Regional Differences in SARS-CoV-2 Transmission and Virulence Across Four U.S. States

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Abstract.

The United States has the honor (or dishonor!) of being the top on the podium of countries with the highest number of its citizens infected with SARS-COV-2 and also the highest number of deaths due to SARS-COV-2 infections. Environmental factors, including Temperature, Humidity and Far Infrared Irradiation have been proposed to play significant roles in SARS-COV-2 Infection and Virulence. However, these factors are not uniform. Here, the IP-10000 (Total Number of Individuals Infected with SARS-COV-2 Per 10000 Population), DPP-10000 (Total Number of Deaths Due to SARS-COV-2 Infections Per 10000 Population) and DPI-10000 (Total Number of Deaths Per 10000 Individuals Infected with SARS-COV-2) were analyzed in four States, including California, Florida, New York and Texas, and correlated them with Temperature, Humidity and Far Infrared Irradiation. The results show that IP-10000, DPP-10000 and DPI-10000 were inversely correlated with Temperature, Humidity and Far Infrared Irradiation. The much higher deaths of individuals infected with SARS-COV-2 in New York and New York City can be explained at least in part by the average low Temperature and low Far Infrared Irradiation experienced by New York and New York City. As winter is just around the corner, it is submitted that the control of Temperature, Humidity and Far Infrared Irradiation with protocols that exist already will significantly reduce SARS-COV-2 Infection and Virulence in New York, New York City and other areas.

Introduction.

In the United States, the total number of individuals infected with SARS-COV-2, the etiologic agent of COVID-19 has reached over 7 million and over 200,000 deaths due to COVID-19 have been recorded (See below). There is no correlation between SARS-COV-2 Infection and Virulence [1 and See below]. It has been proposed that Environmental factors, including Temperature, Humidity and Far Infrared Irradiation could play significant roles in SARS-COV-2 Infection and Virulence [2,3]. It was shown that there are reverse correlations between environmental factors, including Temperature, Humidity and Far Infrared Irradiation, and SARS-COV-2 Infections and Virulence as measured by IP-10000 (Total Number of Individuals Infected with SARS-COV-2 Per 10000 Population) and DPI-10000 (Total Number of Deaths Per 10000 Individuals Infected with SARS-COV-2) [2,3]. Temperature, Humidity and Far Infrared Irradiation are not uniform. Can differences in Temperature, Humidity and Far Infrared Irradiation account for the variable IP-10000 and DPI-10000 that are observed in different locations in the United States (See below). The IP-10000, DPP-10000 and DPI-10000 numbers were determined for California, New York, New York City, Florida and Texas, and correlation analysis was performed to determine the relationships between Temperature, Humidity and Far Infrared Irradiation and Infection and Virulence. The results of these studies show that Difference in Temperature, Humidity and Far Infrared Irradiation could account for the difference in IP-10000, DPP-10000 and DPI-10000 that are observed between New York and New York City, and California, Florida and Texas. It is submitted as Temperature, Humidity and Far Infrared Irradiation decrease with the approaching winter in New York, New York and other parts of United States, the control of Temperature, Humidity and Far Infrared Irradiation by protocols that are already in existence can significantly reduce SARS-COV-2 Infection and Virulence.

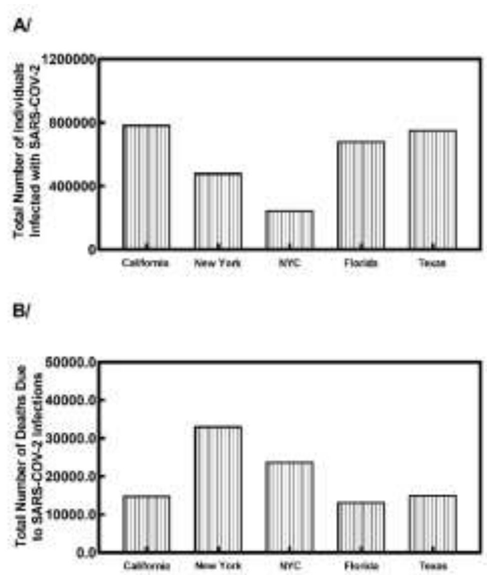


Figure 1. Comparison of SARS-COV-2 Infections (Panel A) and Virulence (Panel B) from California, New York, New York City, Florida and Texas.

Methods.

Data for the total number of individuals infected with SARS-COV-2 and total number of deaths due to SARS-COV-2 infections for each country was curated from the World Health Organization, the United States Center For Disease Control and Prevention, and Department of Health of each State. IP-10000, a measure of Infectivity is defined as the Total Number of Individuals Infected with SARS-COV-2 Per 10000 Population. DPI-10000 is defined as the Total Number of Deaths Due to SARS-COV-2 Infections Per 10000 Population. DPP-10000, a measure of Virulence is defined as the Number of Deaths Per 10000 Individuals Infected with SARS-COV-2. IP-10000, was calculated based on the total number of individuals infected with SARS-COV-2 per 10000 population. DPI-10000 was calculated based on the total number of deaths due to SARS-COV-2 infections per 10000 population. DPP- 10000 was calculated based on the total number of deaths due to SARS-COV-2 infections per 10000 Individuals Infected with SARS-COV-2.

Temperature, Humidity and Far Infrared Irradiation values were curated from the Meteorological Readings and Forecasts of each State.

Data was analyzed for correlations by the Pearson method [4,5]

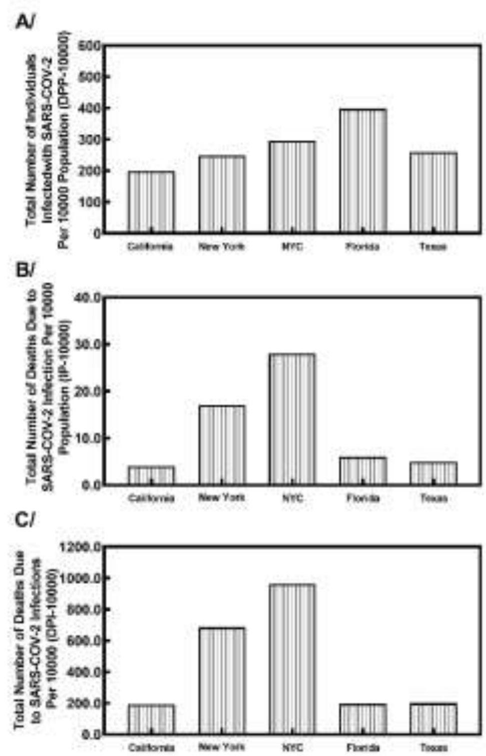
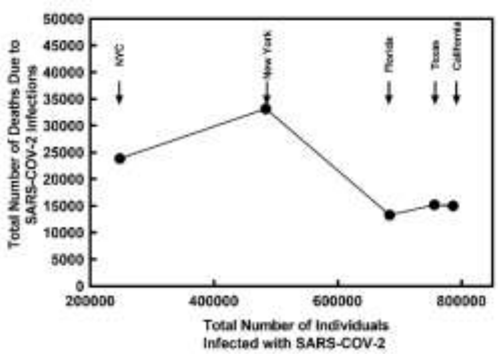


Figure 2. Comparison of IP-10000 (Panel A), DPP-10000 (Panel B) and DPI-10000 (Panel C) from California, New York, New York City, Florida and Texas.



<u>Figure 3. No correlation between Infectivity and Virulence of SARS-COV-2 from California, New York, New York City, Florida and Texas.</u>

<u>Results.</u>

Figures 1 compares the total number of individuals infected with SARS-COV-2 in the States of California, Florida, New York, New York City and California while Figure 2 compares the total number of deaths due to COVID-19 States of California, Florida, New York, New York City and California. The State of California has the highest number of individuals infected with SARS-COV-2. However, the state of New York and the City of New York have the highest number of deaths due to COVID-19. That there is no correlation between Infection and Virulence is shown in Figure 3.

An analysis of the IP-10000 number or the Total Number of Individuals Infected With SARS-COV-2 Per 10000 Population (Figure 4), DPP-10000 number or Total Number of Deaths Due to SARS-COV-2 Infections Per 10000 Population (Figure 5) and DPI-10000 or Total Number of Deaths Per 10000 Individuals Infected With SARS-COV-2 (Figure 6) shows that while IP-10000 numbers, a measure of infectivity for California (~198), Florida (~398), New York (248), New York City (295) and Texas (260) are very similar, there was great variability in DPP-10000 numbers and DPI-10000 numbers which measure virulence. The DPP numbers for California, Florida, New York, New York City and Texas were calculated to be ~4, 17, 28, 6 and 5 respectively. The DPI numbers for California, Florida, New York, New York City and Texas were calculated to be ~192, 686, 962, 196 and 201 respectively.

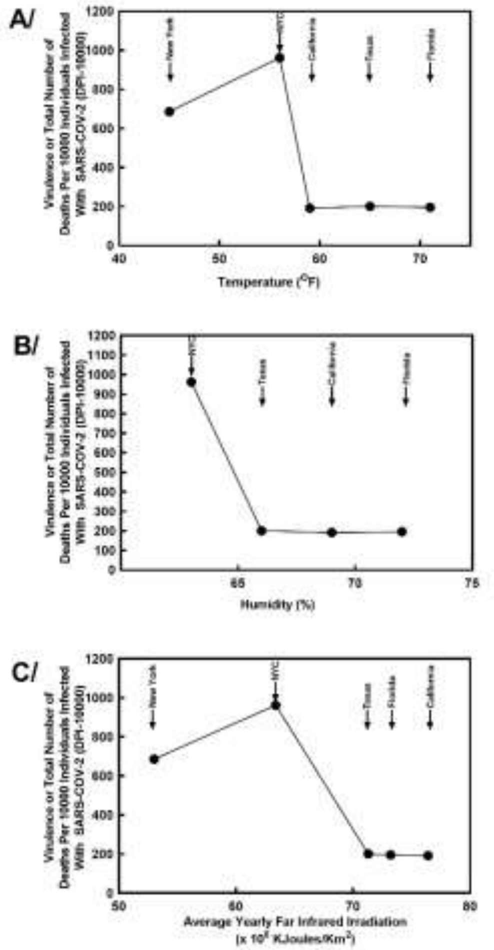


Figure 4. Graphs of IP-10000 v. Temperature (Panel A), v. Humidity (Panel B) and v. Far Infrared Radiation (Panel C) from California, New York, New York City, Florida and Texas.

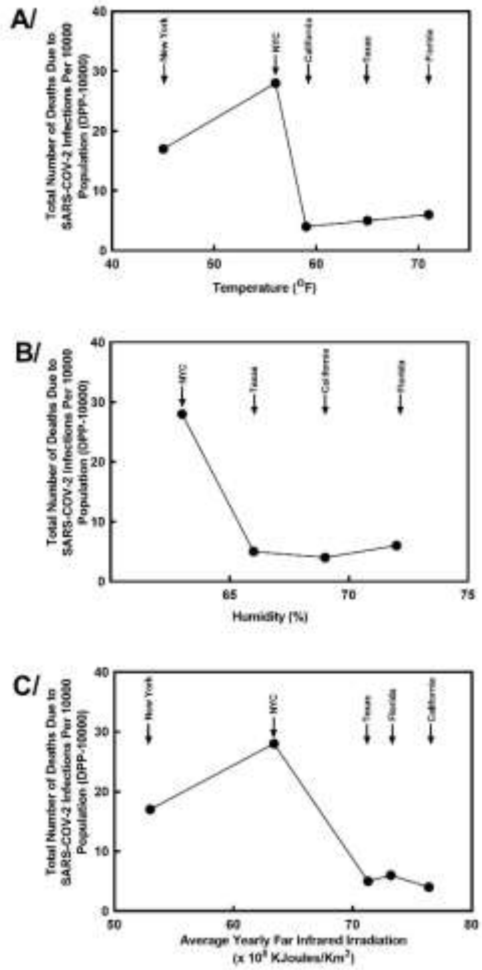


Figure 5. Graphs of DPP-10000 v. Temperature (Panel A), v. Humidity (Panel B) and v. Far Infrared Radiation (Panel C) from California, New York, New York City, Florida and Texas.

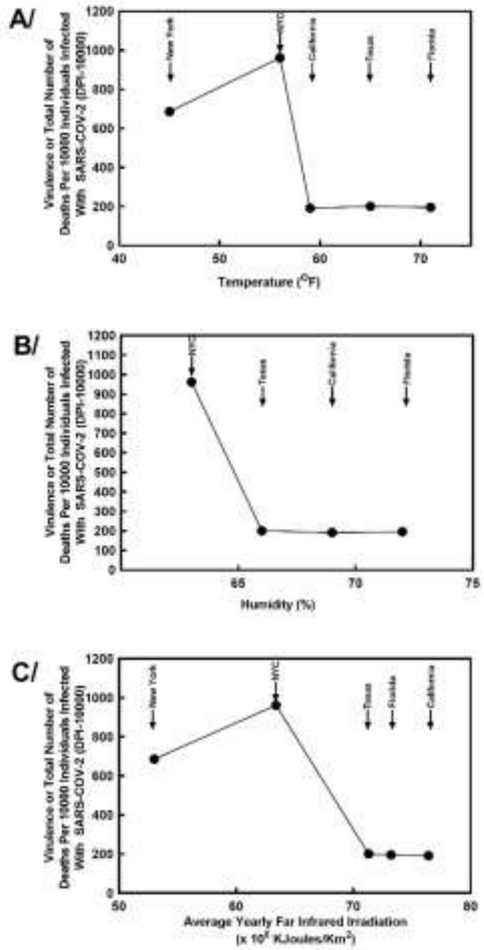


Figure 6. Graphs of DPI-10000 v. Temperature (Panel A), v. Humidity (Panel B) and v. Far Infrared Radiation (Panel C) from California, New York, New York City, Florida and Texas.

The DPP numbers for California, Florida, New York, New York City and Texas were calculated to be ~4, 17, 28, 6 and 5 respectively. The DPI numbers for California, Florida, New York, New York City and Texas were calculated to be ~192, 686, 962, 196 and 201 respectively. The results show that high Temperature, Humidity and Far Infrared Irradiation were associated with low DPI-10000 and DPP-10000 numbers which measure SARS-COV-2 Virulence.

The high DPP-10000 and DPI-10000 numbers for New York and New York City can be due to factors that are inherent to SARS-COV-2 itself such as mutational events that renders SARS-COV-2 more virulent in New York and New York City or extrinsic to SARS-COV-2, including environmental factors, healthcare response strategy and living condition. Figures 4, 5 and 6 also summarize the analysis of the potential correlations between Infectivity as measured by IP-10000 number and Virulence as measured by DPP-10000 and DPI-10000 numbers. The results show that compared to California, Florida and Texas, Infectivity of SARS-COV-2 in New York and New York City was not influenced by Temperature, Humidity and Far Infrared Irradiation. However, Virulence of SARS-COV-2 was greatly influenced by Temperature, Humidity and Far Infrared Irradiation. Figures 5 and 6 show that the much lower Temperature and Far Infrared Irradiation experienced by New York and New York City could account for the much higher SARS-COV-2 Virulence as measured by DPP-10000 and DPI-10000 numbers.

Discussion.

With respect to SARS-COV-2 Infectivity and Virulence, the United States was previously classified as being part of Group F countries which have high IP-10000 number (Total Number of Individuals Infected with SARS-COV-2 Per 10000 population) and DPI-10000 number (Total Number of Deaths Per 10000 Individuals Infected with SARS-COV-2 [3]. As shown above, the IP-10000, DPP-10000 and DPI-10000 numbers are not uniform in various cities. Although, California, Florida and Texas have very similar IP-10000 numbers (which measures Infectivity) as New York and New York City, their DPP-10000 and DPI-10000 numbers (which measure Virulence of SARS-COV-2) are much lower (See Figures 4, 5 and 6). The high DPP-10000 and DPI-10000 numbers observed in New York and New York City can be due to environmental factors, including Temperature, Humidity and Far Infrared Irradiation [2,3]. The results presented in this work show that high DPP-10000 and DPI-10000 numbers recorded in New York and New York City were associated with low Temperature, relatively low humidity and low Far Infrared Irradiation. Several studies have shown that environmental factors including, Temperature and Humidity could be inversely correlated with SARS-COV-2 Infectivity and Virulence [2,3,6-14]. A study based on computer simulation nevertheless concluded that environmental factors, including temperature and humidity had no effect on SARS-COV-2 Infectivity and Virulence [15] which is in stark contradiction to laboratory studies showing that elevated temperature and humidity generally lowers the viability of viruses, including SARS-COV-2 [6-14]. Chan et al. [17] showed that at a temperature of ~38^0 C and relative humidity greater than 95%, there was a significant loss of SARS-COV viability and infectivity than at ~33^0 C and relative humidity greater than 95% indicating that SARS-COV preferred a low temperature and low humidity for its viability and infectivity. Far Infrared Irradiation has also been shown to kill SARS-COV-2 in controlled setting [18].

Based on the above studies, it has previously been proposed that elevated Temperature, Humidity and Far Infrared Irradiation would significantly lower Infectivity and Virulence of SARS-COV-2 and that currently available protocols can be easily implemented to combat SARS-COV-2 Infections and deaths [2,3]. Earn et al. [19] have suggested that "fever suppression increases the expected number of influenza cases and deaths in the US". Wu et al. [20] have indicated that "High fever (≥ 39 ^{O}C) was associated with higher likelihood of ARDS development but lower likelihood of death" and concluded that "high fever was associated with better outcomes among patients with ARDS". Earlier seminal studies of Armstrong [21], Lwoff and Lwoff [22] and Lwoff et al. [23] showed that viruses that infect humans, including Herpes Simplex Virus and Polio Virus cannot survive in an environment of moderately elevated temperature that can be tolerated by all humans. Lwoff [24,25] had also proposed that "hyperpyrexia may save an animal infected intra-cerebrally by a high dose of a virulent strain of poliovirus, or transform a hyper-acute disease into a latent infection". Can SARS-COV-2 establish Latency in humans? Sheles and Vasilevsky [26] have inquired whether SARS-COV-2 may be able to establish Latency in humans. There is a report suggesting the possibility of SARS-COV-2 reactivation [27]. An even more provocative question is whether SARS-COV-2 is a Latent Virus that had become reactivated as a result of environmental factors, including drought that resulted in sudden decrease in humidity and global climate change that engendered sudden decrease of Temperature, Humidity and Far Infrared Irradiation.

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