Effect of Weather Parameters on Recovered Cases of Covid-19 in Baghdad, Iraq

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Abstract
This paper aims to test the correlation between the recovered cases of covid-19 and weather parameters in Baghdad city of Iraq, also estimated the importance weight values of each weather parameter and it is affected by recovered cases. The daily-recovered cases were obtained from reports of the Ministry of Health and Environment for the period (20 March to 24 July 2020). The daily weather parameters included maximum temperature, minimum temperature, average temperature, average humidity, maximum wind speed, minimum wind speed, and average wind speed. Based on each data distributions, the nonparametric method utilized to estimate the correlation between them. Spearman rank was used to conclude the very strong and strong correlation between the recovered covid-19 cases with temperature and humidity respectively. The relationship between the recovered cases and temperature was directly proportional while its relation inverse with humidity. The neural network techniques were applied to predict the importance of the weight values of each weather parameter and recovered cases. These outcomes researched to hope the increase of recovered cases with weather changes, but it is important to note that even if there is an influence of weather in any aspect during covid-19 pandemic all precautions must be taken and social distancing must be committed considering many confounding factors.

Keywords: Covid-19, Coronavirus, Temperature, Humidity, Wind speed, Iraq, Neural network

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Introduction
The novel Coronavirus Disease or, as it is named, covid-19, is not only sharply increased with a high rate of distribution but has become a universal pandemic that affects several, involving developing countries with bounded sources[1]. Even the developed countries, which afflicted are confused in their combatversuscovid-19 [2]. It is regarded that the majority of developing countries will experience more confrontation than developed countries in inhibiting the prevalence of covid-19 in their country, and this makes these countries a new focus of the pandemic and Iraq is not an excuse [3]. As former coronaviruses, the novel coronavirus results in disease of the respiratory system [4]. As stated by the Centers for Disease Control and Prevention (CDC), the signs and symptoms of novel coronavirus disease can be very Clement to severe and the most prevalent signs and symptoms comprise a fever, cough, and shortness of breath. A high percentage of affected people are asymptomatic. Symptoms may seem two to
14 days after getting the virus [4]. The average incubation period is 5–6 days [5]. The available information proposed that the virus can result in mild, flu-like symptoms, or very severe cases of the disease. The patients with mild disease were found in high percentages, and the deterioration occurs in only 20% nearly and the advanced case, including pneumonia, respiratory failure, and, in some situations death [4]. The severe cases of covid-19 are characterized by the clinical symptoms which are likely identical to the clinical symptoms of SARS and MERS [6]. In Iraq, on February 24, 2020, Iraq has reported 1 confirmed cases of covid-19. The disease is widely spread around the world. In response to that, the WHO reports that covid-19 is a pandemic [7]. The maximum weather states that join long-term climate alteration may also participate in the spread of the Lyme disease in the United States [8]. Particular climatic conditions can be considered as the first predictors of many respiratory system diseases such as SARS. The variability of climate can also be a direct cause of how SARS-CoV interacts with the biological system of humans. Humidity, optimal temperature, and wind speed are inconstant values that can set the transmission and survival of the SARS virus [9]. The transmission of viruses can be affected by many factors, including climatic status (such as temperature and humidity), and density of population [10]. Researches on climate changes and the novel coronavirus until now are very limited epically in Iraq so this study will contribute in some part to efforts to control the covid-19 disease. The correlations between the recovered cases of covid-19 and weather parameters of Baghdad city (temperature, humidity, and wind speed) are tested by statistical methods, also the neural network techniques utilized to predict the importance weight of weather parameters of this city.

Methods

Study area

Baghdad city data is utilized in the case study of recovered cases recorded in it. This city is a Capital of the Republic of Iraq. The location of the city along with Tigris River, which longitude and latitude as illustrated in Fig. 1. The total area of it about is 833.2 square kilometers. According to the Republic of Iraq / Ministry of planning Central Organization for Statistics in 2018 [11], the population of Baghdad has exceeded 8 million, and that the total population of the country has exceeded 38 million until the date of the preparation of the census this year.

Data collection
The daily data of confirmed, recovered, and death cases of COVID-19 were utilized in Baghdad city that recorded by reports of the Ministry of Health and Environment of Republic of Iraq for the period 20 March – 24 July 2020 [12]. The daily data of temperature, humidity, and wind speed were used for this research to study that affected on the increasing or decreasing of COVID-19 recovered cases. Temperature data obtained from the Ministry of transportation / Iraqi Meteorological Organization and Seismology website, which included the maximum, minimum, and average of daily records [13]. The average daily humidity, maximum, minimum, and average wind speed took from this website [13]. The rainfall data were not used in this study because the weather is dry for these date ranges, therefore this parameter is no effect of the COVID-19 cases kinds.

**Data analysis**

The statistical distribution types of data were illustrated in Fig.2 and Table 1. From these results, distributions of all parameters are not normal, therefore, the test of Spearman rank correlation was utilized to predict the relation between these parameters and recorded daily COVID-19. The recorded data of temperatures were shown in Fig. 3. Maximum, minimum, and average temperatures were increased with time until a 50-celsius degree for high temperature, while Fig. 4 was exposed the wind speed with time which recorded the fluctuation of wind till a 23 km/h of high value. Finally, the average daily humidity decreased with time with high and low values were 31 to 91 percent respectively as illustrated in Fig.5.

![Data analysis graphs](data:image/png;base64,iVBORw0KGgoAAAANSUhEUgAAAAEAAABCAQAAACw69FhAAAABGdBTUEAALGPC/xhBqYByxAOyHaWeluRMbLUIe4gWAEywFj8QoAAAgAElEQVR42mR1d...)

**Confirmed cases**

**Death cases**

**Recovered cases**

**Maximum Temperature**

**Minimum Temperature**

**Average Temperature**

**Maximum wind speed**

**Minimum wind speed**

**Average wind speed**

Table 1 Statistical distribution of each parameter

<table>
<thead>
<tr>
<th>Data name</th>
<th>Unit</th>
<th>Statistical distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confirmed Cases</td>
<td>No.</td>
<td>Beta</td>
</tr>
<tr>
<td>Death Cases</td>
<td>No.</td>
<td>Gen. Pareto</td>
</tr>
<tr>
<td>Recovered Cases</td>
<td>No.</td>
<td>Beta</td>
</tr>
<tr>
<td>Maximum Temperature</td>
<td>C°</td>
<td>Gen. Pareto</td>
</tr>
<tr>
<td>Minimum Temperature</td>
<td>C°</td>
<td>Triangular</td>
</tr>
<tr>
<td>Average Temperature</td>
<td>C°</td>
<td>Triangular</td>
</tr>
<tr>
<td>Maximum wind speed</td>
<td>Km/h</td>
<td>Weibull (3P)</td>
</tr>
<tr>
<td>Minimum wind speed</td>
<td>Km/h</td>
<td>Gamma (3P)</td>
</tr>
<tr>
<td>Average wind speed</td>
<td>Km/h</td>
<td>Beta</td>
</tr>
<tr>
<td>Average humidity</td>
<td>%</td>
<td>Lognormal (3P)</td>
</tr>
</tbody>
</table>

Fig. 3 Daily variation of maximum, minimum and average temperature (C°)

Fig. 2: the statistical distribution of all dataset of study

Average humidity
Fig. 4 Daily variation of maximum, minimum and average wind speed (km/h)

Fig. 5 Average daily of Humidity values (%)

3. Results and discussion

The first case of covid-19 in Baghdad city recorded on 27 February 2020. The confirmed cases where little increased but the presented study took the daily reports of the Ministry of Health and Environment of Republic of Iraq on 20 March 2020 because the reports didn't record the recovered cases until this date. The confirmed, recovered and death cases at days were drawing in Fig. 6.

There are many factors that affect infectious disease dynamics among them the services of public health and its availability which can influence the distribution of disease significantly (book). Public health steps like good nutrition, amended sanitation, and environmental alteration have been of considerable affect in changing disease transmission patterns. Indeed, some diseases have been eliminated in specific regions because of these steps. In Iraq, health services were not at the required level due to the general conditions of the country, and this could have a role in the high number of deaths compared to other regions.

Although the temperatures of Baghdad city were increased, the confirmed cases also increased with time this may be attribute to the limited health awareness level among a large segment of society, and the lack of awareness of the severity of the disease could be an effective reasons for increasing the number of conformed cases. Also the social nature of people and not distancing between them especially in occasions. Besides, regarding that the majority of people have a low standard of living with little daily income especially in the capital city, so they were not obligated to government curfew. The spread of infectious disease is highly affected by social patterns and vice versa[8]. The recovered situations increased with time and these cases were focused in the present study, which noted to 977 cases per day at maximum. The death cases were initially increased and then decreased after 8 July that illustrated in Fig. 7. The hypothesis of a statistical test to check the Spearman correlation as below [14]; the results of the correlation test at a significant level of 5%. The null hypothesis $H_0$: There is no statistically significant relationship between the recovered cases of covid-19 and weather phenomena. The alternative hypothesis $H_1$: There is a statistically significant relationship between the recovered cases of covid-19 and weather phenomena. Spearman correlation values ($r_s$) were compared with standard limits as following 0-0.19: very weak, 0.20-0.39: weak, 0.40-0.59: moderate, 0.60-0.79: strong and 0.80-1.0 very strong [15]. A positive or negative signal of Spearman values gives an impression on the nature of the relationship, whether it is direct or inverse. If it is positive that meaning direct proportional and vice versa. Table 2 offered the correlation values $r_s$ of recovered cases with each weather parameter and its conclusion according to the hypothesis. All types of daily temperature values (maximum, minimum, and
average) have a very strong directly proportional correlation with daily-recovered cases but the average value was the largest. There are no correlation between the wind speed (maximum, minimum, and average) and recovered cases because the wind speed no changed a long time. The strong inversely proportional correlation between the averages daily of humidity and daily-recovered cases. The neural networks technique was utilized to predict the importance weight of each parameter of weather that affects recovered cases. Table 3 illustrated the daily temperatures had the largest value of the importance weight, then humidity and wind (43.6%, 33.8%, and 22.6% respectively). From the above mentioned, there are matching between results of the neural network and Spearman correlation values about the largest of weather parameters effect on recovered cases represented by temperature. The high temperatures were ordinary results of sunlight; some patients may had proper exposure to the sun that may be contributed to increasing the recovered cases of the study area. In 2020, Asyary [16] concluded that the recovered cases increased with sunlight exposure. It is important to note that even if there is an influence of weather in any aspect during covid-19 pandemic all precautions must be taken and social distancing must be committed, by returning to a much higher level of compliance with social distancing that would slow the spread of covid-19.

**Table 2 Recovered cases and correlation values coefficient**

<table>
<thead>
<tr>
<th>Weather phenomena</th>
<th>Units</th>
<th>Spearman correlation coefficient</th>
<th>P-Value</th>
<th>Conclusion about H₀</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. temperature</td>
<td>Celsius</td>
<td>0.859</td>
<td>0.000</td>
<td>Reject</td>
</tr>
<tr>
<td>Min. temperature</td>
<td>Celsius</td>
<td>0.842</td>
<td>0.000</td>
<td>Reject</td>
</tr>
<tr>
<td>Av. temperature</td>
<td>Celsius</td>
<td>0.873</td>
<td>0.000</td>
<td>Reject</td>
</tr>
<tr>
<td>Max. wind speed</td>
<td>Km/h</td>
<td>0.096</td>
<td>0.281</td>
<td>Accept</td>
</tr>
<tr>
<td>Min. wind speed</td>
<td>Km/h</td>
<td>0.058</td>
<td>0.519</td>
<td>Accept</td>
</tr>
<tr>
<td>Av. speed wind</td>
<td>Km/h</td>
<td>0.092</td>
<td>0.305</td>
<td>Accept</td>
</tr>
<tr>
<td>Humidity</td>
<td>%</td>
<td>-0.746</td>
<td>0.000</td>
<td>Reject</td>
</tr>
</tbody>
</table>

![Fig.6 Cases types of covid-19 in Baghdad city](image-url)
Conclusions

The recovered cases of COVID-19 may be affected by the weather parameters according to available data of Baghdad city. However, when regarding the inclusion of these findings attentiveness is required, that may be expose to conflicting. Moreover, the majority of COVID-19 data has until now been peer-reviewed. The recovered cases had very strong to strong correlation with weather parameters that represented the temperatures and humidity values respectively. The direct proportional between the recovered cases and daily temperatures while it is inverse with daily humidity. The neural network techniques gave the importance weight of the independent variables of weather on the dependent variables of recovered cases. These results arranged the percentages of weather importance as daily temperatures, humidity, and wind speed sequentially. These outcomes researched to hope the increase of recovered cases with weather changes. But depending on weather changes alone to slow the COVID-19 spread are not to give a clear picture of what is actually happening on the ground.

References


Fig. 7 Number of daily death cases of COVID-19

Table 3 Independent variable importance of weather parameters

<table>
<thead>
<tr>
<th>Weather parameters</th>
<th>Importance</th>
<th>Normalized Importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humidity</td>
<td>0.338</td>
<td>77.6%</td>
</tr>
<tr>
<td>Temperature</td>
<td>0.436</td>
<td>100.0%</td>
</tr>
<tr>
<td>Wind speed</td>
<td>0.226</td>
<td>51.8%</td>
</tr>
</tbody>
</table>