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RESEARCH ARTICLE

Impact of Meteorological Parameters on the COVID-19 Incidence: The Case of the City of Oran, Algeria

Farid Rahal [1*], *Salima Rezak* [2], *Fatima Zohra Baba Hamed* [3]

[1] Laboratory of Science, Technology and Process Engineering, University of Science and Technology of Oran - Mohamed BOUDIAF, Oran, Algeria

[2] Laboratory of Inorganic Materials Chemistry and Applications, University of Science and Technology of Oran - Mohamed BOUDIAF, Oran, Algeria

[3] Civil Engineering Department, University of Science and Technology of Oran - Mohamed BOUDIAF, Oran, Algeria

ABSTRACT

The current coronavirus disease 2019 (COVID-19) pandemic in the major countries of the world has become a serious threat to the health of all human beings. A better understanding of the effective parameters in infection spreading can bring about a logical measurement toward COVID-19. Among these parameters, we find the climatic factors that can play an important role in the spread of the COVID-19 epidemic. We have studied this phenomenon in the city of Oran in Algeria, which experienced its first case of COVID-19 on March 19, 2020.

In this study, the main parameters, including the number of infected people with COVID-19, the average, minimum and maximum temperatures, the relative humidity rate and the wind intensity.

A first analysis of the data with a Spearman rank correlation test did not yield significant results.

Taking into account the average incubation period to adjust the data made it possible, during a second analysis, to show that the minimum temperature is significantly correlated with the new cases of COVID-19 in Oran city, but further studies over longer periods with additional parameters are needed to better understand this matter.

Keywords: COVID-19, temperature, humidity, wind, incubation period

Correspondence:

Farid Rahal

Address: Laboratory of Science, Technology and Process Engineering, University of Science and Technology of Oran - Mohamed BOUDIAF, Oran, Algeria

Email: farid.rahal.dz@gmail.com

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INTRODUCTION

Millions of people have been put on lockdown in order to reduce the transmission of the COVID-19. This epidemic has also changed the people's life style; caused extensive job losses and threatened the sustenance of millions of people, as businesses have shut down to control the spread of virus [1].

The transmission of viruses can be impacted by several factors, including climatic conditions such as temperature, humidity and wind as well as population density [2]. Many research works have been carried out on this field [3, 4, 5, 6] since the World Health Organization (WHO) declared that the COVID-19 pandemic is a Public Health Emergency of International Concern (PHEIC), on January 30, 2020.

Algeria, like other countries in the world, has not escaped this COVID-19 pandemic. The first case reported on February 25, 2020, was imported from Italy [7]. In order to limit exposure to the virus, partial containment measures were imposed on some cities that reported the highest number of contaminated cases. More and more people are invited to isolate themselves or to quarantine themselves, they only leave their homes to buy essential items such as food and medicines [8].

The city of Oran in Algeria is a significant example of the COVID-19 epidemic evolution in Algerian urban areas. The main objective of this work is to find the meteorological parameters that contribute to the spread of COVID-19 in Oran city.

THEORETICAL FRAMEWORK

The behavior of an enveloped virus is affected by extra-human conditions, such as climatic conditions [9]. Hence, the effect of climatic factors on spreading of COVID-19 can play an important role in the new Coronavirus outbreak [10].

It has been reported that there is a negative relationship between COVID-19 mortality and temperature [11] because at lower temperatures, the performance of the.

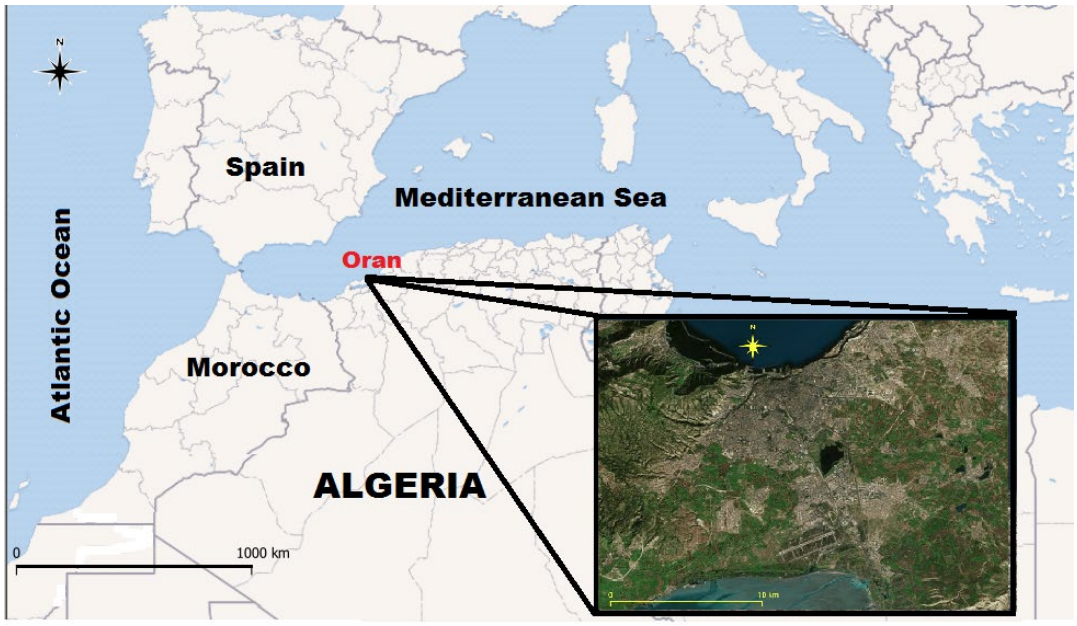

Figure 1. Geographical position of the city of Oran.
Source: Authors

immune system, as well as the liver, is decreased; as a result, the situation will be conducive to the activity of infectious agents and virus transmission [12-16].

Both epidemiological and laboratory studies have shown that ambient temperature could affect the transmission and survival of coronaviruses. Xie et al. [17] found that mean temperature has a positive linear relationship with the number of COVID-19 cases with a threshold of 3 °C.

Temperature increase and sunlight can facilitate the destruction of SARS-COV-2 and the stability of it on surfaces. Eslami et al. [18] show that when the minimum ambient air temperature increases by 1 °C, the cumulative number of cases decreases by 0.86%.

Indeed, high temperatures damage the virus lipid layer decreasing its stability and infection potential and may even cause virus inactivation, therefore lowering the transmission rate [19, 20].

MATERIALS AND METHODS

Sample and Sources

The Oran region is characterized by a semi-arid climate [21] with annual rainfall less than 330 mm, occurring mainly between the months of October and May; average monthly temperatures vary between 5 ° and 17 ° C in winter and 16 ° and 31 ° C in summer [22].

The city of Oran is located in the northwest of Algeria, bordered by the Mediterranean Sea to the north and the Sebkha to the southwest as shown in **Figure 1**.

Bukhari et al. [23] have shown that low temperature and humidity levels are key variables in determining the transmission of COVID-19. Therefore, it is interesting to study this phenomenon for the region of Oran.

For this study, we used the meteorological data recorded, during the months of April, May and June, at the meteorological station of Es Senia concerning minimum temperature (° C), average temperature (° C), maximum temperature (° C), relative humidity (%) and wind intensity (km/h). Data on new COVID-19 cases in Oran are from the MSPRH [7].

Measures

The meteorological parameters were obtained from the Algerian Meteorological Office. The temperature was measured in °C from March to June, 2020 and the humidity in % for the same period.

The wind is implied as a critical climatic factor for the transmission of COVID-19 [24]. Hence, we also collected wind data in km/h regarding the study period from March to June, 2020.

COVID-19 infection data is considerate as number of cases COVID-19 per 10,000 inhabitants and collected from MSPRH [7].

Data Analysis Procedure

Before using a statistical analysis, it is necessary to verify that the sample follows a normal distribution or not. Given the size of our data, the Shapiro-Wilk test [25] appears to be the most suitable for performing a normality test.

The data on daily cases of the COVID-19 showed non-normal distribution, so the relationship between weather and COVID-19 incidence was studied using the Spearman rank correlation test.

RESULTS AND DISCUSSION

The city of Oran, the second largest city in Algeria, registered on March 19, 2020 its first case of COVID-19.

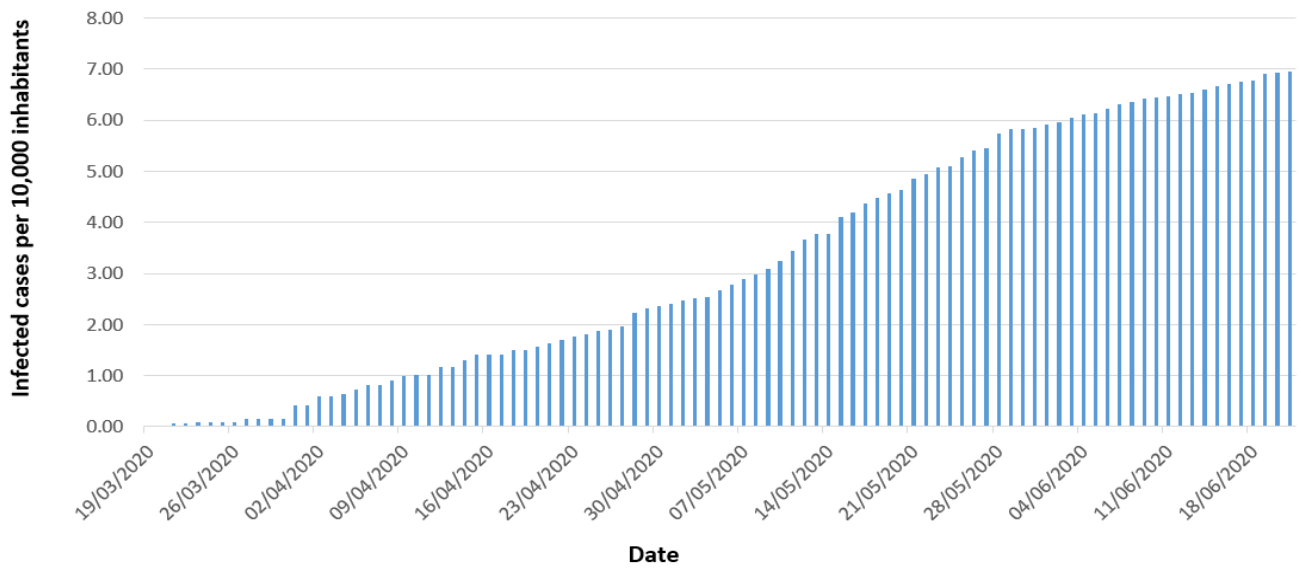

Figure 2. Number of infected cases per 10,000 inhabitants with Covid-19 in Oran since March 19, 2020
Source: [7]; compiled by authors

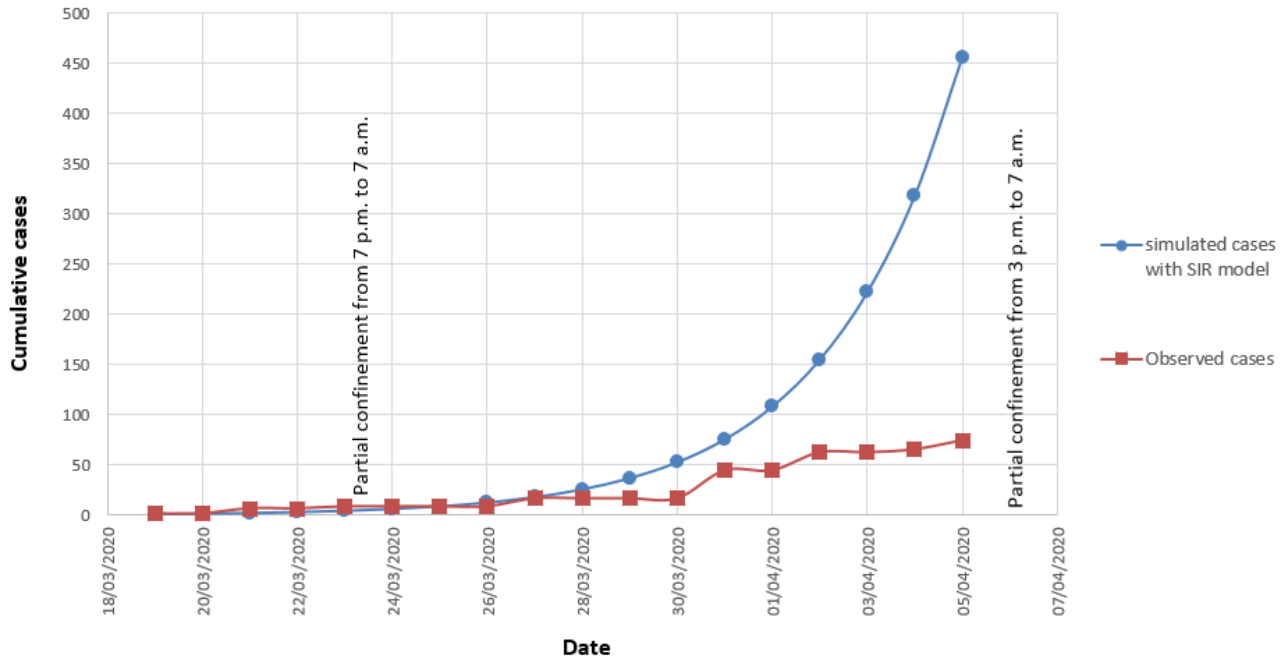

Figure 3. Comparison between simulated cases with SIR model and observed cases recorded by the MSPRH during the period from 19/03/2020 to 05/04/2020
Source: Authors

Figure 2 shows the progression of proven cases from COVID-19 to Oran since that date.

Several models can help monitor an outbreak and predict its evolution. The most classic being the SIR model [26] which is based on the work of the theory of Kermack et al. [27].

We carried out a simulation of the SIR model for the period from 03/19/2020, date when the first case was registered in Oran until 04/04/2020, date of application of the strictest partial containment in Oran.

The result of the simulation gives a basic reproduction number R0 = 2.125638 for the above-mentioned period. Thus, at the start of the outbreak, a person infected with COVID-19 could infect more than 2 people. This situation could have caused an exponential spread of the virus after 02 weeks as shown by the simulation of the SIR model presented in **Figure 3**. We can also see that this reproduction of the virus was probably slowed down by the sanitary and containment measures taken by Public powers. Indeed, containment is a barrier measure used to break the chains of virus transmission during an outbreak [28].

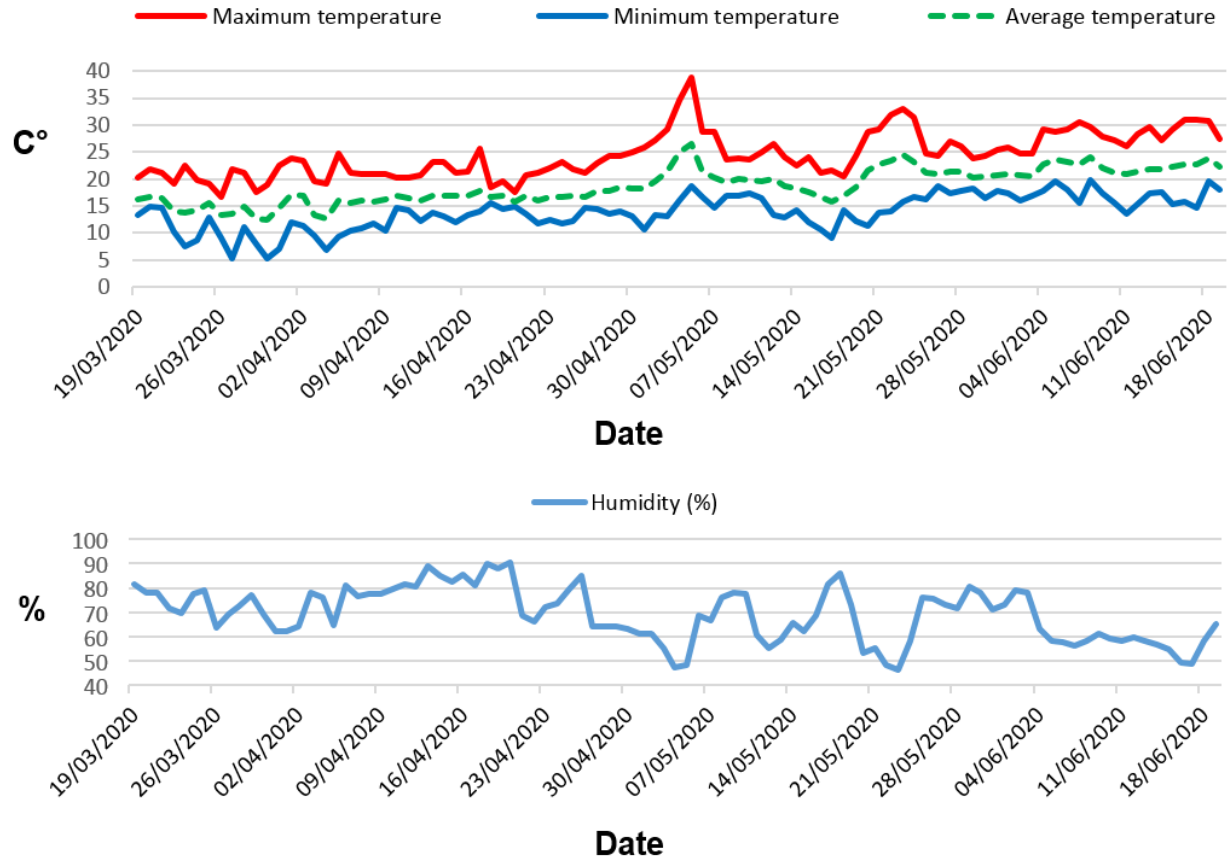

Figure 4. Evolution of temperature and humidity during the studied period, at the city of Oran
Source: authors

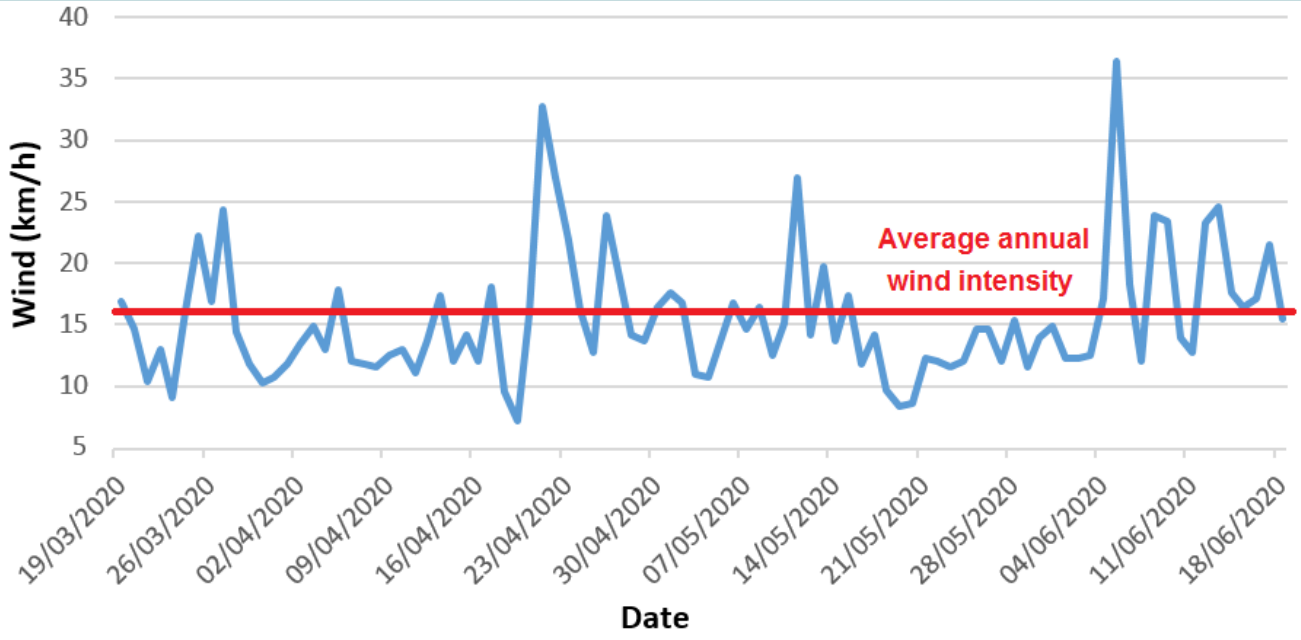

Figure 5. Evolution of wind intensity during the studied period, at the city of Oran and the average annual wind intensity
Source: authors

The evolution of temperature and humidity during the studied period is shown in **Figure 4**.

As shown in **Figure 5**, we collected wind data in km/h from March to June, 2020. We also represented the average annual intensity of the wind in Oran, which according to Boudia et al. [29] is 15.12 km/h.

A Spearman rank correlation test was used to analyze this data. **Table 1** shows the obtained coefficients.

Table 1. Spearman correlation coefficients between infections of COVID-19 and weather variables

Weather variables	Spearman correlation coefficient
Maximum temperature (°C)	-0.1702
Minimum temperature (°C)	-0.0937
Average temperature (°C)	-0.168
Humidity (%)	0.124
Wind (km/h)	-0.008

Table 2. Spearman correlation coefficients between infections of COVID-19 and weather variables, taking into account the incubation period

Weather variables	Spearman correlation coefficient
Maximum temperature (°C)	0.0129
Minimum temperature (°C)	-0.312
Average temperature (°C)	-0.108
Humidity (%)	-0.141
Wind (km/h)	0.123

The result does not show a significant correlation between the weather variables and the COVID-19 in Oran. However, taking into account the incubation period of COVID-19 has produced a significant result. Indeed, according to Wang et al. [30], the average incubation time of COVID-19 is approximately 6.4 days.

A 6-day shift in weather data from COVID-19 data found a significant correlation between new COVID-19 cases and minimum temperatures as shown in **Table 2**.

Spearman's correlation between minimum temperature and COVID-19 infections indicates a significant negative relationship. That is, when minimum temperatures decrease, COVID-19 infections increase.

During the studied period, the minimum temperatures varied between 5.3 ° C and 19.9 ° C. The result confirms that temperature is an environmental driver of the Covid-19 outbreak as observed in China by Shi et al. [31].

CONCLUSION

Even if the COVID-19 pandemic in Oran seems relatively under control, the significant correlation between the minimum temperatures and the spread of the virus should alert health authorities to the risk of the epidemic worsening when the temperatures drop.

Given that meteorological parameters have a significant and consistent distribution of the seasonal behavior of respiratory viruses [32], it is desirable that the fight against COVID-19 be intensified during the summer in order to anticipate a possible upsurge contaminations that could appear in autumn and winter.

This work, which was limited to the study of the impact of meteorological parameters on the incidence of COVID-19 in the city of Oran, would benefit from being extended to other similar cities on the Mediterranean rim and to other parameters, like air pollution.

Indeed, the combination between air pollution and meteorological conditions with high relative humidity, low wind speed and fog, trigger a take-off of viral infectivity [33]. There has been a close correlation between regions with worse air pollution and diffusion of the virus [34].

Indeed, cities with atmospheric stability based on little wind and frequently high levels of air pollution had higher numbers of COVID-19 related infected individuals and deaths [35].

Furthermore, it is important to assess the environmental and social weaknesses of regions exposed to infectious diseases to prevent and / or contain new outbreaks of COVID-19 and other viral agents that generate a negative impact on public health and the economy of country [36].

There are many factors that may affect COVID-19 distribution and mortality in different areas [37]. In the presence of different viral diffusion mechanisms, it is also important to promote interdisciplinary research studies capable of analyzing the problem from different angles [38]. A comprehensive strategy to prevent future epidemics similar to COVID-19 has also to be designed in environmental and socioeconomic terms, that is in terms of sustainability science and environmental science, and not only in terms of biology, medicine, healthcare and health sector [39]. Globalization makes us share its benefits but also its damages which could become more and more recurrent.

Declaration of interest: The authors report no conflicts of interest.

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