Air Quality Status During Pandemic Covid19 in Urban and Sub-Urban Area in Malaysia

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Abstract. This paper discussed the API status in the urban and sub-urban cities in Malaysia before, during and after Movement Control Order (MCO) was implemented in year the 2020. The lockdown implemented worldwide including Malaysia has come as a respite to the environment, especially in air pollutant levels. 2 cities have been chosen in this study that is Kangar (suburban) and Cheras (urban). The Air Pollutant Index (API) data recorded on an hourly basis throughout different series of national lockdown phases was obtained from the Malaysian Air Pollutant Index website. The findings show that the API status quality in sub-urban does not change much compare to the urban area. But it can be seen that the API reduces during MCO implementation in the sub-urban and urban areas. This is because, during the MCO, there are several restrictions on mass movement and gatherings, and the closure of educational institutions, government and private agencies (except for essential services). This MCO restriction reduced the traffic density, industrial activities, and other social activities.

1. Introduction

Coronavirus Disease 2019 (COVID-19) is caused by a novel coronavirus (SARS-CoV-2) previously known as 2019 novel coronavirus (2019-nCoV) [1]. In late December 2019, the epidemic began in Wuhan, Hubei Province, People's Republic of China [2]. Human activities were disrupted by the COVID-19 pandemic, particularly when the Movement Control Order (MCO) was deployed to break the chain of infection among the world's population. On January 25, 2020, the first COVID-19 incidence was discovered in Malaysia (Ministry of Health Malaysia)[3]. Since then, the number of cases has continued to rise, particularly in March 2020.

The rising COVID-19 outbreak in Malaysia has prompted the implementation of a surveillance system to detect cases as soon as possible, as well as swift diagnosis, case isolation and rigorous tracking, and quarantining close contacts of people who have tested positive for COVID-19. The Malaysian government has announced the implementation of a Movement Control Order (MCO) in order to isolate the COVID-19 outbreak's source. Several activities, including conducting business, are prohibited under MCO, except for vital services (Malaysian National Security Council (NSC)[4]. Traffic density and industrial pollutants have decreased as a result of people working from home and some companies being stopped. Vehicles, industrial pollutants, and open burning are all sources of air pollution in Malaysia [5-6].

The Air Pollutant Index (API) of six criterion pollutants is used to determine air quality, with fine particulate matter being the most prevalent pollutant in Malaysia (PM2.5). Instead of using actual concentrations of air pollutants, the API is designed in easily understandable ranges of values as a
method of reporting air quality. This indicator also shows its impact on human health, ranging from good to hazardous, and can be classified according to the National Haze Action Plan's action requirements. The Malaysian API system closely resembles the United States Environmental Protection Agency's (US-EPA) Pollutant Standard Index (PSI).

The sub-index values (for all five air pollutants included in the API System) were generated based on the average concentration determined to determine the API for a given time. The API was chosen as the highest sub-index of all five pollutants, and the exactly responsible air pollutants for the API value must be given in order to identify the applicable health effect category and actions to be done. Figure 1 shows the process flow diagram for determining API value at a particular time.

![Figure 1. Flow chart for calculating API value.](image)

Previous research looked into lockdown effects on air pollution concentrations [7-12], air pollution relationships with COVID-19 cases [13-15]. Therefore, in this study, the researchers will evaluate the changes in air quality status during, before and after MCO in Malaysia.

2. Methodology

2.1. Study area

Two large cities in Malaysia were chosen for this study, each representing a different group of urban and suburban areas. The cities were chosen based on the data available data and the locations of each cities are far from each other. Besides, the activities between these two cities are also dissimilar. Cheras, Kuala Lumpur (urban) and Kangar, Perlis were the cities (sub-urban). Cheras, a suburb of Kuala Lumpur, is recognised for its rapid economic development. It also has a high population and traffic density, so one of the key interests is looking into the impacts of reducing the number of vehicles on the roadways during the MCO. Meanwhile, Kangar is the state capital and largest town in the Malaysian state of Perlis. It has a population of 48,898 people and covers an area of 2,619.4 ha. It is situated near the Thai border on Peninsular Malaysia's northernmost tip. The town also serves as a hub for the neighbouring district's paddy rice production. The town is Malaysia's tiniest state capital, with a population of primary farmers and public officials. Cement, sawmills, rubber, paper, and sugar and prawn processing are among its industries.
The locations of the selected cities in this study are shown in Figure 2.

![Image](http://example.com/image.jpg)

**Figure 2.** The location of Kangar and Cheras in Peninsular Malaysia.

### 2.2. Data collection

In Malaysia, the air quality is managed by the Department of Environment under the Ministry of Environment and Water. Malaysia added PM$_{2.5}$ to its Air Pollution Index calculation in August 2018, meaning the index is now based on the average concentrations of six air pollutants: PM$_{2.5}$, PM10, sulphur dioxide, nitrogen dioxide, carbon monoxide, and ozone.

The Air Pollution Index (API) is a measurement of air quality provided by Malaysia's Department of Environment (DOE)\cite{16}. The data for the Air Pollutant Index (API) was obtained from the Malaysian Air Pollutant Index website (available at http://apiims.doe.gov.my/public_v2/home.html) on an hourly basis from 1 January 2020 to 31 December 2020 to determine the relative changes (%) of air quality. These data covered the air quality status before MCO (January to March 2020), MCO I (March – April 2020), MCO II (April 2020), MCO III (April – May 2020), CMCO (May – June 2020) and RMCO (June – December 2020). Overall, there are 0.02% of missing data and the missing data were omitted in this study.

### 2.3. Air pollution indicator

The air pollution indicator that uses as a reference in this study is the Air Pollution Index scale as defined by Malaysia's Department of Environment (DOE). Table 1 defines the Air Pollution Index scale as defined by Malaysia's Department of Environment (DOE).
Table 1. Comparison of API values with the level of population and health measures.

| API     | Status   | Level of Pollution                          | Health Measures                                                                 |
|---------|----------|---------------------------------------------|----------------------------------------------------------------------------------|
| 0 - 50  | Good     | Population low and has no ill effects on health | No restriction of activities for all groups of people                              |
|         |          |                                              | To practice a healthy lifestyle e.g. not to smoke, exercise regularly and observe proper nutrition |
| 51 - 100| Moderate | Moderate population and has no ill effects on health | No restriction of activities for all groups of people                              |
|         |          |                                              | To practice a healthy lifestyle e.g. not to smoke, exercise regularly and observe proper nutrition |
| 101 - 200| Unhealthy | Mild aggravation of symptoms among high-risk persons i.e. those with heart or lung disease | Restriction of outdoor activities for high-risk persons                             |
|         |          |                                              | The general population should reduce vigorous outdoor activity                    |
| 201-300 | Very Unhealthy | Significant aggravation of symptoms and decreased exercise tolerance in person with heart or lung disease | Elderly and persons with known heart or lung disease should stay indoors and reduces physical activity |
|         |          |                                              | The general population should avoid vigorous outdoor activity                     |
|         |          |                                              | Those with any health problem to consult a doctor                                 |
| 301-500 | Hazardous | Severe aggravation of symptoms and endangers the health | Elderly and persons with existing health or lung disease should stay indoors and reduce physical activity |
|         |          |                                              | The general population should avoid vigorous outdoor activity                     |
| Above 500 | Emergency | Severe aggravation of symptoms and endangers the health | The general population advised to follow the orders of the National Security Council and always to follow the announcement through the mass media |

3. Results and Discussion

3.1. The trend of API before, during and after MCO
The API values of Kangar and Cheras are shown in Figure 3 and Figure 4. The value shows the hourly data measurement daily for 12 months (January to December 2020). For Kangar, there are 741 numbers of reading for January 2020 with 31% reading is more than 50 API (status: moderate) (n=744; API > 50 = 30.9%), February (n=696; API > 50 = 22.6%), March (n=744; API > 50 = 62.1%), April (n=720; API > 50 = 26.7%), May (n=744; API > 50 = 11.4%), June (n=720; API > 50 = 36.1%), July (n=720; API > 50 = 36.1%), August (n=744; API > 50 = 50.5%), September (n=720; API > 50 = 36.5%), October (n=744; API > 50 = 50.5%), November (n=720; API > 50 = 49.2%) and December (n=744; API > 50 = 41.7%). The results show that for 12 months, API reading for Kangar give “good” status for 11 months except 1 month that is on March give API status as “moderate”. 
Figure 3. API hourly data from January to December at Cheras (urban area) in the year 2020.
Figure 4. API hourly data from January to December at Kangar (sub-urban area) in the year 2020.
The API values of Kangar and Cheras are shown in Figure 5(a) and (b). The value shows the hourly data measurement daily for 12 months (January to December 2020). For Cheras, there are 741 numbers of reading for January 2020 with 31% reading is more than 50 API (status: moderate) (n=744; API > 50 = 80.1%), February (n=696; API > 50 = 65.2%), Mac (n=744; API > 50 = 86.0%), April (n= 720; API > 50 = 58.3%), May (n= 744; API > 50 = 74.1%), June (n= 720; API > 50 = 86.7%), July (n= 720; API > 50 = 86.0%), August (n= 744; API > 50 = 89.9%), September (n= 720; API > 50 = 70.4%), October (n= 744; API > 50 = 63.4%), November (n= 720; API > 50 = 56.4%) and December (n= 744; API > 50 = 67.6%). The results show that for 12 months, API reading for Cheras give “moderate” status for 12 months.

In Malaysia, the MCO included several restrictions on mass movement and gatherings, as well as restrictions on Malaysians travelling abroad, tourists and visitors’ entry, and the closure of educational institutions, government and private agencies (except for essential services) (Malaysian National Security Council (NSC), 2020). These restrictions decrease air pollution in Malaysia indirectly, but a more thorough analysis is needed to consider other contributing factors such as local meteorology and anthropogenic emissions.

Figure 5 shows the average daily value API for Kangar from January to December 2020. It can be seen that the API value in Kangar is under “good” status meanwhile the API value in Cheras is mostly under “moderate” status. According to Air Pollution Index scale as provided by Malaysia's Department of Environment (DOE), both status that does not pose any bad effect on health condition (no restriction of activities for all groups of people; and to practice healthy lifestyle e.g. not to smoke, exercise regularly and observe proper nutrition).

Figure 6 shows the monthly average API before (No MCO), during (MCO I, MCO II, MCO III and MCO IV) and after MCO (CMCO and/or RMCO) for Kangar and Cheras area. The duration of the before, during and after MCO is represented by the sections as shown in the figure.
In the sub-urban area, Kangar recorded 43 (January and February) of average API before MCO, 50, 42 and 37 (for March, April and May) during MCO I, during MCO II and MCO III. The API level however increased during CMCO (43.1) and RMCO (40, 49, 41, 42, 43 and 43 for July, August, September, October, November and December). Meanwhile, Cheras recorded 55 and 51 of average API before the implementation of MCO (on January and February), and further reduced to 56 (MCO I), 48 (MCO II) and 53 (MCO III) of average API. Once the country entering conditional and recovery MCO (CMCO and RMCO), the reading started to increase to 56 and 55, 58, 52, 51, 50 and 51 API, respectively.

It can be seen that before the MCO the API for Kangar was increasing from 42 to 50 (14.5%) but when the MCO was implemented, the API was slightly decreased to 36 (26.9%). The API increasing when the CMCO was implemented to 43 (16.3%) and the trend fluctuating from 49 to 43 API (16.3 – 4.7%) during RMCO until December 2020. Overall, the API for sub-urban Kangar is under “good” status.

4. Conclusion

The air quality status in sub-urban and urban areas was determined in this study. The findings show that in the sub-urban area (Kangar), the API does not change much. The lowest average monthly API at Kangar is 36 and the highest API is 50. This shows that the API status in Kangar is “good” for the year 2020. Meanwhile, the lowest API in Cheras (urban) is 47 and the highest API is 57. Out of 12 months API reading, only one month (April) give the API status as "good" and the other 11 months is "moderate". It can be seen that the API reduce during MCO implementation in the sub-urban and urban areas. This is because, during the MCO, there are several restrictions on mass movement and gatherings, and the closure of educational institutions, government and private agencies (except for essential services). This MCO restriction reduced the traffic density, industrial activities, and other social activities.

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