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Lessons from a decade of suicide surveillance in India: who, why and how?

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Abstract

Background: This paper investigates trends in suicide rate, the reasons for and means of suicide and the occupation of deceased, to prioritize suicide prevention activities in India and to highlight the limitations to data quality for surveillance.

Methods: Data available in the public domain from the National Crimes Record Bureau (NCRB) were analysed from 2001 to 2010 at the national and sub-national levels, split by age groups and sex for ages 15 years and above.

Results: The reported suicide rate was 14.9 and 15.4 suicides per 100 000 population in 2001 and 2010, respectively. More developed states reported significantly higher suicide rates than the less developed (mean 20.5 versus 8.16), but neither experienced large changes over time. Among males, the reported suicide rate changed slightly (17.8 to 19.5); it remained almost similar for females (11.9 to 11.1). Housewives accounted for the highest proportion of suicide deaths over the decade. Distribution of the reasons for suicide remained almost constant over time; most suicides (33.7%) were due to personal/social reasons, followed by health at 24.3% and unknown reasons at 16.4%; differences were observed between the more and less developed states. Marriage-related suicides were higher for females, and health reasons increased with increasing age. Nationally, poison/overdose with drugs/pesticides was the leading means of suicide through the decade, although the gap between this and hanging decreased over time. The state level data showed considerable heterogeneity in the quality of data across the indicators assessed.

Conclusions: These data provide a range of information to identify vulnerable groups, to formulate appropriate suicide prevention strategies. Addressing the limitations in data quality would facilitate further utility of surveillance data to prevent suicides.

Key words: Hanging, India, poisoning, suicide, surveillance

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Key Messages

- India has yet to develop a systematic response to suicides, despite having one of the highest suicide burdens in the world.
- Disaggregated trend analysis of the national surveillance data from 2001 to 2010 reveals that more developed states recorded significantly higher suicide rates than the less developed states.
- Housewives recorded the highest proportion of suicide deaths over the decade.
- Poison/overdose with pesticides/medicines and hanging were the dominant means of suicide.
- Personal/social reasons were the leading reasons for suicide, highlighting that prevention strategies beyond the curative mental health services are needed to address the underlying social determinants of health, to reduce suicide rate at the population level in India.

Introduction

Most suicides occur in low- and middle-income countries where resources and services are often scarce and limited in effectively identifying, treating and supporting people in need.[1,2] India has yet to develop a systematic response to suicide, despite having one of the highest suicide burdens in the world.[3–8] The major national source of surveillance for suicides in India is the National Crime Records Bureau (NCRB).[9] Though under-reporting of suicides in NCRB is well documented,[7,10,11] it remains the most comprehensive longitudinal source of suicides available at the state level for India. With the aim of drawing on the available data to prioritize suicide prevention activities in India, we undertook a situational analysis for the years 2001 to 2010 using the NCRB data with three major objectives. First, to highlight variability in the reported magnitude of suicide over time and within country, using the NCRB data. Second, to draw attention to the reasons for and means of suicide, and to highlight the variability within countries and by demographic groups that could facilitate identification and prioritization of immediate actions for suicide prevention. Last, we discuss the limitations of the available NCRB data for surveillance, to address the gaps in data to improve surveillance data quality.

Methods

Data source

The NCRB provides annual summary reports of deaths due to a variety of injuries, including suicides, in India.[9] The primary source of these data is the First Information Report (FIR) completed by a police officer for any death including that due to suicide,[12] which is compiled at the state level and provided to NCRB. We used data for the years 2001 to 2010 available from the ADSInfo India software provided in the public domain by NCRB as detailed tables.[9] Though reports for the years 2011–14 were available, detailed data in a comparable format were not available for disaggregated analysis as for 2001–10. We used three separate tabulations that split the NCRB data by reason for suicide, means of suicide and occupation of the deceased, and each of these tabulations is aggregated to the year for each state, for the two sexes, and is available in 15-year age groups. NCRB does not provide individual-level data.

Data analysis

The available categories in NCRB data for the variables of interest were re-categorized to have meaningful interpretation by reducing the redundancy of the original, smaller groupings (Table 1). We included persons $\geq$ 15 years of age for this analysis. The primary aim of this analysis was to quantitatively define the trends in NCRB time series for suicide rates, and reasons and means for suicide, and to explore occupation of the deceased over time. We analysed these data along three administrative splits: nationally; by development status of states; and by individual state. State-wise annual population estimates were obtained from the Global Burden of Disease 2015 study (unpublished). These data are available on the year-sex-state level, by 5-year age groups, and were aggregated to 15-year age categories for meaningful interpretation. States were categorized as 'less developed' if they belonged to the Empowered Action Group (Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Odisha, Rajasthan, Uttar Pradesh and Uttarakhand) or were among the group of north-eastern states (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura).[13–15] The rest were considered as 'more developed' states. The union territories other than Delhi (which was considered as a state) were excluded from this analysis due to small numbers. For each of the three administrative levels, the trends were explored for all individuals and splitting by sex and age groups.

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Table 1. Mapping of the National Crimes Record Bureau (NCRB) tabulated data for reason and means of suicide, and occupation of the deceased from smaller categories into larger classifications

Variable of interest	Classification used for analysis	Category (NCRB data)
Reason for suicide	Economic	Bankruptcy, poverty, profession/career problems, unemployment
	Health	Drug abuse, illness: AIDS, illness: cancer, illness: mental, illness: paralysis, other/prolonged illness
	Marriage	Cancellation/non-settlement of marriage, divorce, dowry dispute
	Personal/social	Barrenness/impotence, death of a dear person, failure in examinations, fall in social reputation, family problems, ideological causes/hero worship, illegitimate pregnancy, love affairs, physical abuse, property dispute, suspect/illicit relations
	Other	Other
	Unknown	Unknown
Means of suicide	Drowning	Drowning
	Hanging	Hanging
	Jumping	From building, from moving vehicle/train, from other site, under moving vehicle/train
	Poison/overdose	Overdose of sleeping pills, alcohol; use of insecticide or other poison
	Self-immolation	Fire/self-immolation
	Other	Electrocution, firearm, machine, other
Occupation of the deceased	Salaried employee	Government, public sector, private sector salaried employees
	Housewife	Housewife
	Retired	Retired
	Self-employed: business	Self-employed: business
	Self-employed: farm/agriculture	Self-employed: farm/agriculture
	Self-employed: professional	Self-employed: professional
	Self-employed: other	Self-employed: other
	Student	Student
	Unemployed	Unemployed
	Other	Other

For summary measures of suicide, rate per 100 000 population were calculated. Although the NCRB data are known to be an underestimate, these do not systematically under-report any one type of suicide;[7] thus, it can be inferred that even if the number of suicides by a particular means is an underestimate in NCRB, the proportion of all suicides that are consummated by that particular means is probably close to the NCRB estimate. For this reason, we report trends in the reasons and means for suicide, and suicides by occupation, as proportions of all suicides rather than as counts or rates.

Given the political spotlight on farmer suicide in India in recent years,[16–18] we repeated this analysis splitting states by agriculture as a predominant occupation. To determine which states contributed most to the farming population, we calculated a state-wise 'percent agricultural' metric by dividing the number of individuals engaged in agriculture by the number of members in the rural adult workforce (employed men and women age 15–65 years living in rural areas), using data from the 2001 and 2011 censuses.[19,20] The mean agricultural percentage across states was 25.9% in 2001 and 19% in 2010. The states with agricultural percentage above the annual mean in both 2001 and 2010 were considered as 'more agricultural', which included Andhra Pradesh, Bihar, Chhattisgarh, Gujarat, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal. The other states were considered as 'less agricultural'.

Bivariate regressions were run on all levels and tabulations to summarize the direction and magnitude of trends in suicide. Regression outputs are used as a descriptive guide to trends in the data, but are not intended for inference or prediction, hence the absence of *P*-values or confidence intervals. All rates are reported per 100 000 population. All analyses were run in R version 3.2.0. As this analysis used aggregated data available in the public domain, so no ethics approval was necessary.

Results

Suicide rate

For the ages 15 years and above, the NCRB reported 104 720 suicides in 2001, increasing to 130 653 in 2010.

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Figure 1. Suicide rate per 100 000 population by sex from 2001 to 2010 for India and grouping of states by development and agriculture predominance.

This corresponds to a rate of 14.9 to 15.4 suicides per 100 000 population (estimated increase of 0.0405 suicides/year, Figure 1) over the decade. Among males, the reported suicide rate changed slightly from 17.8 to 19.5 (estimated increase of 0.138/year), whereas it remained nearly constant for females, 11.9 to 11.1 (estimated decrease of 0.062/year). More developed states reported significantly higher suicide rates than less developed (20.5 on average, compared with 8.16 in less developed), but neither group experienced large changes in reported suicide rate over the decade (estimated increase of 0.032 and 0.080 per year in more and less developed, respectively).

Female suicide rates remained effectively constant at every level shown in Figure 1. More developed states consistently reported the highest female suicide rate (14.6 on average) as compared with the less developed states (6.63). Among males, changes in suicide rate had a slightly larger magnitude, with an estimated increase of 0.17, 0.16 and 0.15 suicides per year in agricultural, less developed and more developed states, respectively. The more developed states consistently reported higher male suicide rate (26.1 on average) than the less developed states (9.58).

The state-level data showed much more heterogeneity, both in magnitude and direction of suicide rates (Figure 2). The states of Tripura (estimated decline of 1.12 suicides per 100 000/year), Kerala (−0.72), Karnataka (−0.45), Maharashtra (−0.30) and Uttarakhand (−0.23) all experienced a decline in suicide rate of over 0.2 per year, whereas Sikkim (4.68), Chhattisgarh (0.81), Tamil Nadu (0.57), Jharkhand (0.56), Andhra Pradesh (0.53), Himachal Pradesh (0.47), Rajasthan (0.30) and Gujarat (0.24) all experienced increases greater than 0.2 per year. Among those states in which the overall reported suicide rate increased, the gender gap in suicide rate appeared to be widening. This is especially clear in Andhra Pradesh, Haryana and Rajasthan, where the suicide rate in males increased (estimated increases of 0.99, 0.40 and 0.55 suicides per year, respectively) whereas that in females stayed at roughly same level or declined (estimated change of 0.08, -0.13, and 0.04 per year). In states with declining suicide rates, conversely, declines for males and females were comparable (−1.0 for males and -1.25 for females in Tripura, -0.20 for males and -0.40 for females in Maharashtra) or the gender gap was closing (−1.02 for males and -0.43 for females in Kerala, -0.57 for males and -0.33 for females in Karnataka).

Reasons for suicide

On the national level, the breakdown of suicides by reason has remained almost constant over time (Figure 3). Most suicides (33.7% on average) were classified as due to personal/social reasons, followed by health reasons at 24.3%, unknown reasons at 16.4%, 'other' reasons at 14.2%,

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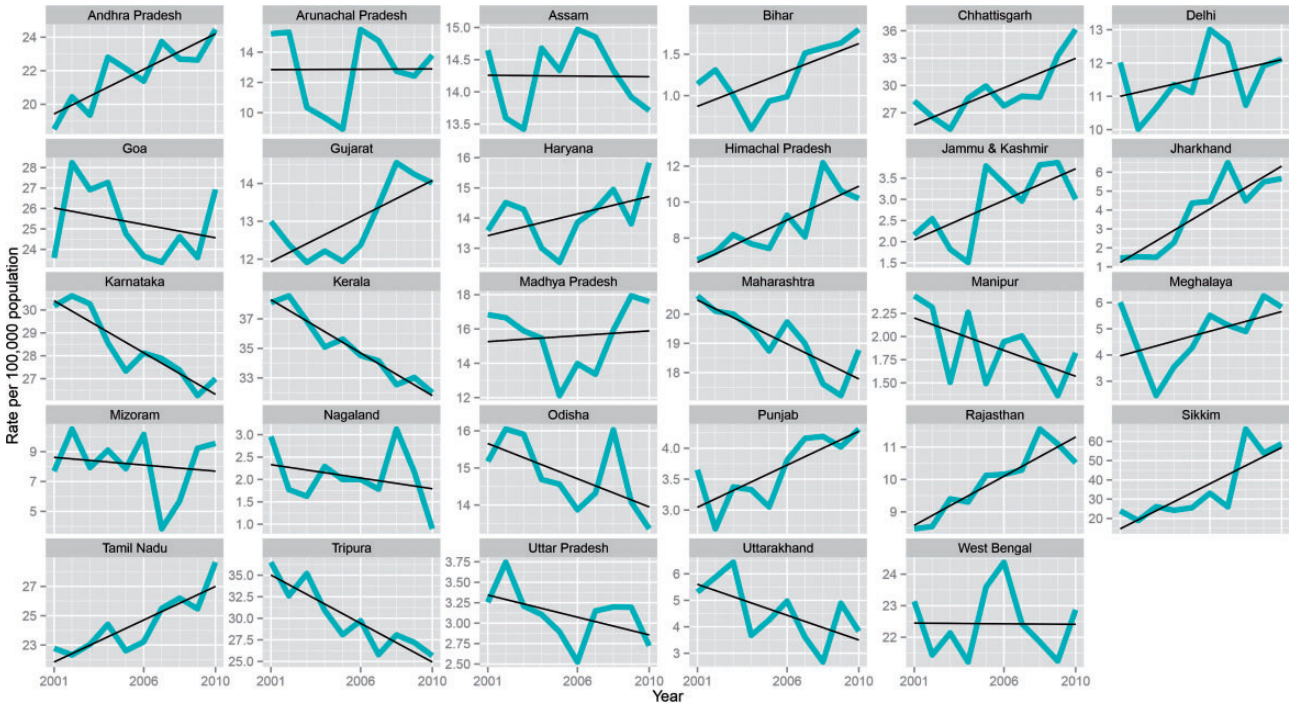


Figure 2. Suicide rate per 100 000 population for Indian states from 2001 to 2010.

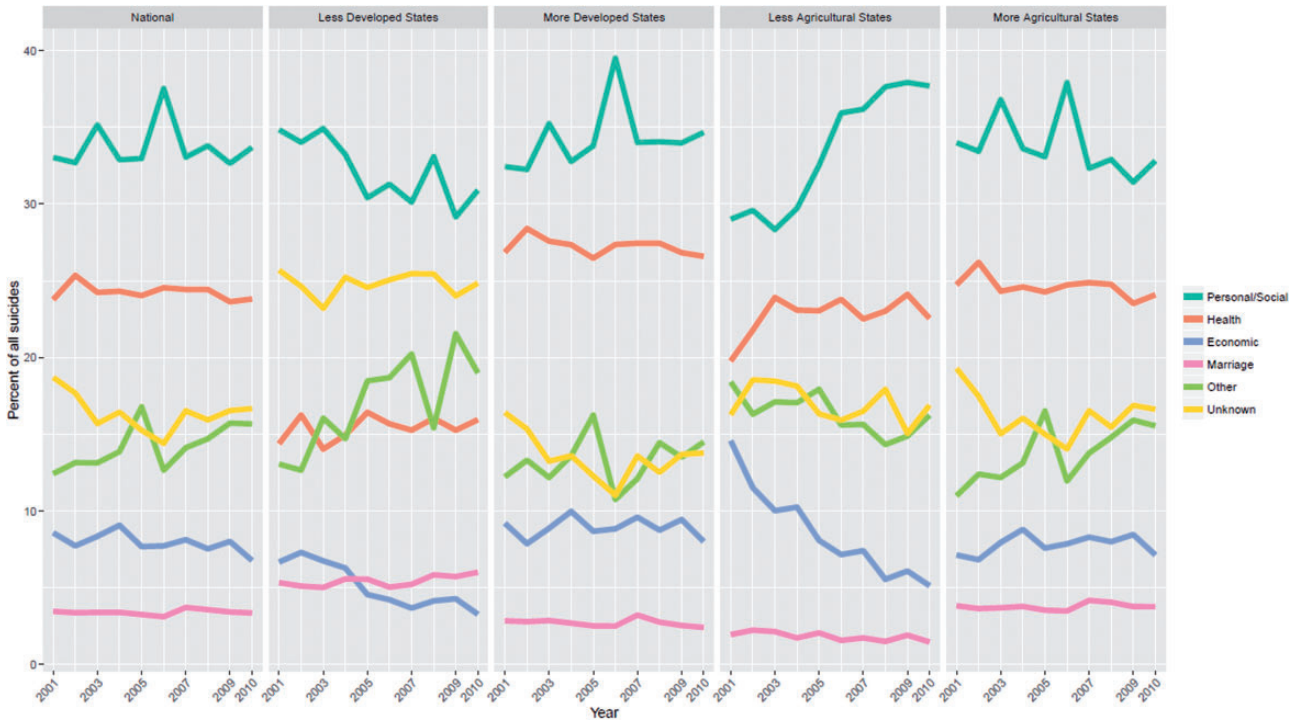


Figure 3. Reasons for committing suicide from 2001 to 2010 for India and grouping of states by development and agriculture predominance.

economic reasons at 8% and finally marriage at 3.4%. The trend in more developed states closely resembled that at the national level, but in the less developed states the reasons were distributed differently (Figure 3). Here, personal/social remained the leading reason for suicide (32.2% on average), but it was followed by unknown reasons (24.8%). At the beginning of the decade, 'other reasons' ranked fourth with 13.1% of suicides, but quickly overtook health reasons to become the third-ranking reason for suicide, finishing the decade with 19% of all

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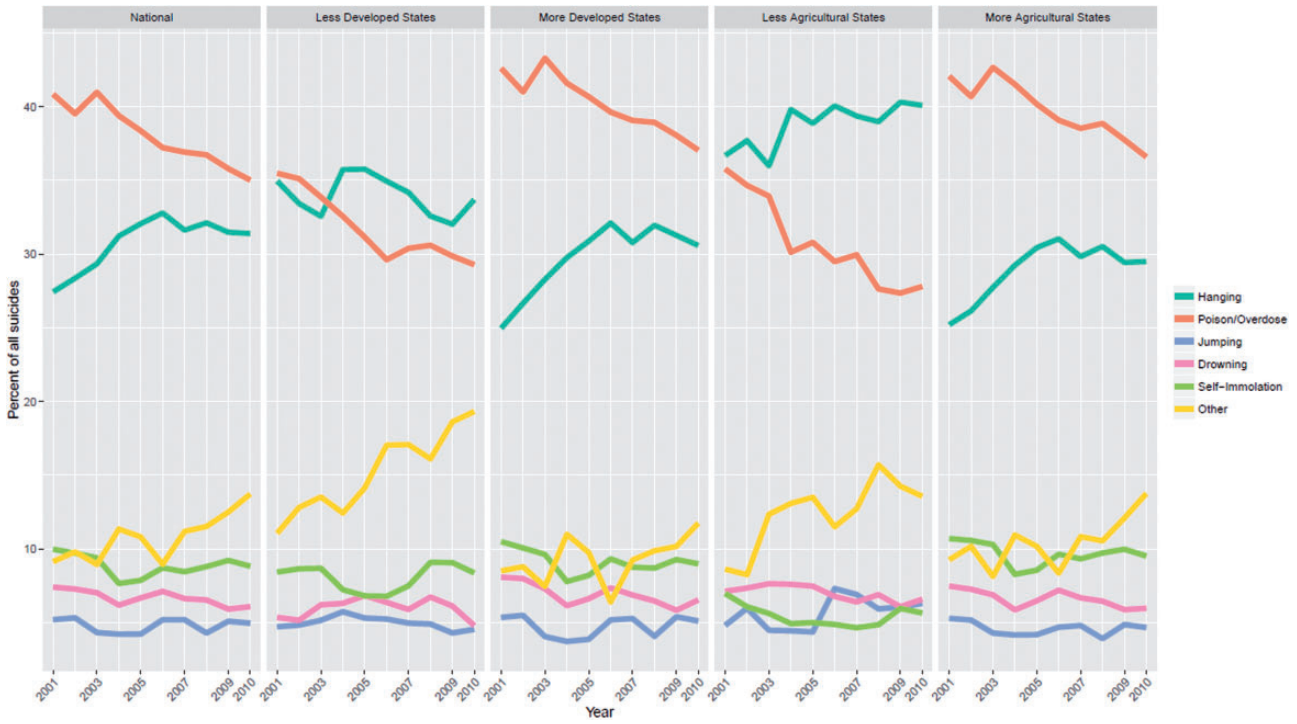


Figure 4. Means of committing suicide from 2001 to 2010 for India and grouping of states by development and agriculture predominance.

suicidal deaths (estimated increase of 0.8 percentage points/year). The percentage of suicides due to health reasons remained constant over time, with an average value of 15.4%. In the more agricultural states, trends in reason for suicide mirror those at the national level, but less agricultural states show dramatic changes in two categories: personal/social, which increased by an estimated 1.25 percentage points per year, from 29% to 37.7% over the decade, and economic, which decreased by an estimated 0.94 percentage points/year, from 14.6% to 5.1%.

Though the data are noisier at the state level (data not shown), some states echo the rough national trend but others deviate. In Andhra Pradesh and Punjab, for example, suicides committed for health reasons consistently exceeded those committed for personal/social reasons. In yet other states (Manipur, Meghalaya, Chhattisgarh), the majority of suicides were for reasons unknown (77.3%, 50.1% and 32.0% percent of deaths, respectively).

Splitting by sex, the ordering of reasons is similar, except that for females the magnitude of marriage-related suicides is higher: these comprise 8% of suicides on average, as opposed to 0.8% for males. As individuals aged, they committed suicide more for health reasons: in 2010, 40.1% of suicide committers aged 15–30 years committed suicide for personal/social reasons, and only 17.1% for health reasons. For those aged 60+ years, those numbers were 22.9% for personal/social reasons, and 40.8% for health reasons.

Means of suicide

Nationally, poison/overdose with drugs/pesticides was the leading means of suicide from 2001 to 2010, although the gap between poison/overdose and hanging as means has decreased over time (Figure 4). The percentage of suicides due to poison/overdose decreased by an estimated 6.56 percentage points nationally, whereas those due to hanging increased by 4.44 percentage points. 'Other means' ranked third overall, and increased by an estimated 4.29 percentage points over the decade.

The less developed states drove the increase in suicide by 'other means' (Figure 4). These suicides increased by an estimated 8.8 percentage points over the decade in less developed states and by just 2.6 percentage points in more developed states. In less developed states, suicides by hanging overtook poison/overdose in 2004, though the gap between the two means is smaller than in more developed states. In both the more and less agricultural states, suicides by hangings increased while those by poison/overdose decreased, but this corresponded to a narrowing of the gap between the two causes in more agricultural states and a widening in less agricultural states (Figure 4).

At the state level (data not shown), poisoning/overdose and hanging were the leading means of suicide in most cases. Some states with poor reporting, like Jammu & Kashmir and Bihar, report 'other means' as one of the two leading means of suicide (on average 34.5% of deaths were due to poison/overdose, and 39.9% to 'other' means in

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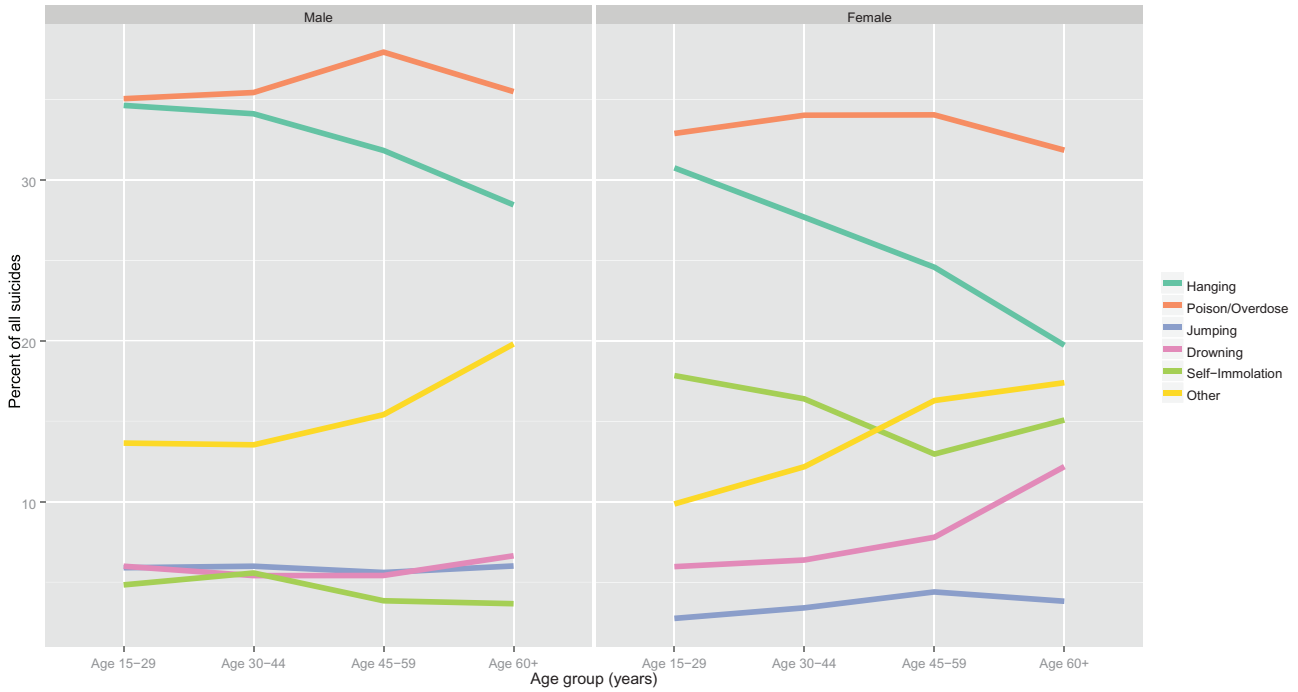


Figure 5. Means of committing suicide from 2001 to 2010 by age group and sex.

Jammu & Kashmir, and the respective figures in Bihar were 32.5% and 32.9%. In Punjab, a majority of suicides were by 'other means' (on average 41.2% of deaths between 2001 and 2005), but switched to jumping post-2005 (on average 48.5% of deaths between 2006 and 2010); Goa is the only state in which drowning featured in the top two leading means of death.

The trend among males mirrored the national trend, whereas for females self-immolation was the third-ranking means of suicide (16.3% on average, no change over time). Among both males and females, suicides by hanging decreased with age, suicides by 'other means' increased and suicides by poison/overdose stayed roughly constant (Figure 5).

Occupation of the deceased

Nationally, housewives accounted for the highest proportion of suicide deaths over the decade (Figure 6), with a relatively little change over time. The second-ranking occupation is 'self-employed: other', which steadily gained in percentage of all suicides since 2001 (estimated 3.87 percentage point increase over the decade). In 2007, 'other' overtook 'self-employed: farm/agriculture' as the third largest category, the former having increased by an estimated 3.30 percentage points over the decade as the latter decreased by 4.32 percentage points. Splitting by development status of the states did not show a substantially different pattern from the national level (data not shown). The vast majority of females who committed suicides were housewives (Figure S1, available as Supplementary data at *IJE* online); 57.4% on average, no change over time), whereas 'self-employed: other' and agriculture each claimed about 20% of all male suicides on average, followed by 'other' and salaried jobs, each at about 15.5% on average.

Interestingly, the percentage of suicides by farmers in recent years is not dramatically different in the less and more agricultural states (Figure S2, available as Supplementary data at *IJE* online). Suicides among the unemployed dropped dramatically in less agricultural states (estimated 8.25 percentage point decrease), whereas suicides among 'other' professions increased by 7.14 percentage points. At the state level among females, housewives claimed the largest proportion of suicides in all states except the small eastern states, where the data were too noisy to extract a clear trend (data not shown). Among males at the state level, trends in suicide by occupation were more heterogeneous (data not shown).

Discussion

Nationally, the reported suicide rate in India has remained constant according to the NCRB data from 2001 and 2010. More developed states reported significantly higher suicide rates than the less developed states. Personal/social reasons were documented as the leading reason for suicide, and poison/overdose and hanging dominated the means by

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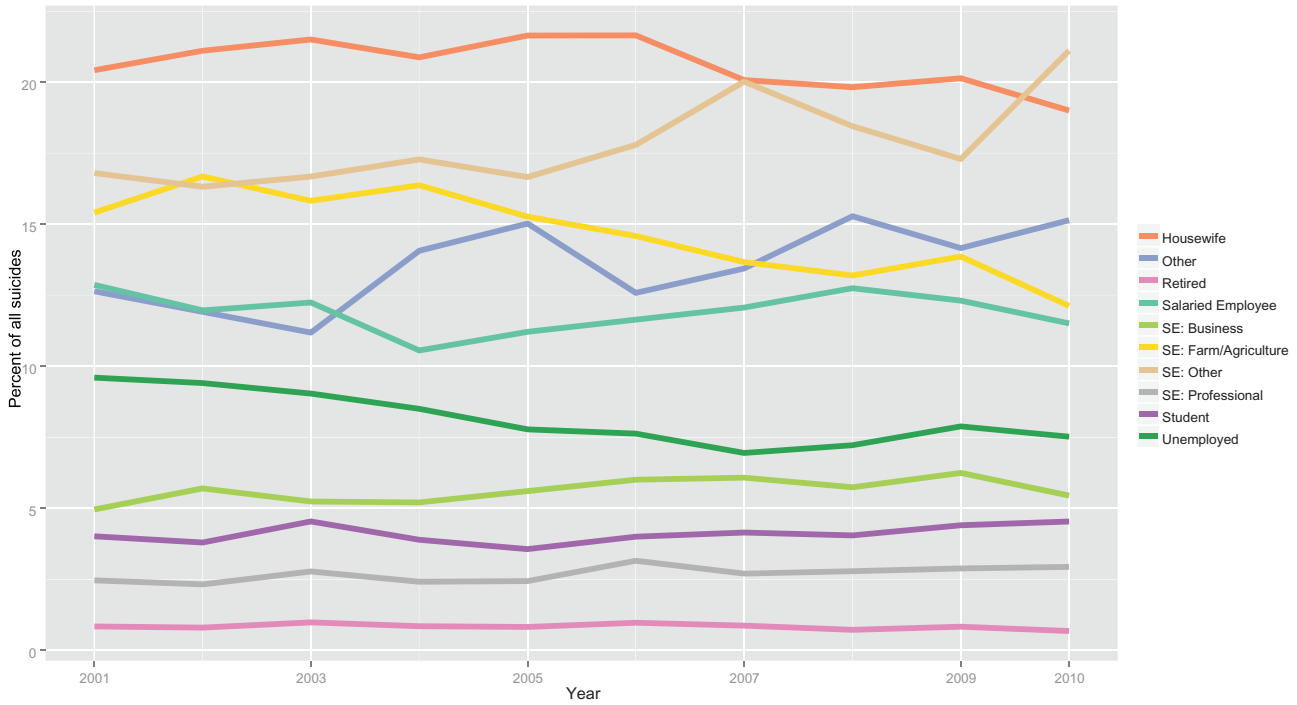


Figure 6. Occupation of those who committed suicide from 2001 to 2010. SE denotes self-employed.

which people committed suicide over this decade. Housewives experienced the highest proportion of suicide deaths. We discuss these findings within the context of surveillance to draw attention to the areas of the greatest need for suicide prevention activities and also to highlight improvements needed in surveillance.

Thus far, the most debatable aspect of NCRB data has been the magnitude of suicides as compared with estimates available from verbal autopsy studies, with the latter having higher estimates than the former.[1,4–8,21] The methods used to arrive at these estimates vary. The higher estimates in the verbal autopsy studies are a result of specifically designed studies including the Sample Registration System (SRS) or monitored community surveillance programmes that capture all deaths actively.[1,7] However, NCRB data provide passive surveillance, with the source being the FIR filed by family/kin/community member with the police for a particular death, and hence is dependent on the reporting from the community, which is known to be selective for various reasons including stigma attached to suicide deaths and criminalization of attempted suicide until recently.[22–24] To this effect, the Indian government has recently decriminalized suicide, which is expected to improve reporting from the community.[24] Misclassification of suicide as homicide in NCRB data also potentially results in under-reporting of suicide.[7] From a passive surveillance perspective, the very wide range of reported numbers of suicides in NCRB between the more developed and less developed states probably reflects the reality rather than different reporting practices, as higher suicide rates are reported from the southern richer Indian states in SRS data.[7] However, the heterogeneity in the NCRB data at the state level, highlighted by the noisy trends for certain states which do not allow meaningful interpretation, indicates the need to understand the reporting practices at state level, the varied quality of which is documented for road traffic injuries (RTI).[25]

Personal/social reasons for committing suicide remained the foremost reason over the decade. Psychosocial factors including socioeconomic circumstances, interpersonal, social and cultural conflicts, alcoholism, financial problems and unemployment are reported as significant risk factors for suicide in India.[26–29] In addition, qualitative data suggest that suicide is perceived as an option by many for apparently insoluble personal difficulties and misfortune.[30] Depression accounts for the largest proportion of disability-adjusted life years for suicide globally;[31] however, the relative contribution of severe mental health issues to suicides in India is still debatable,[26,27,30,32,33] similar to China and Baltic states.[34,35]

Beyond the personal/social reasons, variation was seen between the more and less developed states, with the former having health-related and the latter having recorded unknown and other reasons as the next leading reasons for suicide, as high as 77% on an average in Manipur state. Suicide risk increases significantly with comorbidity, and hence timely and effective access to health care is imperative to reduce the suicide risk.[1] From a surveillance

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perspective, the extent of recording of unknown/other reasons in the less developed states is an immediate concern, as it reflects the poor quality data that do not yield any reasonable understanding of the real situation. Misreporting of RTI deaths by police is reported previously to reduce administrative burden on the system.[36] It may be useful to understand the reasons for poor documentation for suicides in less developed states, to improve utility of these data.

The reasons for suicide in NCRB highlight that the suicide prevention strategies beyond the curative mental health services are needed to address the underlying social determinants of health, to protect the vulnerable and to reduce suicide rates at the population level.[23,26] With mental health services not widely available in India,[37,38] and with poor standing in social determinants of health,[15] the macroeconomic policies in India need to more comprehensively address and protect population groups from ill health, including suicide.

Use of poison/overdose of medicine and hanging were the two most preferred means of suicide over the decade, with the gap between the two decreasing over time, similar to that reported from verbal autopsy studies.[3,6,7] Different patterns were observed for the means of suicide at the state grouping levels, with poisoning leading in the more developed states and more agricultural states whereas hanging was more common in the less developed and less agricultural states. Distinctive patterns were seen for the individual states as well, which are important to understand in order to plan preventive strategies. Self-poisoning with pesticides is a significant public health problem in developing countries.[33,39] Restricting access to commonly used methods of suicide may lead to reduction in the overall and method-specific suicide rates;[33,40,41] however, restricting the sale and use of pesticides or certain medications in these regions requires effective regulatory framework.[39–41] In addition, with hanging being increasingly preferred as a means of suicide, restricting access is unlikely to assist with reduction in suicides.[42] Given the impulsiveness of the action and consequently death in suicide, setting up broad universal population-based strategies designed to reach the population with the aim to increase access to health care, promote mental health and limit or reduce harmful use of pesticides/medicines are needed.[1] Overdose of alcohol as a means of committing suicide does not seem plausible, which further highlights the need to improve data quality.

Housewives recorded the highest proportion of suicide deaths over the decade, followed by self-employed-other (not including agriculture, business or professional). This finding was a surprise, given that Indian media have generally highlighted only farmer suicides. In fact, farmer suicide proportions were not dramatically different between the more and less agricultural states. One of the reasons for less focus on suicides among housewives could be reporting of occupation categories in NCRB. The 'self-employed category' forms the largest collective group including professional, business, farm/agriculture and others. For this analysis, we disaggregated the self-employed category group, thereby resulting in more informative proportions for each occupation category, which highlighted the burden among housewives. Marriage is less protective against suicide for females than males,[27,43] and the greater female vulnerability could be related to psychopathology and psychosocial stressors including arranged and early marriage, young motherhood, low social status, domestic violence and economic dependence.[43–45] These data suggest the need for selective prevention strategies for housewives, again within the gamut of social determinants of health, to prevent suicides.

Despite the under-reporting of suicides in NCRB, these data offer significant insights for the planning of suicide prevention strategies. As NCRB is a passive surveillance source, these data will inherently under-report suicides as it is not the primary function of the police system to generate these data. However, efforts can be made to improve the quality of information collected by the police during their routine tasks, to render these more useful for planning action. These efforts could include standardization of data collection forms, clear guidelines to capture specific type of data (in particular, reasons for suicide) to ensure comparability over time and area, and training of relevant staff to compile these data. Despite the weaknesses in these data, more informative analyses are possible if the NCRB makes anonymized individual-level data available in the public domain. Currently, the data are available in heavily tabulated fixed formats that limit the extent of disaggregated analysis. Though NCRB has published reports for the years 2011–14, detailed data for analytical purposes are not yet available in the public domain for this period. The data in these published reports do not lend themselves to the disaggregated analysis that we have reported in this paper for the years 2001–10. This is a limitation, but the insights from the 2001–10 analysis highlight the need to make detailed recent data available for analysis in a timely manner as a public good.

In conclusion, the NCRB data capture a range of useful information to facilitate identification groups vulnerable for suicide, that can help formulate prevention strategies in India. The need to focus on the underlying causes of human suffering to reduce the burden of suicides is highlighted. Addressing the limitations of these data to improve the quality of surveillance data would further facilitate

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availability of relevant nuanced information needed to develop appropriate suicide prevention programmes in India.

Supplementary Data

Supplementary data are available at *IJE* online.

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Author contributions

R.D. and A.B.V. had full access to all the data in the study and take full responsibility of the integrity of data and accuracy of the data analysis. R.D. and G.A.K. conceptualised the study; R.D., G.A.K. and L.D. guided data analysis and interpretation; R.D. drafted the manuscript; A.B.V. conducted data analysis and contributed to drafting the manuscript; all authors approved the final manuscript. R.D. is the guarantor for the paper.

Conflict of interest: The authors have no conflict of interest.

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