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Original Research Article

Correlation of mean temperature and suicide rates of India

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ABSTRACT

Background: Environmental temperature affects life in numerous ways and spheres. There were reports that it impacts human behavior of suicide. Indian medical literature was almost silent on this topic.
Aim: To find out the relationship between suicide and max., min., and average temperatures over a six-decade period in India.
Materials and Methods: The suicides for the years from 1964 to the year 2021 were collected from the Ministry of Home, Govt. of India, displayed National Crimes Record Bureau-Accidental Death & Suicides in India (NCRB-ADSI) portal. The annual Max., Min., and Average temperature were obtained from the website Indiastat for the same period. After basic analysis, the Spearman rank correlation coefficient was performed to find the association between suicides and temperature. The statistics were done using online software from Social Science Statistics.
Results: There were 5157992 suicides in 59 years-1964-2021 with a highest of 164033 in 2021 and a lowest of 38217 in 1979. The maximum temperature recorded was 30.08 °C in 2009. The lowest temperature of 17.2 °C was recorded in 1971. The average temperature ranged from 23.74 °C to 26.21 °C. There were no outliers in either. Spearman rank correlation coefficient was estimated to be: 0.73509. Spearman rank correlation coefficient showed a p-value of <0.001 for a significant large positive relationship between suicides and each of the three parameters studied. There was a substantial, monotonic, increasing positive relationship between the variables.
Conclusion: Increasing temperature impacts suicide.

1. Correlation of Suicides in India and Temperature

Suicide, premature self-inflicted caseation, is a human disaster and enigma. It has disastrous consequences on the family and society. Various parameters were studied concerning suicide. They include BMI, Cultural factors, Developmental indices, Education, Employment, Gender, Income, Lunar phase, Marital status, Occupation, Property rights, Season, Social factors, Weather, etc. The environmental temperature, a weather component, affects life in numerous ways and spheres. It can affect acutely or chronically; directly or indirectly; and temporarily or permanently. There were reports of it impacting the human act of suicide. There were few studies about it in Indian medical literature. Hence, an exercise was undertaken to assertain the relationship between suicides and max., min., and average temperatures over decades.

2. Materials and Methods

The methodology involves a quantitative approach using secondary data sources. Ministry of Home, Govt. of India, displays in the National Crimes Record Bureau-Accidental Death & Suicides in India (NCRB-ADSI) portal[1] every year details of suicides in India. The suicides for the years from

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1964 to the year 2021 were taken. The annual Max., Min., and Average temperature were obtained from the website Indiastat for the same period. After descriptive analysis, Spearman rank correlation coefficient was performed to find the association between the suicide and max., min., and average temperatures. The statistics were done using online software from Social Science Statistics.[2]

No permission was sought, as this study was based on material obtained from the open public domain, does not involve clinical trials, does not identify any person, and does not ethically or morally violate anyone's rights.

3. Results

The results were for 57 years, from 1967 to 2021. The suicides ranged from 38217 (1979) to 164033 (2021). There were no outliers. There was a significant, monotonic, increasing positive relationship between the variables. If one variable increases in value, then the other one increases too.

ives details of the suicides and max., min., and average temperatures and Spearman rank correlation coefficient results.

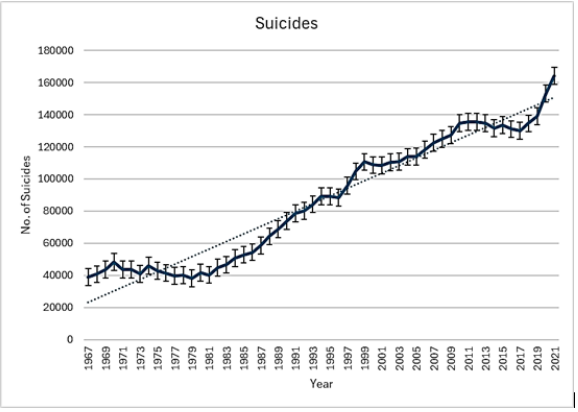

Figure 1: Suicides 1967-2021.

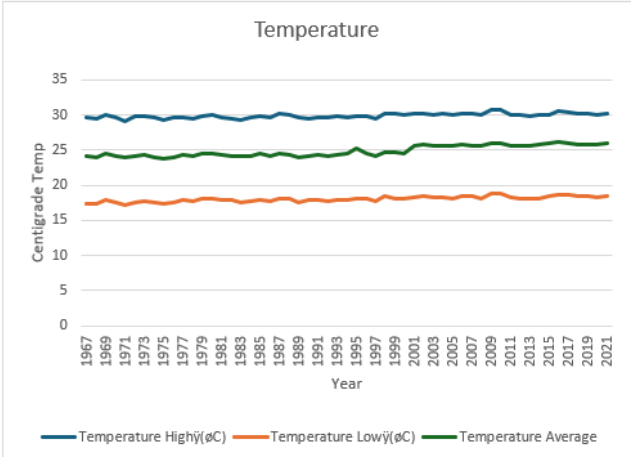

Figure 2: Annual max., min., and averagetemperature-1967-2021.

4. Discussion

Temperature has long been associated with changes in human behavior and mental health. Individuals and nations can be susceptible to temperature, alone or in tandem with other weather elements like humidity, rainfall, and precipitation. Temperature can affect an individual in different ways. The present analysis indicates a significant relationship between the variables. This is in support of various studies from other countries. Increased temperature and temperature variability could be associated with increased cases of suicide and suicidal behavior, hospital attendance or admission for mental illness, and poor community health and well-being.[3] Climate (weather over a long period of 30 years or more) change is likely to increase temperature anomalies, variability, heat waves, and average temperatures.[3] Temperature can significantly affect sleep calmness, difficulty in falling asleep, sleep satisfaction, and sleep adequateness[4] and chronic heat stress can lead to increased stress, anxiety, and cognitive impairment.[5] These in turn can lead to suicide.

Increasing temperatures should be a cause for concern for mental health professionals. A link between elevated temperature and mortality has been established[6,7] This was also observed in India[8] As global temperatures rise due to climate change, suicide rates could increase. It was suggested that increasing temperatures could be considered a risk factor for suicidal behavior in Switzerland,[9] and this may be true for other countries too. Suicide rates rise 0.7% in US counties and 2.1% in Mexican municipalities for a one °C increase in monthly average temperature.[10]

The risk of suicide increases with increasing ambient temperature in many countries, but to varying extents and not necessarily linearly, and this temperature–suicide association should be interpreted cautiously, and further evidence of the relationship and modifying factors is needed. Like in most studies, the present analysis showed a linear relationship. Other variables might be responsible for the difference.

Several factors can influence suicide, the temperature being one. Several factors could explain the association between temperature and suicide. The relationship between suicide and temperature may be casual but may or may not be causal. The increasing temperatures affect the biological mechanisms of humans vastly and can have dire consequences. Both increase and decrease in temperature can influence suicide rates by influencing mood. This is reflected in the seasonal variation reported.[11]

Carleton's[12] conclusion that high temperature stimulates suicides through a crop-damaging agricultural channel as the temperature deviations above the twenty °C threshold in the growing season are significantly linked to a rise in suicide, but not the deviations in the nongrowing season

Table 1: Details of the Indian suicides and temperature 1967-2021.

Statistic	Suicide	Temperature		
		Maximum	Minimum	Mean
Count	59	59	59	59
Mean	9.03203	24.86119	9.03203	24.86119
Median	9.47	24.55	9.47	24.55
Standard Deviation	1.84285	0.7722	1.84285	0.7722
Outliers	None	None	None	None
Skewness	-0.197031	0.379267503	-0.197031219	0.379268
Kurtosis	-1.327234	1.59988391	1.83441973	-1.56177
	Spearman rank correlation coefficient			
Suicide rate vs	Temperature			
	Maximum		Minimum	Mean
	r (53) = .679, p < .001		r (53) = .764, p < .001	r (53) = .819, p < .001
Interpretation	a significant positive relationship			

was questioned by Das.[13] Elevated temperatures and high humidity may stimulate suicidal tendencies, especially in people with health problems.

Researchers found that small increases in temperature while stimulating the brain can profoundly alter brain activity, sometimes with negative consequences. As neurons warm, they can go silent when cool back to their normal temperature and become very excitable.[14]

Cold temperatures reduce negative mental health outcomes while hot temperatures increase them with no evidence of adaptation.[15] Instead, the temperature relationship is stable across time, baseline climate, air conditioning penetration rates, accessibility of mental health services, and other factors.[15]

Among all causes of death, suicide was the only cause displaying a monotonic trend with temperatures[16] and the present analysis agrees with it.

Higher temperatures can impact the old, infirm, poor who cannot afford remedial measures, employees involved in hard physical labor, women, etc., more than others. Increased temperature can lead to drought, which in turn can lead to unemployment, agrarian distress, leading to migration, stress, and suicide.[15] The neurotransmitter, Serotonin, may be a common factor involved in both suicide and temperature. Increasing temperatures might impact delicate body chemical, neurological, and endocrinal balance and cause drastic effects on the human mind leading to suicide in the vulnerable.

Even though the human mind is versatile and adaptable, this has its limitations. Individuals react differently to different situations. The same thing holds good for suicide and temperature. The average temperatures can vary between states and regions, with some areas experiencing extreme heat in the summer months and others experiencing milder temperatures throughout the year. Some areas are mostly cool-hill, mountain areas, while others are mostly hot. Thus, mean annual temperatures will mask reality. This must be taken into consideration while generalizing and interpreting the results. Both suicide and temperature are widely scattered in a vast country like India and can lead to a mask effect when averages are taken. Season-wise and area-wise analysis may throw more valuable information. Even a state-wise analysis can be skewed. India consists of a hot Ganganagar, Phalodi of Rajasthan, Mungeshpur of Delhi recording 50 °C + and a cold Jammu and Kashmir, Ladakh with temperature touching below °degrees. So, when averaged it does not give a real picture. The present analysis is a macro one, micro analysis will provide more insights. The better way of seeing the effect of temperature is by comparing cold areas with hot areas, season-wise with corresponding suicides. Nevertheless, the present analysis gives a broad picture of suicides correlating with temperatures. Temperature alone might not influence suicide rates. The concurrent changes in tedium with other component factors of climate, and other parameters may influence the rate. All this needs extensive investigation.

The main flaw in the present analysis was that the humidity component was ignored. Nevertheless, the analysis gives a broad idea about the impact of temperature on suicide. The present findings highlight the importance of considering temperature-related risks in suicide prevention campaigns. The present analysis adds to the vast body of evidence, mostly non-Indian, about the topic.

5. Source of Funding

None.

6. Conflict of Interest

None.

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