Research Article

Correlation between the Weather, Body Temperature and COVID-19 Transmission: A Preliminary Study

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Abstract: The global pandemic COVID-19 gave a big impact worldwide either in terms of the medical condition, economy, education, or working mode. Millions of deaths were reported due to COVID-19. At the moment, a central repository to store all information about the patient is very significant for monitoring and analysis purposes. Hence, this paper presents a preliminary study on human temperature screening during COVID-19 and the effect of warm and hot weather on body temperature with COVID-19 transmission. The information was stored in a dashboard and the effect of warm and hot weather on body temperature was further analyzed by using the Spearman Rank Correlation Coefficient. Based on the analysis, it showed that the correlation result between cases and all-weather factors has a weak positive correlation and weak negative correlation. In the future, more dataset and external factors should be further integrated for a better result.

Keywords: COVID-19, Climate, Dashboard, Temperature Screening, Risk Management.

1. Introduction

Coronavirus or known as COVID-19 is first discovered in 2019 and has become a pandemic across the world. Dr. Tedros representing World Health Organization (WHO), has declared COVID-19 as a pandemic disease on 11th March 2020[1]. It has effects and symptoms such as common cold, extreme acute respiratory syndrome (SARS), and Middle East respiratory syndrome (MERS) and ranging from five to twelve days, with signs, usually appearing two to fourteen days after infection [2]. It is also correlated with fever, cough, shortness of breath, and a few cases of vomiting, nausea, and sore throat. Figure 1, showed the total number of cases across the world, with a total of 90,220,763 by 9th January 2021. Based on Figure 2, the leading country with the highest cases is the United States, with 25.18% worldwide active cases.

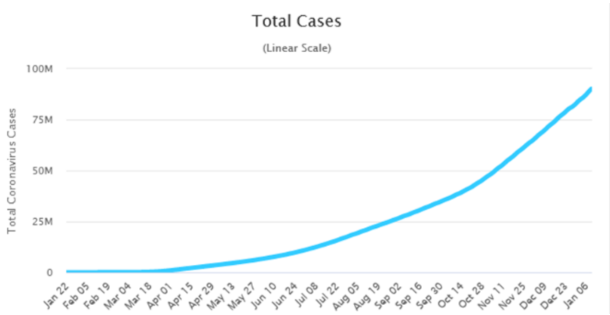

Figure 1. Total Number of Cases Worldwide

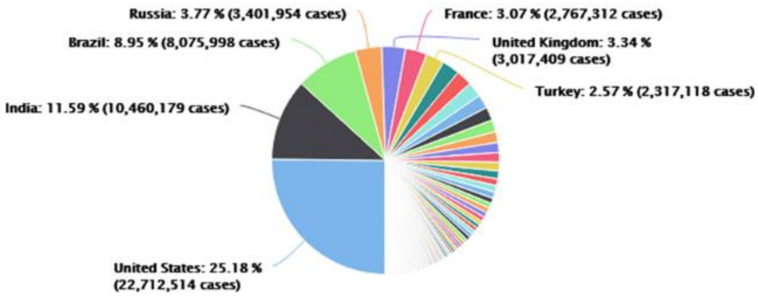

Figure 2. Distribution of COVID-19 by Countries

One of the main challenges during COVID-19 is in identifying and differentiating between healthy and infected persons [3]. Therefore, temperature screening is seen as one of the COVID-19 mitigation steps in identifying potential COVID-19 patients. As a result, this paper presents a case study on the effect of weather on body temperature and correlation with COVID-19. This paper is organized as follows: Section 2 explains the related works, Section 3 discusses the methods used, Section 4 presents the findings, and finally Section 5 with conclusions and future work.

2. Related Works

There are many existing works were discussing the correlation between weather, human body temperature, and COVID-19 transmission. These existing works by [4-12] and summarized in Table 1. These existing works came from different countries across the world. Based on the summarization in Table 1, this paper used the Spearman correlation due to its suitability with the dataset used (non-linear dataset).

Table 1. Existing work dashboard types

Author	Method	Result
[4]	Partial and Multiple Wavelet Coherence	• The overall results suggest the insignificance of an increase in temperature to contain or slow down the new COVID-19 infections.
[5]	Generalized additive model	•There is no evidence supporting that case counts of COVID-19 could decline when the weather becomes warmer,
[6]	Dynamic transmission model	•Confirmed the statistically significant association between temperature and RR during the study period (Coefficient = −0.0100, 95% CI: −0.0125, −0.0074).
[7]	Generalized additive model	•Results indicated that temperatures had a negative linear relationship with the number of confirmed cases. •The curve flattened at a threshold of 25.8 °C. •There is no evidence supporting that the curve declined for temperatures above 25.8 °C
[8]	Log-linear generalized additive model	•The results remained robust when different lag structures and the sensitivity analysis were used. •These findings provide preliminary evidence that the COVID-19 pandemic may be partially suppressed with temperature and humidity increases.
[9]	Spearman correlation coefficient	•Since normality was not fulfilled, a non-parametric correlation test was used for data analysis. •Maximum temperature, normal temperature, and precipitation level were significantly correlated with the COVID-19 pandemic.
[10]	Mann-Whitney U Test	•The distribution of substantial community outbreaks of COVID-19 along restricted latitude, temperature, and humidity measurements was consistent with the behavior of a seasonal respiratory virus.
[11]	Spearman correlation coefficient	•The components of weather include minimum temperature (°C), maximum temperature (°C), temperature average (°C), humidity (%), and amount of rainfall (mm). • Among the components of the weather, only temperature average (°C) was significantly correlated with the COVID-19 pandemic.
[12]	The multivariate Poisson regression	

• The data show that PM2.5 and humidity are substantially associated with an increased risk of COVID-19 and that PM10 and temperature are substantially associated with a decreased risk of COVID-19.

3. Method

3.1 Spearman's Rank Correlation Coefficient

Spearman's rank correlation test is the non-parametric version of the Pearson product-moment correlation. Spearman's correlation coefficient (ρ, also signified by rs) measures the association's strength and direction between two ranked variables. This correlation needs two variables that are either ordinal, interval, or ratio. There are two methods to calculate Spearman's correlation depending on whether the data does not have tied ranks or tied ranks. The formulas for when there are no tied ranks as follows:

$$\rho = 1 - \frac{6\sum d_i^2}{n(n^2-1)} \qquad Equation\ 1$$

where d_i = difference in paired ranks and n = number of cases. The formula to use when there are tied ranks as follows:

$$\rho = \frac{\sum_i (x_i - x')(y_i - y')}{\sqrt{\sum_i (x_i - x')^2 (y_i - y')^2}} \qquad Equation\ 2$$

where i = paired score & x', y' is the actual mean value.

3.2 Data Collection

The dataset for the screening temperature was taken from an organization in Nilai, Negeri Sembilan, Malaysia from June 2020 until December 2020 on daily basis. While the weather datasets were taken from timeanddate.com. It consists of Minimum Temperature (°C), Maximum Temperature (°C), Average Temperature (°C), and Precipitation / Rainfall (mm).

3.3 Data Analysis

We used Microsoft Power BI to build the dashboard. The whole process involved in this preliminary study is shown in Figure 3. The main interface of the dashboard is displayed in Figure 4. The above correlation made, was stored in the developed dashboard.

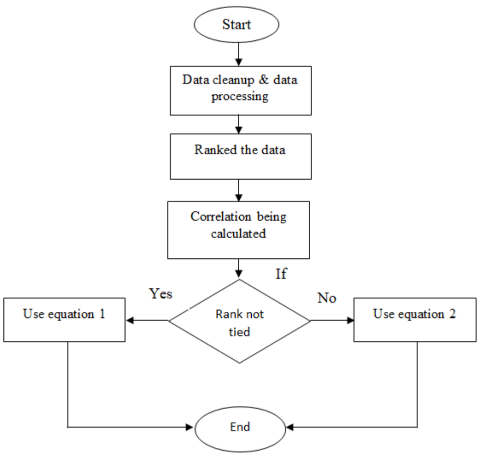

Figure 3. Overall Processes

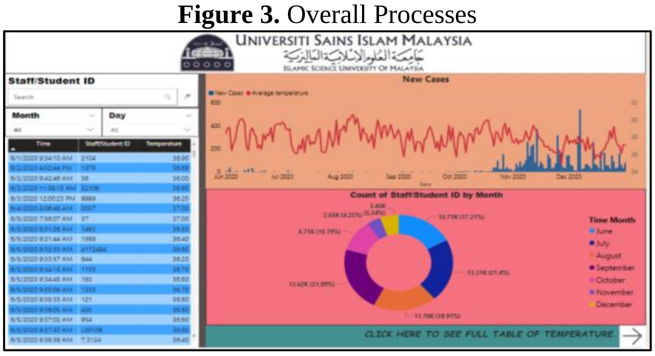

Figure 4. Dashboard Main Page

Figure 5. Dashboard Correlation Climate Calculation

4. Findings

According to [13], meteorological factors such as humidity, visibility, and wind speed may affect the equilibrium of the environment, or affect the viability of viruses as there is an effect on the spread of the disease as well as on-air temperatures. Besides, absolute air temperature and humidity have been found to influence the transmission of COVID-19 significantly. Changes in temperature and humidity can be an important factor that can influence COVID-19 mortality as there is a correlation between the spread of COVID-19 on temperature and climate latitude. Based on our finding, for this preliminary study from June 2020 until December 2020, the average cases are 33 cases per day and total cases of 6968 cases. From the average cases, the weather data for June 2020 until December 2020 showed the lowest minimum temperature of 24.25 °C (with the highest minimum temperature of 29.75 °C), the lowest maximum temperature of 25.25 °C (the highest maximum temperature of 31.50 °C), the lowest average temperature of 24.88 °C (the highest average temperature of 30.63 °C) and the lowest precipitation/rainfall of 0.20 mm/inch (the highest precipitation/rainfall of 17.50 mm/inch). Since the data has tied rank, we used equation 2, to calculate the correlation between COVID-19 cases and weather variables. Table 2 shows the result of the correlation calculation result and is supported by Figure 6 until Figure 9. These figures showed the scatter plot for the correlation between COVID-19 cases and weather variables respectively.

Table 2. Spearman's correlation coefficients between COVID-19 cases and weather variables

Weather variables	Correlation Value
Temperature Minimum	-0.23
Temperature Maximum	-0.22
Average Temperature	-0.20
Precipitation/Rainfall	0.26

For hypothesis, authors [14] found that temperature and relative humidity have a strong influence on the R-value, with a significant level of 1 percent for both in China. Temperature and humidity have a significant and consistent distribution of the seasonal behavior of respiratory viruses [15]. Meteorological variables can predict worldwide outbreaks with high correlations ($r > 0.6$) with real data [13]. In Wuhan, the COVID-19 transmission is very important to be associated with the transmission as there is a correlation coefficient between weather and disease spread, and weather factors will suppress disease when the weather warms up [16]. This hypothesis is supported by previous research that shows the relationship between weather transmission and Respiratory Syncytial Virus (RSV) [17]. The result for correlation needs to be read in two-part where firstly the result have either positive or negative value sign. A positive value sign is considered as a positive correlation where with an increase for a dataset, the other will also increase. A negative value sign is considered as a negative correlation where if one dataset shows an increase, the other will show a decrease. Next is the value of the result. The correlation is considered as strong when the R-value is higher than 0.6 while the correlation is weak when the R-value is less than 0.3 (*Pearson Correlation Coefficient - Magoosh Statistics Blog*, n.d.).

Figure 6 shows the scatter plot result between COVID-19 cases and minimum temperature where the R-value is ($r= -0.23$). From the R-value, this correlation is negative as it has a negative value and the scatter plot shows a slight decrease in trendline which means the two data have a negative relationship where with a decrease in minimum temperature, there is an increase in COVID-19 cases. However, with R-value ($r< 0.30$), this correlation is considered a weak correlation.

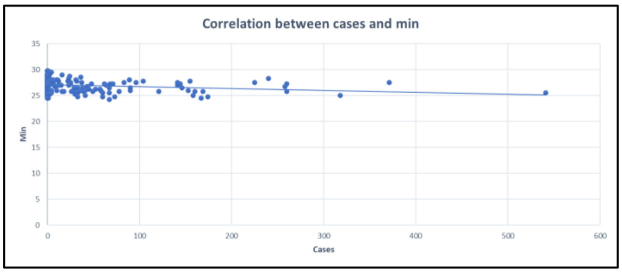

Figure 6. Scatter Plot between New cases and Minimum Temperature

Figure 7 shows the scatter plot result between COVID-19 cases and maximum temperature where the R-value is (r= -0.22). From the R-value, this correlation is negative as it has a negative value and the scatter plot shows a slight decrease in trendline which means the two data have a negative relationship where with a decrease in maximum temperature, there is an increase in COVID-19 cases. However, with R-value (r< 0.30), this correlation is considered a weak correlation.

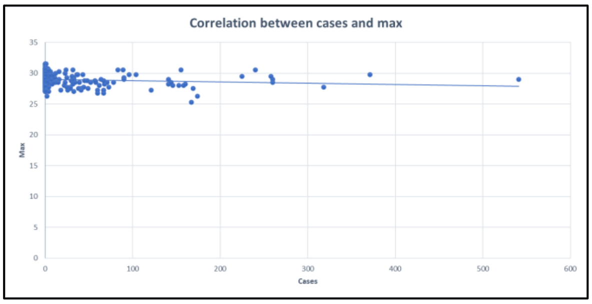

Figure 7. Scatter Plot between New cases and Maximum Temperature

Figure 8 shows the scatter plot result between COVID-19 cases and average temperature where the R-value is (r= -0.20). From the R-value, this correlation is negative as it has a negative value, and the scatter plot show a slight decrease in trendline which means the two data have a negative relationship where with a decrease in average temperature, there is an increase in COVID-19 cases. However, with R-value (r<0.30), this correlation is considered a weak correlation.

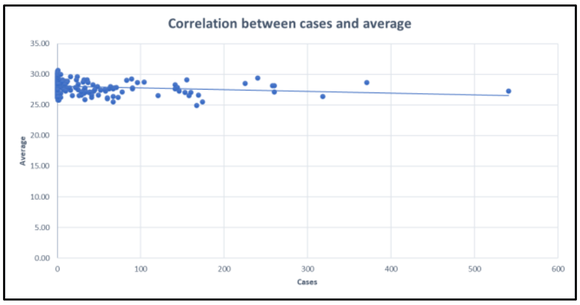

Figure 8. Scatter Plot between New cases and Average Temperature

Figure 9 shows the scatter plot result between COVID-19 cases and precipitation/rainfall where the R-value is (r= 0.26). From the R-value, this correlation is positive as it has a positive value, and the scatter plot show a slight increase in the trendline. increase where with an increase in precipitation/rainfall, there is an increase in COVID-19 cases. However, with R-value (r<0.30), this correlation is considered a weak correlation.

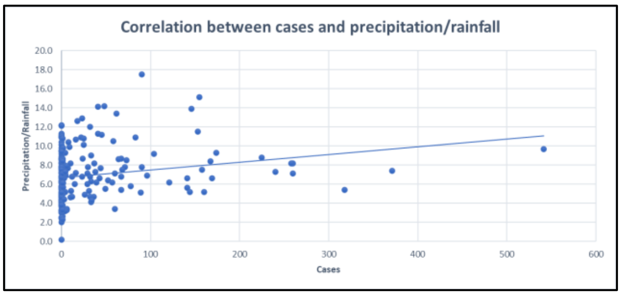

Figure 9. Scatter Plot between New cases and Precipitation/Rainfall

Following the Proof of Concept (POC) by using real-time data on correlation above in Figure 6 to Figure 9, we rejected the hypothesis as the correlation value for each weather factor is less than the minimum making all the factors a weak correlation. The POC also not in line with previous research that stated there is a high correlation between virus transmission and weather factors. However, this study is just a preliminary analysis. A firm conclusion requires time and an extended dataset.

5. Conclusions and future works

This paper presents a preliminary study for the correlation between weather, human body temperature, and COVID-19 transmission. For future work, a bigger dataset is needed. Moreover, individual health factors such as hand washing habits, personal hygiene, and use of hand sanitizers may be the other related factors of COVID-10 for further analysis.

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