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Effects of Temperature on Global Trends in Epidemiology of COVID-19

A. S. M. Sarwar[1*], Khandaker Sabit Bin Razzak[2], Anika Bushra[3], Mohammad Nabil Hossain[4], Md. Moshiur Rahman[5], Shirin Tarafder[6], Ashfa Mahjuba[7], Sabrina Rahman[7], Md. Evangel Islam Anik[7] and Tah-Ima-Tabassum[7]

[1]East West University, Dhaka, Bangladesh.
[2]Department of Public Health, American International University-Bangladesh, Dhaka, Bangladesh.
[3]Department of Biochemistry and Microbiology, North South University, Dhaka, Bangladesh.
[4]College of Biological and Pharmaceutical Sciences, China Three Gorges University, Hubei, China.
[5]Neurosurgery Department, Holy Family Red Crescent Medical College Hospital, Dhaka, Bangladesh.
[6]Microbiology and Immunology Department, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh.
[7]Topbright, Dhaka, Bangladesh.

Authors' contributions

This work was carried out in collaboration among all authors. Authors ASMS, KSBR, AB, MMR and ST conceived the study. Authors ASMS and MNH performed statistical analysis. Authors KSBR and AB involved in developed data collection strategy and tools. Author ASMS wrote the first draft of manuscript. Author MNH interpreted the result. Authors AM, SR, MEIA and TIT involved in raw data extraction from WHO situation report, Weather 2 Visit, Worldometer and World Bank. All the authors critical revised the manuscript and approved its final version.

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ABSTRACT

Identifying the effects of temperature on coronavirus disease (COVID-19) outbreak is essential for modelling studies and guiding intervention strategies all over the world. The aim of the study is to understand the effect of temperature on global epidemic trends, geographic distribution, and

**Corresponding author: E-mail: sarwartopbright2019@gmail.com;*

transmission patterns of COVID-19. Data on COVID-19 and temperature from 1st February 2020 to 30th April 2020 were included. The epidemic trends we analyzed using both descriptive and inferential statistics; the growth of affected countries was by descriptive analysis; and the global distribution and transmission trend by inferential statistics. Scattered plot diagram matrix was performed for Europe and Africa data. Based on 90 days COVID-19 affected and death data survival analysis was performed for South East Asian region. Lowest three months average temperature was in Europe (41.06^0F) from February 2020 to April 2020 (34.6^0F, 41.1^0F and 47.5^0F) shows the highest average confirmed case. Highest three months avg. temperature was Africa (74.4^0F) February 2020 to April 2020 (73.4^0F, 74.7^0F and 75.3^0F) shows the lowest avg. confirmed case and avg. death. In Europe, average temperatures with transmission positively correlated on the other hand in Africa average with transmission were negatively correlated. The results of the study suggested that, temperature had positive or negative effects on the geographical trend of COVID-19 confirmed cases, death cases, recovered case or transmission. It is being suggested that geographical regions with a lower temperature need to adopt the stricter control measures and WHO is a guideline to prevent rapid spread of COVID-19.

Keywords: Temperature; global trends; COVID-19 transmission.

1. INTRODUCTION

According to the statement of the World Health Organization (WHO), the current outbreak of COVID-19 was first reported from Wuhan, China, on December 31, 2019. WHO has announced a global emergency on January 30, 2020, and officially called an outbreak as pandemic on March 11, 2020, for the severity and fast spread of COVID-19 [1].

After the confirmation of COVID-19 outbreak, the global number of cases increased to over 8 million marks. According to the WHO website report as of 18 June 2020, confirmed cases were 8,223,454 including 444,813 deaths and new cases were 119,759. WHO region-wise case comparison showed that the highest number of COVID-19 confirmed cases were in America, 4,015,386 followed by Europe, 2,45,2247, Eastern Mediterranean, 837,497, South East Asia, 521,582, Western Pacific, 201,462 and Africa, 194,539 [2].

It is very much important to recognize biological characteristics in the natural environment, especially during transmission, in order to understand the geographical pattern in the OCOVID-19 outbreak. The temperature has a major impact on the living environment of people in different parts of the world under different climatic conditions, which can play an active role in the epidemic development and control in public health [3].

On 6 January 2020, the first generations of patients with COVID-19 were identified. On 20 January secondary, generation was reported to be able to transfer amongst humans [4]. Cases of transmission from 3rd and 4th generations have been reported since 4 February 2020 [5]. The problem persists how many reported instances from one continent to the next will be introduced as the global temperature changes for a given time span. We can say that the lack of knowledge in this area can weaken prevention and control measures' strength and focus. In addition, several countries limited the boarders and suspended the major affected flight commutation, even with regard to WHO warnings, countries, including South Korea and Iran [6,7]. Like any other the pandemic situations, all protective actions also have a negative effect on the global economy, when for a long-time country like China and South Korea contribute to global industrial production and running of goods and services. The challenge facing under-resourced middle revenue countries with inadequate infrastructure to successfully contain breakout and rely on external sources of medical supplies is a major challenge to global industrial production and delivery of goods and services [8,9].

More geographical trend of the virus must be analyzed to know about threats of medical supply scarcity or future LMIC outbreaks which may lead to high associated mortality from COVID-19 [10]. In this context, very prompt responses and global strategic alliances are immediately required to prevent further outbreaks and to prevent a pandemic. The outcomes of this study could provide an indication of how COVID-19 shares genetic similarity with SARS.

We have conducted the study because there is no study published on the temperature effects on

COVID-19 geographical trend both continent and WHO region wise data so far and find out the ranking of very highly affected, death and recovered country. We gathered full sample data from the outbreak, destruction, and recovery countries and regions, and their average, minimum and maximum temperature values were measured and worldwide.

2. METHODS

2.1 Data Sources

We have collected COVID-19 affected, death and recovered data of the countries of six continents and WHO regions from the official website and coronavirus disease (COVID-2019) situation reports of WHO from February 2020 to April 2020. The day-wise average temperature data were collected from country weather report from the official weather website. For economic status of the COVID-19 affected country we follow World Bank latest update.Other relevant data were collected from different secondary sources like published and pre-print articles of renowned journals and used by systematic review. The relevant and reliable data collected by searching following website and data base:

- WHO Situation Report 12 (February 1, 2020) to situation report 101 (April 30, 2020) [https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports]
- WHO website (https://covid19.who.int), June 18,2020
- Coronavirus Update (Live) –Worldometer [https://www.worldometers.info/coronavirus/]
- Weather2 visit [https://www.weather2visit.com]
- World Bank [https://www.worldbank.org]

2.2 Statistical Analysis

The statistical method was applied for this study for respective average, minimum and maximum temperature values. Both descriptive and inferential analysis was performed. Numerical variables were described with percentages. For the South-East Asian region, survival analysis was performed to calculate the length of time from the time origin to the endpoint. Accurate scatter plot diagram matrix also performed.

2.3 Ethical Statement

This research is based on secondary data accessible to the public, and no particular personal information has been used. Ethical approval was not required for this study.

3. RESULTS AND DISCUSSION

3.1 Continent Demographic and Economic Profile from February to April 2020

In this study, we found that separate continent wise highest population growth rate countries (3.50-3.99)% were in Asia (2.1%) followed by Africa (1.8%) on the other hand highest (34.1%) countries in Europe have lowest (Less Than 0%) population growth rate followed by North America (8.5%). Highest population density countries (10,000 plus) were in Europe (2.1%) on the other hand the highest (16.7%) countries in Australia were lowest (1 to 9) population density. Highest high-income countries (66.7%) were in Australia on the other hand the highest (42.6%) countries in Africa were lower-income country (Table 1).

3.2 Continent Wise Demographic and Temperature Relationship of COVID-19

From February 2020 to April 2020 our study identified that highest population density continent cause's high death. In Europe avg. population density were 798.08 per square km and total death cases were 159,105 and lowest density were in South America 23.38 per square km and death cases 7545 which were third highest death of COVID-19 (Fig. 1a). Lowest three month avg. temperature was in Europe (41.06^0F) from February 2020 to April 2020 (34.6^0F, $41,1^0$F and 47.5^0F) shows highest avg. confirmed case February 2020 (25.3), March 2020 (9204.9) and April 2020 (29272.8) and avg. death cases in Europe February 2020 (0.5), March 2020 (604.8) and April 2020 (3194.0). Highest three month avg. temperature was Africa (74.4^0F) February 2020 to April 2020 (73.4^0F, $74,7^0$F and 75.3^0F) shows lowest avg. confirmed case February 2020 (0), March 2020 (67.7) and April 2020 (367.1) and avg. death. February 2020 (0), March 2020 (1.4) and April 2020 (15) (Fig. 1b).

3.3 Continent Wise Ranking of Top Five Country of COVID-19 Spread Trend

In our study we identified the continent wise top 05 countries in terms of confirmed cases, death cases and recovery cases from February 2020 to April 2020. We can also identify top 05 countries in the world in terms of confirmed case, death case and recovered case from following (Table 2). Considering COVID-19 confirmed case the top ranked 05 countries were USA (1,003,968), Italy (305,330), Spain (298,112), Germany (221,032), United Kingdom (187,370). In terms of COVID-19 death cases top ranked 05 countries were USA (54,826), Italy (39,273), Spain (31,615), United Kingdom (27,505) and France (27,071). In terms of recovered case top ranked 05 countries were USA (161,563), Spain (142,450), Italy (78,249), China (77,685) and IRAN (76,318) (Table 2). Considering COVID-19 confirmed and death case all top four countries were from Europe and only one country from North America (USA). This data indicate that the lowest avg. temperature continent Europe is very highly trend of COVID-19 spread.

3.4 WHO Region Wise COVID-19 Trend Analysis

To measure the affected and death trend of COVID-19 among the WHO region we have prepared a 5-point COVID-19 trend measurement scale by using numeric value of certain cumulative interval as per data requirement and by nature it was a judgmental scale. February 2020 to April 2020 the measurement of our scale indicates that highest 6 (11.54%) countries from European region were very highly COVID-19 affected and highest 46 (95.83%) countries from African region were very low COVID-19 affected. On the other hand highest 2 (3.85%) countries from European region were medium COVID-19 death ranked countries and highest 48 (100%) countries from African region were very low COVID-19 death ranked countries (Table 3).

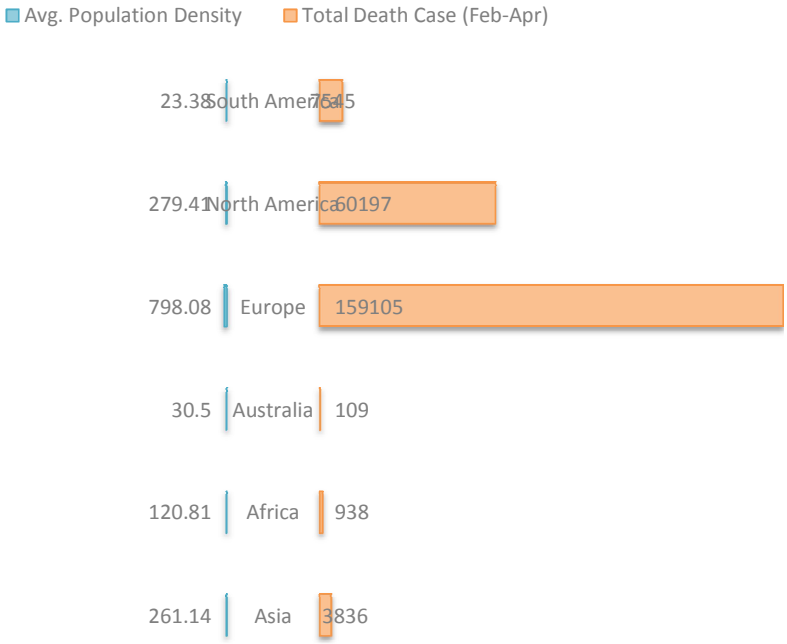

Fig. 1(a). Relationship of avg. population density and total death cases from February to April 2020

Data Source: WHO (2020)

Table 1. Continent wise demographic and economic profile of COVID-19 affected countries

Demographic and Economic Profile	Continent						
	Group	Asia (%)	Europe (%)	Africa (%)	North America (%)	South America (%)	Australia (%)
Population growth rate	Less Than 0%:	6.4	34.1	1.8	8.5	7.7	0.0
	0-.49%:	12.8	45.5	3.5	35.1	15.4	0.0
	50-.99%:	12.8	15.9	1.8	29.7	30.8	66.7
	1-1.49%:	27.7	2.3	17.5	13.5	30.8	16.7
	1.50-1.99%:	21.3	2.3	8.8	13.5	7.7	16.7
	2-2.49%	12.8	0.0	17.5	0.0	7.7	0.0
	2.50-2.99%	4.3	0.0	35.1	0.0	0.0	0.0
	3-3.49%	0.0	0.0	12.3	0.0	0.0	0.0
	3.50-3.99%	2.1	0.0	1.8	0.0	0.0	0.0
Population Density	1 to 9	4.3	4.5	12.3	2.8	23.1	16.7
	10-99	40.4	38.6	54.4	27.8	76.9	83.3
	100-999	46.8	50.0	33.3	63.9	0.0	0.0
	1000-9999	8.5	4.5	0.0	5.6	0.0	0.0
	10000 plus	0.0	2.3	0.0	0.0	0.0	0.0
Economic Status	Lower income:	12.8	2.3	42.6	6.3	0.0	0.0
	Lower middle income:	36.2	22.7	36.2	9.4	8.3	16.7
	Upper middle income:	29.8	75.0	19.1	31.3	75	16.7
	High income:	21.3	0.0%	2.1	53.1	16.7	66.7

Data Source: World Bank (2020)

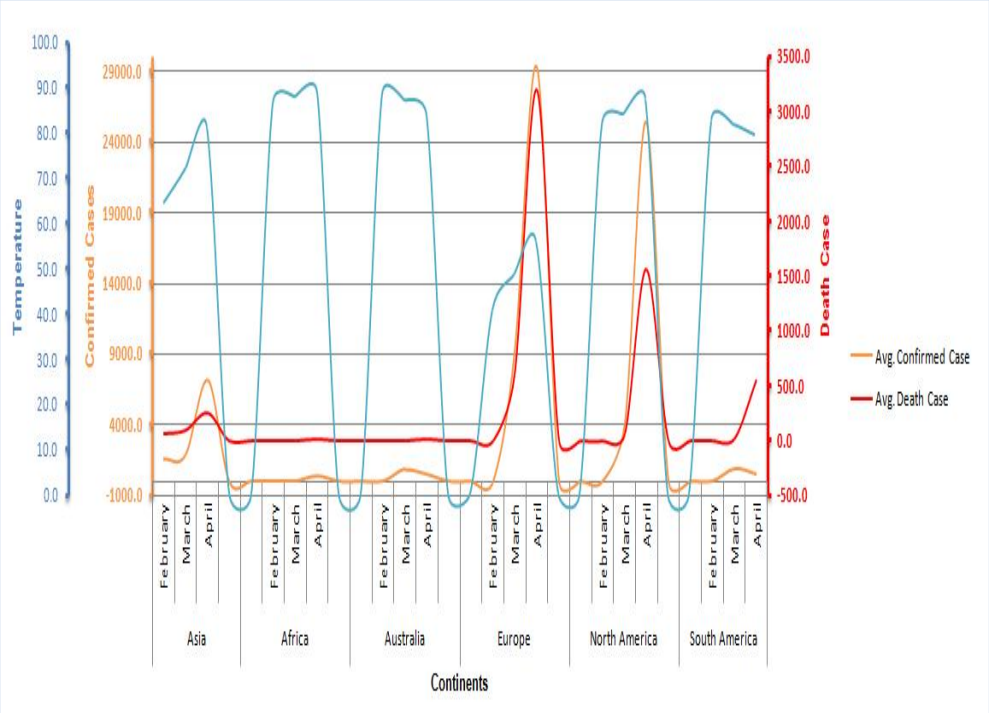

Fig. 1(b). Effects of temperature on Covid-19 confirmed case and death cases from February to April 2020

Data Source: WHO (2020) & Weather2 visit (2020)

Table 2. Continent wise top 5 countries of COVID-19 confirmed, death and recovered cases from February to April 2020s

Continent	Ranking	Country	Confirmed Cases	Country	Death Cases	Country	Recovered Cases
Asia	1	Turkey	117,591	Iran	5,957	China	77,685
	2	Saudi Arabia	21,403	China	4,853	Iran	76,318
	3	Israel	15,782	Turkey	3,081	Turkey	53,808
	4	Qatar	12,564	India	1,074	India	10,007
	5	UAE	11,925	Indonesia	784	Israel	9,156
Africa	1	South Africa	5,350	Algeria	444	South Africa	2,073
	2	Algeria	3,849	South Africa	103	Algeria	1,779
	3	Cameroon	1,806	Cameroon	59	Egypt	1,381
	4	Ghana	1,671	Nigeria	44	Morocco	1,055
	5	Nigeria	1,533	Burkina Faso	42	Cameroon	934
Australia	1	Australia	6,737	Australia	90	Australia	5,789
	2	New Zealand	1,129	New Zealand	19	New Zealand	1,263
	3	French Polynesia	58	French Polynesia	0	French Polynesia	51
	4	New Caledonia	18	New Caledonia	0	New Caledonia	17
	5	Fiji	18	Fiji	0	Fiji	14
Europe	1	Italy	305,330	Italy	39,273	Spain	142,450
	2	Spain	298,112	Spain	31,615	Italy	78,249
	3	Germany	221,032	United Kingdom	27,505	Ireland	13,386
	4	United Kingdom	187,370	France	27,071	Russia	13,220
	5	France	171,043	Belgium	8,014	Denmark	6,729
North America	1	United States	1,003,968	United States	54,826	United States	161,563
	2	Canada	50,360	Canada	2,970	Canada	22,751
	3	Mexico	16,752	Mexico	1,589	Mexico	12,377
	4	Dominican Republic	6,652	Dominican Republic	335	Dominican Republic	1,387
	5	Panama	6,200	Panama	200	Cuba	714
South America	1	Brazil	9,137	Brazil	5,017	Brazil	35,935
	2	Ecuador	2785	Ecuador	883	Peru	10405
	3	Chile	2657	Peru	854	Chile	9018
	4	Peru	1695	Colombia	269	Ecuador	1558
	5	Argentina	1007	Chile	216	Colombia	1439

Data Source: WHO & Worldometer (2020)

Table 3. WHO region wise COVID-19 affected and death trend from February to April 2020

A. Affected WHO Region	No of Countries	Very Highly Affected Countries	Highly Affected Countries	Medium Affected Countries	Low Affected Countries	Very Low Affected Countries
South East Asia Region	10	0.00% (n= 0)	0.00% (n= 0)	10.00% (n= 1)	20.00% (n= 2)	70.00% (n= 7)
Western Pacific Region	15	0.00% (n= 0)	6.67% (n= 1)	0.00% (n= 0)	40.00% (n= 6)	53.33% (n= 8)
European Region	52	11.54% (n= 6)	0.00% (n= 0)	3.85% (n= 2)	26.92% (n= 14)	57.69% (n= 30)
Eastern Mediterranean Region	22	4.55% (n= 1)	0.00% (n= 0)	0.00% (n= 0)	22.73% (n= 5)	72.73% (n= 16)
Regions of Americans	49	2.04% (n= 1)	0.00% (n= 0)	2.04% (n= 1)	8.16% (n= 4)	87.76% (n= 43)
African Region	48	0.00% (n= 0)	0.00% (n= 0)	0.00% (n= 0)	4.17% (n= 2)	95.83% (n= 46)
B. Death WHO Region	**No of Countries**	**Very Highly Death Ranked Countries**	**Highly Death Ranked Countries**	**Medium Death Ranked Countries**	**Low Death Ranked Countries**	**Very Low Death Ranked Countries**
South East Asia Region	10	0.00% (n= 0)	0.00% (n= 0)	0.00% (n= 0)	0.00% (n= 0)	100.00% (n= 10)
Western Pacific Region	15	0.00% (n= 0)	0.00% (n= 0)	0.00% (n= 0)	6.67% (n= 1)	93.33% (n= 14)
European Region	52	0.00% (n= 0)	0.00% (n= 0)	3.85% (n= 2)	11.54% (n= 6)	84.62% (n= 44)
Eastern Mediterranean Region	22	0.00% (n= 0)	0.00% (n= 0)	0.00% (n= 0)	4.55% (n= 1)	95.45% (n= 21)
Regions of Americans	49	0.00% (n= 0)	0.00% (n= 0)	0.00% (n= 0)	2.04% (n= 1)	97.96% (n= 48)
African Region	48	0.00% (n= 0)	0.00% (n= 0)	0.00% (n= 0)	0.00% (n= 0)	100.00% (n= 48)

N.B: Very High = 30000+, High = 21000-30000, Medium = 11000-19999, Low = 1100-9999, Very Low = 01-999
Data Source: WHO & Worldometer (2020)

3.5 Average Temperature and COVID-19 Confirmed Cases, Death Cases, Recovery Cases and Transmission of Europe and Africa

Mean value and standard deviation of avg. temperature of 40 countries in Europe in April 2020 were (8.59) and (3.56) respectively and in Africa among 50 countries were (24.03) and (5.02) respectively. In Europe Pearson Correlation among avg. temperature, COVID-19 confirmed cases, death cases, recovery cases and transmission on the other hand in Africa this variables are negatively correlated (Tables 4, 5 & 6). COVID-19 Confirmed case significantly correlated with death and recovery in both Europe and Africa. The following Figs. 2(a) & (b) shows the trend of COVID-19 in Europe and Africa.

Number of all COVID-19 confirmed cases, attributable to COVID-19 by surveillance consecutive 90 days (February 2020 to April, 2020) among the 10 affected countries of the South East Asia region. The length of time from the time origin to the endpoint was calculated. It illustrates the periodicity of SARS-CoV-2 infection and the transmission range of associated baseline observations, the utility time series forecasting, the determination of pandemic thresholds and the potential for mathematical models to contribute to the scientific basis for public health policy (Fig. 3).

In ancient Greece as early human beings noticed the close relationship between epidemics and seasons [11]. It is notable that May to September in the southern hemisphere and November to March in the northern hemisphere is the high season for influenza in temperate regions. Some renowned journals including Nature started the discussed on the airborne transmission of influenza virus in low-temperature and low-humidity environment in Mid-20th Century [12]. Now a day's low temperature, low-humidity environment is usually recognized as the key factor contributing to the transmission of influenza in winter [13]. Many researches had also shown more direct lab evidence in epidemiological statistics [14–16]. Another study performed on swine flu conducted in 2007 in a strictly controlled indoor environment other factors, the researchers identified that after they excluded the possibility of immune system impact from the low temperature, the virus could be transmitted through aerosoland the infectivity of the virus was stronger under lower-temperature, lower-humidity conditions. The infection rate was 75-100% in an environment where temperature was 5^0Cand relative humidity 35% and 50%. When the temperature was increased to 30^0C and the relative humidity was 35%, the infectious rate was 0 [17]. Mao Wang et.al, 2020 in their recent study titled 'Temperature Significantly Change COVID-19 Transmission in 429 cities' showed that under the circumstance of lower temperature, every 1^0C increase in average, minimum and maximum temperatures led to an increase of the cumulative number of cases by 0.83, 0.82 and 0.83 respectively. In the single-factor model of the higher-temperature group, every 1^0C increase in the minimum temperature led to a decrease of the cumulative number of cases by 0.86 [18]. In a study, Tapiwa Ganyani et.al, 2020 showed that high estimates of the proportion of pre-symptomatic transmission imply that case finding and contact tracing need to be supplemented by physical distancing measures in order to control the COVID-19 outbreak [19]. In our study, we also found the correlation between temperature and the COVID-19 in both Europe and Africa. The countries of lower temperature geographical region faced highest outbreak and the countries higher temperature geographical region faced lowest outbreak of COVID-19. In this situation lockdown, social distancing measure and contract tracing is more applicable for lower temperature region.

In the existing scenario in the COVID 19 countries with extremely fragmented communities, creative curbing operations have been initiated, such as urban lockdowns, the creation of drive-through screening centers and social isolation to control the virus locally and prevent new cases [20,21]. The introduction of country-specific preventive, early case identification and quarantine, isolation and care strategy has begun with extremely infected and lesser infected countries in compliance with WHO guidelines [22]. Several SARS studies indicate that the temperature is importantly correlated with the epidemic in the four major affected cities of China, including Beijing and Guangzhou. The risk of a higher daily incidence could be 18.18 times higher when the temperature is low during the SARS outbreak in 2003 [23].

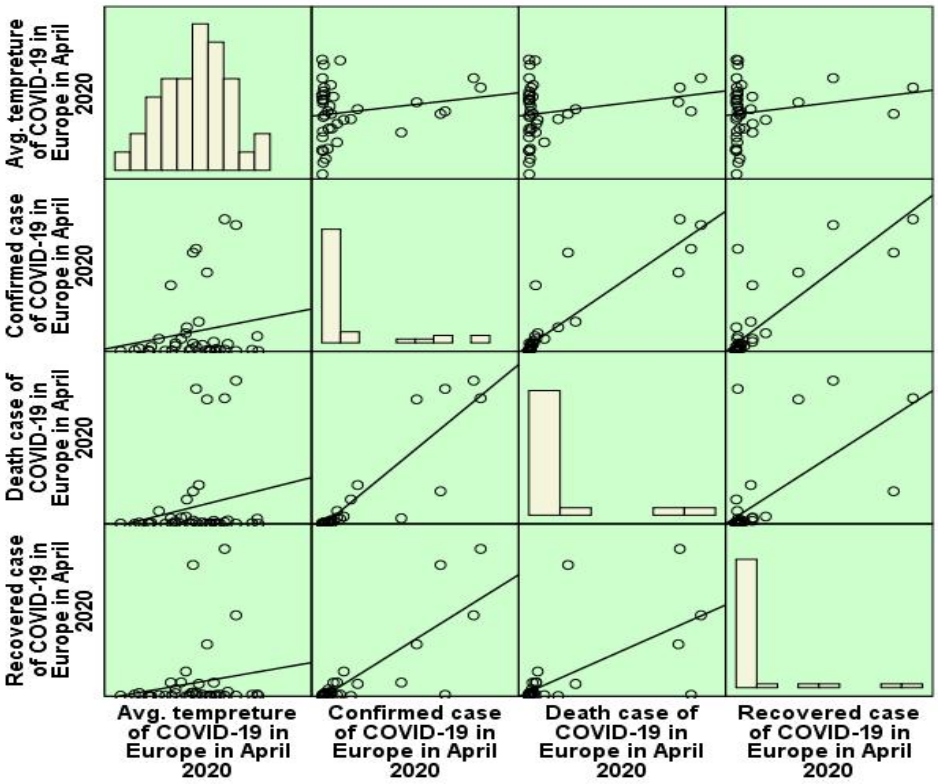

Fig. 2(a). Comparative spread trend of COVID-19 scatter plot diagram matrix and correlation of Europe in April 2020

Data Source: WHO & Worldometer (2020)

Table 4. Descriptive analysis of Temperature and COVID-19 affected, death, recovered and transmission trend of Europe and Africa in April 2020

Europe				Africa		
Description	**Mean**	**Std. Deviation**	**N**	**Mean**	**Std. Deviation**	**N**
Avg. temperature of COVID-19 in April 2020	8.5985	3.56876	40	24.0336	5.02739	50
Confirmed case of COVID-19 in April 2020	31958.9250	58446.41453	40	367.1404	757.20436	57
Death case of COVID-19 in in April 2020	3306.2000	7694.97175	40	15.1053	56.14894	57
Recovered case of COVID-19 in April 2020	12943.3750	31909.97957	40	231.7895	430.32673	57
Transmission of COVID-19 in April 2020	2.4750	.84694	40	3.0213	.94384	47

Note: Here N= number of country; the countries included based on available data on temperatures and COVID-19 trends

Table 5. Correlations of temperature and COVID-19 affected, death, recovered and transmission trend of Europe in April 2020

Correlations						
Description		**Avg. temperature of COVID-19 in Europe in April 2020**	**Confirmed case of COVID-19 in Europe in April 2020**	**Death case of COVID-19 in Europe in April 2020**	**Recovered case of COVID-19 in Europe in April 2020**	**Transmission of COVID-19 in Europe in April 2020**
Avg. temperature of COVID-19 in Europe in April 2020	Pearson Correlation	1	.178	.209	.175	.110
	Sig. (2-tailed)		.273	.195	.279	.500
	N	40	40	40	40	40
Confirmed case of COVID-19 in Europe in April 2020	Pearson Correlation	.178	1	.900**	.825**	.088
	Sig. (2-tailed)	.273		.000	.000	.589
	N	40	40	40	40	40
Death case of COVID-19 in Europe in April 2020	Pearson Correlation	.209	.900**	1	.640**	.209
	Sig. (2-tailed)	.195	.000		.000	.196
	N	40	40	40	40	40
Recovered case of COVID-19 in Europe in April 2020	Pearson Correlation	.175	.825**	.640**	1	-.023
	Sig. (2-tailed)	.279	.000	.000		.890
	N	40	40	40	40	40
Transmission of COVID-19 in Europe in April 2020	Pearson Correlation	.110	.088	.209	-.023	1
	Sig. (2-tailed)	.500	.589	.196	.890	
	N	40	40	40	40	40

***. Correlation is significant at the 0.01 level (2-tailed)*

Table 6. Correlations of temperature and COVID-19 affected, death, recovered and transmission trend of Africa 2020

Correlations						
Description		**Avg. temperature of COVID-19 in Africa in April 2020**	**Confirmed case of COVID-19 in Africa in April 2020**	**Death case of COVID-19 in Africa 2020**	**Recovered case of COVID-19 in Africa 2020**	**Transmission of COVID-19 in Africa 2020**
Avg. temperature of COVID-19 in Africa in April 2020	Pearson Correlation	1	-.126	-.235	-.250	-.202
	Sig. (2-tailed)		.383	.100	.080	.206
	Sum of Squares and Cross-products	1238.458	-24936.479	-3467.629	-27960.711	-36.424
	Covariance	25.275	-508.908	-70.768	-570.627	-.911
	N	50	50	50	50	41
Confirmed case of COVID-19 in Africa in April 2020	Pearson Correlation	-.126	1	.729**	.773**	-.248
	Sig. (2-tailed)	.383		.000	.000	.093
	Sum of Squares and Cross-products	-24936.479	32108072.877	1736711.158	14106263.684	-8756.255
	Covariance	-508.908	573358.444	31012.699	251897.566	-190.353
	N	50	57	57	57	47
Death case of COVID-19 in Africa 2020	Pearson Correlation	-.235	.729**	1	.639**	-.089
	Sig. (2-tailed)	.100	.000		.000	.554
	Sum of Squares and Cross-products	-3467.629	1736711.158	176551.368	865126.263	-236.319
	Covariance	-70.768	31012.699	3152.703	15448.683	-5.137
	N	50	57	57	57	47
Recovered case of COVID-19 in Africa 2020	Pearson Correlation	-.250	.773**	.639**	1	-.193
	Sig. (2-tailed)	.080	.000	.000		.193
	Sum of Squares and Cross-products	-27960.711	14106263.684	865126.263	10370141.474	-3467.511
	Covariance	-570.627	251897.566	15448.683	185181.098	-75.381
	N	50	57	57	57	47
Transmission of COVID-19 in Africa 2020	Pearson Correlation	-.202	-.248	-.089	-.193	1
	Sig. (2-tailed)	.206	.093	.554	.193	
	Sum of Squares and	-36.424	-8756.255	-236.319	-3467.511	40.979

Correlations						
Description		**Avg. temperature of COVID-19 in Africa in April 2020**	**Confirmed case of COVID-19 in Africa in April 2020**	**Death case of COVID-19 in Africa 2020**	**Recovered case of COVID-19 in Africa 2020**	**Transmission of COVID-19 in Africa 2020**
	Cross-products					
	Covariance	-.911	-190.353	-5.137	-75.381	.891
	N	41	47	47	47	47

***. Correlation is significant at the 0.01 level (2-tailed)*

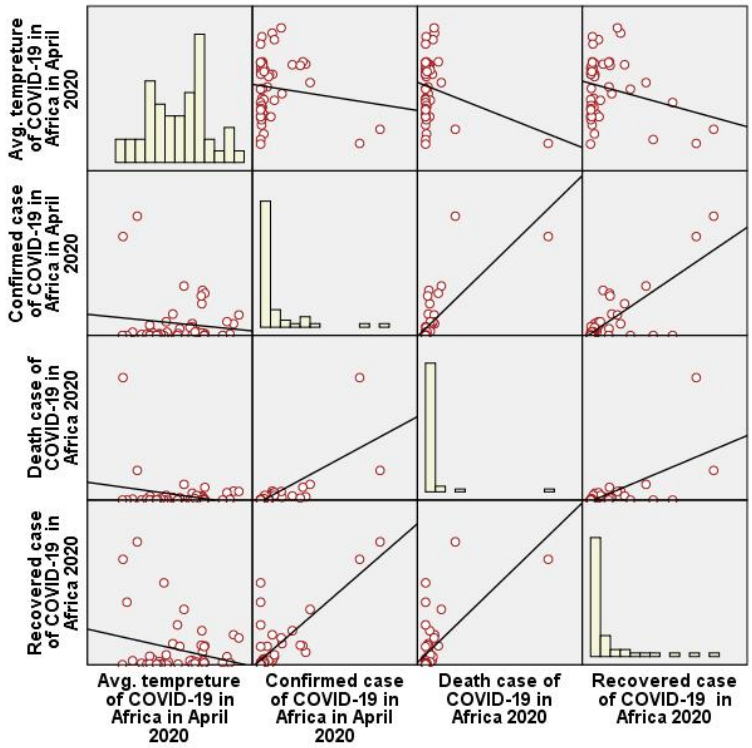

Fig. 2(b). Comparative spread trend of COVID-19 scatter plot diagram matrix and correlation of Africa in April 2020

Data Source: WHO & Worldometer (2020)

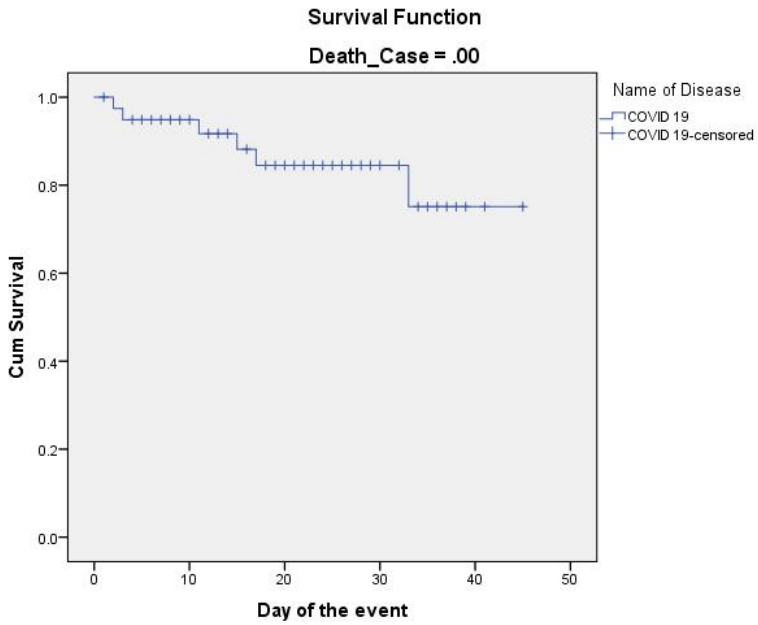

Fig. 3. Survival analysis of affected and death case of COVID-19 in South East Asian region from February to April 2020

Data Source: WHO (2020)

4. CONCLUSION

We were trying to identify that different temperature could have a significant impact on viral transmission in the countries in question worldwide. We also highlighted certain temperatures that best suit the advantage of the virus and contribute to the transmission by lower temperatures.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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