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Restricted transmission of 2019-nCoV/SARS-CoV-2 in human body due to meteorological variables dependent immune system

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Abstract:
Background*: 2019-nCoV/SARS-CoV-2 or most commonly novel coronavirus has become extremely important considering the pandemic situation declared by WHO on 11th March 2020. It has become a prime aim to the researchers to understand it's pathological, clinical, structural and transmission parameters. Though the report was first registered from Wuhan, China but gradually it has spread worldwide. In the present work the role of meteorological variables dependent immune system with the severity of the outbreak was surveyed on a world wide scale. This meteorological correlation model will provide some important information to any government for their future plan of action to get control over the rapid spread of SARS-CoV-2. The confirmed case counts of COVID-19 and meteorological variables were collected systematically from World Health Organization and website and World Meteorological Organization website on 29th March 2020. A systematic growth of the infection rate and population density of that particular country was also considered in this research.*
Materials and Methods*: In the present work the countries affected severely by COVID-19 is divided into two parts, one group situated between the latitude of 15^0 to 30^0 and other between 45^0 to 60^0 in both the hemisphere. Continuous monitoring was done through WHO official website to collect the raw data of COVID-19 infected people from the countries particularly suffering from 3rd stage of community transmission and the maximum and minimum temperature of those countries during the last fifteen days of March is recorded from World Meteorological Organization. From the raw data heavily populated countries were taken into consideration for analysis.*
Results*: It is clearly observed that at the equatorial zone that is between latitude ranges 15^0 to 45^0, the rate of transmission is low whereas between the latitude ranges 45^0 to 60^0 the transmission of viral infection is very high. Rate of transmission is naturally lesser in few countries due to its low population density. According to the guide line of WHO and the official pathological reports published in different country , it is observed that COVID-19 is not airborne but it transmit either in direct or indirect contact. Hence density of population and number of migrating people plays very vital role. But apart from these parameters, temperature plays an important role in the immune system of human body and on the pathogenic character of such RNA virus.*
Conclusion: *The collected data from 57 countries and more than 600000 people around the world and its corresponding graph gives a very clear trend about the 2019-nCoV/SARS-CoV-2 or most commonly novel coronavirus infection transmission rate. The analysis represents that there will be gradual decrease of infection transmission rate with the natural hike of temperature. In this case may be Stromal interaction molecule 1(STIM1) is activated moderately with high degree of temperature. Most commonly used drug Chloroquine, due to Malaria, interferes with ACE2 receptor glycosylation, which prevents SARS-CoV-2 to bind with the target cells may also be very important factor to reduce the transmission of infection.*
Key Word*: SARS-CoV-2, COVID-19, temperature, immune system, population density*

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I. Introduction

In the very beginning of the season 2020, COVID-19 outbreak has imposed a massive impact on public health and worldwide economy. Within a very small span of time it has proved its aggressiveness compared to MERS, SARS or any kind of seasonal and localized influenza [1-10]. Very high human to human transmission rate compared to other coronavirus infection has been compared with uncontrolled chain reaction literally. As of March 14 2020 the officially reported confirmed case inside China and other courtiers around the world was 63000 and 81050 whereas the reported death was 5388 which is nearly 4% of the total infected people. The overall situation has got worsen enough very rapidly and according to WHO the total infected person as on 29th March 2020 is 575444 and confirmed death is 26654 around the world and affected over 202 countries[11]. Therefore even if the outbreak of COVID-19 in China showed a flatten graph at the end of March 2020 but

exponential growth of infection is still very important considering the public health and worldwide economic crisis [12].

To understand and predict the epidemic trend, meteorological parameters and its correlation with the virus has become important. Earlier investigation of effect of temperature on RNA viruses led to the conclusion that inactivation between 25^0 to 35^0 generally takes place according to two thermodynamically distinct mechanism, depending on the temperature range. Infectivity degradation at low temperature typically at very few degree Celsius is considered to be caused selectively by denaturation of the nucleic acid. On the other hand, human body infected by virus and its growth rate inside body were less symptomatic. These CoVs are pleomorphic RNA viruses characteristically containing crown shaped peplomers with size of 80 to 160 nm and with 27-32 kb positive polarity [13-14]. COVID-19 is a RNA virus. In the present work, a strong correlation between transmission rate of COVID-19 virus with the mean temperature is observed.

II. Material And Methods

In the present work the countries affected severely by COVID-19 is divided into two parts, one group situated between the latitude of 15^0 to 30^0 and other between 45^0 to 60^0 in both the hemisphere. Continuous monitoring was done through WHO official website to collect the raw data of COVID-19 infected people from the countries particularly suffering from 3^{rd} stage of community transmission and the maximum and minimum temperature of those countries during the last fifteen days of March is recorded from World Meteorological Organization.

Study Design: Statistical analysis of transmission of infection was done using Origin Software.

Study Location: COVID-19 infection rate in the equatorial and Tropical region. Data collected from WHO official website and temperature were recorded from World Meteorological Organization.

Study Duration: March 15 2020 to March 29 2020.

Sample size: Around 600000 COVID-19 infected people.

Sample size calculation: In the present work the countries affected severely by COVID-19 is divided into two parts, one group situated between the latitude of 15^0 to 30^0 and other between 45^0 to 60^0 in both the hemisphere. Continuous monitoring was done through WHO official website to collect the raw data of COVID-19 infected people from the countries particularly suffering from 3^{rd} stage of community transmission and the maximum and minimum temperature of those countries during the last fifteen days of March is recorded from World Meteorological Organization. From the raw data heavily populated countries were taken into consideration for analysis.

Subjects & selection method: Randomly taken the countries suffering from high, moderate and very low COVID-19 infection. According to mean temperature these countries were divided into three categories for analysis. Raw data was taken directly without any manipulation. Population density count was also taken into consideration.

Inclusion criteria:

1. Countries with 3^{rd} stage infection transmission into population.
2. Either sex
3. Virus infected people from Tropical, Equatorial and Temperate zone.

Exclusion criteria:

1. Country with very low population density
2. Country with first stage of COVID-19 infection that is disease among the migrating people only.
3. Country with very less country to country migration record.

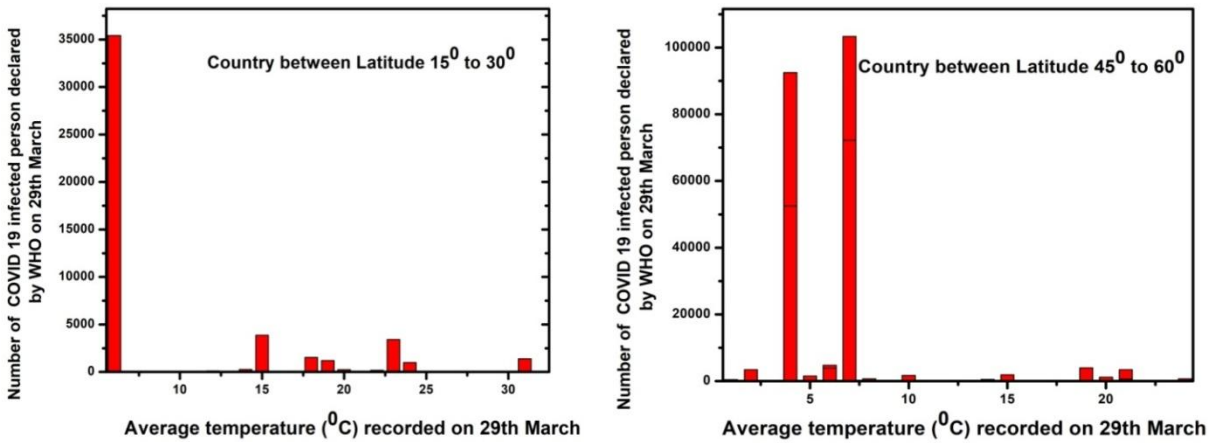
Procedure methodology

In the present work the countries affected severely by COVID-19 is divided into two parts, one group situated between the latitude of 15^0 to 30^0 and other between 45^0 to 60^0 in both the hemisphere. Continuous monitoring was done through WHO official website to collect the raw data of COVID-19 infected people from the countries particularly suffering from 3^{rd} stage of community transmission and the maximum and minimum temperature of those countries during the last fifteen days of March is recorded from World Meteorological Organization. From the raw data heavily populated countries were taken into consideration for analysis. Table no 1 represents the average maximum and minimum temperature and the number of people affected in that country.

Country between Latitude 45^0 to 60^0	No of confirmed cases reported as on March 30 2020	Average temperature during last 15 days of March 2020	Country between Latitude15^0 to 30^0	No of confirmed cases reported as on March 30 2020	Average temperature during last 15 days of March 2020
France	37145	2/10	Morocco	437	12/21
Italy	92472	8/17	Algeria	409	7/21
Croatia	657	0/8	Libya	03	11/17
Bosnia	269	-1/3	Egypt	576	11/20
Belgrade	659	1/6	Israel	3865	9/17
Serbia	659	1/6	Jordan	246	10/17
Romania	1452	5/6	Saudi Arabia	468	17/28
Ukraine	418	-2/4	Iraq	506	15/29
Russia	1534	-4/10	Kuwait	235	17/28
Kazakhstan	265	-2/11	Iran	35408	5/15
Uzbekistan	133	11/25	Afghanistan	114	0.7/12
China	82356	7/21	Pakistan	1526	10/21
Mongolia	12	-10/3	India	979	17/32
Japan	1693	6/17	Nepal	5	10/30
U.S.A	103321	7/14	Senegal	119	19/25
Canada	4757	5/8	Mali	18	22/38
Norway	3845	2/8	Sudan	5	20/36
Sweden	3447	-3/3	Myanmar	8	24/39
U.K.	17093	4/10	Thailand	1388	28/37
South Africa	1187	14/23	Laos	6	25/39
Australia	3996	11/25	Vietnam	179	18/28
Brazil	3417	19/27	Mexico	717	9/25
Bolivia	74	01/04	Honduras	67	15/29
Peru	635	19/26	Zambia	16	17/27
Chile	1909	12/28	Madagascar	26	17/25
Argentina	690	22/27	Peru	635	20/27
New Zealand	476	13/17	Brazil	3417	19/27
Spain	72248	3/11	South Africa	1187	14/23
Germany	52547	-2/5			

Corresponding countries and the infected people is plotted in a world map and is shown in Figure 1.
From the figure it is quite evident that the Country between Latitude 45^0 to 60^0 is affected more compared to the Country between Latitude 15^0 to 30^0. The mean temperature versus number of people infected in the corresponding country is shown in Figure 2.

Figure1. Plotting of the infected countries (i) Red symbol indicates the number of infected people greater than 1000 as on 29th March 2020 (ii) Green symbol indicates the number of people less than 1000 as on 29th March 2020.



(a) **(b)**

Figure 2. The bar diagram shows the affected people in different countries mention in Table 1 in the country between latitude (a) 15^0 to 30^0 (b) 45^0 to 60^0.

The world map of population density [15-16] is also depicted in Figure 3 here to make a comparative study of the transmission rate of COVID-19 among the people along with meteorological variables.

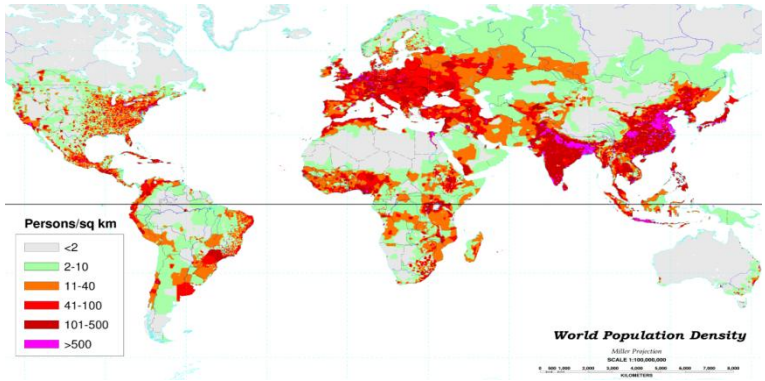


Figure3. World population density per square kilometer.

Statistical analysis

It is clearly observed from the Figure 1 and its corresponding mean temperature versus number of infected people (Figure 2) that at the equatorial zone that is between latitude ranges 15^0 to 45^0, the rate of transmission is low whereas between the latitude ranges 45^0 to 60^0 the transmission of viral infection is very high. Rate of transmission is naturally lesser in few countries due to its low population density. According to the guide line of WHO and the official pathological reports published in different country, it is observed that COVID-19 is not airborne but it transmit either in direct or indirect contact. Hence density of population and number of migrating people plays very vital role. But apart from these parameters, temperature plays an important role in the immune system of human body and on the pathogenic character of such RNA virus. From the present experiment it is observed that the transmission of COVID-19 virus among the people at the temperature range 1^0C to 4^0C is very small whereas it drastically increases between the temperature range 5 ^{0}C to 15 ^{0}C and again delayed its transmission between the temperature range of 19 ^{0}C to 35^0C.

III. Result

This is because temperature has a very profound effect on every biological process including the immune system of the human body. In this case may be Stromal interaction molecule 1(STIM1) is activated moderately with high degree of temperature. The activated STIM1 and plasma membrane pore-forming protein is identified as calcium release activated channel. This calcium is very essential for a number of different cellular functions which directly linked with the immune system of the body. The sustained influx of such calcium into these cells activates the gene expression. The STIM1 is also acts as a function of temperature sensor in tissues which intern improve the immune system that is the self defense of the cell. This may be the reason due to which the rate of transmission of COVID-19 is regulated and lost its potentially high transmission rate. High average surrounding temperature in the tropical and equatorial region may increase the evaporation

rate of the moisture present in the droplets which may reduce the sphere of influence of infection. The most commonly used drug Chloroquine due to Malaria disease, used in Tropical and Equatorial region may affect the internal biological mechanism. Chloroquine interferes with ACE2 receptor glycosylation, which prevents SARS-CoV-2 to bind with the target cells. It also limit the biosynthesis of sialic acids that may be required for cell surface binding of SARS-CoV-2.

IV. Conclusion

The collected data from 57 countries and more than 600000 people around the world and its corresponding graph gives a very clear trend about the 2019-nCoV/SARS-CoV-2 or most commonly novel coronavirus infection transmission rate. The analysis represents that there will be gradual decrease of infection transmission rate with the natural hike of temperature. This is because temperature has a very profound effect on every biological processes including the immune system of the human body. In this case may be Stromal interaction molecule 1(STIM1) is activated moderately with high degree of temperature. Chloroquine interferes with ACE2 receptor glycosylation, which prevents SARS-CoV-2 to bind with the target cells may also be very important factor to reduce the transmission of infection.

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