

## The Relationship between Ambient Temperature and Positive Cases of COVID-19; A Case Study in Abarkouh and Qeshm Cities of Iran

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### ABSTRACT

**Introduction:** The prevalence of infectious diseases varies depending on the type of micro-organism involved. Viral diseases can spread rapidly among communities, due to the specific characteristics of the virus. Coronavirus disease 2019 (COVID 19) is a new member of the coronavirus family that has caused rapid epidemics and affected the health and economy of the countries. The aim of this study was to investigate the relationship between the ambient temperature and the positive cases of COVID 19.

**Materials and Methods:** In the present research, the relationship between the number of positive cases of COVID 19 and the ambient temperature was investigated in Abarkouh and Qeshm cities during a 49-day period. The collected data were analyzed by SPSS 16 software using descriptive statistics and correlation coefficient tests.

**Results:** The average ambient temperatures in the study period were  $19.16 \pm 3.45$  and  $25.79 \pm 1.83$  for Abarkouh and Qeshm cities, respectively. During this period, the positive cases in Abarkouh and Qeshm cities were 38 and 28 people, respectively. The results of correlation test revealed a negative correlation between the ambient temperature and the number of patients with COVID 19 (the correlation rates were -0.107 and -0.083 with p-values of 0.46 and 0.57 for Abarkouh and Qeshm, respectively).

**Conclusion:** Our results revealed that increase of air temperature was negatively correlated with the number of positive cases of COVID 19. It can be concluded that atmospheric temperature affects the virus outbreak. So, the rate of virus spread is expected to be reduced.

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### Introduction

Viruses are a major cause of acute and chronic illnesses in human beings. They are common pathogens in hospital environments, health care

services, and in crowded places with poor hygiene such as schools and kindergartens<sup>1-3</sup>. Most viral infections are subclinical and asymptomatic; however, mild viral illnesses can put a heavy

burden on the economy and health care systems<sup>4</sup>. The mild viral illnesses are an important predisposing factor for more serious and perhaps secondary fatal bacterial infections<sup>5</sup>. Viral infections cause 60% of the human infections, most of which are caused by respiratory and intestinal viruses<sup>6,7</sup>. Annually, 1.7 million deaths are reported from diarrhea diseases and 1.5 million deaths are caused by respiratory infections worldwide<sup>8</sup>. Several factors can affect environmental pollutants<sup>9</sup> and spread of viral infections that include unsanitary conditions, susceptible host, population congestion, high infectivity of viruses even at low doses, as well as excretion of viruses from the infected person before the onset of symptoms until several days after recovery<sup>10</sup>. In December 2019, the main outbreak center of Coronavirus disease 2019 (COVID 19) (SARS CoV-2) was Wuhan, Hubei province<sup>11</sup>. The virus began to spread rapidly among countries, with a much higher prevalence than severe acute respiratory syndrome (SARS)<sup>11</sup>. The global prevalence of COVID 19 has created many barriers to public health and the global economy<sup>12</sup>. To control the prevalence of COVID 19, biological characteristics of the virus should be investigated in the natural environment, especially in the outbreak time. Temperature is an important factor influencing the survival of micro- and macro-organisms that can play an important role in the spread and control of epidemics<sup>13</sup>. The viability of micro-organisms varies in different environments and temperatures<sup>10</sup>. Temperature and humidity of the environment

are effective factors on the outbreak of COVID19. At the beginning of the outbreak, countries with lower temperatures and humidity (such as Korea, Japan, and Iran) had a higher prevalence rate than warmer countries with high humidity (such as Singapore, Malaysia, and Thailand)<sup>14</sup>. Based on previous studies, at the time of SARS outbreak in 2003, the number of infected people in areas with low temperatures was 18.18 times higher than those who lived in areas with higher temperatures<sup>15</sup>.

The aim of this study was to investigate the positive cases of COVID19 and its correlation with the ambient temperature in two cities of Abarkuh and Qeshm with different average temperatures in a 49-day period.

### Materials and Methods

This descriptive-analytical study was carried out in two cities of Abarkouh and Qeshm with a population of 51199 and 45178, respectively. To conduct the study, the number of positive cases (confirmed by a testing kit and CT scan) and the air temperature were examined from February 20<sup>th</sup> to April 8<sup>th</sup>. The relationship between the number of positive cases and the ambient temperature was analyzed using descriptive statistics and correlation coefficient tests by SPSS (version 16.0.).

### Results

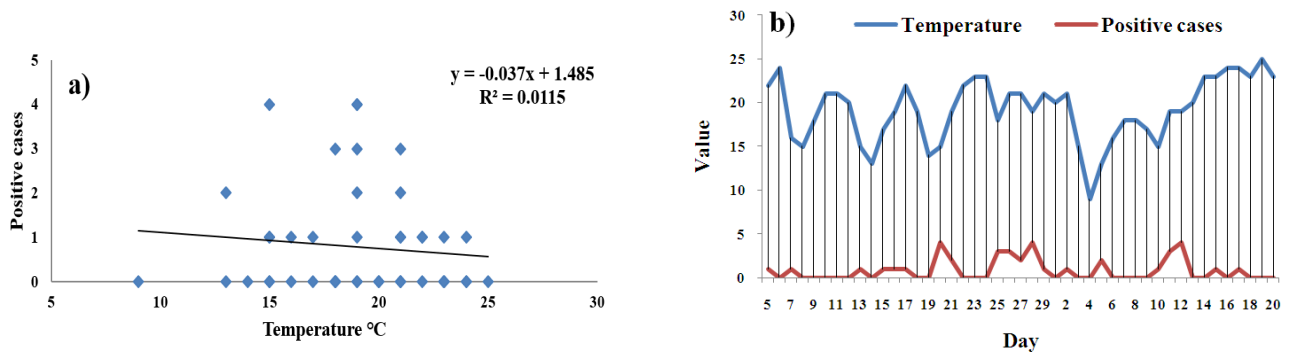
During the studied period, the average ambient temperature for Abarkouh and Qeshm cities were  $19.16 \pm 3.45^{\circ}\text{C}$  and  $25.79 \pm 1.83^{\circ}\text{C}$ , respectively. Moreover, the number of positive cases were 38 and 28 in Abarkouh and Qeshm, respectively (Table 1).

**Table 1:** The ambient temperature, the number of definite cases, and the correlation test during the study period

Location	Days	Minimum temperature	Maximum temperature	Mean temperature	Std. deviation	Positive cases	Correlation	P-value
Abarkouh	49	9.00	25.00	19.16	3.45	38	-0.107	0.46
Qeshm	49	22.00	33.00	25.79	1.83	28	-0.083	0.57

With regard to Abarkouh City, statistical analysis showed that the correlation between ambient temperature and number of positive cases was determined as -0.107. Furthermore, the rate of determination was 0.011, which indicates that 1.1% of the changes in the dependent variable (the

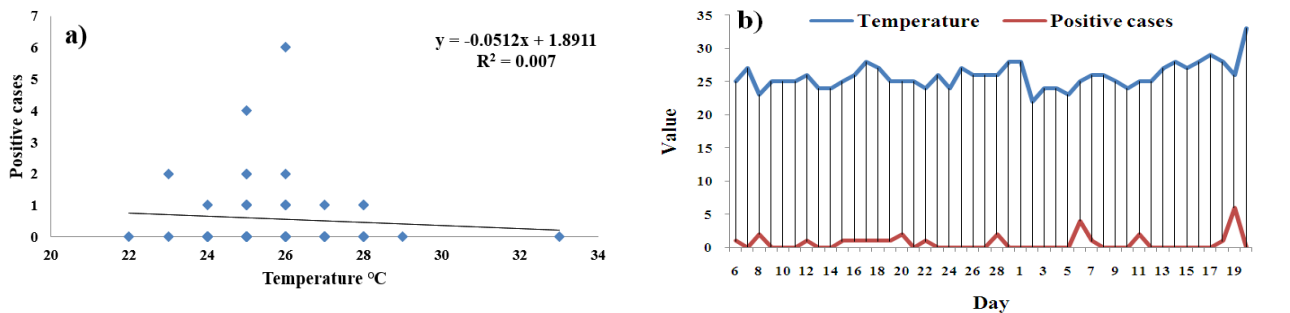
numbers of positive cases) can be expressed by the ambient temperature. Figure 1a illustrates the correlation between temperature and the number of positive cases. The correlation between the number of positive cases and the daily temperature is represented in Figure 1b.



**Figure 1:** a) Correlation between temperature and the number of positive cases (correlation; -0.107 and p-value; 0.46), b) Correlation between the number of positive cases and the daily temperature during the study period in Abarkouh City

Considering Qeshm, statistical analysis revealed that the correlation between the ambient temperature and the positive cases was -0.083 and the rate of determination was 0.007. In other words, 0.07 percent of the dependent variable (the number of positive cases) is expressed by

the ambient temperature. Figure 2a illustrates the correlation between temperature and the number of positive cases. Figure 2b shows the correlation between the number of positive cases and the daily temperature during the study period.



**Figure 2:** a) Correlation between temperature and number of positive cases (correlation; -0.083 and p-value; 0.57) b) Correlation between the number of positive cases and daily temperature during the study period in Qeshm City

**Discussion**

According to the findings, the ambient temperature of Abarkouh City had higher thermal turbulence compared to Qeshm City in the study period; the ambient temperature varied from 9 to 25 °C with an average of  $19.16 \pm 3.45$  °C in Abarkouh City. The city of Qeshm had lower thermal turbulence with a high average temperature of  $25.79 \pm 1.83$ . The comparison of the number of positive cases between these two cities revealed that the percentage of positive cases in Qeshm was 15% lower than that of Abarkouh. Results of the correlation test between temperature and the number of positive cases in the studied cities showed that the number of

positive cases decreased by increase of temperature (Figures 1a and 2a). The correlation between temperature and the number of positive cases was more obvious in Abarkouh due to higher thermal turbulence. The daily temperature comparison chart and the number of positive cases (Figures 1b and 2b) also indicate an increase in the definite number of COVID 19 cases when the average temperature decreases. According to previous studies, high temperature and humidity reduce the rate of transmission and spread of influenza<sup>16-18</sup>, which can be justified by the following justifications. First, influenza is more stable at low temperatures and humidity<sup>19, 20</sup> and second, wet and cold weather can weaken

the host's immune system and make the person more vulnerable to the virus<sup>21, 22</sup>. Moreover, the literature indicated that increase of the ambient temperature and humidity reduced the viability of SARS coronavirus<sup>23, 24</sup>. In addition to the epidemiological studies, laboratory studies have also confirmed this finding<sup>18, 25-27</sup>. Moreover, infectivity of the virus increases under low temperature and humidity conditions. The results of a study on swine flu revealed that the infection rate at a temperature of 5 °C and humidity of 35-50 % was in the range of 75 to 100%. However, with an increase of temperature to 30 °C and humidity to 35%, the infectious rate was zero<sup>28</sup>. Another study found that three key factors of temperature, humidity, and wind speed were effective in the spread of SARS virus<sup>24</sup>. A laboratory study of the SARS virus reported that the virus could remain active on smooth surfaces for at least 5 days at the temperature of 22 to 25 °C with the humidity of 40 to 50%. In the case that the temperature elevated to 38 °C and the relative humidity increased to 95%, the virus lost its activity quickly<sup>23</sup>. Another study published in 2013 found that Middle East Respiratory Syndrome virus remained active for a long time under low temperature and humidity conditions<sup>29</sup>. Wang et al. also investigated the effect of high temperature and humidity. Based on their results, high temperature and humidity reduced the transmission of COVID-19<sup>14</sup>.

### Conclusion

The correlation between the number of positive cases of COVID 19 and temperature was investigated in Abarkouh and Qeshm cities during a 49-day period. Based on the findings, the number of positive cases were decreased by increase of the ambient temperature in both cities. In Abarkouh, the relationship between the number of positive cases and the air temperature was more obvious due to the higher thermal turbulence. A significant decrease is expected in the number of positive cases in the coming days and months due to the increase of ambient air

temperature, which is unfavorable for the virus survival.

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### Conflict of interest

No conflict of interest was stated by the authors.

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