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Original Research Paper

The Association Of Some Environmental Factors With Covid-19 Cases In Babylon Province

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Abstract: *Environmental factors can impact induce on health aspects of humans. The COVID-19 pandemic may interlink with environmental conditions regarding the influence on transmission and survival of the virus or host respiratory infections incidence. Thus, this study aims to evaluate the association of temperature, humidity and wind speed with COVID-19 cases in Babylon province.*
The maximum and minimum temperature, relative humidity and wind speeds were studied under the assistance of the Iraqi Meteorological Organization in Babylon province for 90 days, starting from 1/12/2021 with calculation of the COVID-19 cases in Babylon province that were recorded every day within the study duration. The temperature, relative humidity and wind speeds were measured using a mercury thermometer, dry-wet bulb thermometers and SIAP device respectively.
The results of this study showed a negative and significant correlation ($r = -0.432$, $p< 0.0001$) between the minimum temperature and COVID-19 cases and January recorded the highest average number of COVID-19 cases in Babylon province and 96.77 cases every day. The correlation of COVID-19 cases with maximum temperatures was weak negative ($r = -0.255$, $p= 0.0153$). While the result revealed no correlation and insignificance between COVID-19 cases and wind speed ($r = 0.027$, $p = 0.8006$) as well as relative humidity ($r= 0.019$, $p = 0.7861$).
The conclusions of the study exhibited that some environmental factors have a role on rate of infections with Covid-19 and it may influence transmission or the vitality of the virus.

Keywords*: *COVID-19, temperature, humidity, wind, speed

1.Introduction

The pandemic of COVID-19, which is caused by the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) has spread quickly over the globe [1]. The coronavirus disease 2019 (COVID-19) outbreak in over 250 nations has become a severe threat to people's health worldwide [2].
A long time ago, coronavirus transmission was influenced by a range of factors, including climate [3]. However, environmental factors have direct and indirect effects on COVID-19 disease [4].The relative humidity and temperature relative humidity had an impact on

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the stability of the SARS virus during the 2003 pandemic [5]. Since COVID-19 has been found to survive in typical air-conditioned surroundings at 22-25 °C temperature and 40-50% relative humidity for more than 5 days [6]. While, cold working circumstances be considered a COVID-19 occupational risk factor [7]. McClymont and Hu [8] reveal that wind speed and rainfall results were inconsistent among studies, however meteorological variables like temperature and humidity can boost COVID-19 transmission, particularly in winter circumstances due to increased virus viability and host vulnerability.

The climate and environmental characteristics like wind speed, temperature, and humidity air have a significant impact on COVID-19 transmission [9]. To avoid severe cases of COVID, it is critical to take care to prevent infection in both cold and warm seasons [10]. More extensive analysis of environmental indicators (e.g., wind speed, temperature, etc.) may also help us better comprehend transmission patterns and identify possible COVID-19 risk zones in the future [11]. However, Haque and Rahman [12] showed high temperatures and humidity considerably inhibit COVID-19 transmission, and the onset of summer and rainy season can effectively diminish COVID-19 transmission. In the spring and summer of 2020, increased humidity was related to a decrease in cases, but decreasing humidity and a rise in residential mobility during the winter months likely caused an increase in COVID-19 cases [13].

Many different environmental factors affect a person and may control his health in terms of their interaction with the life and activities of humanity, so the rate of infection with COVID-19 disease varies in countries of the world, and this is due to these environmental factors which affect in decrease or increase [14].The virus's transmission can be influenced by environmental conditions because it is transmitted by either direct or indirect contact with infected people throughout infected respiratory droplets, fomites, saliva, or aerosols that are affected by environmental factors [15]. It was uncertain during the COVID-19 pandemic whether the climatic circumstances affect virus viability outside of the human body. The relationship of COVID-19 with environmental conditions may be confounded by many factors [16]. Because the pandemic became a severe health and socioeconomic problem that threatened the world in the future, therefore, this study was carried out to reveal the relationship of some environmental factors to the Covid-19 pandemic to help health administrations combat the spread of COVID-19.

2.Methodology

The environmental factors that were studied under the assistance of the Iraqi Meteorological Organization in Babylon province for three months (90 days), starting from 1/12/2021 with calculations of the COVID-19 cases of Babylon Province that were recorded every day within the study duration include:

1-Maximum and Minimum Temperature

Temperature is measured using a mercury thermometer with units in degrees Celsius to measure daily the maximum and minimum air temperature. The maximum and the minimum thermometer is designed to record the highest and the lowest temperature reading during a day.

2- Relative humidity

The dry bulb and the wet bulb thermometers are used to determine the relative humidity in the air during the day.

3- Wind speeds

Wind speed is measured by SIAP device (Italy manufacture) for detection the wind speed and direction.

Statistical Analysis

The degree of association between the temperature (minimum and maximum), wind speed and humidity with the number of COVID-19 cases in Babylon Province was

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calculated by Spearman correlation coefficient (r) and the level of significance (*p*) by employing IPM®SPSS® software.

3.Results and discussion

Environmental factors can influence the spread of communicable diseases. The characteristics of the environment are important factors that determine the infectivity, extent and speed of the spread of COVID-19 cases. The COVID-19 pandemic has a close relationship between health and the environment; for example, urban lifestyle has a considerable impact on air quality and consequently on population health [17]. The lowest temperatures in Babylon province in December 2021, January 2022, and February 2023 are displayed in Figure 1. The findings showed that the lowest recorded temperatures throughout the research period were -2 °C in January. The mean of the minimum temperatures of December, January and February were 7.48, 4.29 and 8.36°C respectively (Table 1). The most significant risk factors for the disease outbreak of Covid-19 are temperatures between 0 and 10 °C [18].

The highest numbers of COVID-19 infections were in Babylon province at the end of January and the beginning of February, as shown in Figure (2). January recorded the highest average number of COVID-19 (96.77 cases/day) in Babylon province (Table 1). The results revealed that the correlation between COVID -19 cases and minimum temperatures was moderate negative significant (r = - 0.432, $p< 0.0001$). The temperature and COVID-19 instances per million have an inverse relationship [19]. An increased risk of COVID-19 infection may be linked to low temperatures [20]. While there is only a sluggish relationship between meteorological conditions and the daily new cases of COVID-19. Additionally, COVID-19 could adapt to high or low temperatures, and other variables other than weather could have an impact on the virus's propagation, such as demography [21]. These results agreed with Pérez-Gilaberte et al. [22] who discovered statistically significant inverse relationships between temperature and the frequency of COVID-19 patients at practically all latitudes.

The result in Figure (3) showed the maximum temperatures within the study duration. It was observed the maximum temperatures in December and February months (26°C). One of the most important factors influencing the severity of COVID-19 was temperature [23]. Climate-related factors that contributed to a rise in COVID-19 instances were an increase in temperature, stronger winds, and a drop in relative humidity [24].The mean of the maximum temperatures of December, January and February were 19.43, 17.22 and 21.75°C respectively (Table 1). While the highest average number of COVID-19 cases in Babylon Province was 96.77 in January. The correlation coefficient between COVID-19 cases and maximum temperatures was weak negative (r = -0.255, $p= 0.0153$).The study of Wang et al., [25] observed the spread of COVID-19 may be inhibited by higher temperatures, but the pandemic cannot be stopped by the potential influence of temperature on the effective reproductive number alone. According to Azizah et al. [26], the provinces with the greatest COVID-19 instances are those with warmer climates (high air temperature, little rainfall, and humidity).In addition, high temperatures do not inhibit the virus' growth, nor are they the primary contributors to the formation of COVID-19 [27].

The results regarding relative humidity during December (2021), January and February (2022) in Babylon province were exposed in Figure (4). These results showed the highest percentages of relative average on study duration was in January month (74%). However, the percentages of relative average in

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December and February showed 66% and 54% respectively (Table 1). While the highest average number of COVID-19 patients in Babylon province was 96.77 in January. The results revealed that was no significant correlation between relative humidity with COVID -19 cases (r= 0.019, p = 0.7861). In the study carried out by Sali [28], the averages of the groups with medium and high relative humidity did not substantially correlate with the rise in outdoor illnesses. According to Verheyen and Bourouiba [29], the intermediate relative humidity (40-60%) is strongly correlated with better COVID-19 outbreak results.

The relative humidity and temperature play a role via an interactive effect of COVID-19 [30]. In the spring and summer of 2020, reducing cases were linked to rising humidity, whereas increases in residential mobility and rising COVID-19 cases during the winter were likely linked to falling humidity [13]. The transmission of COVID-19 in Addis Ababa is influenced by climatic variables such as humidity, rainfall, and wind speed [31].In studies done by Sarkodie and Owusu [32], decline though low temperature and wind speed prolong the activation and spread of the virus, high relative humidity and high temperature decrease the viability, survival, viability, and transmission of COVID-19. There was a consistent inverse relationship between relative humidity and cases, which was linked to decreased instances and increased relative humidity. An increase in instances of 7-8% was linked to a 1% reduction in relative humidity [30].

In contrast, Ogaugwu et al. [33] reported that there was no discernible relationship between wind speed or humidity and daily COVID-19 mortality. The transmission of COVID-19 may be inhibited by higher relative humidity, although this effect may not be sufficient to stop the pandemic [25]. Figure (5), shows the wind speed (Km/hr) during December (2021), January(2022) and February in Babylon province. The findings indicated that the wind speed during the study period was 13 km/h in the month of February. The mean of the minimum temperatures of December, January and February were 3.52, 3.87 and 3.96 Km/hr respectively (Table 1). The result in table (1) showed that was no correlation and significance between COVID-19 cases and wind speed (r = 0.027, p = 0.8006).

Clouston et al. [34] mentioned in the summer, days with little wind speed were associated with a higher chance of COVID-19 transmission. Wind speed initially caused Covid-19 to increase, but when the wind speed exceeded 4 km/h, the COVID-19 cases showed a decrease [35]. High wind-speed settlements, particularly those on the coast, tended to have an earlier rise in instances. People who failed to follow safety precautions were more likely to be exposed to the COVID-19 virus in the air because of the higher wind speed [36]. On the contrary, Rendana [37] mentions the wind rose analysis can be used to assess the direction of COVID-19 dissemination, and the range of virus spread can be predicted from the direction of the wind. The wind speed is substantially connected with COVID-19 cases, indicating a lower wind speed, and a higher number of COVID-19 cases. While the warmer, more humid areas, where the incidence rate appears to be lower, can reduce COVID-19 transmission and shield the most vulnerable from it. If sufficient safety measures fail to be taken, warm weather alone might not be able to stop the spread of COVID-19, even in humid and hot countries, as they already have evidence that positive cases of COVID-19 also continue to rise in humid and hot locations [38].

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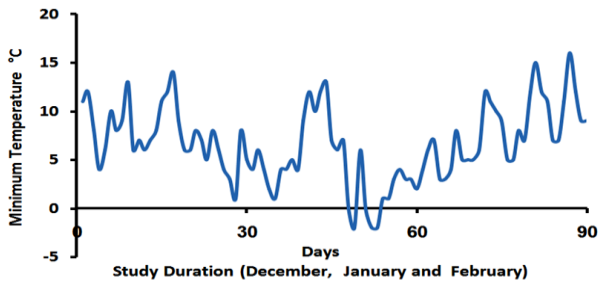

Figure (1): The minimum temperatures within the study duration in Babylon province

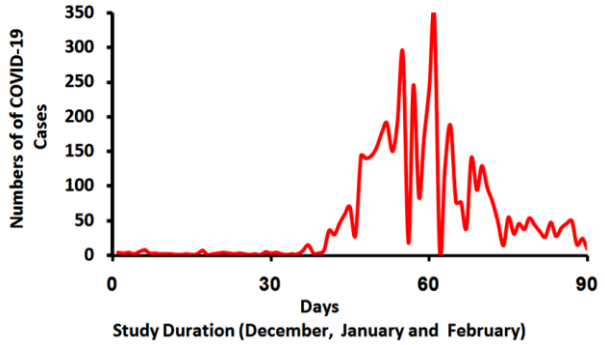

Figure (2): Numbers of COVID -19 Cases within the study duration in Babylon province

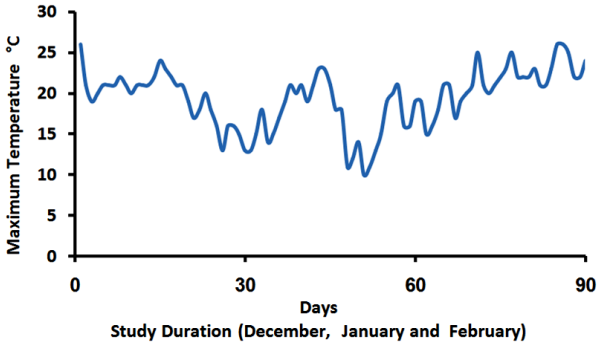

Figure (3): The maximum temperatures within the study duration in Babylon province

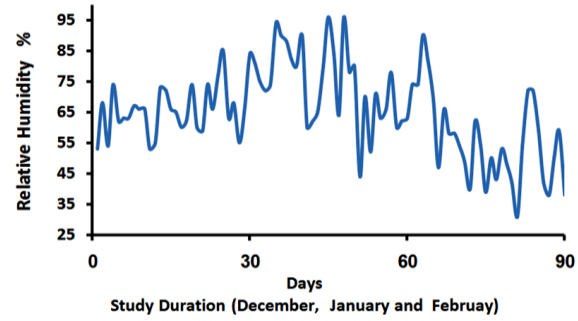

Figure (4): The percentages of relative humidity within the study duration in Babylon province

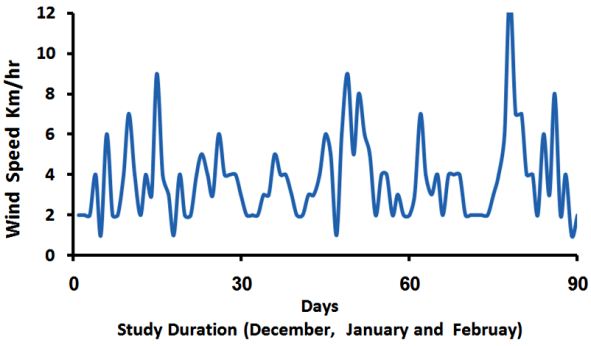

Figure (5): The wind speed (Km/hr) within the study duration in Babylon province

Table (1): The correlation between environmental factors and COVID-19 cases in Babylon province within the study duration

Average of No. of COVID-19 cases/day in Babylon Province	Average Wind speed Km/hr	Average Relative Humidity%	Average Maximum Temp. ℃	Average Minimum Temp. ℃	
2.84	3.52	66%	19.43	7.48	**Dec.(2021)**
96.77	3.87	74%	17.22	4.29	**Jan.(2022)**
60.60	3.96	54%	21.75	8.36	**Feb.(2022)**
	0.027	0.019	-0.255	-0.432	**Correlation coefficient**
	0.8006	0.7861	0.0153	< 0.0001	***p*-value**

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Conclusion

The relationship of environmental factors with COVID-19 is important for understanding the pandemic and reducing outbreaks. The minimum temperature associated with an increase in COVID-19 cases significantly ($p < 0.001$) and the highest average of COVID-19 cases in Babylon province was in January. Temperature is an important factor of the environment that has a risk for the spread of COVID-19 due to the moderate negative correlation result ($r = -0.432$). While the wind speed and relative humidity were not correlated with disease. The results indicated that the pandemic is influenced by temperature, this may be due to temperatures impact on the transmission or survival of COVID-19 as well as may change people's behaviors in their lives or work when raising or lowering the weather temperatures.

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