IMPACT OF COVID-19 PANDEMIC CONDITIONAL MOVEMENT CONTROL ORDER (CMCO) ON THE DENGUE SITUATION IN MALAYSIA

ABSTRACT

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This study highlights the effects of COVID-19 pandemic to our dengue situation in Malaysia. Specifically, the purpose is to identify and determine the distribution of dengue fever pattern affected by the country's Conditional Movement Control Order (CMCO) and further evaluate it. This is an observational and descriptive research where dengue cases in all states of Malaysia were recorded weekly and compared to the previous MCO. During CMCO, the pattern of dengue fever cases was calculated and observed whether it showed any change after the MCO. The results showed that the overall cases of dengue during CMCO were reported to be higher compared to the numbers during MCO which was only 1395 cases. The highest reporting cases of dengue was exhibited during CMCO Epidemiological Week (EW) 23, which was as much as 1871 cases. In each week of the CMCO period, incidence of dengue did not show any sign of decreasing. Hence, this research work has revealed that CMCO did not help in combatting dengue fever. Despite that, further analysis of variation, mean difference, and nonparametric tests were done to understand the significance. This is essential to understand the density of a dengue outbreak amidst a pandemic, so risk assessment and hazard mitigations can be planned.

Keywords: COVID-19, CMCO, dengue cases, pandemic, Malaysia

1.0 INTRODUCTION

The World Health Organization (WHO) declared that the world is having a global emergency, as Coronavirus (COVID-19) spreads across multiple continents worldwide (Sohrabi et al., 2020). Originating from Wuhan City, China, this virus subsequently spreads more vigorously crossing international boundaries, making it the fifth pandemic after the 1918 Spanish Flu (H1N1) (Liu et al., 2020). The virus causing COVID-19 is in a family of viruses called Coronaviridae, which is also the virus that causes common cold, severe acute respiratory syndrome (SARS), and Middle East respiratory syndrome (MERS) (Sheng, 2020). In general, coronavirus has a major influence on the human respiratory system, where a unique clinical feature targets the lower airway together with upper respiratory tract symptoms like rhinorrhoea, sneezing, and sore throat (Rothan & Byrareddy, 2020). As it spreads from person to person through direct contact, this tiny virus circulates through the society and disrupt lives of many.

As the pandemic reach Malaysia in January 2020, case numbers remained relatively low until there was a massive religious event in March that caused a spike of 500 cases (Aziz et al., 2020). The first wave began in late January and ended with minimal cases. Consequently, the second wave broke out in late February and drastically grew in the first three weeks (Ng et al., 2020). To this date, we are experiencing the resurgence of the coronavirus as the third wave according to Health director-general Dr Noor Hisham at a virtual press conference. Despite the control measures taken to curb the transmission in Malaysia, COVID-19 cases are rising up to four digits.

The rapid transmission of COVID-19 adversely impacted the whole world, prompting the decision to lockdown in order to curb the infection and mortality rate. Remarkably, Malaysia was among the first few countries to implement MCO as the outbreak worsens (Khor et al., 2020). After MCO, we were more adaptable to the presence of COVID-19 and began CMCO. Although citizens were still advised to stay home, travelling to work in addition to buying food, daily necessities and healthcare were allowed (Fan & Cheong, 2020). Controlling the human movement is crucial as physical proximity determines the direct transmission of COVID-19, but the effect on indirectly transmitted diseases like dengue is still in research (Ong et al., 2020). As a vector borne disease, dengue spreads through the bite of an infectious *Aedes* mosquito transmitting dengue viruses. To control this form of indirect transmission, the mitigation involves integrated vector management. Activities like cleaning of stagnant water and spraying of pesticides are listed as essential services therefore are allowed to be continued during the lockdown in Malaysia. Nevertheless, people staying at home led to abandoned and neglected premises, which could result in hidden *Aedes* breeding (Arumugam, 2020).

The theory of this paper is that distribution of dengue fever is affected by the implementation of CMCO. Hence, this study aims to explore the ways in how the different mitigating measures of COVID-19 could have an impact towards the number of dengue cases in different states. To add on, dengue primarily spreads through exposure in the home. Hence, with longer lockdown periods, there is a greater risk of being infected with dengue moreover with low-rise residential buildings (Uildriks, 2020). Therefore, this study is vital as it helps to contribute to our understanding of our practices during COVID-19 pandemic that would have significant impact on the distribution of dengue fever.

2.0 MATERIAL AND METHODS

2.1 Study Design

This paper applied an epidemiological study design to assess the impact of movement control orders due to COVID-19 on the dengue fever distribution in Malaysia. A descriptive study was conducted from 26th April 2020 to 6th June 2020 to analyse the information obtained from Jabatan Kesihatan Negeri (JKN) and MOH. This information consists of dengue fever statistics by each state and federal territories, classified to corresponding epidemiological weeks. Data was extracted from the reports, accumulating it into the epidemiological weeks required for this study, which correlates with CMCO.

The collection of the dengue cases data from this specific period provides a baseline that could be beneficial in developing better mitigating measures for mosquito-borne disease outbreaks. The results obtained were analysed by comparing the dengue cases distribution during CMCO to the period before that which is MCO, finding the causal relationship between these variables. The dependent variable, which is number of dengue cases, were determined whether it is affected or not by the implementation of CMCO. To do so, data of dengue cases during the last week of MCO was also obtained so comparison can be made fairly. These variables were summarized in Table I and further analysed in two parts following the objective of this paper. Firstly, by evaluating the pattern of dengue fever during CMCO and secondly, determining the relationship between distribution of dengue fever and CMCO using a nonparametric Wilcoxon signed-rank test with statistic package for social science (SPSS) 21.

Table I. Summary on study variables which include inclusive and exclusive criteria

Objectives	Dependent Variable	Independent Variable	Inclusion Criteria	Exclusion Criteria
To evaluate the pattern of dengue fever distribution in Malaysia during CMCO period	Dengue fever in 13 states and 2 Federal Territories in Malaysia	Implementation of MCO	Dengue fever data collection from 26th June 2020 – 2nd May 2020	Other mosquito-borne diseases (eg: malaria, lymphatic filariasis, Japanese encephalitis and chikungunya)
To determine the relationship between the dengue fever distribution and CMCO		Implementation of CMCO	Dengue fever data collection from 3rd May 2020 – 6th June 2020	

2.2 Study Site

This study was conducted in Peninsular and East Malaysia, where it is situated in Southeast Asia, occupying some parts of the Malay Peninsular and Borneo Island. In this research, a total of 13 states and 2 federal territories in Malaysia are identified as seen in Figure I. The total land area of Malaysia is 329,847 km^2 which includes about 690km^2 of inland water. According to Department of Statistics Malaysia, the country's total population as of 2020 is estimated at 32.7 million, with citizens amounting to 29.7 million and non-citizens to 3.0 million. The topography of Malaysia allows an equatorial climate of high temperatures and humidity, coupled with heavy rainfall that patterned all year long (Ahmad et al., 2020). This weather is conducive for *Aedes* mosquito development, which justifies the site selection of this study.

Figure I: The visualization of the 13 states and 2 federal territories, (i) States (Perlis, Kedah, Pulau Pinang, Perak, Selangor, Negeri Sembilan, Melaka, Johor, Pahang, Terengganu, Kelantan, Sabah, Sarawak) and (ii) Federal territories (Wilayah Persekutuan Kuala Lumpur, Wilayah Persekutuan Labuan)

2.3 Data Source, Collection, and Management

As secondary data, the data collection method was firstly done by emailing all JKN to formally get permission for their respective dengue cases. Following that, the existing data was also already present in the MOH official website from the weekly news report. Following the implementation of the Prevention and Control of Infectious Disease Act 1988 (Act 342) in Malaysia, notification of dengue cases is mandatory and done by all Registered Medical Practitioner to the nearest District Health Office. Most of mosquito-borne diseases which includes dengue is defined as clinical mosquito-borne disease cases with confirmed laboratory blood tests. Moreover, these data are managed and investigated by trained environmental health practitioners, where they must subsequently report it to state and national level for surveillance activities. To add on, publication of these cases is made available daily and cumulatively on the Dengue Operations Centre website, iDengue, which is also accessible by smart phone application.

For the duration of CMCO implemented by the government, the data of CMCO dates and corresponding periods was collected from existing sources such as MOH COVID-19 website and Prime Minister's Office of Malaysia. In order to correlate the incidence and prevalence of dengue cases during CMCO, the CMCO dates were then aligned with epidemiological weeks. This present study only uses dengue cases reported by all states in Malaysia within the MCO and CMCO period. Details of dataset distribution of the dengue cases obtained are presented in Table II.

Table II. Datasets and their attributes

Datasets	Sources	Specifications	Attributes	Value	Being pre-processed
Dengue fever distribution	Disease Control Division, Ministry of Health, Malaysia	Weekly aggregated epidemiological information:	Date time interval	2020/April – 2020/June	-
		i) Dates onset	Weekly	18 – 23	-
		ii) No. of cases	Number	-	-
		iii) Localities	States and Federal Territories	-	Perlis, Kedah, Pulau Pinang, Perak, Selangor, Negeri Sembilan, Melaka, Johor, Pahang, Terengganu, Kelantan, Sabah, Sarawak, WP Kuala Lumpur, WP Labuan

2.4 Data Processing

The data processing involved in this study consists of two main parts: the spatial mapping of dengue cases across Malaysia during the CMCO period and tabulating the compilation of cases throughout this same period. In this study, the trends in distribution of the dengue cases had been monitored and recorded spatially and temporally. For spatial analysis, the distribution of dengue cases in Malaysia are mapped using an online GIS-based application "Heatmapper". The extraction data was done in Microsoft Excel spreadsheet and then uploaded on the application. It formed a spatial statistical analysis by having the geographical map of Malaysia color-coded according to number of dengue cases reported by each state. The distribution of dengue cases is presented in each state over the duration of each epidemiological week in the CMCO period in order to determine the locations with a high distribution of cases.

In order to understand the temporal trends, the CMCO phases were classified into different epidemiological weeks. Initially, CMCO was divided into two phases, namely phase 5 and phase 6. The duration for these phases differs, where phase 5 take only one week and phase 6 take four weeks, respectively. Therefore, to determine how dengue distributes fairly over time, the behaviour of a variable in a data set over time was modelled following the previous data points of the same series. In this case, dengue cases in CMCO were compared to the cases in the MCO, which take one epidemiological week. Consequently, all of these weekly dengue cases were divided by the number of districts in each respective state to obtain the mean number of dengue cases.

2.5 Data Analysis

Data analysis is a process of evaluating and summarizing all the data obtained in order to extract a significant finding and drawing up a conclusion. In this paper, the data analysis is carried out by calculating the variation of dengue cases from CMCO compared to MCO, and further evaluating it by using a Wilcoxon signed-rank tests with SPSS 21.

Understanding the pattern of dengue cases throughout Malaysia during CMCO that progresses from MCO is essential in order to identify whether there is a relationship between the two independent variables to the distribution of dengue cases. For a better understanding, the variation of dengue fever (DF) cases for each state was calculated by subtracting the dengue cases of each CMCO phases to dengue cases of the previous MCO phase. This value is then divided with the total dengue cases from all states during MCO and multiplied to 100% to achieve the percentage. By doing so, it is easier to analyse the percentage of increase or decrease occurring throughout CMCO phases.

In further analysis, the mean differences between each data sets were compared using a Wilcoxon signed-rank test. The purpose for this approach is to investigate the change from MCO to CMCO and its effects to the number of dengue cases. Wilcoxon signed-rank is a non-parametric test used as an alternative to the paired *t-test*, when distribution of the sample obtained were assumed not to be normally distributed. Moreover, the data of dengue cases come from the same population chosen independently, measured on an interval scale. Fulfilling all the assumptions to carry out this test, overall statistical analysis used a p-value below 0.05.

3.0 RESULT

3.1 Distribution of dengue fever pattern by states in Malaysia affected by COVID-19 Conditional Movement Control Order (CMCO).

A thorough assessment of the spread of dengue cases in Malaysia before and during the stages of CMCO implementation was carried out. A few recent studies concluded that the early stages of MCOs have positively affected the onset on new dengue cases (Lim et al., 2020; Ong et al., 2020). As for the implementation of CMCO that happened after MCO, comparisons of the number of total dengue cases were carried out between the period of enforcement of MCO Epidemiology Week (EW) 18 with CMCO EW 19 to EW 23.

In order to understand the spatial and temporal pattern of dengue fever in Malaysia and its distribution throughout the CMCO period, total dengue cases by states had been analysed and compared through the use of spatial mapping. In Figure II, the enforcement of CMCO after MCO did not show any noticeable change in the states recording dengue cases. Before CMCO was implemented, Selangor, Wilayah Persekutuan Kuala Lumpur dan Putrajaya, and Johor were among the states that recorded significant dengue cases during the MCO (Figure A). For the entire period of CMCO, these three localities maintained to have high cases of dengue. Additionally, throughout the same period during EW 22, a decrease of dengue cases was noted in Johor (Figure E). Nonetheless, the incidents increased again afterwards in EW 23 (Figure F). In general, the overall distribution pattern of the dengue cases in Malaysia showed a constant statistic during the implementation of CMCO.

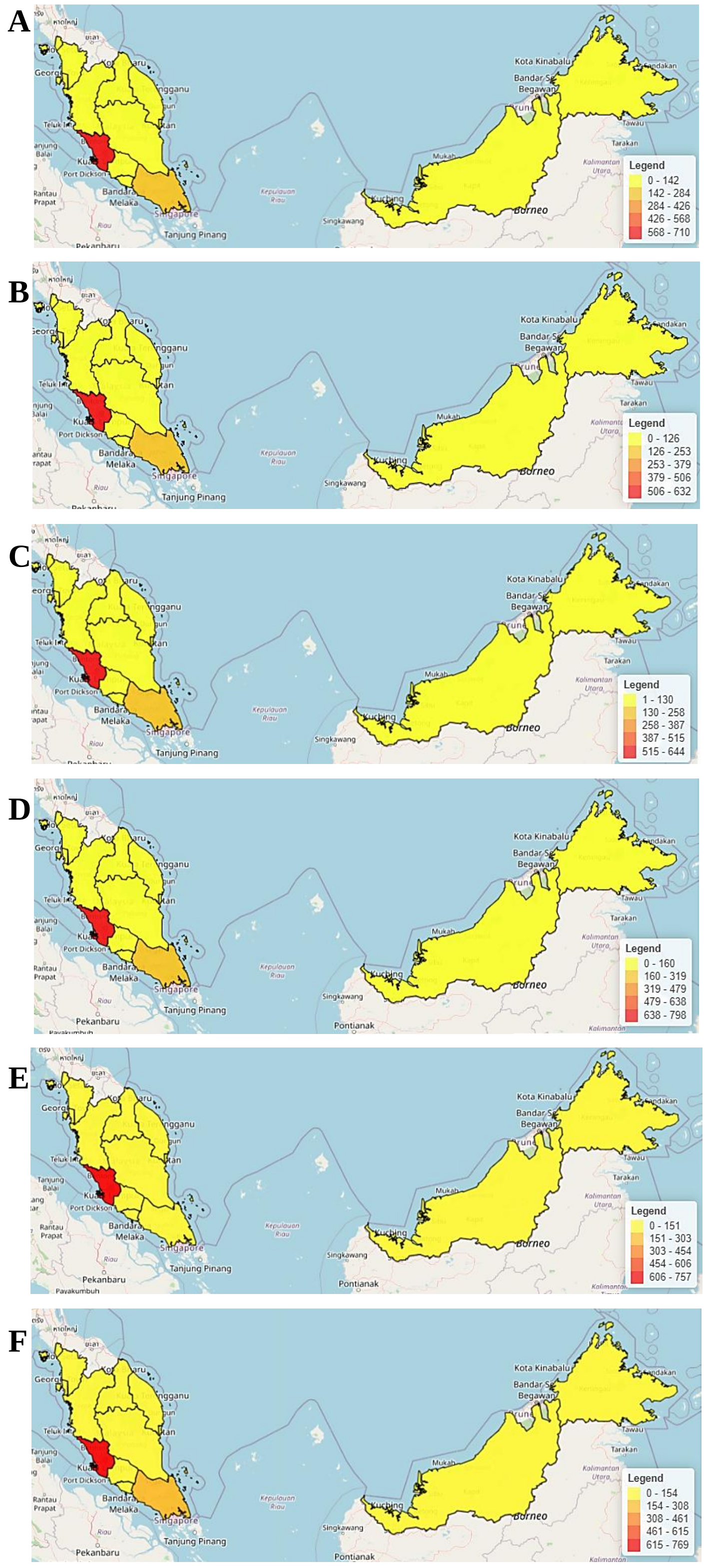

Figure II: Spatial mapping of dengue fever distribution during MCO and CMCO period by states, denoted with A, B, C, D, E, F portraying EW18, EW19, EW20, EW21, EW22, EW23 respectively

Subsequently, the results obtained in Table III is contrary to that of past papers who found MCO to have a positive effect on the dengue situation. Instead, it presented more cases of dengue. The number of dengue cases before and during CMCO (EW 18 and EW 19) implementation ranged from 0 to 710 cases and 0 to 632 cases respectively seemed like a decrease, but the total cases of dengue were more during this period. EW 19 recorded 1415 total cases, amounting to 1.44% increment from EW 18. Out of all the states and federal territories, Johor showed the most increase in the number of dengue cases, from 155 to 185 cases (i.e., 2.15%) followed by Sabah (i.e., from 40 to 57; i.e., 1.22%) and Melaka (i.e., from 25 to 39; i.e., 1.00%). By contrary, Selangor showed the highest decrease in the number of dengue cases, from 710 to 632 cases (i.e., -5.58%).

Following EW 20, the total dengue cases proceeded to show growth up to 1494 cases. In comparison to EW 18 where MCO took place, WP Kuala Lumpur demonstrated the highest increment as much as 3.66%. By contrast, the state with the most reduction in terms of variation of dengue cases was Selangor, with -4.73% drop from EW 18. Continuing to EW 21, the total dengue cases exhibited as much as 27.76% increase from EW 18. WP Kuala Lumpur remained to be the state with highest variation (7.89%), followed by Selangor (6.31%) where it rose to 798 cases. In EW 22, the progression of total dengue cases showed a slight decrease from EW 21 (from 1782 cases to 1625 cases). However, linking EW 22 with EW 18, the variation still proved an increment of 16.49% from the implementation of MCO. Finally, in EW 23, the total dengue cases increased most, reaching to 34.14% difference from EW 18.

Table III. Variation of daily dengue fever cases during MCO and CMCO that are divided into epidemiological weeks (EW).

States and Federal Territories	During MCO (EW 18) (a)	During CMCO (EW 19) (b)	During CMCO (EW 20) (c)	During CMCO (EW 21) (d)	During CMCO (EW 22) (e)	During CMCO (EW 23) (f)	Variation of DF cases									
							b – a	%	c – a	%	d – a	%	e – a	%	f – a	%
Johor	155	185	186	201	142	260	30	2.15	31	2.22	46	3.30	-13	-0.93	105	7.53
Kedah	9	4	11	15	18	15	-5	-0.36	2	0.14	6	0.43	9	0.65	6	0.43
Kelantan	34	43	36	59	30	49	9	0.65	2	0.14	25	1.79	-4	-0.29	15	1.08
Melaka	25	39	56	66	47	68	14	1.00	31	2.22	41	2.94	22	1.58	43	3.08
Negeri Sembilan	59	57	78	64	78	65	-2	-0.14	19	1.36	5	0.36	19	1.36	6	0.43
Pahang	39	48	50	42	42	43	9	0.65	11	0.79	3	0.22	3	0.22	4	0.29
Penang	6	2	6	13	20	18	-4	-0.29	0	0	7	0.50	14	1.00	12	0.86
Perak	70	82	71	105	88	100	12	0.86	1	0.07	35	2.51	18	1.29	30	2.15
Perlis	1	0	5	1	1	1	-1	-0.07	4	0.29	0	0	0	0	0	0
Sabah	40	57	51	44	58	61	17	1.22	11	0.79	4	0.29	18	1.29	21	1.51
Sarawak	17	24	20	27	23	21	7	0.50	3	0.22	10	0.72	6	0.43	4	0.29
Selangor	710	632	644	798	757	769	-78	-5.59	-66	-4.73	88	6.31	47	3.37	59	4.23
Terengganu	6	5	4	13	17	18	-1	-0.07	-2	-0.14	7	0.50	11	0.79	12	0.86
WP Kuala Lumpur	224	237	275	334	304	383	13	0.93	51	3.66	110	7.89	80	5.73	159	11.40
WP Labuan	0	0	1	0	0	0	0	0	1	0.07	0	0	0	0	0	0
Total	**1395**	**1415**	**1494**	**1782**	**1625**	**1871**	**20**	**1.44**	**99**	**7.1**	**387**	**27.76**	**230**	**16.49**	**476**	**34.14**

3.2 Evaluation of dengue fever pattern by states in Malaysia affected by COVID-19 Conditional Movement Control Order (CMCO)

The distribution of dengue fever in Malaysia during CMCO was further analysed by assessing the significance between movement control orders and dengue cases. This was carried out by the calculation of mean and a Wilcoxon signed-rank test. Considering that the outcome of the data did not assume normality, a dependent *t-test* is inappropriate. Therefore, a Wilcoxon signed-rank test is used to compare the overall cases of dengue that occurred during CMCO with the prevalence during MCO.

As seen in Table IV, the mean calculation of all the dengue cases were calculated before further analysis was carried out in order to evaluate the distribution of dengue cases by districts in the states. From the table, it was observed that dengue cases showed an increasing trend. During MCO, the total mean of cases was calculated to be 354.4. Progressing to CMCO, the numbers show an increment on all the epidemiological weeks. The highest mean throughout this CMCO period was recorded on the final week of CMCO which was EW 23, amounting to 555.83 mean cases. To add on, the results also showed the mean difference where the mean calculations from all CMCO are respectively subtracted to the dengue cases in MCO. By doing so, the difference between CMCO and MCO get to be observed and evaluated more specifically. From the results, the highest mean difference was observed on CMCO EW 23, where it demonstrated a difference of 201.43 with MCO EW 18.

Table IV. Mean calculation of all dengue cases and its differences

States and Federal Territories	Mean							Mean difference				
	During MCO EW 18 (a)	**During CMCO EW 19 (b)**	**During CMCO EW 20 (c)**	**During CMCO EW 21 (d)**	**During CMCO EW 22 (e)**	**During CMCO EW 23 (f)**	**Total mean**	**b – a**	**c – a**	**d – a**	**e – a**	**f – a**
Johor	15.50	18.50	18.60	20.10	14.20	26.00	112.90	3.00	3.10	4.60	-1.30	10.50
Kedah	0.75	0.33	0.92	1.25	1.50	1.25	6.00	-0.42	0.17	0.50	0.75	0.50
Kelantan	3.40	4.30	3.60	5.90	3.00	4.90	25.10	0.90	0.20	2.50	-0.40	1.50
Melaka	8.33	13.0	18.67	22.0	15.67	22.67	100.34	4.68	10.34	13.67	7.34	14.34
Negeri Sembilan	8.43	8.14	11.14	9.14	11.14	9.29	57.28	-0.29	2.71	0.71	2.71	0.86
Pahang	3.55	4.36	4.55	3.82	3.82	3.91	24.01	0.81	1.00	0.27	0.27	0.36
Penang	1.20	0.40	1.20	2.60	4.00	3.60	13.00	-0.80	0.00	1.40	2.80	2.40
Perak	6.36	7.45	6.46	9.55	8.00	9.10	46.92	1.09	0.10	3.19	1.64	2.74
Perlis	1.00	0.00	5.00	1.00	1.00	1.00	9.00	-1.00	4.00	0.00	0.00	0.00
Sabah	1.60	2.28	2.04	1.76	2.32	2.44	12.44	0.68	0.44	0.16	0.72	0.84
Sarawak	0.53	0.75	0.63	0.84	0.72	0.66	4.13	0.22	0.10	0.31	0.19	0.13
Selangor	78.89	70.22	71.56	88.67	84.11	85.44	478.89	-8.67	-7.33	9.78	5.22	6.55
Terengganu	0.86	0.71	0.57	1.86	2.43	2.57	9.00	-0.15	-0.29	1.00	1.57	1.71
WP Kuala Lumpur	224.00	237.00	275.00	334.00	304.00	383.00	1757.00	13	51.00	110.00	80.00	159.00
WP Labuan	0.00	0.00	1.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	0.00	0.00
Total	**354.4**	**367.44**	**420.94**	**502.49**	**455.91**	**555.83**	**2657.01**	**13.05**	**66.54**	**148.09**	**101.51**	**201.43**

Moving on to Table V, the Wilcoxon signed-ranked showed that the implementation of CMCO and number of dengue cases was fluctuating when calculated (b – a; p=0.14, c – a; p=0.30, d – a; p=0.001, e – a; p=0.009, f – a; p= 0.001). In addition, the lowest and highest 95% Confidence Interval (CI) for lower and upper levels respectively were demonstrated was in phase (f – a) at -56.71, and phase (b – a) at 11.92. With this wide interval, the corresponding relationship between implementation of CMCO and number of dengue cases was not statistically significant.

Table V. Wilcoxon signed-rank test of dengue distribution of CMCO compared to MCO

Phases	**Mean difference**	**Z (p-value)**	**95% Confidence Interval**	
			Lower	**Upper**
(b – a)	13.05	0.14	-14.58	11.92
(c – a)	66.54	0.30	-20.54	7.33
(d – a)	148.09	0.001	-44.40	-7.20
(e – a)	101.51	0.009	-27.90	-2.77
(f – a)	201.43	0.001	-56.71	-6.75

Nonparametric test equivalent to the dependent *t-test*

4.0 DISCUSSION

In contrast to earlier findings, these results differ from past studies that found the dengue cases decreased as lockdown was executed by the government (Lim et al., 2020; Ong et al., 2020). A possible explanation for this might be that the past papers were studying the relationship between implementation of MCO and its effects on dengue, whereas this present study focuses on the implementation of CMCO, a conditional lockdown with more flexibilities and less restrictions. Nonetheless, other factors such as environmental parameters, local meteorology, population size, and duration of each lockdown must also be determined to understand the correlation with dengue cases.

This present study raises the possibility of CMCO being more flexible and allowing human movement has indirectly prompted the spread of dengue virus after successfully decreasing it in the early stages of MCO. From the results, the highest cases of dengue were recorded during CMCO EW 23, which was 1871 cases. While still prohibiting the mass movement and the gathering of people, citizens were allowed to travel for work and essential purposes, dine in restaurants and few other activities provided that social distancing is practiced at all times. It can therefore be assumed that the increase in human movement causes a risk of spreading the dengue virus of infected persons, and hence indirectly escalating the number of dengue cases. This finding was also reported by a study that claimed human mobility increases the spread of infection, not only by increasing the final size of epidemic, but also increasing the speed of propagation and changing the morphology of the epidemic outbreaks (Barmak et al., 2016). Additionally, mobility of individuals already infected with dengue virus can create multiple dengue waves (Enduri & Jolad, 2018).

Not only that, but vector-control measures such as search and destroy, fogging, larvicidal spraying and such were not able to be carried out routinely in the period of CMCO. From the evaluation of the mean difference calculated from this research, the distribution of dengue cases by districts in the state showed an increasing trend. The highest mean calculation throughout CMCO was recorded on EW 23, where it showed a difference of 201.43 with MCO EW 18. This is supported by a study that found density of *Aedes* mosquitoes to be drastically increased during the lockdown due to the paused dengue vector control programs (Daniel Reegan et al., 2020). Generally, vector control is the primary public health intervention for dengue in countries like Malaysia, Thailand, and Singapore. With similar climate properties and urbanisation demographics, low-rise residential buildings with denser drainage networks would increase the breeding habitats of dengue vectors. Moreover, it was found that 60% of dengue cases come from the same transmission chain, which makes residential areas a focal point of dengue outbreaks (Lim et al., 2020).

Another significant factor of the rising dengue cases despite the implementation of CMCO is the dengue trend itself. While MCO and CMCO implementations have proven to be effective in controlling the spread of COVID-19, it does not help in combatting dengue. Over the past decade, it is predictable that dengue will continue to peak in the wet weather during monsoon season. Furthermore, dengue cases around EW 18 to EW 23 have showed a consistent increasing trend since 2010 (Pang & Loh, 2016). Hence, it could be hypothesised that the incidence and prevalence of dengue would continue to increase during this time of the year, despite any restriction on human movement.

One of the limitations with this paper is the lack of previous research studies on the topic. COVID-19 is a recent and on-going pandemic, hence finding a foundation for the research question being investigated is challenging. There is less research studies to cite and refer to, and so there is a need for further development in this area of study. Next, there was limited access to the data needed in this paper, which is dengue cases. As this research involved JKN and MOH, obtaining the complete set of dengue cases that occurred during the entire period of lockdown was not available. Nonetheless, the findings obtained are still reliable and valid despite this limitation, as the data for CMCO was available and obtained from the official website of MOH.

In spite of its limitations, this study adds to the understanding of the variation in trend and pattern of dengue cases during the implementation of CMCO in Malaysia. The results have indicated that during the 35 days of CMCO, the trend of dengue cases showed a constant increase from MCO. Even so, is it unlikely that such connections exist between the implementation of CMCO to the rising cases of dengue. The combination of findings from the Wilcoxon signed-rank test to investigate the relationship between MCO and CMCO with dengue were not very encouraging. The present results were only partially significant and did not convince that there was a relationship between the variables. Therefore, future research to study the impact of CMCO on dengue distribution is not necessary.

5.0 CONCLUSION

The purpose of this current study was to determine the impact of CMCO on dengue distribution in Malaysia. One of the more significant findings to emerge is that number of new dengue cases declined during the early stage of the MCO but started to increase during the latter stages of the MCO leading to CMCO as well. These findings suggest that in general, an endemic like dengue should not be forgotten amidst a global pandemic like COVID-19. Authorities like the MOH shall formulate effective measures to curb the spread of dengue together with the ongoing coronavirus. Moreover, this present study adds to the growing body of research about COVID-19 and its effects to the public health. This new understanding should help to improve predictions of the impact of a global pandemic to our everyday endemic issues, like dengue. Nevertheless, the major limitation of this study is the absence of data on dengue cases after the implementation of CMCO. This has caused a strain in analysing the complete impacts of the movement control order in conditions of before, during, and after its implementation. In spite of the limitation, this study still offers some insight into CMCO and how it has affected Malaysia. To develop a full picture of the relationship between CMCO and dengue, other variables such as environmental parameters and entomological issues will need to be undertaken.

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