

## Geographical and Temporal Variation of Suicide in India, 2006–2015: An Investigation of Factors Associated with Suicide Risk Difference across States/Union Territories

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### ABSTRACT

**Background:** In India, about 130,000 people died by suicide in the year 2015. It is important to understand the variation of suicide across different parts of India and the trend of suicide rates over the years. The objectives of this study were to determine whether suicide rates in India showed temporal variation in the last decade and to determine whether suicide rates in India showed geographical variation across different states and union territories (UTs). **Methods:** Data on suicide rates for the years 2006–2015 were collected from the official publication of the National Crime Records Bureau. This study looked for time trend in suicide rates over the years. Further, the variation in suicide rates across different states/UTs in India and the factors associated with the variation were also analyzed. **Results:** The average suicide rate in India for the years 2006–2015 was 10.9/100,000 population. Overall, there was no significant variation in the suicide rate over time in the years studied. The average suicide rate varied widely across the states and UTs, between 0.91 and 43.92 per 100,000 population. The analysis revealed a positive association between suicide rates and accident rates for the above years. In addition, for the year 2011, a positive association between suicide rate and per capita state domestic product was noted. **Conclusion:** There was no variation in the suicide rate in India over time. However, there were significant regional differences. Reporting differences and economic factors could partially explain the differences.

**Key words:** *Deliberate self-harm, geographical variation, temporal variation*

### INTRODUCTION


Tragic tales of suicide are ubiquitous across the globe. As per the World Health Organization (WHO) estimates, suicide claims the lives of close to 800,000 people every

year.<sup>[1]</sup> According to the WHO, low- and middle-income countries contributed to 78% of global suicide in 2015.

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Suicide is the second leading cause of death among 15–29-year-olds globally.<sup>[1]</sup>

Wide variation in suicide rates across different geographical regions has been reported time and again from several countries.<sup>[2–5]</sup> Spatiotemporal variations of suicide rate have been described from several countries including Australia,<sup>[2]</sup> China,<sup>[3]</sup> Ireland,<sup>[4]</sup> and the European Union.<sup>[5]</sup> Without exception, all the reports described a wide variation in suicide rates across different countries and different regions within the same country. Misclassification as deaths due to undetermined causes,<sup>[5]</sup> socioeconomic deprivation,<sup>[2,4]</sup> low access to mental health services,<sup>[2]</sup> rurality,<sup>[3]</sup> social fragmentation,<sup>[4]</sup> and population density<sup>[4]</sup> were the key factors contributing to the variation of suicide rate across different geographical areas.

In India, about 130,000 people died by suicide in the year 2015 as per official statistics, thus contributing to >15% of global suicide deaths. Geographical variation of suicide has not been systematically studied in India.

This study was conducted with the objectives of determining whether suicide rates in India showed temporal variation in the last decade and whether suicide rates in India showed geographical variation across different states and union territories (UTs).

To address the above objectives, we relied on the data on suicide rate of different states and UTs published annually by the National Crime Records Bureau (NCRB) in the past 10 years.

## METHODS

Data regarding suicide rates for the 29 states and 7 UTs of India were gathered from the annual publication “Accidental Deaths and Suicides in India” by the NCRB for the years 2006–2015.<sup>[6–15]</sup> Rate of suicides has been calculated using mid-year projected population for the noncensus years, whereas for the census year 2011, the estimate of “The Population Census 2011” was used.

In India, the general public forwards the information about any unnatural death to the police. When the officer in charge of a police station receives information that a person has suffered an unnatural death, he/she proceeds to the place where the body of such deceased person is, makes an investigation, and draws up a report of the apparent cause of death. The above proceeding is called the “Inquest.” After the conclusion of inquest, autopsy is conducted to determine the cause of death. When the investigation has been completed, the investigating officer draws up a report in a standardized

format, in which the apparent cause of death is stated. The manner of death (accident/suicide/homicide) is decided based on composite information available from the examination of the scene, the collection of trace evidence, circumstantial evidence, and autopsy report.

The above information from the police stations is collated by the respective State Crime Records Bureaus. The NCRB collects and collates numerical data from State Crime Records Bureaus of all states/UTs using 24 standardized pro formas. Projected midyear population, as provided by the office of Registrar General of India/Population Commissioner, Ministry of Home Affairs, is used for calculation of suicide rate for states/UTs.

In our study, we collected and tabulated state-wise suicide rate for the 10 years 2006–2015. Age-specific suicide rates were not available for individual states and UTs. Hence, age-standardized suicide rates could not be calculated. The states with the highest and lowest average suicide rate for the past 10 years were compiled and studied.

Population density, per capita state domestic product, police strength, and misclassification of suicides as accidents were considered as possible factors that could contribute to the variability of suicide rate across different states and UTs.

Suicide rates for the different geographical regions of India were compiled and studied. The different geographical regions include North India, South India, East India, West India, Central India, and Northeast India.

The number of civil police for the year 2011 was available from the Union Government of India’s Open Data Initiative <https://data.gov.in>.<sup>[16]</sup> Police strength per lakh population was calculated using the total number of civil police in each state divided by population of each state.

State domestic product is the total value of goods and services produced during any financial year within the geographical boundaries of a state. Per capita Net State Domestic Product for the year 2010–2011 was obtained from the publication of the Central Bureau of Health Intelligence titled “National Health Profile 2011.”<sup>[17]</sup>

To check for possible misclassification of suicide, the accidental death rate for the years 2006–2015 was obtained from the annual publication “Accidental Deaths and Suicides in India” by the NCRB for the years 2006–2015.<sup>[6–15]</sup> An inverse relationship might suggest misclassification of suicide as accidents.

Statistical analysis was done using Statistical Package for Social Sciences (SPSS) version 20 (IBM Corp, Armonk, NY). The significance of the trend of suicide in India and each of the Indian states was analyzed using linear regression with time as the independent variable and suicide rate as the dependent variable.<sup>[18]</sup> Spearman’s correlation analysis was done to check for the relationship between suicide rate and accident rate for the years 2006–2015. This assisted us in the detection of possible inverse relationships between suicide rate and accident rate for that particular year. Suicide rate 2011 was considered for evaluation of the role of population density, per capita state domestic product, and police strength on the variability of suicide rate across different states and UTs. The year 2011 was selected due to the availability and accuracy of data for that particular year. Spearman’s correlation analysis was done to check for the relation between suicide rate 2011 and the above-mentioned factors.

**RESULTS**

The mean suicide rate per 100,000 population for India for the years 2006–2015 was 10.9 (standard deviation – 0.30) [Figure 1]. The states/UTs with the highest average suicide rates for the years 2006–2015 were Puducherry, Sikkim, Andaman and Nicobar Islands, Kerala, and Chhattisgarh [Table 1]. The states with the lowest average suicide rates for the above years were Bihar, Nagaland, Manipur, Uttar Pradesh, and Jammu and Kashmir [Table 2].

To analyze the significance of time trend, a simple linear regression was calculated to predict suicide rate based on year. The overall suicide rate in India did not show any significant increasing or decreasing trend over the years 2006–2015. Out of the 29 states and 7 UTs, 7 showed a significantly increasing trend over the years 2006–2015. They were Gujarat, Haryana, Madhya Pradesh, Meghalaya, Mizoram, Punjab, and

Tamil Nadu [Table 3]. On the other hand, the seven states/UTs that showed a significantly decreasing trend of suicide rates over the years studied were Andhra Pradesh, Karnataka, Kerala, Rajasthan, West Bengal, Andaman and Nicobar Islands, and Puducherry [Table 3]. None of the other 22 states or UTs showed any significant trend over the 10 years studied. The temporal trend of suicide rates in the different regions of India is represented in Figures 2-7. As noted in Figures 2, 3, and 7, there is a significant variation of suicide rates even among neighboring states and UTs.

Surprisingly, a strong positive association was noted between suicide rate and accident rate reported for each of the years studied [Table 4].

Suicide rate for the year 2011 was found to have a moderate positive association with per capita Net State

**Table 1: States with the highest average suicide rate in the years 2006-2015**

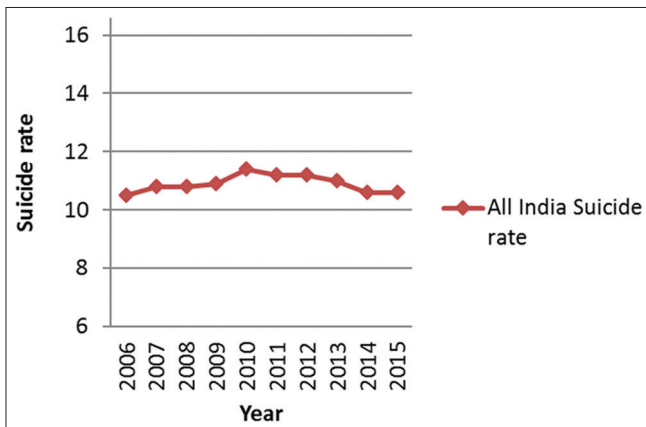
State	Mean suicide rate	SD
Puducherry	43.92	4.91
Sikkim	34.43	8.98
Andaman and Nicobar Islands	31.97	4.51
Kerala	24.77	1.42
Chhattisgarh	23.38	2.76

SD – Standard deviation

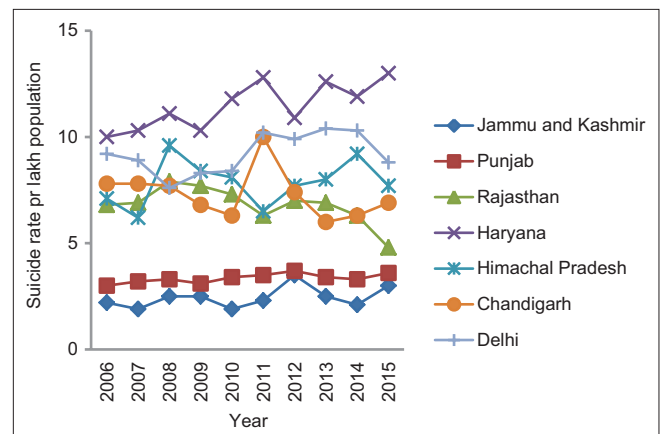
**Table 2: States with the lowest average suicide rate in the years 2006-2015**

State	Mean suicide rate	SD
Jammu and Kashmir	2.44	0.50
Uttar Pradesh	2.04	0.28
Manipur	1.43	0.26
Nagaland	1.23	0.46
Bihar	0.91	0.25

SD – Standard deviation



**Figure 1:** All India suicide rate in the years 2006–2015



**Figure 2:** Time trend of suicide rates in North Indian states in the years 2006–2015

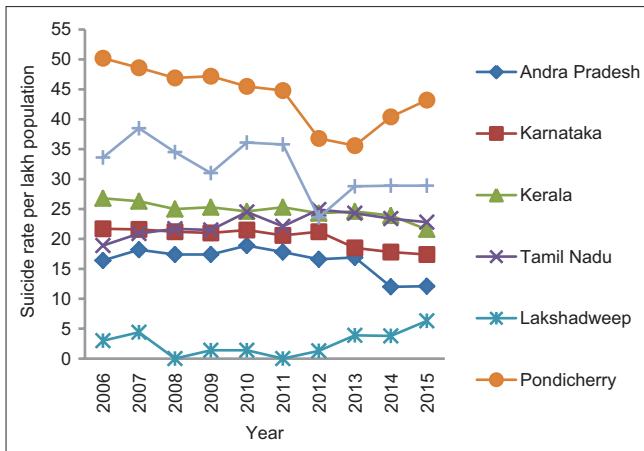


Figure 3: Time trend of suicide rates in South Indian states in the years 2006–2015

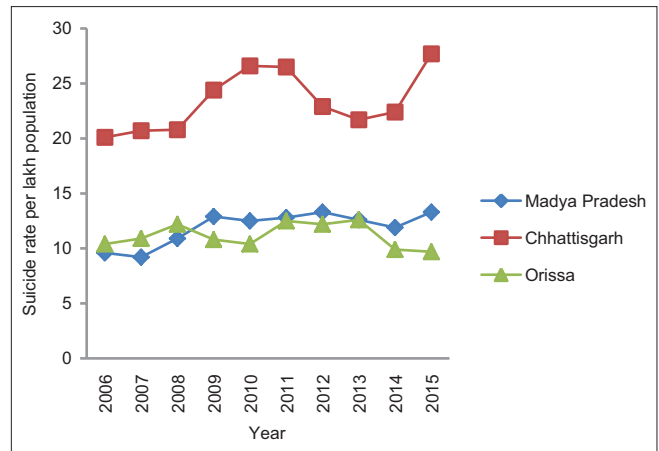


Figure 4: Time trend of suicide rates in Central Indian states in the years 2006–2015

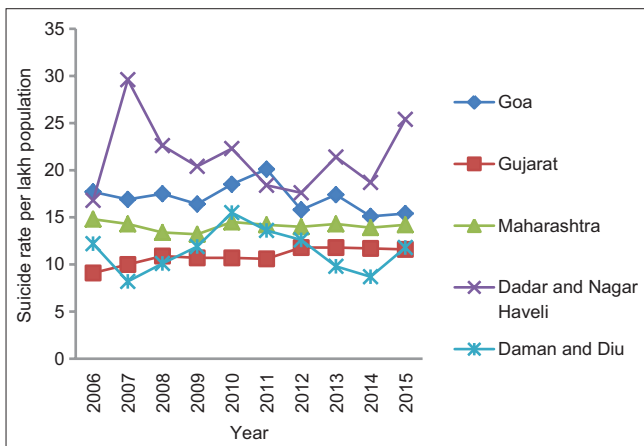


Figure 5: Time trend of suicide rates in West Indian states in the years 2006–2015

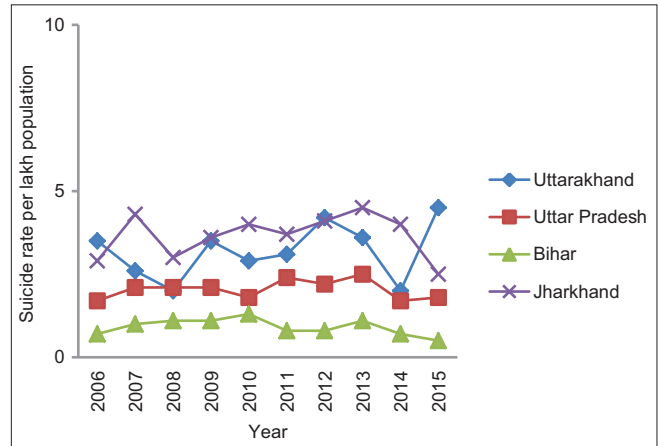


Figure 6: Time trend of suicide rates in East Indian states in the years 2006–2015

Table 3: Time trend analysis using linear regression of suicide rates in specific states of India over the years 2006–2015

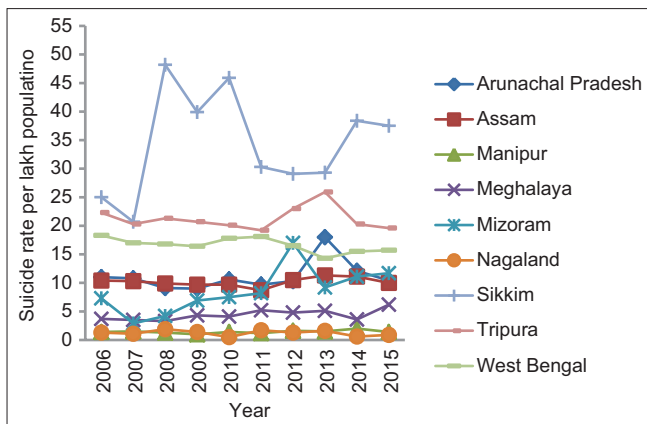
State	F (1,8)	P	R <sup>2</sup>	Beta
Andhra Pradesh	6.705	0.032	0.456	-0.675
Gujarat	26.887	0.01	0.771	0.878
Haryana	14.573	0.005	0.646	0.803
Karnataka	24.445	0.001	0.753	-0.868
Kerala	26.674	0.001	0.769	-0.877
Madhya Pradesh	11.118	0.01	0.582	0.763
Meghalaya	7.150	0.028	0.472	0.687
Mizoram	7.706	0.024	0.491	0.700
Punjab	8.500	0.019	0.515	0.718
Rajasthan	5.500	0.047	0.407	-0.638
Tamil Nadu	8.769	0.018	0.523	0.723
West Bengal	6.547	0.034	0.450	-0.671
Andaman and Nicobar Islands	5.933	0.041	0.426	-0.653
Puducherry	12.440	0.008	0.609	-0.780

Domestic Product (Spearman rho – 0.585,  $P < 0.001$ ). There was no significant association between suicide rate for the year 2011 and police strength in the year

2011 (Spearman rho – 0.111,  $P = 0.527$ ). Similarly, no significant association between suicide rate 2011 and population density for the year 2011 was found (Spearman rho – 0.136,  $P = 0.459$ ) [Table 5].

## DISCUSSION

The average suicide rate in India for the years 2006–2015 was found to be 10.9 per lakh population. The overwhelming consensus based on other studies with more rigorous methodology is that the official data are a gross underrepresentation of the true suicide rate. For instance, in the Million Death Study, the suicide rate in India was calculated to be 22 per lakh population among the people with age 15 years and above.<sup>[19]</sup> In another verbal autopsy study, suicide rate in the 85 villages of the Kaniyambadi region of South India for the period 1994–1999 was reported to 95.2/100,000.<sup>[20]</sup> Suicide rate for the same region for the years 2000–2002 using the same methodology was reported to be 92.1/100,000.<sup>[21]</sup> In a prospective



**Figure 7:** Time trend of suicide rates in North East Indian states in the years 2006–2015

**Table 4: Correlation between suicide rates and accident rates in the years 2006-2015**

Year	Spearman's rho	P
2006	0.643	<0.01
2007	0.623	<0.01
2008	0.629	<0.01
2009	0.686	<0.01
2010	0.719	<0.01
2011	0.740	<0.01
2012	0.560	<0.01
2013	0.637	<0.01
2014	0.685	<0.01
2015	0.568	<0.01

community-based study from Kerala, suicide rate of 44.7/100,000 for males and 26.8/1,00,000 for females was reported.<sup>[22]</sup> In another study from a district in Tamil Nadu,<sup>[23]</sup> suicide rate of 71 and 53 per 100,000 population was documented for men and women, respectively. The suicide rate of 82.2 for a population of 108,000 was reported in another study from South India.<sup>[24]</sup> Unfortunately, no such community-based studies using verbal autopsy methodology were found from states which have low official suicide rates.

Our study found that there was no temporal variation of suicide rates for the years 2006–2015 when all India suicide rates were considered. However, seven states/UTs had increasing trend of suicide rate whereas seven other states/UTs had decreasing trend of suicide rate. A previous study has reported temporal variation of suicide rates in the European Union from 1984 to 1998. It was found that significant downward trends occurred in Austria, Denmark, France, Germany, Greece, Netherlands, Portugal, Sweden, and the UK while significant upward trends were observed in Ireland and Spain. In the same study, no significant trend was observed in suicide rates of Belgium, Finland, Italy, and Luxembourg.<sup>[5]</sup> Another study from China reported a

38% decline in age-standardized suicide rates from 2006 to 2012, with a similar decline in males and females and in both urban and rural areas.<sup>[3]</sup> In a study from Sri Lanka, marked fluctuations in suicide rates were reported between 1955 and 2011. The suicide rate increased 6-fold between 1955 and 1980 and halved in the early 21<sup>st</sup> century, and this pattern was attributed to changes in access to highly toxic pesticides.<sup>[25]</sup>

Not surprisingly, the suicide rate varied widely among different states and UTs. The states Nagaland and Manipur have a sizable Christian population, whereas Jammu and Kashmir has a majority Muslim population.<sup>[26]</sup> Religious factors could contribute to the low suicide rates in these states.<sup>[27]</sup> Among other factors, income inequality,<sup>[28]</sup> reporting differences,<sup>[29]</sup> and other sociocultural factors could be responsible for the differences in suicide rates across different regions of India.

In this study, a strong positive correlation between suicide rates and accident rates was observed. It is thus clear that misclassification of suicide as an accident is unlikely to be a factor for variation in suicide rates across different geographical areas in India. Rather, reporting differences of any unnatural death to the police might be lower in some states, and this may explain at least partially the low suicide rates in these states. Alternatively, some states genuinely have both low suicide and accident rate due to factors such as low level of industrialization and sociocultural factors. Misclassification of suicides as undetermined deaths was noted to contribute to the geographical variation of suicide rate in 15 European Union countries in the years 1984–1998.<sup>[5]</sup>

In this study, population density was not associated with suicide rates significantly. In a study conducted in Ireland,<sup>[4]</sup> a weak association was found between high population density (urbanicity) and increased suicide risk, especially among females in the 15–39-year age group.

Per capita State Domestic Product was positively associated with suicide rate significantly in this study. That is, states with high per capita State Domestic Product had higher suicide rates. This is in contrast to findings from other countries such as China and Ireland. In a report from a nationally representative mortality surveillance system in China,<sup>[3]</sup> higher rates of suicide were evident in areas with lower socioeconomic circumstances. In Ireland, for the years 2009–2011, socioeconomic deprivation had the strongest independent effect on small area rates of suicide, with the people of the most deprived areas showing the greatest risk of suicide.<sup>[4]</sup> Our findings are

**Table 5: State-wise suicide rate for the year 2011 and possible factors associated with the variation**

State/union territory	Suicide rate 2011	Police strength per 100,000 population for the year 2011	Population density for the year 2011	Per capita Net State Domestic Product 2010-2011 (in rupees)
Andhra Pradesh	17.8	82.31	308	62,912
Arunachal Pradesh	9.7	257.89	17	55,789
Assam	8.7	92.06	398	30,569
Bihar	0.8	52.21	1106	20,708
Chattisgarh	26.5	108.05	189	41,167
Goa	20.1	287.39	394	168,572
Gujarat	10.6	87.11	308	75,115
Haryana	12.8	169.57	573	94,680
Himachal Pradesh	6.5	141.18	123	65,535
Jammu and Kashmir	2.3	387.64	56	37,496
Jharkhand	3.7	123.08	414	29,786
Karnataka	20.6	108.81	319	60,946
Kerala	25.3	117.49	860	71,434
Madhya Pradesh	12.8	73.91	236	32,222
Maharashtra	14.2	150.53	365	83,471
Manipur	1.2	378.19	128	29,684
Meghalaya	5.2	203.34	132	50,427
Mizoram	8.2	372.66	52	48,591
Nagaland	1.7	284.69	119	52,643
Orissa	12.5	70.28	270	40,412
Punjab	3.5	173.07	551	69,737
Rajasthan	6.3	93.54	200	42,434
Sikkim	30.3	269.02	86	81,159
Tamil Nadu	22.1	113.41	555	72,993
Telangana	NA	NA	NA	NA
Tripura	19.2	290.76	350	44,965
Uttaranchal	3.1	140.80	189	36,368
Uttar Pradesh	2.4	77.90	829	26,355
West Bengal	18.1	66.17	1028	48,536
Andaman and Nicobar islands	35.8	852.36	46	76,883
Chandigarh	10	521.51	9258	128,634
Dadar and Nagar Haveli	18.4	90	700	NA
Daman and Diu	13.6	146.25	2191	NA
Delhi	10.2	398.13	11,320	150,653
Lakshadweep	0	703.33	2149	NA
Puduchery	44.8	152.90	2547	150,653

NA – Data not available

concordant with another report from India<sup>[28]</sup> where significant associations between the suicide rates and per capita gross domestic product, consumer price index, foreign exchange, trade balance, total health expenditure as well as literacy rates were documented. Income inequality and the resulting stress due to contrasting lifestyles could be eventually leading to this interesting association.

There may be several psychosocial factors such as farmer suicide that underlie the observed variations in suicide rates.

**Limitations of this study**

The inherent limitation in the methodology was the source of data as the official data are well known to under-represent the true suicide rate. Age-standardized

suicide rate was not calculated in this study due to nonavailability data on age-specific suicide rate for each state. Thus, at least partially, the variation in the suicide rate among the different states could be due to differing age structure and gender-wise differences in population. Sociocultural differences in the attitude toward suicide and the burning problem of farmer suicides were not incorporated into the analysis of data.

**Future directions**

The findings of this study highlight the need for psychological autopsy studies using representative samples in those states with low suicide rates. Detailed evaluation of police records will provide fresh perspectives on the nature of the association between accident and suicide rates. A closer look at the process of the inquest in various states will throw light on the differences in

reporting methodology. Detailed evaluation of suicide rates at the district level will provide much needed valuable input to guide prevention efforts.

## CONCLUSION

There was no temporal variation in the suicide rate in India in the years 2006-15. However, there were significant geographical differences in suicide rate among the states/union territories. Differences in reporting methodology and economic factors could partially explain this geographical differences in suicide rates.

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## Conflicts of interest

There are no conflicts of interest.

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