Review Article

Open Access CrossMark

A chronicle of temperature and SARS-CoV-2 viability: a retrospective study

Abstract

The COVID-19 outbreak, which emerged in Wuhan city China, at the end of 2019, burgeoned into a pandemic in March 2020 and now has become a grievous public health issue. One of the pronounced features of this malady was its propensity of transmission in the healthcare premises, among close family and social contact. The stability of the virus at different temperature and the influence of meteorological factors on the transmission posed to be key factors for the spread of COVID-19 since the beginning. This study aimed to find the impact of temperature on the extremity of the COVID-19 outbreak on a worldwide scale and to explore the association between COVID-19 death and weather parameter. As it was earlier speculated that the transmission of COVID-19 might be dwindling or even disappeared when the temperature and UV radiation increase in the summer. So, since the climate seems to be one of the key variances between the countries with high and low COVID-19 cases, we have cross-checked temperature among the topmost 50 affected countries with COVID-19. Our perusal showed no possible association between low temperature and high temperature with increases number of daily COVID-19 cases throughout the world.

Keywords: COVID 19, temperature, warmer climate, lipids molecules, transmissible disease

Mohd Faizan Siddiqui
International Medical Faculty, Osh State University, Osh City, 723500, Kyrgyz Republic (Kyrgyzstan)

Correspondence: Mohd Faizan Siddiqui, International Medical Faculty, Osh State University, Yugovostok, Osh City, 723500, Kyrgyz Republic, Tel +996-500005786, Email Fzn.imf@gmail.com

Introduction

The world is currently threatened with a new public health crisis with the emergence and unfurled COVID-19 by SARS-CoV-2 (Severe Acute Respiratory Syndrome Coronavirus 2). Initially, the cases were reported in Wuhan city of China, and now the alarming number of daily cases across the world has resulted in unprecedented public health action by the government of the concern countries, including quarantine announcement and travel restriction in many countries. The disease is predominantly transmitted by inhalation or contact with infected droplets (>5-10µm) and having 2 to 14days of the incubation period.[1] Transmission may also be transpired by indirect contact with the surface in the immediate environment or with object used in infected persons (like a stethoscope or thermometer), i.e. nosocomial transmission, similar to previous coronavirus outbreaks. However, the relative prominence of these routes of transmission is currently unclear.[2] The disease seems to be mild in most people, but it may progress to respiratory distress, pneumonia and multi-organ dysfunction, usually in elder patient, especially those with comorbidities.[3] As of Jun 24, 2020; more than 9.24 Million cases of COVID-19 has been reported in globally with 3% to 4% mortality rate and at the same day this havoc has been proclaimed as a pandemic by the WHO. Also as being transmitted be faecal contamination, hence the country and multiple cities with poor sanitization and sewage disposal system are at major risk for covid transmission too. Therefore it is the utmost importance to halt any additional spread of this serious illness in the public and healthcare sites.[4]

Generally, the flu causing virus, i.e. influenza virus's outer membrane is composed of lipids molecules, and in the cold season, virus's outer covering becomes rubbery and becomes more protective that can withstand travel from person to person. But when the weather temperature raises, these covering thaws gradually, which eventually melts and resulting in a soupy mix.[5] Besides, the sunlight (ultraviolet rays) and humidity change plays an essential role in destroying viruses.[2,6] In our study, we explore the local weather pattern (temperature-based) of the COVID-19 affected countries from Jan 1, 2020, until Jun 24, 2020. We have selected the top 50 most affected countries with the highest number of COVID-19 cases and additional few central Asian countries which are sharing their country border with China, and then we prospect our findings for the possible association between daily COVID-19 cases and the meteorological parameters.

Material and method

Study area and data collection

The per day count of new laboratory-confirmed and probable cases of the 50 most severely affected countries were retrieved from an online collaborative dashboard to track COVID-19 live by the official reports of coronavirus disease (COVID-2019) situation reports - World Health Organization (WHO) from Jan 1,2020, to (Jun 24,2020) (Supplementary data-1). The meteorological data, including the daily average temperature of the most infected cities of the designated countries, were retrieved from the AccuWeather and Weather Spark from Jan 1, 2020, to Jun 24, 2020. The meteorological data was limited and did not include all the cities of the selected countries. Also, these data on the country's climate were fetched from the official reports previously released on their website; therefore, no ethical review was required. The complete details are given in Table 1.

Statistical analysis

A descriptive study was performed with statistical data and numerical variable to calculate the relationship between the temperature data and the total number of cumulative confirmed COVID-19 cases. Table 1 summarizes the expository statistics for the daily increasing confirmed cases of COVID-19 and meteorological variables. This study includes 50 topmost affecting countries, including a total of 9.5 million cases globally in the course of our observation period from Jan 1, 2020, to Jun 24 2020.

Table 1 The average temperature since January 2020 to June 2020 of the top 50 countries

	1st reported case	JAN	FEB	March	April	May	June
USA	20-Jan	Avg MaX. :: Avg Min.	Avg MaX. :: Avg Min.	Avg MaX. :: Avg Min.	Avg MaX. :: Avg Min.	Avg MaX. :: Avg Min.	Avg MaX. :: Avg Min.
· New York		5°C--4°C :: -1°C--2°C	4°C--8°C::-2°C--0°C	8°C--13°C::1°C--5°C	13°C--19°C :: 5°C--11°C	19°C--24°C :: 11°C--16°C	24°C--28°C :: 16°C--20°C
· New Jersey		5°C--4°C::-1°C---3°C	4°C--8°C::-3°C--0°C	8°C--13°C::0°C--5°C	13°C--20°C :: 5°C--10°C	20°C--25°C :: 11°C--16°C	25°C--29°C :: 16°C--20°C
· Michigan		-7°C--9°C :: -4°C--6°C	1°C--5°C::-6°C---2°C	5°C--11°C::-2°C--3°C	11°C--17°C::3°C---8°C	17°C --22°C :: 8°C--13°C	22°C--26°C :: 12°C--16°C
· California		14°C--16°C:: 1°C--3°C	16°C--18°C ::3°C--5°C	8°C--21°C:: 5°C--8°C	21°C--25°C ::8°C--11°C	26°C--30°C :: 12°C--16°C	21°C--23°C :: 16°C--18°C
Brazil	24-Feb	27°C--28°C ::20°C--20°C	28°C--28°C :: 20°C--20°C	28°C--27°C :: 20°C--19°C	27°C--24°C :: 19°C--17°C	24°C--22°C :: 17°C--14°C	22°C--22°C :: 14°C--13°C
Russia	30-Jan	-4°C-- -5°C :: -9°C---11°C	-5°C-- -1°C :: -11°C-- -8°C	-1°C-- 6°C :: -8°C-- °C	6°C--15°C :: -2°C--5°C	15°C--20°C :: 5°C--10°C	20°C--23°C :: 10°C--13°C
India	29-Jan						
· Maharashtra		27°C --34C :: 19°C --22°C	30°C--32°C :: 19°C--1°C	32°C --36C :: 21°C--24°C	33°C --36C :: 24°C --27°C	33°C --35C :: 27°C --28°C	33°C--30°C :: 28°C--27°C
· Tamil Nadu		27°C --31C :: 25°C --27°C	29°C--31°C :: 22°C--23°C	31°C--33°C :: 23°C--26°C	33°C--35°C :: 26°C--28°C	35°C--36°C :: 36°C--30°C	36°C--35°C :: 28°C---28°C
· Delhi		20°C--21°C :: 8°C--9°C	21°C--26°C :: 10°C--14°C	26°C--33°C :: 14°C--19°C	33°C--38°C :: 20°C--25°C	38°C--40°C :: 25°C--28°C	39°C--36°C :: 28°C—28°C
· Kerala		32°C --34°C :: 24°C --26°C	33C --35C :: 24°C --25°C	33C --35C :: 25°C --27°C	34C --36C :: 27°C --28°C	34°C--31°C :: 27°C--26°C	31°C--30°C :: 25°C--25°C
· Telangana		28°C--30°C :: 16°C--18°C	30°C--33°C :: 18°C--21°C	34°C--37°C :: 21°C--24°C	37°C--38°C :: 24°C--27°C	38°C--37°C :: 27°C--30°C	37°C--31°C :: 26°C--24°C
UK	30-Jan	9°C --8°C::4°C--4°C	9°C --13°C::4°C---1°C	8°C--10°C::4°C--9°C	10°C--13°C::5°C--6°C	13°C--16°C :: 6°C--8°C	19°C--22°C :: 12°C--14°C
Spain	30-Jan	10°C--13°C::1°C--5°C	11°C--15°C::1°C--6°C	13°C--17°C::3°C--8°C	13°C--26°C::7°C--9°C	13°C--26°C :: 7°C--9°C	26°C--31°C :: 12°C--16°C
Peru	5-Mar	25°C--27°C ::19°C--20°C	27°C--27°C :: 20°C--20°C	27°C--26°C :: 20°C--19°C	26°C--23°C :: 19°C--18°C	23°C--21°C :: 18°C--16°C	21°C--20°C :: 16°C--16°C
Chile	2-Mar	30°C--30°C :: 13°C--14°C	30°C--29°C :: 14°C--13°C	29°C--26°C :: 12°C--10°C	26°C--21°C :: 10°C--7°C	21°C--17°C :: 7°C--5°C	17°C--15°C :: 5°C--4°C
Italy	29-Jan	6°C--8°C::0°C--3°C	7°C--9°C::0°C--2°C	12°C--15°C::3°C--7°C	18°C--22°C::6°C--10°C	19°C--25°C :: 11°C--15°C	17°C--15°C :: 5°C--4°C
Iran	18-Feb	8°C --14°C::2°C--4°C	9°C--13°C::1°C--5°C	13°C--18°C::5°C--10°C	19°C--25°C::10°C--15°C	25°C--31°C :: 15°C--20°C	31°C--35°C :: 21°C--24°C
Germany	26-Jan	2°C--4°C::-3°C--1°C	3°C--7°C::-4°C--0°C	6°C--12°C::-2°C--4°C	12°C--17°C::2°C--7°C	15°C--21°C :: 6°C--11°C	21°C--23°C :: 11°C--14°C
Mexico	27-Feb	21°C--22°C :: 6°C--7°C	22°C--24°C :: 7°C--9°C	24°C--26°C :: 9°C--11°C	26°C--26°C :: 11°C--13°C	27°C--26°C :: 13°C--13°C	26°C--24°C :: 14°C--14°C
Turkey	9-Mar	9°C --14°C::4°C--9°C	9°C--10°C::4°C--9°C	10°C--14°C::4°C--7°C	14°C--18°C::7°C--11°C	19°C--24°C :: 11°C--16°C	24°C--28°C :: 16°C--20°C
Pakistan	25-Feb	17°C--22°C :: 4°C--7°C	20°C--27°C :: 7°C--16°C	22°C--32°C :: 8°C--18°C	28°C--33°C :: 15°C--26°C	28°C--33°C :: 19°C--28°C	34°C--34°C ::29°C--29°C
Saudi Arabia	1-Mar	29C --32C :: 19°C --22°C	28°C--30°C :: 19°C--23°C	30°C--33°C :: 19°C--21°C	33°C--36°C :: 21°C--24°C	36°C--37°C :: 24°C--25°C	41°C--42°C :: 28°C--29°C
France	23-Jan	3°C --15°C :: 2°C--8°C	10°C--12°C :: 2°C--4°C	12°C--16°C :: 4°C--6°C	16°C--19°C :: 6°C--9°C	19°C--23°C :: 9°C--13°C	23°C--26°C ::13°C--16°C
Bangladesh	7-Mar	24°C--26°C :: 14°C--15°C	26°C--30°C :: 15°C--19°C	30°C--33°C :: 19°C--24°C	33°C--33°C :: 24°C--25°C	33°C-- 33°C :: 25°C--26°C	33°C--32°C :: 26°C--27°C
South Africa	4-Mar	24°C--25°C :: 17°C--17°C	25°C--24°C :: 17°C--16°C	24°C--23°C :: 16°C--15°C	23°C--20°C :: 14°C--12°C	20°C--18°C :: 12°C--10°C	18°C--17°C :: 10°C--9°C

Table Continued...

	1st reported case	JAN	FEB	March	April	May	June
Canada	24-Jan	6°C-7°C :: 2°C--2°C	7°C--9°C :: 2°C-- 3°C	9°--11°C :: 3°C--5°C	11°C--15°C :: 5°C--8°C	15°C--18°C :: 8°C--11°C	18°C--21°C :: 11°C--13°C
Qatar	28-Feb	22°C--22°C :: 15°C--14°C	22°C--25°C :: 14°C--16°C	25°C--29°C :: 16°C--20°C	29°C--35°C :: 20°C--25°C	36°C--40°C :: 25°C--29°C	40°C--41°C :: 29°C--30°C
China	7-Jan						
· Hubei		7°C --15°C::2°C --6°C	8°C--12°C::2°C-6°C	12°C--17°C:6°C--11°C	18°C--24°C::11°C--17°C	24°C--28°C ::18°C--22°C	28°C--30°C :: 22°C--25°C
· Guangzhou		19°C --25°C::11°C--17°C	8°C--20°C::11°C-14°C	20°C--24°C::14°C-18°C	24°C--28°C::18°C-22°C	29°C--31°C::22°C-25°C	31°C--32°C ::25°C--26°C
· Zhengzhou		6°C --13°C::-3°C--2°C	7°C--11°C::-2°C-2°C	11°C--18°C::2°C-8°C	18°C--24°C::8°C-14°C	25°C--30°C::15°C-20°C	30°C--32°C :: 20°C--23°C
· Zhejiang		2°C --8°C::1°C --6°C	8°C--12°C::°C 2 -- 5°C	12°C--17°C::5°C-10°C	17°C--24°C::10°C-16°C	24°C--27°C::16°C-20°C	28°C--31°C :: 20°C--24°C
· Hunan		8°C --15°C::2°C ---2°C	9°C--12°C::3°C-6°C	12°C--17°C::6°C-11°C	17°C--24°C::12°C-18°C	24°C--28°C::18°C-22°C	28°C--31°C :: 22°C--25°C
Colombia	5-Mar	19°C--19°C :: 7°C-7°C	19°C--19°C :: 7°C-8°C	19°C--19°C :: 8°C-9°C	19°C--18°C :: 9°C--10°C	18°C--18°C :: 10°C--9°C	18°C--17°C :: 9°C--9°C
Belgium	3-Feb	6°C--6°C :: 2°C--1°C	1°C--2°C :: 6°C--8°C	8°C--12°C :: 2°C--4°C	12°C--16°C :: 5°C--7°C	16°C--19°C :: 7°C--10°C	19°C--21°C :: 10°C--13°C
Sweden	30-Jan	1°C-- -0°C :: -4°C---5°C	-0°C--1°C :: -5°C---5°C	2°C--6°C ::-5°C--1°C	7°C--13°C :: -1°C--3°C	13°C--17°C :: 3°C--8°C	18°C--21°C :: 8°C--12°C
Belarus	27-Feb	-2°C-- -3°C :: -6°C-- -8°C	-3°C—0°C :: -8°C--6°C	0°C -- 7 °C ::-6°C -- -1°C	8°C--15°C :: -0°C--5°C	16-°C--20°C :: 5°C--10°C	20°C--22°C :: 10°C--13°C
Egypt	13-Feb	19°C--20°C :: 11°C--10°C	20°C--22°C :: 11°C--12°C	22°C--26°C :: 12°C--15°C	26°C--30°C :: 15°C--18°C	31°C--34°C :: 18°C--21°C	34°C--35°C :: 21°C--23°C
Ecuador	28-Feb	28°C--28°C :: 23°C--24°C	28°C--28°C :: 24°C--24°C	24°C--24°C :: 28°C--28°C	28°C--28°C :: 24°C -- 23°C	23°C--23°C :: 28°C--28°C	28°C--27°C :: 23°C--22°C
Netherland	26-Feb	6°C--6°C :: 2°C--1°C	6°C--7°C :: 1°C--2°C	2°C--4°C :: 7°C--11°C	11°C--15°C :: 4°C--7°C	15°C--18°C :: 7°C--10°C	18°C-20°C :: 10°C--13°C
Indonesia	1-Mar	30°C--33°C :: 24C--25°C	30°C--32°C :: 24C--25°C	31°C--33°C :: 24C--26°C	32°C--33°C :: 25--26°C	32°C--33°C :: 24C--25°C	32°C--32°C :: 24°C--24°C
Argentina	2-Mar	28°C--27°C :: 21°C--21°C	27°C--26°C :: 21°C--20°C	26°C--23°C :: 20°C--17°C	23°C--20°C :: 17°C--14°C	20°C--16°C :: 13°C--11°C	16°C--14°C :: 10°C--9°C
UAE	28-Jan	25°C--24°C :: 15°C--14°C	24°C--27°C :: 14°C--16°C	27°C--31°C :: 16°C--19°C	31°C--36°C ::19°C--23°C	36°C--40°C :: 23°C--26°C	40°C--40°C :: 26°C--28°C
Singapore	22-Jan	30°C--31°C :: 25°C--25°C	31°C--31°C :: 25°C--25°C	31°C--32°C :: 25°C--26°C	32°C--32°C :: 26°C--26°C	32°C--32°C :: 26°C--26°C	32°C--31°C :: 26°C--26°C
Kuwait	23-Feb	19°C--19°C ::9°C--8°C	19°C--23°C :: 9°C--12°C	23°C--28°C :: 12°C--17°C	29°C--35°C :: 17°C--23°C	35°C--42°C :: 23°C--28°C	42°C--45°C :: 28°C--30°C
Portugal	1-Mar	14°C--15°C :: 8°C--9°C	15°C--17°C ::9°C--10°C	17°C--19°C :: 10°C--11°C	19°C--21°C :: 11°C--13°C	21°C--24°C :: 13°C--15°C	24°C--27°C :: 15°C--18°C
Ukraine	2-Mar	-1°C-- -1°C :: -5°C-- -6°C	-1°C-- 2°C :: -7°C---4°C	2°C--9°C :: -4°C--2°C	10°C--17°C :: 2°C--8°C	18°C--22°C :: 8°C--13°C	22°C--24°C :: 13°C--15°C
Iraq	21-Feb	16°C--17°C :: 6°C--6°C	17°C--21°C :: 6°C--9°C	21°C--27°C :: 9°C--13°C	27°C--33°C :: 14°C--19°C	34°C--40°C :: 19°C--24°C	40°C--43°C :: 24°C--27°C
Oman	23-Feb	25°C--24°C :: 18°C--18°C	24°C--26°C :: 18°C--19°C	27°C--31°C :: 20°C--23°C	31°C--36°C :: 23°C--28°C	36°C--38°C :: 28°C--30°C	38°C--38°C :: 31°C--31°C
Poland	3-Mar	1°C--1°C :: -4°C---4°C	1°C--4°C :: -4°C---3°C	4°C--10°C :: -3°C--1°C	10°C--17°C :: 1°C--6°C	17°C--21°C :: 6°C--10°C	21°C--23°C :: 10°C--13°C
Philippines	29-Jan	29°C--30°C :: 23°C--23°C	30°C--31°C :: 23°C--23°C	31°C--33°C :: 23°C--25°C	33°C--34°C :: 25°C--26°C	34°C--33°C :: 26°C--25°C	33°C--31°C :: 25°C--25°C

Table Continued...

	1st reported case	JAN	FEB	March	April	May	June
Switzerland	24-Feb	3°C--10°C::-3°C--2°C	4°C--7°C::-2°C---1°C	7°C--12°C::-1°C--3°C	12°C--17°C::3°C--6°C	17°C--20°C::6°C--10°C	
Afghanistan	23-Feb	8°C--7°C :: -4°C--4°C	7°C--11°C :: -4°C-0°C	11°C--17°C :: 1°C--6°C	17°C--25°C :: 6°C--10°C	25°C--29°C ::10°C--15°C	15°C--19°C :: 29°C--33°C
Dominican Republic	29-Feb	29°C--29°C :: 20°C--20°C	29°C--29°C :: 20°C--20°C	29°C--30°C :: 20°C--21°C	30°C--30°C :: 21°C--22°C	30°C--31°C :: 22°C--23°C	31°C--32°C :: 23°C--23°C
Panama	9-Mar	31°C--32°C :: 24°C--24°C	32°C--32°C :: 24°C--24°C	32°C--32°C :: 24°C--25°C	32°C--31°C :: 25°C--25°C	31°C--30°C :: 25°C--25°C	30°C--30°C ::25°C--25°C
Bolivia	9-Mar	30°C--30°C :: 22°C--22°C	30°C--30° :: 22°C--30°C	30°C--29°C :: 22°C--21°C	29°C--27°C :: 21°C--19°C	27°C--25°C :: 19°C--17°C	25°C--25°C :: 17°C--16°C
Ireland	28-Feb	8°C--8°C :: 4°--3°C	8°C--9°C :: 3°C--3°C	9°C--11°C :: 4°C--4°C	11°C--13°C :: 4°C--6°C	13°C--16°C :: 6°C--9°C	16°C--18°C :: 9°C--11°C
Romania	25-Feb	3°C--3°C :: -4°C--4°C	3°C--7°C :: -4°C--1°C	7°C--15°C :: -1°C--4°C	15°C--20°C :: 4°C--8°C	21°C--25°C :: 9°C--14°C	26°C--28°C :: 14°C--16°C
Bahrain	23-Feb	20°C--20°C :: 15°C--14°C	20°C--23°C :: 15°C--17°C	23°C--27°C :: 17°C--20°C	27°C--33°C :: 20°C--25°C	33°C--37°C :: 25°C--29°C	37°C--38°C :: 29°C--31°C
Israel	20-Feb	5°C --12°C :: 14°C --19°C	5°C --11°C :: 12°C --21°C	7°C --12°C :: 15°C --23°C	9°C --13°C :: 16°C --21°C	12°C --20°C :: 23°C --27°C	27°C--28°C :: 15°C--18°C
Armenia	29-Feb	3°C--3°C :: -7°C--7°C	3°C--9°C :: -7°C--2°C	9°C--16°C :: -2°C--3°C	16°C--21°C :: 4°C--9°C	21°C--27°C :: 9°C--13°C	27°C--32°C :: 13°C--18°C
Nigeria	27-Feb	32°C--32°C :: 24°C--25°C	32°C--33°C :: 25°C--26°C	33°C--33°C :: 26°C--26°C	33°C--32°C :: 26°C--25°C	32°C--30°C :: 25°C--25°C	30°C--28°C :: 25°C--24°C
Additional :							
Kyrgyzstan	17-Mar	-10°C ---2°C :: 4°C --6°C	-12°C ---3°C :: -3°C ---5°C	-3°C --0°C :: 11°C --18°C	0°C --6°C :: 11°C --18°C	5°C --10°C :: 17°C --26°C	26°C--31°C :: 14°C--17°C
Kazakhstan	12-Mar	-1°C-- -1°C :: -10°C-- -10°C	-1°C-- 3°C :: -10°C-- -7°C	4°C--13°C :: -6°C--2°C	13°C--20°C :: 2°C--7°C	20°C--24°C :: 8°C--12°C	24°C--29°C :: 12°C --16°C
New Zealand	27-Feb	22°C--23°C :: 16°C--17°C	23°C--23°C :: 17°C--16°C	23°C--21°C :: 16°C--14°C	21°C--18°C :: 14°C--12°C	18°C--16°C :: 12°C--10°C	16°C--14°C :: 10°C--9°C
Uzbekistan	14-Mar	6°C--7°C :: -2°C--2°C	7°C--11°C :: -2°C--2°C	11°C--18°C :: 2°C--7°C	18°C--25°C :: 8°C--13°C	25°C--31°C :: 13°C--17°C	31°C--35°C :: 17°C--21°C
Tajikistan	30-Apr	8°C--8°C :: -0°C--1°C	8°C--12°C :: -1°C--2°C	12°C--18°C :: 3°C--8°C	18°C--24°C :: 8°C--13°C	25°C--30°C :: 13°C--16°C	30°C--35°C :: 16°C--20°C

The relation between COVID-19 and temperature

A hypothesis arose earlier whether the temperature is associated with the significant infectivity of COVID-19 cases. So, we have noted and analyzed the temperature of the particular country with its first reported case to disease acceleration date. The disease acceleration rate against the time is provided in Figure 1(A&B).

Results and discussion

Earlier reports on the correlation among the respiratory-borne infectious disease and the temperature have evinced that both SARS and influenza viruses need to survive and endure under the destined temperature condition as the increase in the temperature variable reduced their propensity to transmit. Although the direct droplet transmission is an important route of further infection, but the role of fomites contamination contributes a significant role in continued transmission in the nosocomial setting, that happens quite often in spite of much awareness and precaution.[4,5,7]

As the temperature seemed to be an essential component in the viability of COVID-19 virus and its dissemination since its emergence, so we focus on the apprehension of the correspondence to temperature and transmission of COVID-19 infection from the data available between from Jan 1, 2020, to (Jun 24, 2020) and we get the following results:
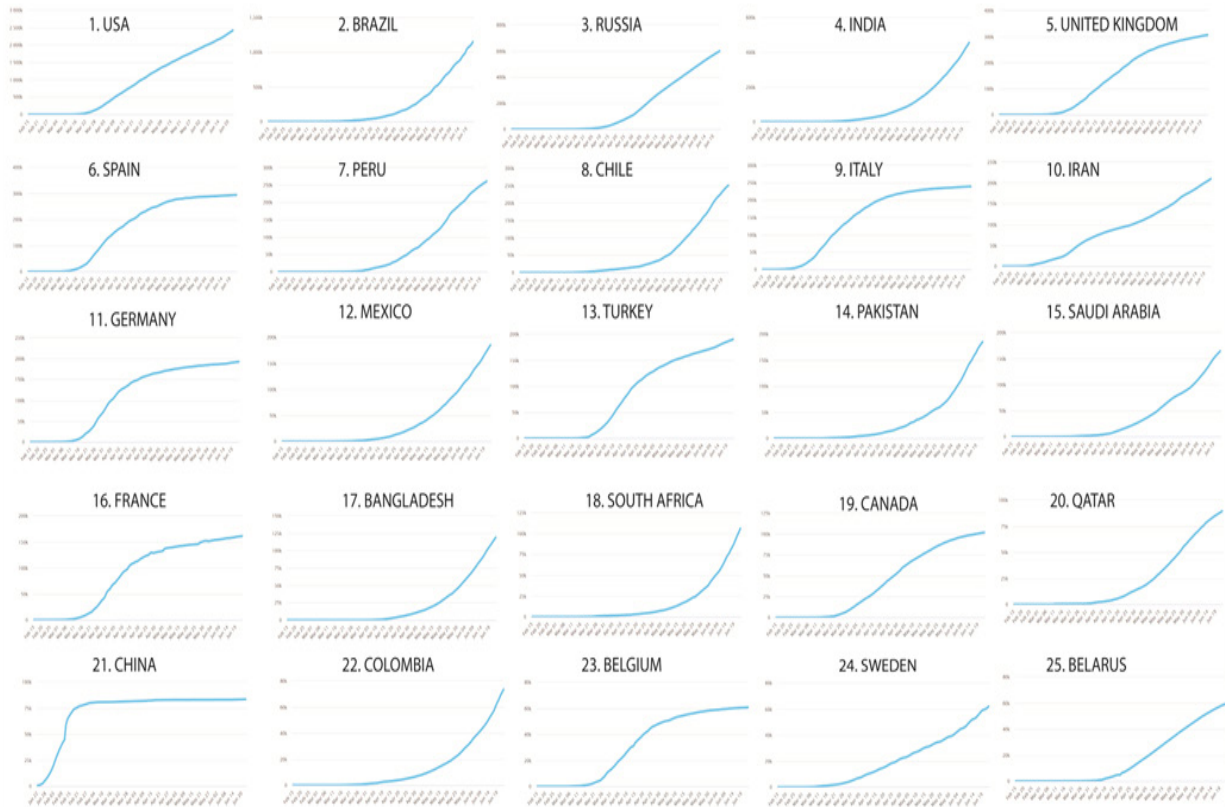
Figure 1(A) Total COVID-19 Cases in the top 50 countries and the acceleration graphs represent the COVID-19 cases over time (per day).
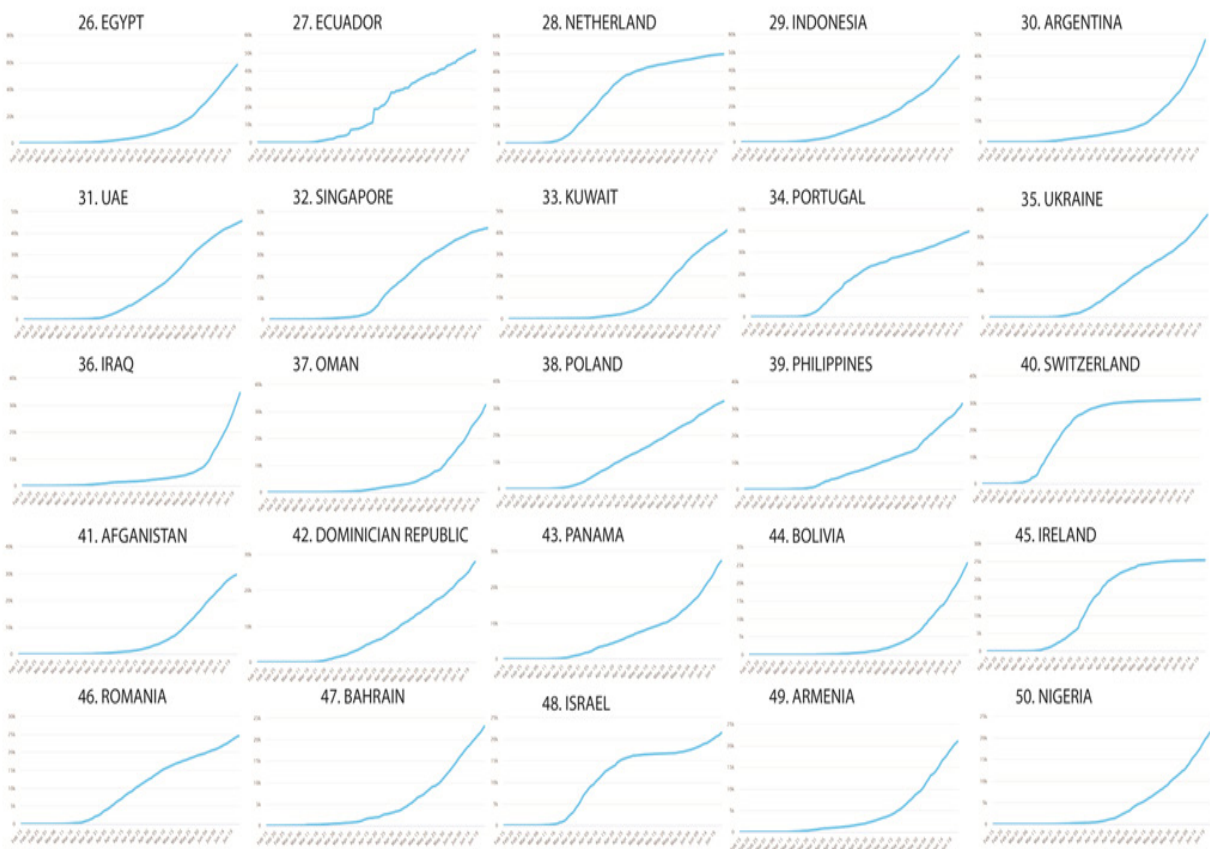

Figure 1(B) Total COVID-19 Cases in the top 50 countries and the acceleration graphs represent the COVID-19 cases over time (per day).

Countries showing the repercussion on the transmission and morbidity of COVID-19

Because of the geographic proximity and the substantial travel routes, the main concern for many epidemiologists was not only about the rapid spread of the ongoing pandemic but also about speculating the dynamic of this havoc in upcoming time.[8]

Initially in our study, we traced and compared the countries with high temperature (>20°C) and the lowest temperature (<-2°C) shows a symbiotic effect on inactivation of COVID-19, which results in the decreasing number of per day new cases of those countries; while the mid-range temperatures (20°C to 04°C) supports the prolonged survival of virus on the environment and contaminated surfaces.

From the above study, we perceived that the unfortunate first 50 worse affected COVID-19 countries including USA, Brazil, Russia, India, UK, Spain, Peru, Chile, Italy, Iran, Germany, Mexico, Turkey, Pakistan, Saudi Arabia, France, Bangladesh, South Africa, Canada, Qatar, China, Colombia, Belgium, Sweden, Belarus, Egypt, Ecuador, Netherlands, Indonesia, Argentina, UAE, Singapore, Kuwait, Portugal, Ukraine, Iraq, Oman, Poland, Philippines, Switzerland, Afghanistan, Dominican Republic, Panama, Bolivia, Ireland, Romania, Bahrain, Israel, Armenia and Nigeria where the number of active cases and the mortality rate of COVID-19 is now higher, and few have them earlier even having the weather patterns similar to Wuhan city, from where it was initially originated with approx. 11°C to 04°C. In the case of the US, which until now has reported the highest number of active cases worldwide till Jun 24 2020? Our data shows that the first case was reported on Jan 20, 2020, and daily new cases peaks from Mar 17,2020, to till date, and if we compare these statistics with average temperature data, it shows that the average temperature during the highest daily cases in mid-march was between 12°C to 02°C. Similarly, in our selected countries cluster such as Spain, Italy and France which are one of the countries with highest mortality worldwide (28325, 34695 and 29720 respectively), data shows that first cases were reported in last week of January in these three countries. Daily new cases of these countries were peaked between 5-12 March to till date, and we found that the average temperature during these peak days for these countries was 15°C to 04°C. So, this correlation between epidemic situation and weather the range between (15°C to 02°C) depicts a similar pattern from the main outbreak cities and the current countries with the highest number of cases. Therefore, it is essential to understand the role the weather conditions could have on the transmission of COVID-19.

Change in temperature manifests an insignificant correlation with transmitted cases, deaths number or recovered rate

A descriptive analysis, along with the correlation between temperatures, were performed separately for the overall countries from January 2020 to June 2020. For the confirmed positive cases, total death number and the number of recovered cases and the total number of cases was used as a variable value; while a value of average temperature for each of the months of particular countries was used as another variable value. By comparing overall cases of temperature, no remarkable correlation between temperature and confirmed positive cases, the total number of death and the total number of recovered cases were observed (Table 1 & Figure). To further investigate the concomitant of temperature, countries like Russia, India, Argentina, UAE and Pakistan with highest average temperature (Table 1) was separately compared apart with earlier worst affecting countries

and now with their subsequent lower number of per day cases like Switzerland, New Zealand and Belgium for the month January 2020 to June 2020. Once more, an insignificant correlation among temperature variable with the total confirmed positive cases, a total number of dead or recovered cases was observed. However, a fascinating correlation paradigm was noted where a drop in the association was found as the daily number cases in Russia, India, Argentina, UAE and Pakistan was surprisingly increased between April to June when the average temperature of those countries was (16.5°C-6.8°C, 33.3°C-26.8°C, 18.15°C-12.3°C, 37.1°C-24.14°C, 30°C-26°C) and now these countries are listed among the worst affected nation by this pandemic with the higher number of confirmed new case reports. Also, Switzerland and New Zealand, which were having a more significant amount of active cases in earlier this year showed a considerable decline in their active cases numbers and death reports.

China is the initial and profoundly COVID-19 infected country, So, we separately correlate and analyze the temperature with the positive confirmed cases, recovered number and their death reports for the month January to June with the countries currently sharing the almost similar temperature variable, herein does not supports the hypothesis of any relation between the active number of cases or deaths report with the meteorological variables as per our study.[9] Other Central Asian countries which share its border with China like Kyrgyzstan, Kazakhstan, Tajikistan and Uzbekistan and few tropical and continental countries which were having low COVID-19 cases and now their subsequent increase in their cases could be explained by many factors may be less COVID-19 testing, disperse population (density), Social dynamics, substandard community structure and global connectivity.[10,11] So, unfortunately, here again, no strong correlation between any of the selected variables of temperature with the total confirmed positive cases, the total number of death or recovered cases were recorded.

Conclusion

The association of COVID-19 pandemic with temperature variable remains a controversial topic since the very beginning. According to our study and the current pattern of COVID-19 transmission, the total number of active COVID-19 cases and the total number of death reports seems to be having no significant association with the average temperature, suggesting that the ambient temperature has insignificant effect of SARS-CoV-2. This pattern depicts the much equivalency to the following previous outbreak by this coronavirus family, in Middle East Respiratory Syndrome (MERS) or camel flu epidemic in middle east countries in 2012, where the daily number of MERS infection continue to rise even when the temperature was reached up to 45°C. Also, the other emanated zoonotic disease like Ebola, or other pandemics have also shown the unforeseeable transmission format too. Although, the SARS transmission (from November 2002 to July 2003), also propound that perhaps it may be seasonal or credibly have been curbed by sufficient case finding, contact tracing and through social distancing and quarantine measure. In our study, however, the previous results on the earlier relationship between respiratory-borne infectious disease and temperature have pointed the dissimilarity with the expected epidemiological pattern in the transmission of COVID-19 infection. Data analysis from Jan 1, 2020, to Jun 24, 2020, confirmed positive cases of COVID-19, the number of reported deaths and recovery number; identify an increased number of recovered cases being reported particularly in China, while Switzerland, Iran and Germany showed a slow recovery rate respectively. Even though, a

compelling concurrence between the recovered cases with the number of death, where the variation of temperature showed no significant association with the number of transmitted cases, number of death reported or the number of recovered cases for the period Jan 1, 2020, to Jun 24, 2020. Further another interesting finding was observed between the number of increment in the daily COVID-19 cases of Russia, India, Argentina, UAE and Pakistan with the confirmed cases with Switzerland, New Zealand and Belgium.

Although several limitations should also be acknowledged, firstly, we did not perform subgroup analysis by age group and gender to explore the sensitive population due to the lack of patient information. Second, our data only covers the top 50 most affected countries. Also, we could not include other confounding factors such as humidity in our analysis, which might have influenced our result. Third, some potential risk factors that could impact the COVID-19 incidences like social dynamics, the number of testing programs and government policies were not included in our studies.

By considering our finding, our results do not endorse and mainstay the hypothesis that high temperature can decrease and mitigate the COVID-19 transmission which supports the statement made by World Health Organization, which elucidated that the SARS-CoV-2 virus is transmissible in any climatic condition, even in hot and humid weather, as the countries having hot weather in their region have also reported the cases of COVID-19 respectively.[5] The ongoing pandemic causes substantial morbidity and mortality worldwide. Hence it's good to take a few things into account like personal hygiene, maintaining social distancing and following quarantine protocols to minimize the risk of infection in the era of 'THE NEW NORMAL' until we get a vaccine. Many studies on the relation between the spread of COVID-19 with temperature in laboratories is needed to understand their mutual relation.

Acknowledgments

Conflicts of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Funding

References

1. Wang C, Horby PW, Hayden FG, et al. A novel coronavirus outbreak of global health concern. *The Lancet*. 2020;395(10223):470–473.

2. Shaman J, Kohn M. Absolute humidity modulates influenza survival, transmission, and seasonality. Proc Natl Acad Sci U S A. 2009; 106(9):3243–3248.

3. World Health Organization (WHO). Novel Coronavirus – China. Switzerland, Geneva: World Health Organization (WHO); 2020.

4. Alam A, Siddiqui MF, Imam N, et al. Covid-19: current knowledge, disease potential, prevention and clinical advances. *Turk J Biol*. 2020;44(3):121-131.

5. Ksiazek TG, Erdman D, Goldsmith CS, et al. A novel coronavirus associated with severe acute respiratory syndrome. *N Engl J Med*. 2003;348(20):1953–1966.

6. John Roach. Higher temperatures affect survival of new coronavirus, pathologist says. AccuWeather. 2020.

7. Yang W, Marr LC. Dynamics of airborne influenza A viruses indoors and dependence on humidity. *PLoS One*. 2011;6(6):e21481.

8. Sajadi MM, Habibzadeh P, Vintzileos A, et al. Temperature, Humidity, and Latitude Analysis to Estimate Potential Spread and Seasonality of Coronavirus Disease 2019 (COVID-19). *JAMA Netw Open*. 2020;3(6):e2011834.

9. Pawar S, Stanam A, Chaudhari M, et al. Effects of temperature on COVID-19 transmission. medRxiv. 2020;3(29).

10. World Health Organization (WHO). First data on stability and resistance of SARS coronavirus compiled by members of WHO laboratory network. World Health Organization (WHO). Switzerland, Geneva: World Health Organization (WHO); 2020.

11. https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public/myth-busters?gclid=CjwKCAjwsO_4BRBBEiwAyagRTfmd4cVqk3lJfKRaJ_bHs0ObQgpvgGJJhsa9E_KH-Zjvjkf-xzFL2BoCorMQAvD_BwE#climate