It has been 17 years since the outbreak of severe acute respiratory syndrome (SARS) caused by the SARS coronavirus (SARS-CoV) and now the SARS-CoV-2 or also known as COVID-19 has infected the human population globally and announced to be the most epizootic disease among the family of coronaviruses. Pointing to more than 110 countries and regions with 118,000 cases reported worldwide with the risk of further global

spread, the World Health Organization (WHO) declared this novel coronavirus disease a pandemic on 11th March 2020.

In the early stages of the epidemic, the uncertainty and lack of clarity only aggravated the situation and until now, 185 countries are suffering from the virus with no cure in sight (Sahai , Rath, Sood, & Singh, 2020). Medical staffs and authorities are striving for this never-ending war to find the best way and suggest effective treatment for those in need. However, it is very important to bring this virus under control as soon as possible, which will help to effectively mitigate the spread. Based on a finding of epidemiological modelling that has influenced policymaking in recent weeks in the United Kingdom and other countries, there were two fundamental strategies that are possible to cope with this current pandemic which are mitigation and suppression (Ferguson, *et al.*, 2020)., 2020). Nonetheless, each policy has its major challenges specifically towards economic sector.

As of 25th January 2020, Malaysia reported its first COVID-19 positive case after 48 hours Singapore reported theirs and it was imported from the origin country, Wuhan, China. Population densities and social interaction intensity are the key factors for the transmission and amplification of this COVID-19 respiratory virus (Rocklov & Sjodin, 2020). This outbreak at its spike when five generations that linked to the cluster of a religious gathering from Seri Petaling Mosque was detected. The situation was even alarming when two deaths were recorded which involved a Sarawakian and Johorean on 17th March 2020 (Malay Mail, 2020). As a measure to restrict the movement of individuals into and out of a specific area that may cause the chain of infection, Movement Control Order (MCO) was implemented on 18th March 2020. This regulation is enacted under the Prevention and Control of Infectious Disease Act 1988 and Act 1967 (New Straits Times, 2020). To enhance this action, only business center who are selling daily necessities, essential services which are utilities, telecommunication, transportation, oil and gas, healthcare center, post-service, financial and banks and security were allowed to continue their operation during this order is taken (New Straits Times, 2020).

Malaysia suddenly moved to Conditional Movement Order (CMCO) to restart the economy in stages from 4th May 2020 until 9th June 2020. The number of new confirmed cases daily were reported in a stable and calm situation as a positive effect of the implementation of four series of MCO and two CMCO (Aziz, Othman, Halyna, & Suleiman, 2020). Relaxation of regulations during this CMCO brings joy to the whole country especially the economic sector. After the two series of CMCO ended on 9th June 2020, Malaysia's order was replaced to Recovery Movement Order (RMCO) starting from 10th June 2020 until 31st August and extended to the end of the year, 31st December 2021 with new rules and Standard Operating Procedure (SOP). The MCO series brings a high impact on several levels of community and sector. However, this measure was imposed by the government to curb the spread of COVID-19, which was increasing in its number daily. Broadly, the purpose of each series of MCO was to assure that the order served its purpose.

Outcomes from a study carried by Malaysia researchers reveals the MCO's success and effectiveness in flattening the curve, thereby helping to monitor the peak number of active cases and spread of this COVID-19 infection growth when the actual infections were less than predicted active cases which would be expected the carrying capacity to reach 5901 in 120 days after the first MCO implemented. In addition, this study also shows that if various stages of MCOs were not taken, the rate of infection would have been greater than the current rate of infection (Amiruzzaman, Abdullah Al-Wadud, Mohd Nor, & Abdul Aziz, 2020). Besides, isolation order was found to have a negative and statistically significant correlation after 10 days after the implementation, meaning that there are less new cases in countries that

introduced this action compared to countries did not (Alfano & Ercolano, 2020). Its efficacy continues to rise up to 20 days after implementation. The benefits of lockdown can be seen exponentially rising with the passing of time.

As many countries across the globe are taking unprecedented measure by implementing national lockdown through the restriction on the time of movements, limitation on the crossing between states and the closure of big premises, to name a few, in coping with this pandemic, there are also several countries that did not implement the same action. Many studies compare the effectiveness of the MCO in an observational or retrospective way. Not many studies are done to compare the effectiveness of the MCO in a statistical point of view. Thus, this study seeks to compare the effectiveness of different types of MCO that has been taken by Malaysia government to aid in lowering the number of daily cases of COVID-19. The comparison from this study used a statistical approach rather than observational methods, which the numerical results measure the observational results better. The study also aids in the future intensification of current preventive approaches as part of Malaysia's efforts to combat the pandemic. Data and results gathered were used as reference to discover a new plan to keep the community and nation safe can be accomplished.

2. Methodology

This study uses the Wilcoxon signed-rank test to examine the difference in the effectiveness of the MCO phases. The Wilcoxon signed-rank test is a non-parametric version of the paired t–test, whereby the differences are severely non-normally distributed. The dataset in this study was analyzed using R programming and Microsoft Excel. The time series plots for each MCO phases were derived and observed (Shaadan, Rusdi, Nik Mohd Azmi, Talib, & Wan Azmi, 2019; Abd Rahman, Rahman, Rozaimi, & Zulnahar, 2021)

2.1 Data Description

A total of 279 secondary data were used in this study, obtained from different sources; i) Crisis Preparedness and Response Centre (CPRC) of Malaysia as this is the official center in announcing daily COVID-19 current situation across the country by states and cities, and ii) COVID-19 Dashboard by Center for Systems Science and Engineering (CSSE) at Johns Hopkins University & Medicine, https://coronavirus.jhu.edu/map.html was used as a resource center as this dashboard presents official daily counts of COVID-19 cases worldwide by countries, areas or territories. The cumulative of cases since the first case reported are included together. This study uses the daily number of positive COVID-19 cases from 18th March 2020 until 30th November 2020. The data generated from both repositories are in ratio scale.

2.2 Impact of Lockdown

In order to compare the effectiveness of implementing lockdown as an effort in combating COVID-19, the number of days of implementation of MCO in Malaysia were taken into account from 18th March 2020 as the first day it was imposed until 31st December 2020. This covered 8 MCOs of different kinds, including normal MCO, RMCO and CMCO, as compiled in Table 1.

Table 1: Summary of the Implementation Dates of MCO Phases in Malaysia.

MCO Phase		Date	Total Data
1	MCO 1	18th – 31st March 2020	14
2	MCO 2	1st – 14th April 2020	14
3	MCO 3	15th – 28th April 2020	14
4	MCO 4	29th April – 3rd May 2020	5
5	CMCO 1	4th – 11th May 2020	8
6	CMCO 2	12th May 2020 – 9th June 2020	29
7	RMCO 1	10th June – 31st August 2020	73
8	RMCO 2	1st September – 31st December 2020 (taken as general)	122

Table 1 shows the eight MCO phases implemented between 18th March – 30th December 2020, where MCO 1 was the initial MCO phase from 18th – 31st March 2020, with 14 days (data) of implementation, which was followed by MCO 2 (14 days), MCO 3 (14 days), MCO 4 (5 days), CMCO 1 (8 days), CMCO 2 (29 days), RMCO 1 (73 days) and RMCO 2 (122 days).

In the initial phase, MCO measures included complete prohibition of people from moving outside their houses or attending mass gatherings and restricted all domestic and international travels. Academic institutions, public and private premises were all closed. During this phase, the Royal Malaysian Police was mobilized to support the enforcement of the restrictions. The CMCO and RMCO phases were more flexible MCO where various phases of the MCO allowed for a flexible response to the national situation, adapting restrictions to reflect the current epidemiological situation.

2.3 Wilcoxon Signed-Rank Test

The Wilcoxon signed rank test is used to test that a distribution is symmetric about some hypothesized value, which is equivalent to the test for location. The test of a hypothesized median is performed as follows (Weaver, Morales, Dunn, Godde, & Weaver, 2017):

1. Rank the magnitudes (absolute values) of the deviations of the observed values from the hypothesized median, adjusting for ties if they exist.
2. Assign to each rank the sign (+ or -) of the deviation. This is named the "signed rank".
3. Compute the sum of positive ranks, $T(+)$, or negative ranks, $T(-)$, the choice depending on which is easier to calculate. The sum of $T(+)$ and $T(-)$ is $n(n+1)/2$, so either can be calculated from the other.
4. Choose the smaller of $T(+)$ and $T(-)$, and call this T.
5. Since the test statistic is the minimum of $T(+)$ and $T(-)$, the critical region consists of the left tail of the distribution, containing a probability of at most $\alpha/2$. Since this study is for large samples, the assumption on the sampling distribution of T is approximately normal with $u=n(n+1)/4$ and $\sigma^2=n(n+1)(2n+1)/24$ which can be used to compute a statistic for the hypothesis test.

2.4 Wilcoxon Signed-Rank Test

The impact of lockdown using Wilcoxon Signed Rank Test is implemented as follow:

1. The MCO phases in Table 1 observed as the "before" and "after" for ranking the sign in the Wilcoxon Signed-Rank test as follow:

Table 2: Summary of the Implementation Dates of MCO Phases in Malaysia.

MCO Phase		Before	After
1	MCO 1	-	-
2	MCO 2	MCO 1	MCO 2
3	MCO 3	MCO 2	MCO 3
4	MCO 4	-	-
5	CMCO 1 (MCO 5)	MCO 3	MCO 4+ 5
6	CMCO 2 (MCO 6)	MCO 4+5	MCO 6
7	RMCO 1 (MCO 7)	MCO 6	MCO 7
8	RMCO 2 (MCO 8)	Not taken	Not taken

Table 2 explains the MCO phases which are considered as the "before" and "after" for each MCO implementation. All the number of COVID-19 cases taken was the first 14 days of the implementation of each MCO phases, to ensure that the cut-off days are equal for every MCO phases. MCO 4 and 5 were combined as the number of each implementation was 5 and 8 days (total of 13 days' consideration). MCO 8 was not taken as it was considered not as restrictive as the other MCO phases, and there were smaller MCOs in MCO 8 implementation.

2. For all five MCO phases in Table 2, the line plot "before" and "after" for the first 14 days implementing the phases were observed and tabulated, whether the trend is increasing or decreasing is denoted as "+" or "-".

3. If the "before" and "after" shows the following, the "Is Decrement" in the cases will be denoted in Table 3, as such:

Table 3: Summary of the Implementation Dates of MCO Phases in Malaysia.

Before	After	Is Decrement
-	-	Yes
+	+	No
+	-	Yes
-	+	No

Table 3 shows the summary of rules of the "Is Decrement" status given for the MCO phases in Table 4. Based on Table 2 and Table 3, the hypotheses derived are as follows:

H_0: There is no reduction in the number of daily cases in the MCO implementation

H_1: There is a reduction in the number of daily cases in the MCO implementation

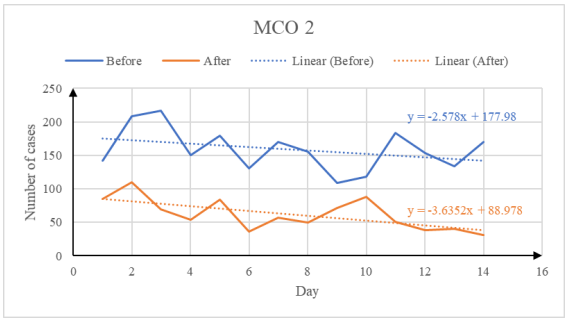
The Binomial probability calculation is performed and compared to the significant value ($\alpha < 0.05$). The probability obtained from the Binomial calculation is the statistical test used to further perform the Wilcoxon Signed-rank the hypothesis test.

3. Result and Analysis

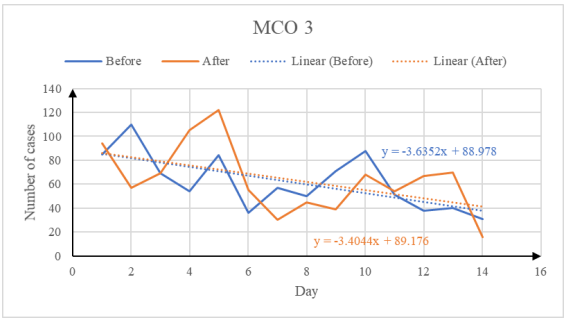
The results and analysis to achieve the objectives of the study are discussed in this section. A description of the effectiveness of national lockdown on the daily cases of COVID-19 in Malaysia based on the result was discussed.

3.1 Effectiveness of National Lockdowns on COVID-19 Daily Cases

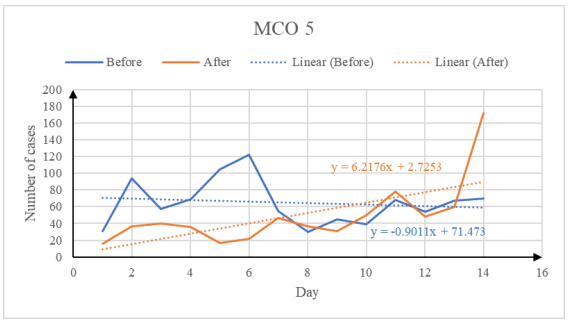
Wilcoxon Sign-rank test was used to test the effectiveness of the implementation of national lockdowns (MCO) phases on the number of COVID-19 cases. From all 8 MCO phases, the MCO phases as grouped in Table 2 were observed. From all these MCO phases, line plots were created to obtain the trends for "before" and "after" the lockdowns implementation as shown in Figure 1.



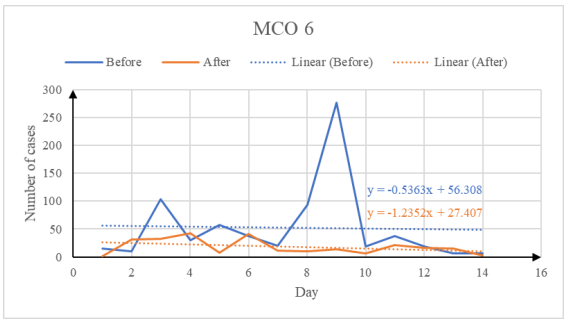
(a)



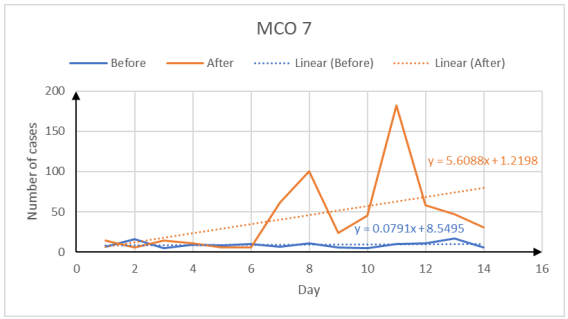
(b)



(c)



(d)



(e)

Figure 1: Line plots for five chosen MCO phases as in Table 2
Note: (a) MCO 2, (b) MCO 3, (c) MCO 5, (d) MCO 6, (e) MCO 7.

All the trends on the plots in Figure 1 were observed and tabulated in Table 4. The "Yes" and "No" from 'Is Decrement' denotes the MCO implementation, which shows a decreasing (for "Yes") and increasing (for "No") from the "before" and "after" the MCO phases implementation as illustrated in Figure 1 and as explained in Table 3. The count of "Yes" which is 4 out of 5, after which the p-value of "Is Decrement" is selected from the Binomial table based on $\alpha=0.05$ with $r=4$ and $n=5$. As the p-value obtained was < 0.001 (p-value $< \alpha=0.05$), implied that the Wilcoxon Signed-Rank hypothesis test is significant (refer to the hypothesis derived in previous section). Thus, the null hypothesis of the Wilcoxon Signed-Rank test is rejected. This concluded that the MCO lockdowns have significant "decreasing" effects towards the number of daily COVID-19 cases.

Table 4: "Before" and "After" trends and signs of differences for MCO phases.

MCO	Before	After	Is Decrement
2	-	-	Yes
3	-	-	Yes
5	-	+	No
6	-	-	Yes
7	+	-	Yes

4. Conclusion

It is important to note that fighting against this deadly disease has not yet ended. Implementing national lockdown in a country is not meant to directly end the spread of COVID-19 disease but a measure to flatten the epidemiological curve and help the healthcare workers to keep up with the awakening of this unsettled pandemic. It is of utmost importance to identify the effectiveness of this attempt on the new daily COVID-19 cases. This study proved that national lockdown in Malaysia has succeeded in 'flattening the curve' after several phases of MCO implemented. The null hypothesis that was expected to have no difference on the number of daily COVID-19 cases before and after the MCO was rejected as the Wilcoxon Signed-rank test statistic was found to be significant. Hence, it was proven that even with the different types of MCO phases imposed in Malaysia, the movement control itself has significant effects on the daily cases of COVID-19 in Malaysia.

Future researchers are recommended to try different forecasting models to identify their performance in different implementations. Furthermore, it is suggested that in-depth analysis is performed to find out the source of COVID-19 transmission. In addition, multiple short-term model validations can be done where dataset is divided into multiple sections, models are evaluated for every section and the best model can be obtained from the average performance throughout the dataset. This can result in better forecasting model to be used for short-term forecast. Moreover, a study on specific MCO phases implemented is recommended to be done for a better result.

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