CORELATION BETWEEN CLIMATE AND COVID-19 IN GORONTALO, INDONESIA

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ABSTRACT
Introduction: Conditions of climatology vary according to the countries affected by the pandemic. Changes in weather are highly correlated with changes in pneumonia mortality rates. On July 18, 2022, the number of COVID-19 cases in Gorontalo reached 13,907. The purpose of this research is to study into the relationship between climate and the COVID-19 pandemic in Gorontalo Province, Indonesia. It used secondary data analysis of COVID-19 monitoring data from COVID-19 Handling Task Force and climate data from the Republic of Indonesia's Meteorological Department in Gorontalo. The components of climate include average of temperature (°C), humidity (%), rainfall (mm), wind speed (m/s), and sun exposure (hours). **Method:** Correlation tests and regression analysis were used to investigate the relationship between COVID-19 cases and climatological data. **Result and Discussions:** In Gorontalo, there is no correlation between climate and the COVID-19 cases. As a result, non-meteorological factors appear to play a more prominent role and should be given greater consideration in preventing COVID-19 spread.

INTRODUCTION

Since the 1918 flu pandemic, the human coronavirus disease Covid-19 has become the fifth pandemic to be reported. Covid-19 was first discovered in Wuhan, China, and quickly spread over the worldwide (1). In late December 2019, numerous local health facilities reported a cluster of pneumonia patients in Wuhan, Hubei Province, China, whose source was unknown epidemiologically linked to a wholesale market for seafood and wet animals (2). On 12 January 2020, the World Health Organization (WHO) called the new virus 2019 novel coronavirus (2019-nCoV), and on 12 February 2020, the infectious disease was formally named coronavirus disease 2019 (COVID-19) (3). The COVID-19 highly contagious pandemic has had a significant impact on the planet and has affected our way of life. Covid-19 has been confirmed in two cases in Indonesia as of March 2, 2020. It has already grown to 6,134,953 cases in 34 provinces as of July 7th, 2022. Jakarta (1,291,984 or 21.1%), West Java (1,120,567 or 18.3%), Central Java (629,048 or 10.3%), East Java (580,723 or 9.5%), and Banten (302,410 or 4.9%) are the five provinces with the highest covid-19 incidences (4).

Viruses are spread by a variety of circumstances, including climatic conditions (such as temperature and humidity), as well as population density (5). Extreme weather events associated with long-term climate change can also contribute to the spread of some viruses in various regions (6). On April 10, 2020, the Covid-19 incidents in Gorontalo Province were confirmed and the number of it instances continues to increase, reaching 13,907 (0.2%) cases in July, 18, 2022 (4). Certain climatic conditions are strong predictors of respiratory diseases like SARS. Climate variables may also be a direct cause of SARS-CoV-human interactions. temperature, humidity, solar radiation, wind speed, and rainfall are all variables that can affect the survival and spread of the SARS virus (7). Bourouiba (2020) in (8) found that droplets from human exhalation sneeze may go up to 7–8 m when the height exhalation speed was between 10–30 m/s. The contacts of virus particles/droplets from an individual's sneeze with ambient flow turbulence (e.g., the turbulent transport of and contact with virus droplets) may play a critical role in virus transmission (9). One of the transport phenomena is mass movement between droplets and the surrounding air, which is currently being researched (10). It also demonstrates that in China, the Covid-19 virus is discovered in the hospital ventilation system and in the hospital rooms of Covid-19-infected patients (11). The influence of temperature and humidity on Covid-19 survival and transmission was found to be quite homogeneous (12).

The goal of this research is to look at the correlation between climate and the Covid-19 pandemic in Indonesia's Gorontalo Province. Because there is still a lack of research on climate change and Covid-19, this study will aid in the prevention of the condition.

METHODOLOGY

Study Area

Based on the geographical location of Indonesia, it is between 0° 19' – 0° 57' North Latitude and 121° 23' – 125° 14' East Longitude. This province shares straight borders with two other provinces in terms of area. The Gorontalo has an area of 11,257 km² and a population of 1,166 million people in 2019. The Gorontalo is divided into five regencies and one city. Boalemo Regency, Gorontalo, Pohuwato, Bone Bolango, North Gorontalo , and Gorontalo City are just a few of them (13). The weather is tropical, with high temperatures in the summer (humid air), mild temperatures during the rainy season (dry air), sunshine all year round, and high rainfall.

Data Collection

The Gorontalo Provincial Health Office provided daily data on COVID-19 in Gorontalo for the period January to December 2021, while Djalaluddin Meteorological Station provided climatic data for the same time. The data consists of temperature (°C), humidity (%), amount of rainfall (mm), wind speed (m/s) and duration of sun exposure (hours).

Data Analysis

Graph/time-trend analysis is performed to show the pattern of graphic relationship between variables temperature, humidity, rainfall, wind speed and sun exposure with covid-19 cases in Gorontalo since January – December 2021.

The Spearman rank correlation test was performed to investigate the link between daily climate and daily Covid19 in Gorontalo Province using data that were non-normal distribution.

RESULT AND DISCUSSION

The Covid-19 found in Gorontalo has increased at a high rate, as seen in Fig. 1, but over time the Covid-19 cases in Gorontalo show a decrease in cases. The first discovery was 1 case on April 10, 2020, the next report found 231 cases in August, 16th, 2021 and this is the highest daily case in the Gorontalo province. The average value of Covid-19 from January to December , 2021 in Gorontalo is 21 cases with a minimum value of 0 and a

maximum value 231 cases. The average temperature is 27.24^{o}C with a minimum value 24.2 ^{o}C and a maximum value 29.7 ^{o}C. The average of humidity is 84.6% with a minimum value 69% and a maximum 98%. The average value of rainfall is 2.81 mm with a min. value 0 mm and a max value 32.8 mm. the average wind speed value is 1.55 km with a min value 1km and a max 4 km. Meanwhile, the average sun exposure in Gorontalo is 5.89/hours with a min. value of 0/hours and a max value 11/hours.

Monami, et al (2020) published a study in (12), the potential impact of climate on the Novel Corona Virus (Covid-19) epidemic, which found that the number of new cases in Hubei is decreasing as the average daily temperature rises. The convincing case that weather has an impact on Covid-19 may be broken down into three parts: (1) experimental evidence of SARS-CoV-2 persistence on surfaces or in air that is sensitive to temperature, humidity, and ultraviolet rays; (2) other environmentally sensitive respiratory viruses are resistant and more common in the winter; and (3) climate effects can protect space (hot, dry places may have less transmission) and time (summer may see a decrease in transmission compared to winter) (14).

According to Nasir,et al (2020) in (15), Covid-19 would stop in Indonesia's climate, according to 13.2% of respondents, whereas Covid-19 is a biological weapon purposefully manufactured by another country, according to 27.7%. Meanwhile, 19.6% thought gargling with salt water or vinegar would destroy the Covid-19 virus. The majority of respondents were under 25 years old (n = 342, 64.5%) and had completed junior/senior high school (n = 277, 52.3%).

Table 1 summarizes that none of the five meteorological factors in Gorontalo Province were significantly correlated with covid-19 (temperature p value=0.92, humidity p value=0.17, rainfall p value=0.71, wind speed p value=0.85 and sun exposure p value=0.32). The research findings contradict those of a study in Jakarta conducted by Tosepu, et al (2020) in (6), Indonesia in 2020, which found that among five meteorological variables, one (average temperature) was substantially connected to Covid-19 incidence ($r=0.392$; $p<0.001$). The study just illustrates the potential impacts of ambient temperature and relative humidity on virus-carrying droplets. According to Chen 2020 in (16), there are impacts on virus carriers caused by environmental temperature and humidity.

Positive patients covid-19 in Gorontalo is confirmed by the results of the test swab which takes several days, in addition to signs of illness after exposure to the corona virus takes more than 3 days to show clinical symptoms such as fever, cough and shortness of breath, so in this study uses data climate 1 day before and 2 days before, but still not significant result was obtained between climate and covid-19 incidence in Gorontalo. Seasonal transmission of influenza, the common cold, and other respiratory illnesses is linked to fluctuations in temperature, humidity, and sun radiation. Seasonal epidemics, on the other hand, are a result of a virus's transmissibility, a population's initial vulnerability, and the degree and nature of immunity imparted by infections. Stable "oscillations," such as seasonal epidemic waves, usually necessitate some level of immunity in basic epidemiological models (14).

Despite the fact that no significant climate conditions were found on COVID-19, this study has some limitations: First, because the sickness is produced by a virus, a variety of characteristics must be explored, including virus resistance, population mobility, density, and endurance. Second, personal hygiene factors such as hand washing behaviors and the usage of hand sanitizer may be associated Covid-19 factors that should be investigated further. This research, however, is simply a preliminary examination. Strong conclusions necessitate time and a large amount of data.

CONCLUSIONS

Climate is an important aspect to consider when evaluating the rate of Covid-19 in Gorontalo, even though there is no correlation between the incidence of Covid-19 and the climate in Gorontalo Province in this study. Our results can be used to help Indonesia manage the Covid-19 disease.

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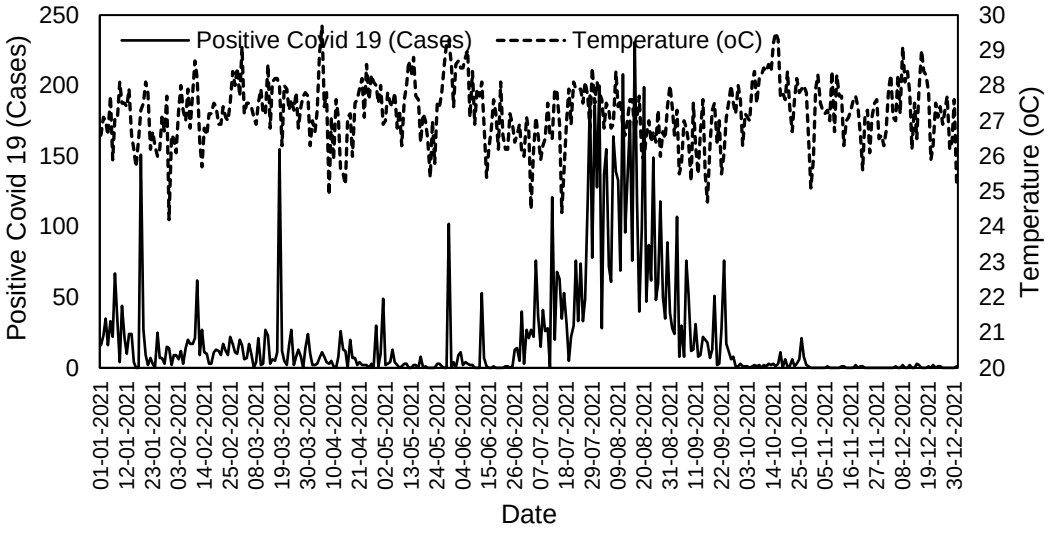
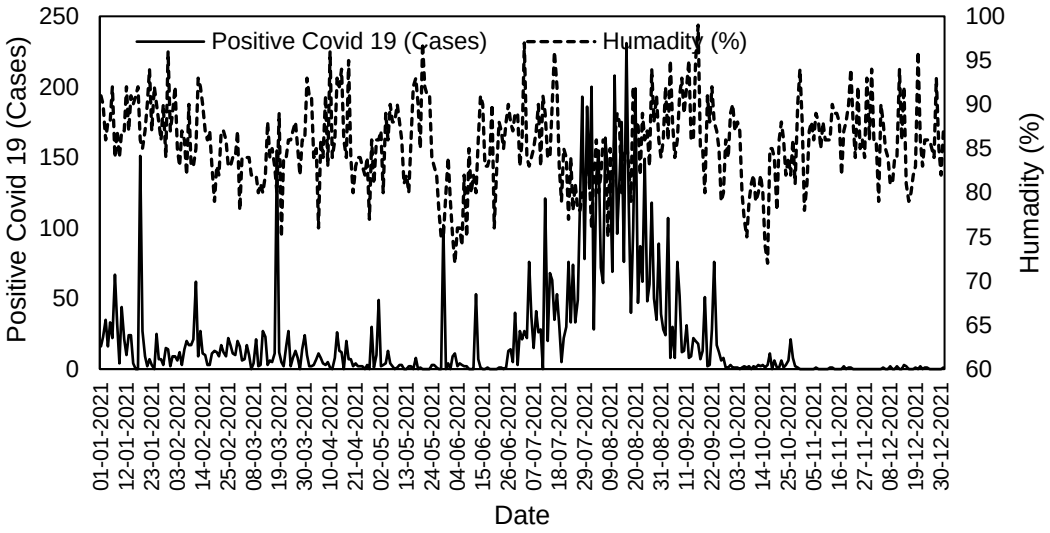
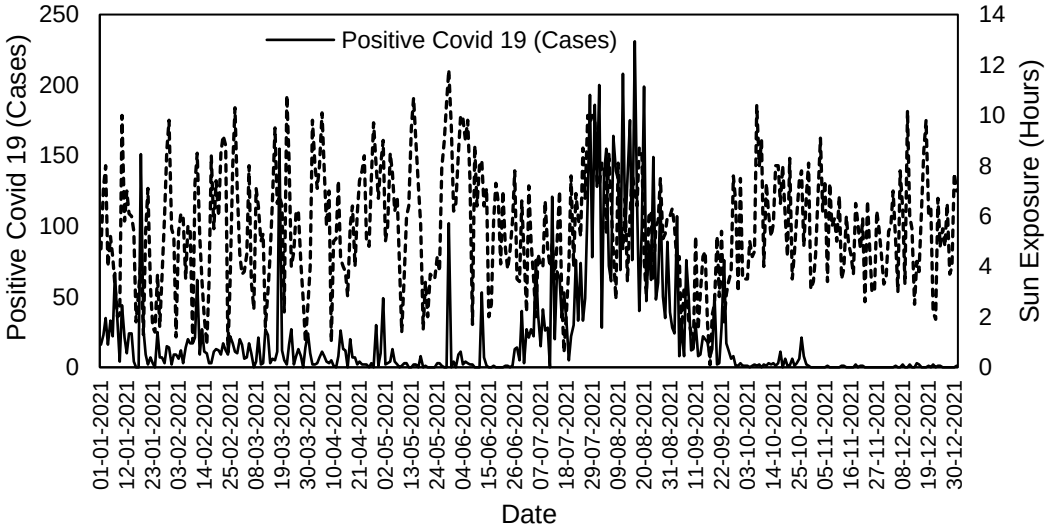

Positive Covid 19 (Cases)
Temperature (oC)
Positive Covid 19 (Cases)
Temperature (oC)
Date


Positive Covid 19 (Cases)
Humadity (%)
Positive Covid 19 (Cases)
Humadity (%)
Date


Positive Covid 19 (Cases)
Positive Covid 19 (Cases)
Sun Exposure (Hours)
Date

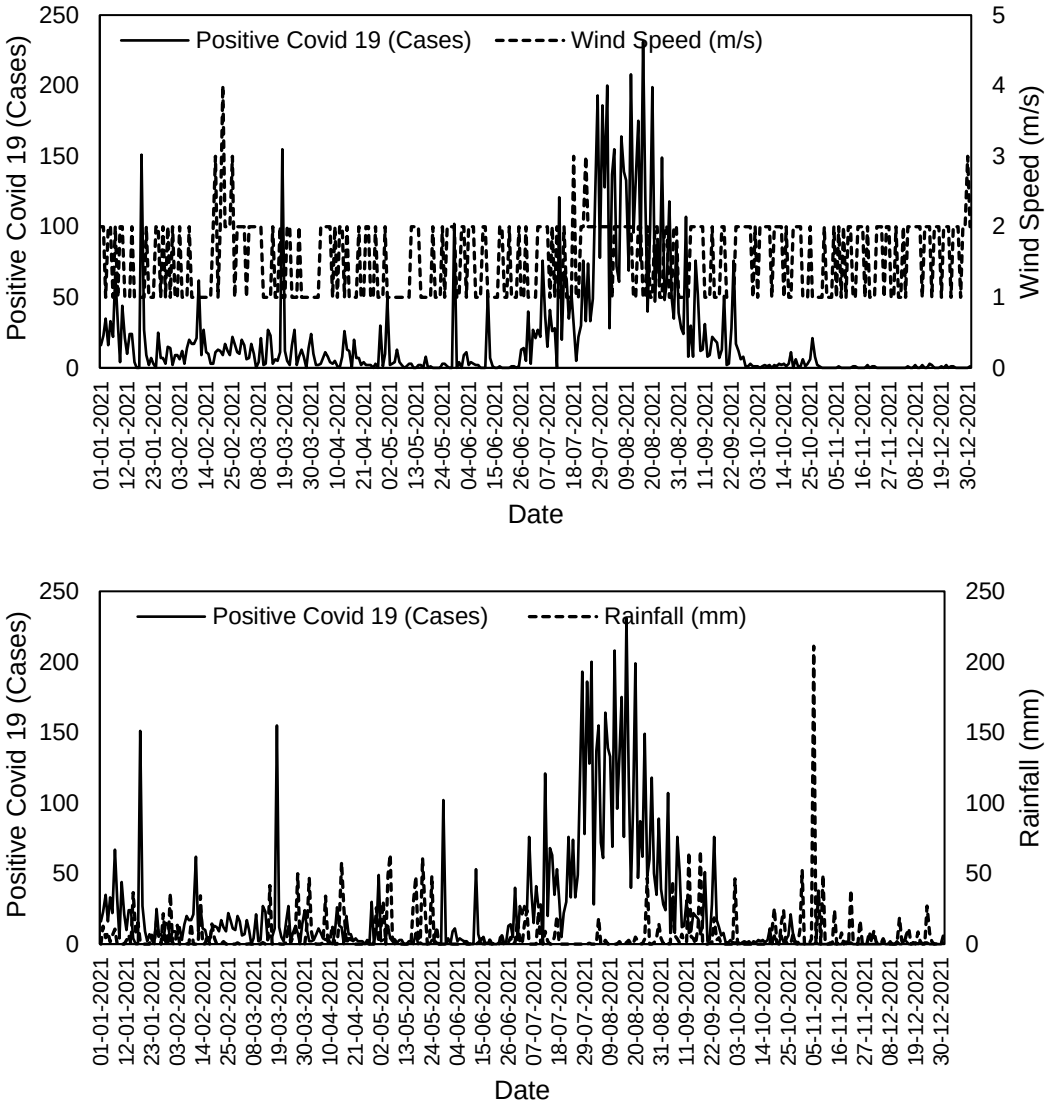


Figure 1. Graph *Time Series* Between Covid-19 Cases and Climatology Parameters

Tabel 1.
Spearman Correlation coefficient between covid-19 and climate variables

Climate variables	**r**	**Spearman correlation coefficient**
Temperature (^oC)	0.0107	0.92
Temperature day -1 (^oC)	-0.1070	0.32
Temperature day -2 (^oC)	-0.0222	0.83
Humidity (%)	-0.1458	0.17
Humidity day -1 (%)	0.0032	0.97
Humidity day -2	-0.0622	0.56
Rainfall (mm)	-0.0397	0.71
Rainfall day -1 (mm)	-0.1208	0.26
Rainfall day -2 (mm)	-0.446	0.68
Wind speed (km)	-0.0197	0.85
Wind speed day -1 (km)	0.0954	037
Wind speed day-2 (km)	0.0459	0.67
Sun Exposure (Hours)	-0.1070	0.32
Sun exposure day-1 (hours)	0.0419	0.70
Sun exposure day-2 (hours)	0.0273	0.80

*Correlation is significant at the $p< 0.05$