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Does the temperature variation and humidity affect the transmission of the coronavirus Covid-19 in Egypt?

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Abstract

The new SARS-CoV-2 coronavirus, that causes the COVID-19 disease, was reported in Wuhan, China, in December 2019. This disease has spread-out speedily around the world in more than 200 countries involved Egypt. This study sought to examine the associations of daily highest temperature (HT), lowest temperature and relative humidity (RH) with the daily counts of COVID-19 cases in Egypt started from 5 March till the first week of August 2020. This study employed the data of daily infected people collected and announced daily by the Egyptian Ministry of Health and population. Many previous studies have supported an epidemiological hypothesis that weather conditions may affect the survival and spread of droplet-mediated viral diseases. However, some contradictory studies have also been reported in the same research topics. Pearson correlation test and multiple regression analysis were used for data analysis to measure the correlation and also multiple regression which have been done on the daily infected cases with minimum and maximum temperature and relative humidity throughout the period of March till the first week of August (2020). The results of Pearson test showed that values of minimum temperature has significant effect on the infected cases of COVID (r= 0.5973, n=160, P= 0.041) and in the meantime the multiple regression analysis revealed that the whole factors including minimum, maximum and relative humidity showed a positive significant relationship with the number of daily infected cases of COVID-19, (F. ratio= 125.375, P=0.000) where the number of infection decrease with the increasing in the temperature and relative humidity.

Keywords: Corona virus, COVID19, climate, temperature, relative humidity

Introduction

Coronavirus disease (COVID-19) is an infectious disease caused by a newly discovered coronavirus. Most people infected with the COVID-19 virus will practice slight to moderate respiratory infection and recover without demanding special treatment. Elder people and those with primary medical difficulties like cardiovascular disease, diabetes, chronic respiratory disease, and cancer are more likely to develop serious illness (WHO, 2020).

In fact, the best way to prevent and slow down transmission is to be updated about the COVID-19 virus, how it causes and way of spreading. Protect yourself and others from infection by washing your hands or using an alcohol based rub frequently and not touching your face. The COVID-19 virus spreads primarily through droplets of saliva or discharge from the nose when an infected person coughs or sneezes, so it's important that you also practice respiratory etiquette (for example, by coughing into a flexed elbow). At this time, there are no medical treatments for curing or any approved vaccines for COVID-19.

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In fact, COVID-19 is a huge social problem more than a health crisis. It created shocking social, financial and political disasters that will leave very deep marks in the near future for everybody. In overall, people lost their jobs and income, and nobody can tell when normality of life will be back. In fact, many countries and small islands where deeply dependent on tourism activities and their economy destroyed due to the effect of COVID-19. Recently, the International Labour Organization declared that at least 25 million jobs will be lost in the very near future. However, most countries

across the globe have now implemented a suite of strategies to reduce transmission of the novel coronavirus and mitigate the effects of the COVID-19. The main objective for this study to investigate the association between the corona virus and variation of temperature and humidity in Egypt, does the hot weather affect the spreading of the COVID 19?

Present situation of Covid-19 in Egypt

Egypt is considered as one of the extraordinary countries due to the richness of its history and the meaning of its position between the other countries. Over the years Egypt has had named by different names with different languages due to the richness of its history. Egypt is well-known as the Arab Republic of Egypt. Egypt is located in the north east part of Africa and covers around 1,001,450 km2, well known as the 3 rd. most populous country in Africa (Photo 1). Due to Egypt's exceptional position on the map Egypt is well known as one of the most powerful countries in the Middle East and the Muslim world. Since ancient Egypt and the land of the pharaohs were divided into two regions or Kingdoms they were called Upper Egypt and Lower Egypt. The terminologies of Upper and Lower Egypt came as result to the flow of the Nile River.

Egypt is a huge country and the desert land represents the largest portion of it. Most Egyptian (95% of Egypt's total people) lives in areas around the coast of the Mediterranean Sea and along the Nile River. This comprises the cities of Cairo, Alexandria, Aswan, and Port Said. Generally, Egypt is divided into 29 areas, called Governorates of Egypt. The current population of Egypt is 102,500,680 as of Tuesday, August 4, 2020, based on World meter explanation of the latest United Nations data. Egypt population is equivalent to 1.31% of the total world population and ranks number 14 in the list of countries (and dependencies) by population. The population density in Egypt is 103 per Km^2 and the total land area is 995,450 Km^2, however 43.0 % of the population is urban (44,041,052 people in 2020). The median age in Egypt is 24.6 years.

Photo 1. General map of Egypt showing the main international boundaries, cities and main roads.

Climate of Egypt

Although different regions experience diverse weather patterns, Egypt has an arid desert climate and is very hot and sunny climate. In fact, Egypt essentially has a hot desert climate (Köppen climate classification). The climate is generally extremely dry all over the country except on the northern Mediterranean coast which receives rainfall in winter. In addition to rarity of rain, extreme heat during summer months is also a general climate feature of Egypt although daytime temperatures are more moderated along the northern coast (Weather Atlas/Egypt, 2020).

Generally, as part of the northern hemisphere, seasons in Egypt follows the similar pattern as in America and Europe with winter falling between November and January, and the highest peak summer months is falling between June and August. Winters are normally mild, and temperatures can fall below 10^{o}C degrees at night. Frequently in desert, temperature dropped below freezing during the winter months. Summer is extremely hot in the desert areas and other areas of the country's interior. In Cairo, average summer temperatures regularly exceed 30^{o}C degrees, while as the highest

degree of temperature recorded in Aswan, 51^{o}C degrees (Figure 1). Egypt receives usually between 20 to 200 mm of annual average precipitation along the narrow Mediterranean coast, and zero mm towards to the south. The cloudiest, rainiest places are in and around Alexandria and Rafah are considered the rainiest and coolest places in Egypt. As an overview for the climate of Egypt around this year can be seen obviously in table 1. In the meantime, to explore the association between climatic variation and COVID-19 transmission, we had to employ and use the daily high and low temperature and humidity, with the infected number of cases with COVID-19, and apply the Pearson correlation test and multiple regression analysis.

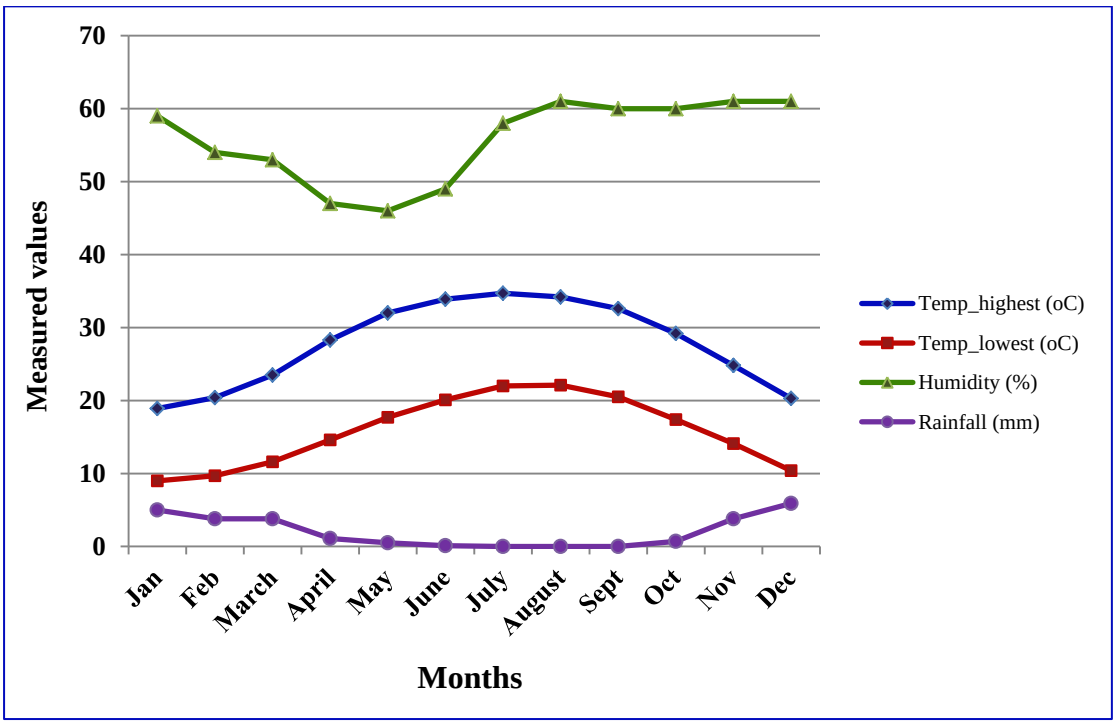


Figure 1. Climatic data including the average of highest, lowest temperatures, relative humidity and amount of rainfall during a whole year in Egypt.

Table 1. Shows the average of high and low monthly temperature, relative humidity, UV index, Daylight/h, and Sunshine/h during the study period March to July 2020.

Month	March	April	May	June	July
High temperature	23.5	28.3	32	33.9	34.7
Low temperature	11.6	14.6	17.7	21.1	22
Humidity percentage	53	47	46	49	58
UV index	7.A	9.A	10.A	12.A	12.A
Day light/h	12	12.9	13.7	14.1	13.9
Sunshine/h	8.7	9.7	10.5	11.9	11.7

The results

The relationship between climatic factors and infected cases of COVID-19 extended 6 month, started from March till the first week of August, 2020 (Figure 2).

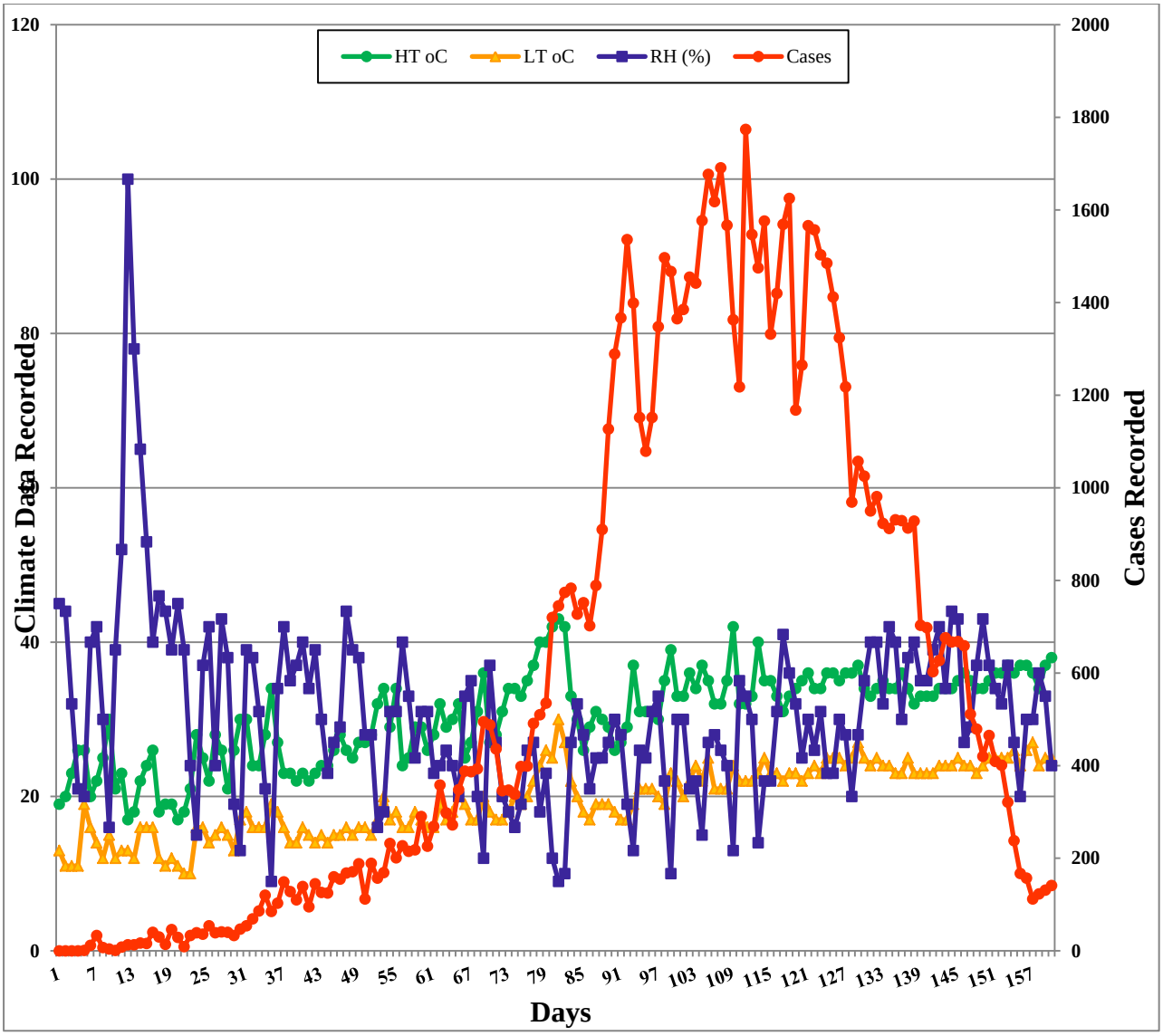


Figure 2. The relationship between number of infected cases with COVID-19 and climate factors including highest temperature (HT), lowest temperature, and relative humidity (RH) during March till first week of August 2020.

The first infected case with COVID-19 was recorded on March fifth, 2020 in Egypt, and then started the infected cases increased gradually in April, May and it reached to the highest peak number in June where the temperature was very high (33.9 ^{o}C) and started to decrease by time at the end of July and beginning of August. The mean values of infected in March was the lowest value for whole period of our study (22.87) and the highest mean value was in June, (1444.2). The number of infected cases decreased in August to reach around 100-200 person daily. The results of Anova

one way analysis showed variation in the infected cases and the climatic factors as follows:

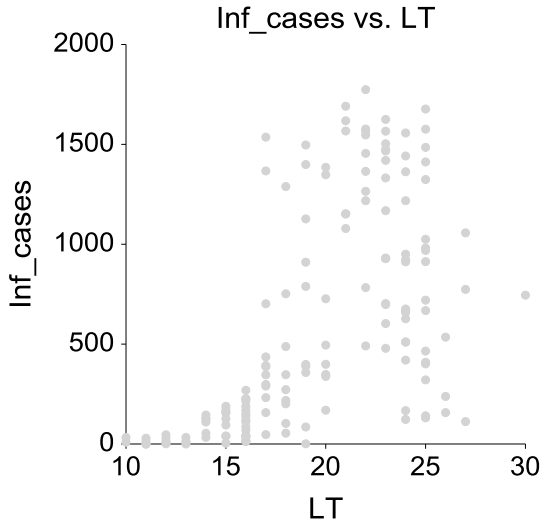
1- Infected cases were varied significantly in five months as categories (F. 166.9653, P= 0.000),

2- The variation of daily minimum temperature (F. 114.4480, P=0.000),

3-The variation of daily maximum temperature (F. 57.5238, P= 0.000), and

4-The variation of relative humidity (F. 10.0734, P= 0.000).

The results of correlation test (Pearson test) showed that there a significant correlation between the increasing in the infected case with daily minimum temperature (r= 0.5973, n=160, P= 0.041), on the other hand the correlation between highest temperature recorded and the infected case was not significant (r=0.5692, n=160, 0.1156). Meantime, there is no significant correlation, between infected cases and relative humidity (r=-0.2788, n=160, P=1.000). The relationship between the infected cases of COVID-19 and minimum temperature, maximum temperature, and relative humidity represented by scatter diagram (Figure 3).



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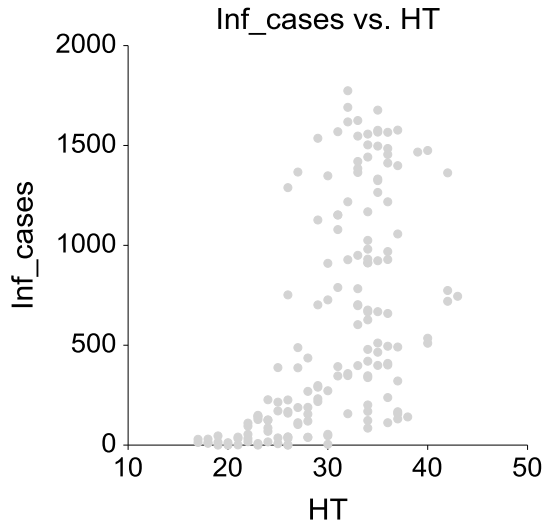

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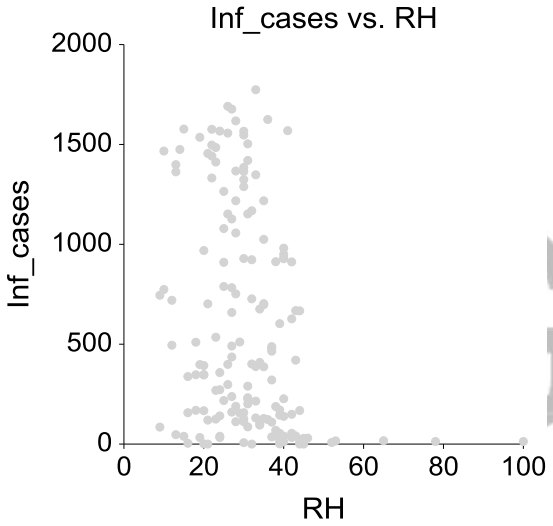
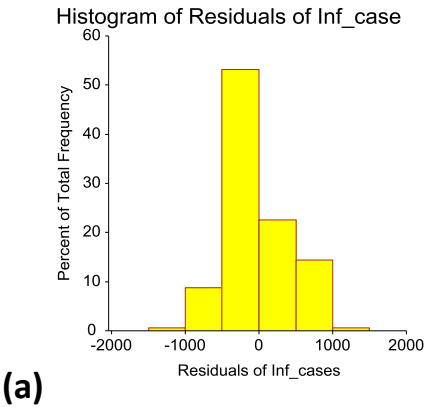


(c)

Figure 3. Scatter Plot Sections show the relationship between the infected cases of COVID-19 and (a) minimum temperature, (b) maximum temperature, and (c) relative humidity.



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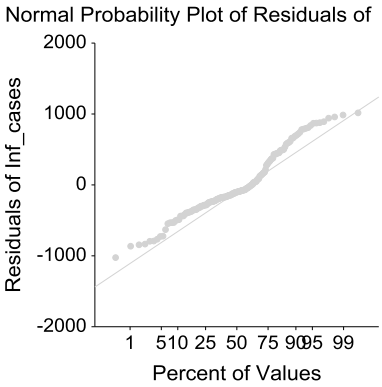
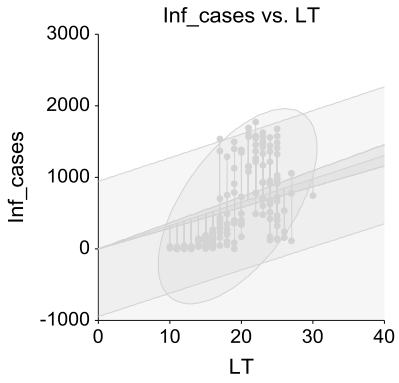


(b)

Figure 4. The output results of multiple regression analysis (a) residuals of infected cases vs. percent of total frequency and (b) normal probability of residuals.



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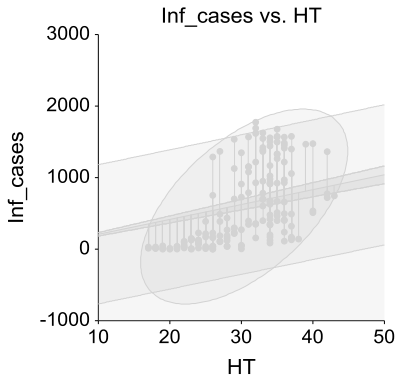

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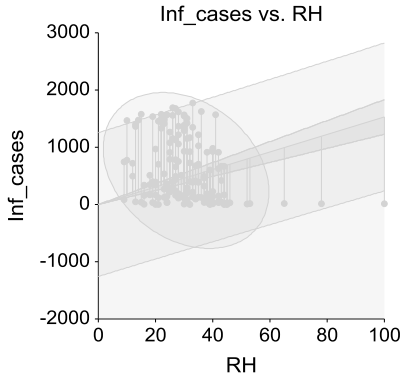

(c)

Figure 5. Output results of multiple regression analysis between infected cases and (a) the daily minimum temperature, (b) daily maximum temperature and (c) relative humidity.

The results of multiple regression analysis considering the infected cases as independent factors and minimum, maximum and relative humidity as a variables, showed a significant correlation, which it means that infection cases decreased with increasing in temperature and relative humidity (F ratio= 125.375, P>0.000), also, 0.0240, 0.000, for minimum, maximum and relative humidity respectively. The output of regression analysis between infected cases and climatic factors represented by figures 4 and 5.

Discussion

Since the outbreak of the novel SARS-like coronavirus (SARS-CoV-2) or what is very known nowadays COVID-19 which appeared in Wuhan, China, and a large number of reports have been published to discuss the possible roles of environmental factors in transmission of the novel coronavirus. Mostly, they have focused especially on the impact of two air parameters, temperature and humidity, on the spread of COVID-19. Our present study focused on finding the associations between the spread-out of COVID-19 in Egypt and the variation in temperature and relative humidity. We will discuss here the most recent studies which published this year 2020 and until now with our results from this study.

Liu, *et al* (2020) projected to explore the associations between novel coronavirus disease 2019 (COVID-19) case counts and meteorological factors in 30 provincial capital cities of China. They found that meteorological factors play an independent role in the COVID-19 transmission after controlling population migration. In fact, their local weather conditions were with low temperature, mild diurnal temperature range and low humidity likely favor the transmission.

Another study in China by Shi, *et al* 2020, they studied the effects of temperature on the dynamics of the COVID-19 epidemic. They found that overall epidemic intensity of COVID-19 reduced slightly following days with higher temperatures with a relative risk (RR) was 0.96 (95% CI: 0.93, 0.99), in general the increase in temperature affect the spread of the virus.

The third main study in China was done by Qi, *et al* 2020, they sought to examine the associations of daily average temperature (AT) and relative humidity (ARH) with the

daily counts of COVID-19 cases in 30 Chinese provinces (December 1, 2019 to February 2020). They found that main conclusion was AT and ARH showed significantly negative associations with COVID-19 with a significant interaction between them (0.04, 95% confidence interval: 0.004–0.07). They found that every 1 °C increase in the AT led to a decrease in the daily confirmed cases by 36% to 57% when ARH was in the range from 67% to 85.5%. Also, they concluded that every 1% increase in ARH led to a decrease in the daily confirmed cases by 11% to 22% when AT was in the range from 5.04 °C to 8.2 °C.

Another similar study done by Xie and Zhu (2020), aimed to determine whether the temperature is an important factor in the infection caused by COVID-19. The daily infected cases and climatic factors in 122 cities were collected between January 23, 2020, to February 29, 2020. They found that mean temperature has a positive linear relationship with the number of COVID-19 cases with a threshold of 3 °C but there is no evidence supporting that case counts of COVID-19 could decline when the weather becomes warmer. This study disagrees with our results which proved significant correlation between the decreasing in infected cases and increasing in temperature and relative humidity.

On other hand, one more study done in China also by Yao *et al* (2020). They aimed to determine the association of meteorological factors with the transmission of COVID-19 in various Chinese cities. They used the cumulative number of confirmed cases from 224 cities; they found no significant associations of, relative humidity, maximum temperature and minimum temperature with cumulative incidence rate or R_0 of COVID-19.

In USA, a recent study done by Bashir, *et al* (2020), that study was aiming as our aim to analyzed the association between COVID-19 and climate indicators but in New York City, USA. They used secondary published data from New York City health services and National weather service, USA. They used the climate indicators including average temperature, minimum temperature, maximum temperature, and relative humidity quite similar to what we done but they added more climatic factors such as rainfall, wind speed, and air quality. Our results agreed with this study Bashir, et al 2020, which it revealed that the increasing in temperature degrees affect and decreases the infection and spread out of COVID-19 pandemic. The findings of this

study will help World Health Organization and health regulators such as Center for Disease Control (CDC) to combat COVID-19 in New York and the rest of the world.

One more recent study on the same topics we discussed here about the correlation between weather and COVID-19, in Jakarta, Indonesia by Tosepu, *et al* (2020). Their study employed the components of weather include minimum temperature (°C), maximum temperature (°C), temperature average (°C), humidity (%), and amount of rainfall (mm). They found that only temperature average (°C) was significantly correlated with covid-19 pandemic ($r = 0.392$; $p < .01$). This also agreed with our present study here in Egypt.

In Spain, a study done by Briz-Redón and Serrano-Aroca (2020), also this year on our topic but they concluded that there is no evidence suggesting a reduction in COVID-19 cases at warmer mean, minimum and maximum temperatures has been found. In the meantime they emphasized that these results need to be interpreted cautiously given the existing uncertainty about COVID-19 data. Subsequently, our study with more studies are describe and important to be there for the scientific community.

Another interesting study done by Jahangiri, *et al* (2020), they intend to investigate the sensitivity of Temperature and population size on the transmission rate of COVID-19, the novel coronavirus in different provinces of Iran. On contrary with our results of present study, they had no scientific reason to confirm that the number of COVID-19 cases in warmer climates is less than that of moderate or cold climates. Therefore, they recommended their cities/provinces with a population of over 1.7 million people have stricter inspections and more precise controls as their management policy.

Eventually, our results showed an association between infected cases and the climatic factors including temperature and relative humidity. In fact, COVID-19 pandemic is presently exhibiting an even more adverse movement. Our results suggest that the growth rate of COVID-19 may increase with decrease in temperature and humidity. However, COVID-19 is in a stage of low infectivity and rapid transmission in Egypt and arid land generally. We think that our country and neighbors countries with same climate should take active and precise measures to control the rest stage of first pandemic and prevent a second wave of COVID-19.

Conclusions

Our present findings deliver initial evidence that the COVID-19 pandemic suppressed with temperature and relative humidity increases. However, active and precise measures must be taken to control the source of infection, block transmission and prevent any further spread of COVID-19 in the country.

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References

Bashir MF, Ma B, Bilal, Komal B, Bashir MA, Tan D, et al. (2020).Correlation between climate indicators and COVID-19 pandemic in New York, USA. *Sci Total Environ.* 728:138835. doi: 10.1016/j.scitotenv.2020.138835

Briz-Redón, Á., & Serrano-Aroca, Á. (2020). A spatio-temporal analysis for exploring the effect of temperature on COVID-19 early evolution in Spain. *The Science of the total environment*, *728*, 138811.

Jahangiri M, Jahangiri M, Najafgholipour M. (2020).The sensitivity and specificity analyses of ambient temperature and population size on the transmission rate of the novel coronavirus (COVID-19) in different provinces of Iran. *Sci Total Environ.* 728:138872. doi: 10.1016/j.scitotenv.2020.138872

Liu J, Zhou J, Yao J, Zhang X, Li L, Xu X, et al. (2020) Impact of meteorological factors on the COVID-19 transmission: a multi-city study in China. *Sci Total Environ.* 726:138513. doi: 10.1016/j.scitotenv.2020.138513

Qi H, Xiao S, Shi R, Ward MP, Chen Y, Tu W, et al.(2020). COVID-19 transmission in Mainland China is associated with temperature and humidity: a time-series analysis. *Sci Total Environ.* 728:138778. doi: 10.1016/j.scitotenv.2020.138778

Shi P, Dong Y, Yan H, Zhao C, Li X, Liu W, et al. (2020).Impact of temperature on the dynamics of the COVID-19 outbreak in China. *Sci Total Environ.* 728:138890. doi: 10.1016/j.scitotenv.2020.138890

Tang, Julian (2009).The effect of environmental parameters on the survival of airborne infectious agents, Journal of the Royal Society, Interface / the Royal Society

Tosepu R, Gunawan J, Effendy DS, et al. (2020). Correlation between weather and Covid-19 pandemic in Jakarta, Indonesia. *Sci Total Environ*.;725:138436. doi:10.1016/j.scitotenv.2020.138436

Weather Atlas/Egypt (2020). https://www.weather-atlas.com/en/egypt-climate

WHO (2020). World Health Organization. https://www.who.int/health-topics/coronavirus#tab=tab_1

Xie J, Zhu Y. (2020). Association between ambient temperature and COVID-19 infection in 122 cities from China. *Sci Total Environ.* 724:138201. doi: 10.1016/j.scitotenv. 138201

Yao Y, Pan J, Liu Z, Meng X, Wang W, Kan H, et al. (2020).No association of COVID-19 transmission with temperature or UV radiation in Chinese cities. *Eur Respir J.* 55:2000517. doi: 10.1183/13993003.00517-