



## Correlation between weather and Covid-19 pandemic in Jakarta, Indonesia

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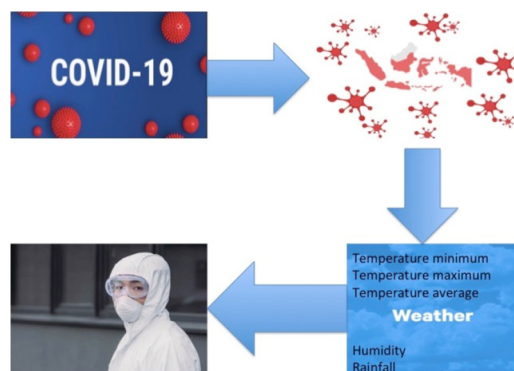
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### HIGHLIGHTS

- Covid-19 is a pandemic disease
- The weather factor is one of the factors that triggered the spread of Covid-19
- The spread of covid-19 in Indonesia is very fast, so the results of this study will be useful in efforts to prevent the spread of covid-19 disease

### GRAPHICAL ABSTRACT



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### ABSTRACT

This study aims to analyze the correlation between weather and covid-19 pandemic in Jakarta Indonesia. This study employed a secondary data analysis of surveillance data of covid-19 from the Ministry of Health of the Republic of Indonesia and weather from the Meteorological Department of the Republic of Indonesia. The components of weather include minimum temperature (°C), maximum temperature (°C), temperature average (°C), humidity (%), and amount of rainfall (mm). Spearman-rank correlation test was used for data analysis. Among the components of the weather, only temperature average (°C) was significantly correlated with covid-19 pandemic ( $r = 0.392$ ;  $p < .01$ ). The finding serves as an input to reduce the incidence rate of covid-19 in Indonesia.

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## 1. Introduction

World Health Organization (WHO) reported that there have been pneumonia cases in Wuhan City, Hubei Province, China (Zhu et al., 2019), but the etiology was unknown (Sohrabi et al., 2020). The case was developed very fast (Anderson et al., 2020), until January 7, 2020, the Chinese government said that pneumonia was a new type of coronavirus or covid-19 (Li et al., 2020).

Common signs and symptoms of covid-19 infection include symptoms of acute respiratory disorders such as fever, coughing and shortness of breath. The average incubation period is 5–6 days with the longest incubation period of 14 days. In severe cases, covid-19 can cause pneumonia, acute respiratory syndrome, kidney failure, and even death. The clinical signs and symptoms reported in the majority of cases are fever, with some cases having difficulty breathing, and X-rays show extensive pneumonia infiltrates in both lungs (Holshue et al., 2020; Perlman, 2020). The clinical symptoms of severe and critical patients with covid-19 are likely similar with the clinical symptoms of SARS and MERS (Wang et al., 2020b).

In Indonesia, on March 2, 2020, Indonesia has reported 2 confirmed cases of covid-19. As of March 29, 2020, it has increased to 1285 cases in 30 provinces. The five highest provinces in the covid-19 cases are Jakarta (675), West Java (149), Banten (106), East Java (90), and Central Java (63) (Kementerian Kesehatan Republik Indonesia, 2020). The increase in the number of cases took place quite quickly and there has been a spread between countries. In response to that, WHO set covid-19 as a pandemic (Cucinotta and Vanelli, 2020).

The extreme weather conditions that accompany long-term climate change may also contribute to the spread of the West Nile virus in the United States and Europe (Epstein, 2001). Certain climatic conditions can be considered as the top predictors of respiratory diseases such as SARS. Climate variables can also be a direct cause of biological interactions between SARS-CoV and humans. Optimal temperature, humidity, and wind speed are variables that can determine the survival and transmission of the SARS virus (Yuan et al., 2006). Changes in weather are very significantly correlated with changes in mortality rates due to pneumonia (Bull, 1980).

Viruses can be transmitted by being influenced by several factors, including climatic conditions (such as temperature and humidity), and population density (Dalziel et al., 2018). Research on climate change and covid-19 is still very limited so this research will contribute to efforts to prevent covid-19 disease.

## 2. Methods

### 2.1. Study area

Jakarta is the Capital of the Republic of Indonesia. Jakarta lies between 6° 12' South latitude and 106° 48' East longitude. The area of Jakarta consists of a land area of 662.33 km<sup>2</sup> and a sea area of 6977.5 km<sup>2</sup>. The population of Jakarta in 2017 based on projections of results of the 2010 Population Census population was 10,374,235 (Mawarni, 2019) inhabitants with the population growth rate of 0.94% per year.

### 2.2. Data collection

The computerized data set on daily covid-19 in Jakarta for the period of January – March 29, 2020 were obtained from the Ministry of Health of Republic of Indonesia, while the weather data for the period of February 2020 were obtained from the Meteorological Department of the Republic of Indonesia. The data consist of temperature minimum (°C), temperature maximum (°C), temperature average (°C), humidity (%), and amount of Rainfall (mm).

### 2.3. Data analysis

As data were not normally distributed, Spearman rank correlation test was used to examine the relationship between weather and daily covid-19.

## 3. Results and discussion

Fig. 1 shows that covid-19 that occurred in Jakarta experienced a rapid increase. The first finding numbered 177 cases, the next report found 40 cases, and on 29 March 2020 the total number of covid-19 cases numbered 678. With an average of 61 cases, the weather data showed temperature minimum of 24.6 °C (with the highest temperature minimum of 27.5 °C), the lowest maximum temperature of 28.6 °C (with the highest maximum temperature of 31.4 °C), the lowest average temperature of 26.1 °C (with the highest average temperature of 28.6 °C), the lowest humidity of 75% (with the highest humidity of 93%), and the lowest rainfall of 1.1 mm (with the highest of 88 mm).

Table 1 shows that, among five weather variables, only temperature average (°C) was significantly correlated with covid-19 ( $r = 0.392$ ;  $p < .001$ ), with medium level. Temperature minimum, temperature maximum, humidity, and rainfall were not significantly correlated with covid-19.

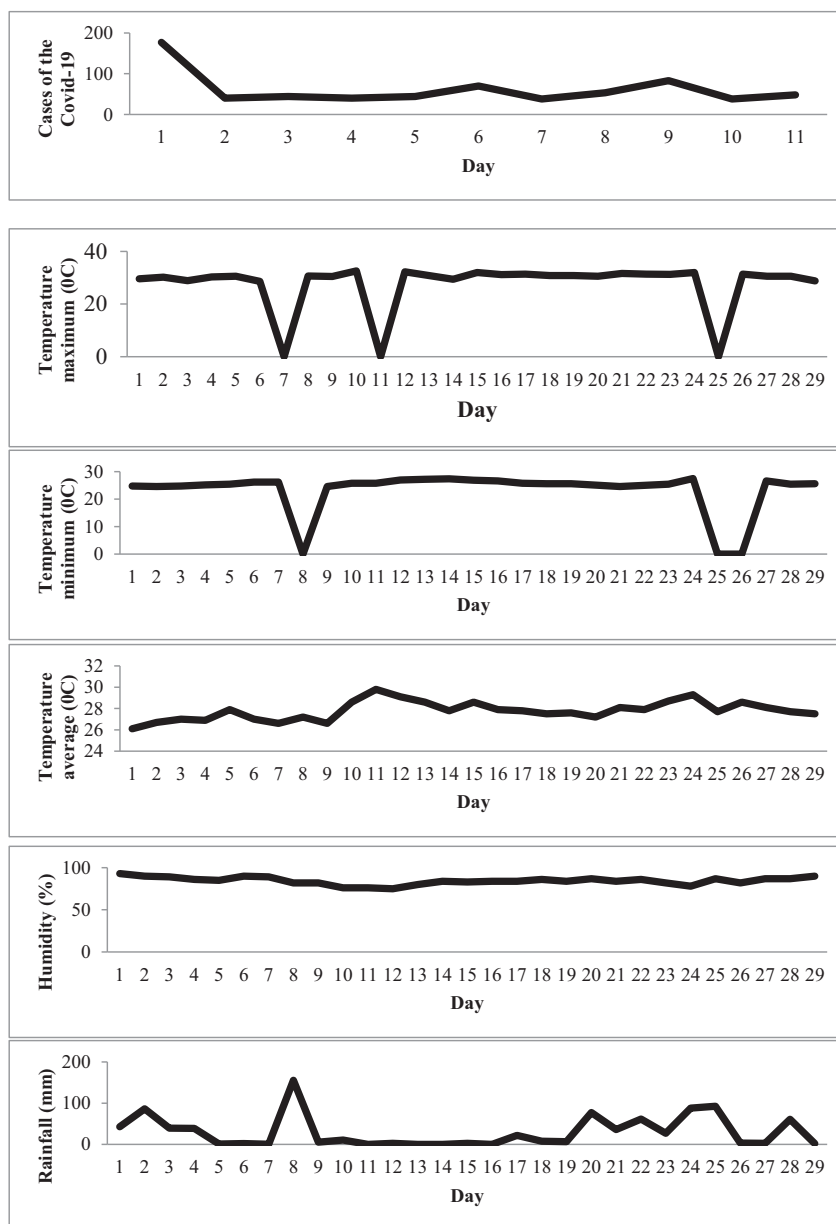
In this study, the pattern of climate change provides a picture of the occurrence of covid-19 in Jakarta. We found only temperature average was correlated with Covid-19, with the lowest average temperature of 26.1 °C and the highest temperature of 28.6 °C. This correlation is in line with previous research that shows the relationship between weather transmission and Syncytial Virus Respiration (RSV) (Vandini et al., 2013), SARS (Tan et al., 2005). Temperature is also the environmental driver of the covid-19 outbreak in China (Shi et al., 2020). The regression equation shows how temperature, relative humidity, and wind speed affected SARS transmission (Yuan et al., 2006).

In spite of the weather, the high covid-19 cases in Jakarta is also caused by the very high mobility of the people. As the capital city of Indonesia, Jakarta is the main economic destination for job seekers who come from various regions in Indonesia. Jakarta's population density is also very high and this allows covid-19 transmission to be very fast.

Another cause is that Jakarta is a very densely populated area. The majority of the population is residents from outside Jakarta, generally they choose the location of residence in the area because of the affordable price factor (Fitria and Setiawan, 2014). According to the results of the last national census, Jakarta is inhabited by almost 9.6 million people, exceeding the projected population of 9.2 million for 2025. Jakarta's population is 4% of the country's total population, 237.6 million people (Widiarso, n.d.). This means Jakarta's population has grown 4.4% over the past 10 years, up from 8.3 million in 2000 (Surjadi and Surja, 2019). With population growth like this allows covid-19 to spread rapidly (Zu et al., 2020).

In China, Wang et al. (2020a) found that temperature and relative humidity have a strong influence on the  $R$  value, with a significant level of 1% for both. Temperature and humidity have a significant and consistent distribution of seasonal behavior of respiratory viruses (Sajadi et al., 2020). Meteorological variables can predict worldwide outbreaks with high correlations ( $r^2 > 0.6$ ) with real data (Chen et al., 2020). In Wuhan, covid-19 transmission is very important to be associated with transmission, there is a correlation between weather and disease spread, and weather factors will suppress disease when the weather warms up (Guo et al., n.d.).

Meteorological factors such as humidity, visibility, and wind speed can affect environmental stability, or affect the viability of viruses. As well as air temperatures have an impact on the transmission of the epidemic. Besides, absolute air temperature and humidity have been indicated to significantly affect covid-19 transmission (Chen et al., 2020). Temperature and humidity variations may be important factors that



**Fig. 1.** (a) Cases of the Covid-19, (b) the amount of temperature maximum (°C), (c) temperature minimum (°C), (d) temperature average (°C), (e) humidity (%), and (f) rainfall (mm) in Jakarta Indonesia from January to March 29, 2020.

influence covid-19 mortality (Ma et al., 2020). There is a correlation between the spread of covid-19 on temperature and climate latitude (Poole, 2020).

Despite the significant finding of the weather on covid-19, this study has limitations: First, as the disease is caused by the virus, many factors are needed to be investigated such as virus resistance, population

mobility, and population endurance. Second, individual health factors such as hand washing habits, personal hygiene, and use of hand sanitizers may be the other related factors of covid-19 that are necessary to be explored. However, this study is just the preliminary analysis. The strong conclusion requires time and a long data set.

#### 4. Conclusion

The weather is an important factor in determining the incidence rate of covid-19 in Jakarta. Temperature average was significantly correlated with covid-19. Our findings can be used as an input in suppressing covid-19 disease in Indonesia.

#### Declaration of conflicts of interest

The authors declared that they have no conflict of interests.

**Table 1**

Spearman correlation coefficients between covid-19 and weather variables.

Weather variables	Spearman correlation coefficient
Temperature minimum/Tn (°C)	.128
Temperature maximum/Tx (°C)	0.238
Temperature average/Tavg (°C)	0.392*
Humidity (%)	0.002
Rainfall (mm)	0.139

\* Correlation is significant at the 0.01 level (2-tailed).

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