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Sunshine and Wind speed effect on COVID-19 cases in mid hill region of Rajouri and Jammu districts of Jammu Kashmir Union Territory, India

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Abstract
The aim of the study was to evaluate the impact of sunshine and wind velocity on COVID-19 cases in Jammu and Rajouri districts of Jammu Kashmir Union Territory. The timeline of data opted to analyze the weather parameters and COVID-19 cases was between *1st July 2020 to 20th August 2020.*Pearson Correlation in SPSS 16.0 was implemented to define the magnitude of association between the number of daily new cases and weather parameters. During analysis, it was found that wind velocity was in non-significant negative correlation with COVID-19 cases in both the districts. However, the sunshine hours were in significant negative correlation with COVID-19 cases, i.e. with increase in sunshine hours the COVID-19 cases has decreased and vice-versa. Therefore, the study results may guide authorities and policy makers on taking specific measures to the curb the weather based COVID-19 spread in the region.

Keywords: Sunshine, Wind velocity, COVID-19 cases

1. Introduction
COVID-19 crisis has introduced the humans to a new challenge involving all aspects of disease control, health care and management. Despite worldwide efforts to make an effective vaccine against the COVID-19, we haven't achieved much success yet. Various abiotic factors like temperature; humidity have showed positive results in controlling the spread of COVID-19 infection (Ma *et al.*, 2020) [6]. Apart from this, the COVID-19 pandemic is just not a disease; it's the outcome of the unacceptable human interventions against nature policies and working which we need to stop immediately before the onset of another pandemic in future.
COVID-19 disease was first reported in Wuhan, China in December 2019 (Zhu *et al.*, 2019) and after that it spread like wild fire in the entire world as a result of which World Health Organization declared it as pandemic (WHO 2020) [12]. COVID -19 first case in India was first reported in Kerala on January 30 and since then we have facing huge surge in cases in the entire country. In India, as on 26th August 2020, 6.30 PM, there were 32,39,096 confirmed cases and 59,645 deaths whereas the confirmed cases in Jammu Kashmir Union Territory were 34,411 (www.covid19india.org). The control measures were opted to reduce the intensity of its spread with lockdown as most effective option in lowering infection numbers; despite all protective measures to reduce contamination, we still have noticed case rise of COVID-19 infection in areas of Jammu and Rajouri since the onset of monsoon causing rise in humidity levels across the area. According to WHO, the symptoms of COVID-19 infection are fever, tiredness, dry cough, shortness of breath, aches, pains and sore throat. Also, a study conducted on virus epidemiology has suggested that virus particles can be transmitted through abiotic factors of ecosystem (Dalziel *et al.*, 2018) [5] but still the research on climate change vs. COVID-19 spread is limited, so this research and analysis can be a contribution in understanding the pattern and prevention of COVID-19 disease in future.
Thus, the present study is more focused towards evaluating the correlation between sunshine and wind with COVID-19 cases.

2. Material and Methods
Jammu district occupies an area of about 3097 sq. kms and lies in between 32°39'35.5"N latitude and 74°47'35.0"E longitude at an elevation of 332 meters above the mean sea level whereas Rajouri district occupies an area of about 2630 Sq. Kms. with peculiar physical features and lies in between 33.3716° N latitude and 74.3152° E longitude at an elevation of

915 meters above the mean sea level. The sunshine (hrs day^{-1}) and wind speed (km hr^{-1}) are considered as parameters of weather and the data related to weather parameters (from *1st July 2020 to 20th August 2020)* was recorded from Agrometeorological Observatory situated at respective locations under study. The data related to COVID-19 cases in respective districts of same timeline was gathered from www.covid19india.org and same was analyzed graphically with sunshine for the entire region (Fig. 1). Pearson Correlation in SPSS 16.0 was implemented to define the magnitude of association between the number of daily new cases and weather parameters. It summarizes the results and explains how well the association between daily transmission and weather parameters can be demarcated.

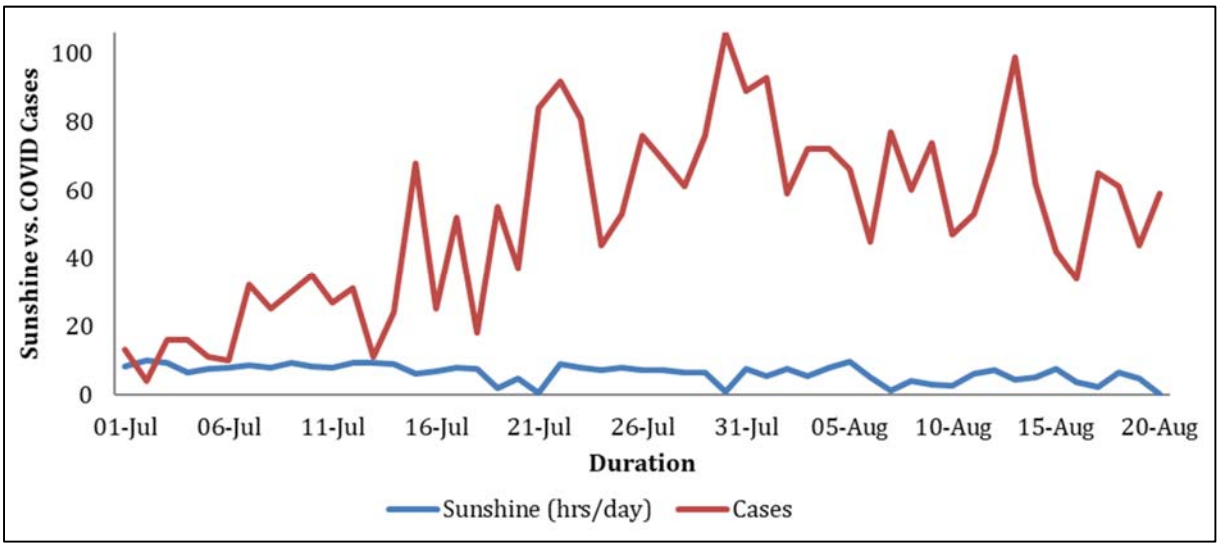

Fig 1: Trend of Sunshine hours vs. COVID-19 Cases in Jammu & Rajouri districts of Jammu Kashmir, U.T

3. Results and Discussion

The correlation results have been described in Table 1. During analysis, it was found that wind velocity was found in non-significant negative correlation with COVID-19 cases in both the districts. However, the sunshine hours were in significant negative correlation with COVID-19 cases, i.e. with increase in sunshine hours the COVID-19 cases has decreased and vice-versa. The same was expressed by Cannell *et al*., (2006) and Miller (2018) which highlighted that sunlight boosts the immune system and slows down the development of influenza and SARS agents in the human body. In Indonesia, Covid-19 patients who experienced sunlight exposure when they were receiving care either in hospitals or home settings were more likely to recover from the disease (Asyary and Veruswati, 2020) [2] and therefore the outcome was highly linked with the study. Also, the high recovery rate in Jammu and Rajouri can be attributed to Vitamin D production in the body triggered through sunlight exposure which functions to increase immunity (Slusky and Zeckhauser, 2018) [10]. It has also been stated that lower exposure to sunlight can instigate the influenza virus (Sagripanti and Lytle, 2007) [8] causing increase in COVID-19 cases during less sunshine hours. Some other studies have also insisted the sunlight exposure as effective remedy in treating tuberculosis and other lung diseases (Aloia and Li-Ng, 2007; Asyary *et al*., 2017) [1, 3]. Both the districts fall in the subtropical region of Jammu Kashmir and therefore can utilize the advantage of greater sunshine hours than sub-temperate or temperate zones and exposure to more sunshine affects health positively (Singhal, 2020) [9].

Also, healthy exposure to sunlight can cause release endorphins which in turn may boost immunity and can fight the viral diseases like COVID-19 easily (Sternberg and Engineer, 2020) [11] which can be considered as a reason in reduction of case number with increase in sunlight frequency in the present study. Despite the study depicted significant impact of sunlight in reduction of COVID-19 case in area but this research still has some limitations. The study is based on only two weather factors however several other factors might also have acted as confounding factors in our correlational observations such as topography, testing facilities, related infrastructure, quarantine measures, population migration and policies like lockdown. Also, before finalizing a policy, it is also essential to find out the type and exposure of sunlight in detail as well as a prompt data depicting patient exposure to sunlight.

4. Conclusion

This study showed that the sunlight exposure can reduce the COVID-19 cases to some extent. In country like India where population density is very high, such study reflecting weather parameter as a factor to COVID-19 spread can help framing an efficient policy in disease control and management specially during onset of monsoon. Thus, this preliminary study need to be researched further with sunlight efficiency as leading parameter in reducing the cases worldwide in every ecological zone so that results can be used as a basis to understand the dynamics of COVID-19 cases in specific region.

Table 1: Correlation of coefficients among Weather Parameters vs. Jammu and Rajouri district of Jammu Kashmir, Union Territory.

Jammu	***Wind Velocity (km hr^{-1})***	***Sunshine (hrs day^{-1})***
Sunshine (hrs day^{-1})	-0.028	-
COVID-19 Cases	-0.176	-0.291*
Rajouri	Wind Velocity (km hr^{-1})	Sunshine (hrs day^{-1})
Sunshine (hrs day^{-1})	0.142	-
COVID-19 Cases	-0.185	-0.349*

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