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A statistical study of suicidal behavior of Indians

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Abstract

Background: According to the reports published by the National Crime Records Bureau (NCRB) India, every year, the number of suicides are continuously increasing. The number of suicidal deaths in 2014 is 15.8% more than 2004.

Objectives: To briefly overview the recent trends in the number of suicides and study risk factors for suicides, means of suicides in India. We explore the association of suicidal deaths and some attributes such as gender (sex), age group and profession of suicide victims.

Method: Multiple correspondence analysis (MCA) and subset MCA are used to study the association of attributes.

Results: In India, family problems and health problems are major reasons for suicides. The association between the risk factors for suicides, means of suicides, gender, profession, age group of suicide victims is studied and explored using biplots.

Conclusions: The leading risk factors for suicides are family problems, illness, drug addiction, failure in examination, etc. Hanging and poisoning are the common means adopted by males and females while females most frequently commit suicide by fire/self-immolation. As per the association of attributes studied, government of India has to launch 'Anti-suicide campaigns' at all levels regularly and the campaign should consider gender, age group, profession while structuring the campaign.

Keywords: Suicides, Risk factors for suicides, Odds ratio, MCA, Biplots

Background

Suicide is the 10th leading cause of death worldwide. More than one million people commit suicide every year, representing an annual global suicide mortality rate of 16 per 100,000 (Nock et al. (2012)). World Health Organization (WHO) reports that suicide attempts are up to 20 times more frequent than completed suicides. According to recent statistics, among more than a million suicidal deaths worldwide, 20% are Indians while India is 17% of the world population Singh and Singh (2003). As per NCRB report, the total number of suicides reported in 2014 are 131,666 out of which 89,129 are males, 42,521 are females and 16 are transgender. According to WHO reports, India ranks 43rd in descending order of rates

of suicide with a rate of 10.6 per 100,000 in 2009 (Radhakrishnan and Andrade (2012)).

Suicide is a major public and mental health problem which demands urgent action. Suicide is the act of intentionally terminating one's own life (Nock et al. (2008b)). It is often carried out as a result of despair, the cause of which is frequently attributed to a mental disorder such as depression, borderline personality disorder, alcoholism or drug abuse, stress factors such as financial difficulties or troubles with interpersonal relationships. A suicide attempt possesses self-initiated, potentially injurious behavior, the presence of intent to die and non-fatal outcome (Levi et al. (2008)). The costs of suicide are not only loss of life, but the mental, physical and emotional stress imposed on family members and friends. Other costs are for the public resources, as people who attempt suicide often require help from health care and

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psychiatric institutes. Suicide is a final act of behavior that is probably the result of interactions of several different factors. Predictors of suicidal behavior and risk factors include a history of previous suicide attempts, particular demographic variables, clinical symptoms and issues related to medical and social support (Hawton and Heeringen (2009)).

An estimated 804,000 suicides occurred worldwide in 2012, representing an annual global age-standardized suicide rate of 11.4 per 100,000 population (15.0 for males and 8.0 for females). With regard to age, the suicide rate is highest in persons aged 70 or over for both men and women in almost all regions of the world. In some countries, the suicide rate is highest in the young age. According to WHO report, suicide is the second leading cause of death in 15–29 year-olds. The countries of the Eastern Europe and East Asia have the highest suicide rate in the world. While the region with the lowest suicide rate is Latin America. Asian countries account for approximately 60% of the world's suicides (Chen et al. (2012)). Compared with Western countries, Asian countries have a higher average suicide rate, lower male-to-female suicide gender ratio, and higher elderly-to-general-population suicide ratios. Vijayakumar et al. (2005a,b,c) studied suicides in developing countries. Maher et al. (2011) studied suicide mortality in Cairo city during 1998 to 2002.

According to WHO, an estimate of number of suicides for the year 2020 is approximately 1.53 million and ten to twenty times more people are estimated to attempt suicide worldwide. These figures do not include the suicide attempts, which are up to 20 times more frequent than completed suicide (Kumar et al. (2013)). The estimates for the year 2020 represent on an average one death every 20 sec and one attempt every one to two seconds (Gvion and Apter (2012)). In most of the countries, suicides are under-reported. Even in some countries, suicides are treated as illegal act and it is very likely that it is unreported. In countries with good vital registration data, suicide may often be misclassified as an accident or other cause of death. Registering a suicide is a complicated procedure involving several different authorities, often including law enforcement. In countries without reliable registration of deaths, suicides simply dies uncounted.

We observe that, gender difference plays a significant role among all age groups in India as well as across the world. According to Nock et al. (2008a), suicide is more prevalent among men, whereas nonfatal suicidal behaviours are more prevalent among women and persons who are young, unmarried, or have a psychiatric disorder. Tousignant et al. (1998)

reported that the gap between male and female suicide rates in India is relatively small. But since 2009, this gap has shown continuous increase. The overall male-female ratio of suicide victims in India for the year 2014 was 68:32 while it was 59:41 in 1998. Steen and Mayer (2004) studied the effect of modernization on male-female suicide ratio in India during 1967–1997.

Suicide is a leading cause of death among teenagers and young people under 35 years of age across the world. Even in India, 66.28% (87,252 out of $n = 1,31,650$ male and female suicides) of the suicide victims are between the age group 18–45 years according to NCRB report for 2014. Specifically, in India, the suicide victims' boy-girl ratio (below 18 years of age) is 51:49. Mayer and Ziaian (2002) studied gender and age variations in suicides in India. Lasrado et al. (2016) studied suicidal behavior in South India whereas Issa et al. (2016) studied suicidal deaths in Saudi Arabia. Hobson and Leech (2014) studied the youths' suicidal behavior and noted that there is a significant relationship between media coverage and youth suicide.

The consumption of insecticides (poisoning) (Argo et al. (2010)), hanging and firearms are the most common means of suicide globally, but many other methods are used with the choice of method, often varying according to population group such as age-group, gender, profession, social status, educational status, etc. In India hanging, poisoning, firearm/self-immolation, and drowning are the prominent means of suicides. During 2014, almost 51.12% (67,303 out of n) of the total male suicides are committed by hanging, poisoning and drowning while near about 24.56% (32,333 out of n) of the total female suicide are committed by hanging, poisoning and fire/self-immolation. Overall, 67.83% (89,295 out of n) of the total suicides are committed by hanging and poisoning.

There is no single reason why someone may try to take its own life, but certain factors can increase the risk, such as illness, family problems, financial loss, harmful use of alcohol, act cumulatively to increase a person's vulnerability to suicidal behavior, etc. According to NCRB report 2014, 'Family Problems (other than marriage related problems)' and 'Illness' have together accounted 39.76% (52,341 out of n) of the total suicides.

Knowledge about suicidal behavior has increased greatly in recent decades. Research at different levels, has shown the importance of the interplay between biological, psychological, social, environmental and cultural factors in determining suicidal behaviors. At the same time, literature has helped to identify many risks and protective factors for suicide, both in the general population and in vulnerable groups.

In this paper, we study the recent trends in the number of suicides in India and briefly review various risk factors for suicide. The main objective of this study is to explore the association between various attributes such as gender, age of suicide victims, the social, economic, educational and professional status of suicide victims, means of suicides, risk factors for suicides, etc. We study the association between various attributes through the Correspondence Analysis (CA). The detail of the methodology to study the suicidal behavior of Indians is discussed in the next section.

Methods

The present study includes the association of various attributes such as gender, age category of victims, social status, economic status, educational status, professional status, risk factors for suicides, means of suicides, etc. for the number of suicides in India during 2013/2014. At primary level, an odds ratio is calculated to measure an association between gender and risk factors for suicides, the means of suicides. Further, we use CA to study the association between various attributes related to the suicides. We summarize the conclusions and findings which may be helpful for policy makers, researchers, NGO's, etc. to develop preventive measures of suicides.

The chi-square test for independence is commonly used to determine whether there is a significant association between the categorical variables (CVs) expressed in a contingency table. Usually if the CVs are found to be dependent through this test, the interest would be, how the levels of CVs are related with each other. To portray the interrelations between the CVs, CA is used. CA is a multivariate statistical technique to visualize graphically the association between CVs in a contingency table. Particularly Simple CA (SCA) and Multiple CA (MCA) are useful for exploring the relations amongst two and more than two CVs respectively. The association between the categories of the variables are visualized on a map, called a biplot, allowing interpretations of their similarities and differences.

The biplot shows the best two dimensional approximations of the distances between row and column profiles of a matrix data. The distance between any row points or column points gives a measure of their similarity (or dissimilarity). Biplot consists of lines and dots. Lines are used to reflect the variables of the dataset, and dots are used to show the observations. In a biplot, the length of a line approximates the variance of the variable. The longer the line, the higher is the variance. The angle between the lines, or, to be more precise, the cosine of the angle between the lines, approximates the correlation between the variables they represent. The closer the angle to 90° or

270° , smaller the correlation, while an angle of 0° or 180° degrees reflects a correlation of 1 or -1 , respectively.

In common practice, CA includes all the categories of the CVs under consideration in the analysis, since this gives the most comprehensive and global view of their interrelationships. Sometimes it is likely that after a global view of the data, it would be of interest to focus attention on a reduced set of response categories of the data. Another reason for restricting the categories to be analysed for a subset is when there are many variables and thus many biplot points in the graphical display. In such situation, it is better to study a subset of variables of interest and their categories. This approach is known as subset CA.

The same concept is applicable for MCA, which is known as subset MCA. Since the variables of interest and their categories are few in Subset MCA, the corresponding biplot is easily interpretable. The idea is to maintain the original relative frequencies of the categories and not to re-express them relative to totals within the subset. Since, the interpretations of biplot obtained from the classical MCA are more delicate, Khangar and Kamalja (2017) used a method for performing MCA based on separate singular value decompositions (SVDs) where the overlaid biplots are used to visualize the association of pairs of CVs across all the categories of others. The main contribution of this paper is application of subset MCA to study the suicidal behavior. The subset MCA based on separate SVDs is applied to study the association of key risk factors for suicides and means of suicides with other attributes related to number of suicides in India.

Statistical analyses

The data about the number of accidental and suicidal deaths in India is recorded and analyzed by NCRB, India every year since 1967. The data is maintained according to various attributes such as gender, age group, social, economic, educational status, profession, etc. Further, the data are also classified according to the risk factors for suicides and the means of suicides. The suicide death rate for a year represents the number of suicides per 100,000 of the population during the reference year.

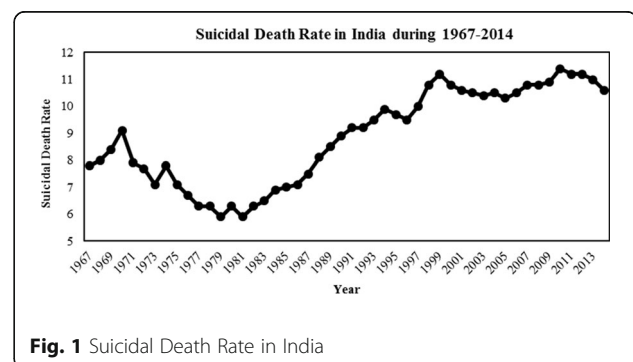


Fig. 1 Suicidal Death Rate in India

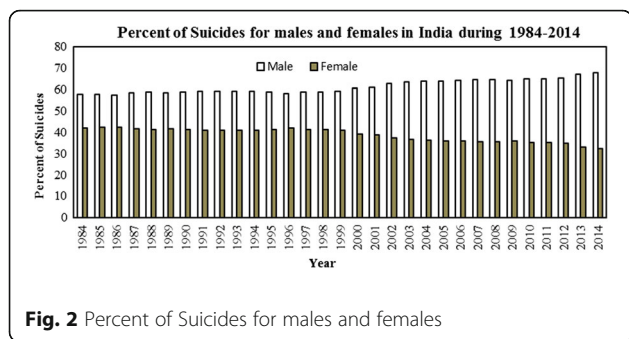


Fig. 2 Percent of Suicides for males and females

Suicidal death rate in India

Figure 1 shows the variation in the suicide death rate in India from 1967 to 2014. The overall increasing trend in the suicide death rate indicates the need to handle this critical issue very carefully.

The number of suicidal deaths in 2014 is 15.8% more than 2004. There is a wide variation in the suicide rates within different states of the country. In the year 2014, a total of 131,166 suicidal deaths is recorded, out of which 67.70% (89,129 out of *n*) are males and 32.30% (42,521 out of *n*) are females. The percent share of males in the number of suicidal deaths is continuously increasing as compared to females since last two decades. Fig. 2 shows the gender wise percent of suicides of the total suicides since 1967 to 2014.

Most of the suicides in India are from a younger age. Fig. 3a and b shows percent of suicidal deaths across each age group and gender. Percent of suicidal deaths for age group below 14 years of age and between 15 and 18 years of age is almost equal for male and female for 2013 and 2014. Also, the percent share of male suicidal deaths for age groups 30–45 and 45–60 is too high as compared to females. Near about 34.08% (44,870 out of *n*) of suicides are committed by people between the age group 18–30 in 2014. The fact that, the percent share of suicides committed by younger age group people imposes the huge social, emotional and economic burden on the society.

Figure 4 represents the percent of suicide victims by their social status and gender. The highest percent share in suicidal deaths is of married male. Fig. 5 presents the

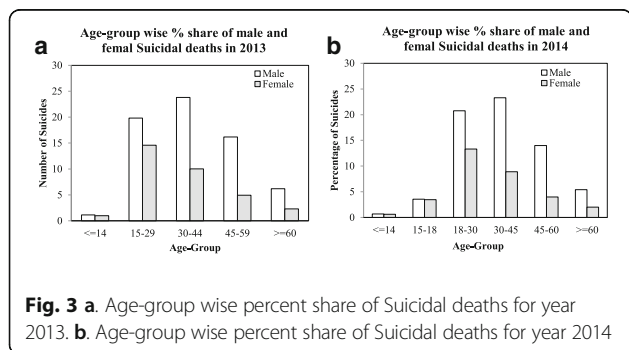


Fig. 3 a. Age-group wise percent share of Suicidal deaths for year 2013. b. Age-group wise percent share of Suicidal deaths for year 2014

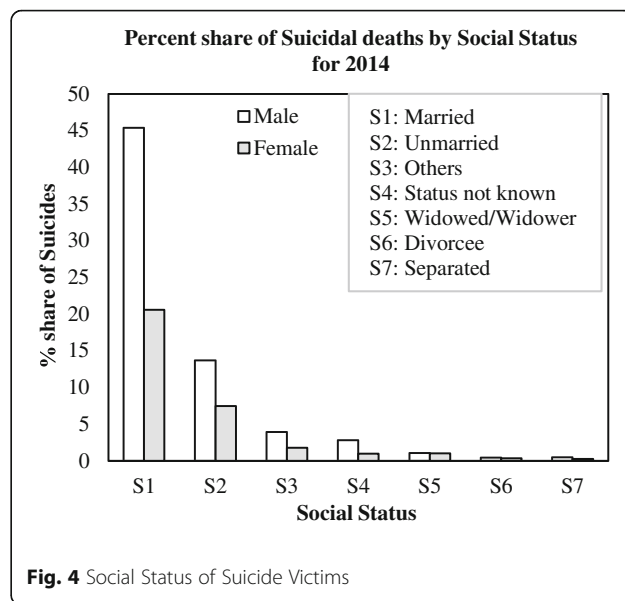


Fig. 4 Social Status of Suicide Victims

percent share of suicides by gender and their educational status. Around 69.74% (91,820 out of *n*) of suicidal deaths are by people belonging to less than 100,000 of the annual income group. It indicates the impact of poverty on suicidal deaths in India.

The percent share of suicidal deaths by gender and educational status of suicide victims is represented in Fig. 6. Overall, less educated people are more likely to commit suicide. Fig. 7 shows the suicide percent by professional status of suicide victims and gender. Out of the total female suicides, 47.38% (20,148 out of 42,521) suicides are committed by housewives followed by 8.95% (3,807 out of 42,521) suicides by students.

The parameters such as age, gender, the social, economic, educational and professional status of suicide victims play a

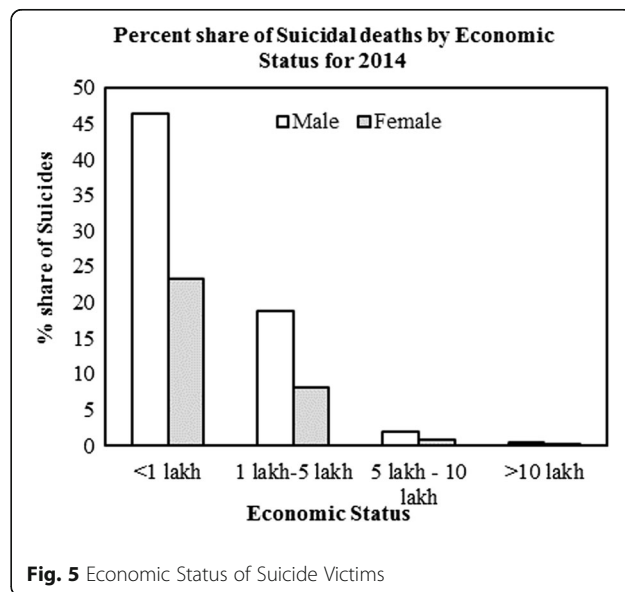
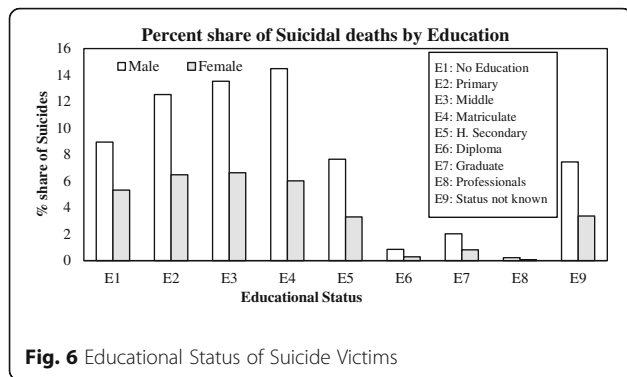


Fig. 5 Economic Status of Suicide Victims

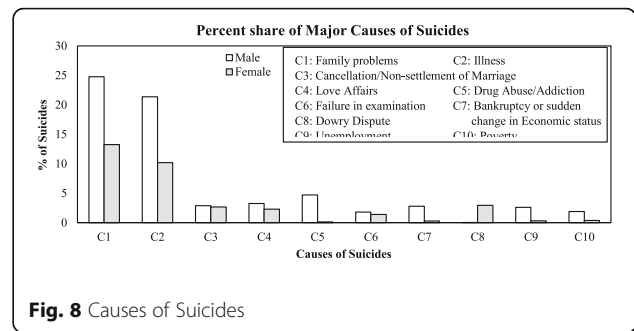
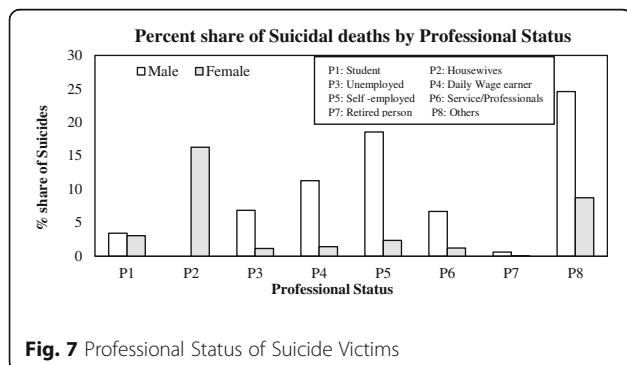


significant role towards the suicidal behavior. However, the risk factors for suicides and means of suicides need to be studied for the prevention of suicidal deaths and to develop the new strategies for the vulnerability of the people tending to suicide. The brief study of risk factors for suicides and means of suicides with respect to age category and gender is presented in the next subsection.

Study of risk factors of suicides

There are various risk factors which ultimately result in the suicide. Suicidal behaviors may be observed when there is a situation or event that the person finds overwhelming, such as aging, the death of loved one, drug or alcohol use, emotional trauma, serious physical illness, unemployment or money problems, etc. So it is imperative to design interventions that can address distress among various demographic groups, and not aggravate the problem by focusing on health and family problems alone.

From Fig. 8, it can be observed that family problems (other than marriage related issues) and illness/health problems are the key risk factors for suicides. During 2014, out of 10 major risk factors for suicides, family problems and illness together caused 69.59% (52,341 out of 75,212) suicides. The percent share of other reported risk factors such as cancellation and non-settlement of marriage, love affairs, drug abuse/addiction, failure in examination, bankruptcy, unemployment, poverty have a relatively lesser share than these two major risk factors. It can be seen that if family problems are handled with



care and precaution, the majority of the suicides can be prevented. If the patients are counseled/therapied with respect to possible suicide attempt, to some extent suicidal deaths due to illnesses can also be reduced.

To further explore the risk factors for suicides, we consider the key risk factors only. We study the risk factors for the suicides by gender through odds ratio. Table 1 gives odds ratios for respective risk factors. From Table 1, it can be seen that, males are 39 times more likely to commit suicide than females due to drug abuse/addiction while males are 10 times more likely to commit suicide than females due to bankruptcy or sudden change in economic status. Unemployment is also a subsidiary cause of males' suicide. Males are 8 times more likely to commit suicide due to unemployment than females. The leading cause of the suicide among females is dowry dispute, since females are 56 times more likely to commit suicide than males due to dowry dispute. Thus, bankruptcy, unemployment, drug abuse/addiction are the common risk factors for suicides among males and dowry dispute is a major risk factor for suicide among females.

Table 1 Odds ratio for causes of suicides for males and females

Sr. No.	Causes	Males	Females	Total	Odds favouring males	Odds favouring females
1	Drug Abuse/Addiction	3555	91	3646	39.0659	0.0256
2	Bankruptcy or sudden change in Economic status	2098	210	2308	9.9905	0.1001
3	Unemployment	1965	242	2207	8.1198	0.1232
4	Poverty	1419	280	1699	5.0679	0.1973
5	Illness	16078	7663	23741	2.0981	0.4766
6	Family problems	18623	9977	28600	1.8666	0.5357
7	Love Affairs	2441	1727	4168	1.4134	0.7075
8	Failure in examination	1358	1045	2403	1.2995	0.7695
9	Cancellation/ Non-settlement of Marriage	2173	2006	4179	1.0832	0.9231
10	Dowry Dispute	39	2222	2261	0.0176	56.9744

Now to study the pattern of association of these two attributes with respect to number of suicidal deaths in a specific age group, we use MCA based on separate SVDs.

Exploration of the association between risk factors for suicide and gender across Age-category of suicide victims

We perform MCA based on separate SVDs for the CVs gender (*A*) and risk factors for suicides (*B*) across age-category (*C*) of suicide victims. The categories of the CVs are summarized as follows.

Name of the CV	Categories of CV
Gender (<i>A</i>)	Male (A_1), Female (A_2)
Risk factors for Suicides (<i>B</i>)	Family problems (B_1), Illness (B_2), Cancellation/Non-settlement of Marriage (B_3), Love Affairs (B_4), Drug Abuse/Addiction (B_5), Failure in examination (B_6), Bankruptcy or sudden change in Economic status (B_7), Dowry Dispute (B_8), Unemployment (B_9), Poverty (B_{10}), Property Dispute (B_{11}), Death of a dear person (B_{12}), Professional/ Career problem (B_{13}), Social Disrepute (B_{14}), Suspected/Illicit relation (B_{15}), Divorce (B_{16}), Barrenness/Impotency (B_{17}), Physical Abuse (Rape, Incest) (B_{18}), Ideological Causes/Hero Worshipping (B_{19}), Illegitimate Pregnancy (B_{20})
Age Category (<i>C</i>)	Up to 14 years (C_1), 15–18 years (C_2), 18–30 years (C_3), 30–45 years (C_4), 45–60 years (C_5), 60 years and above (C_6)

For the year 2014, the distribution of the number of suicidal deaths with reference to these 3-attributes is presented in 3-way contingency table in Table 2. The details of nonzero Singular Values (SV), Inertia (*I*) and % of inertia obtained by performing MCA based on separate SVDs are provided in Table 3 while Fig. 9 shows the corresponding biplot.

The biplot points far from the origin and close to each other are considered for interpretations, since more the vector length, better is the discrimination ability. The interest would be in pairs of biplot points of CVs *B* and *A* across the same category of *C*. The biplot obtained by performing MCA based on separate SVDs on 3-way contingency data for three attributes *A*, *B* and *C* in Table 2 includes all the risk factors for suicides. Fig. 9 consists of too many biplot points associated with the risk factors for suicides. This causes the biplot difficult to interpret. Hence we perform subset MCA based on separate SVDs to the subset of response categories which include 10 key risk factors for suicides contributing almost 94% of the total suicides. In fact, we drop out the risk factors for suicides with a relatively small percent share in

total suicides. We perform a subset MCA based on separate SVDs to the cross-classified data in Table 2 with first 10 risk factors for suicides. The details of nonzero singular values, inertia and % of inertia obtained by performing subset MCA based on separate SVDs is provided in Table 4 while Fig. 10 shows the corresponding biplot.

From the pair of biplot points (A_1C_3, B_9C_3), (A_1C_3, B_4C_3), (A_1C_3, B_6C_3) it is seen that Males (A_1) between age group 18–30 (C_3) commit suicide due to unemployment (B_9), Love Affairs (B_4) and Failure in examination (B_6) respectively. The other conclusions about the association of risk factors for suicides with gender and age group from biplot in Fig. 10 are summarized in the following table sorted on the attributes' discrimination ability and strength of association of pair of attributes. The biplot points are displayed in respective symbol colors in biplot.

Age group	Gender	Pair of Biplot Points	Interpretation of pair of Biplot Points (Association between risk factors for suicides and gender across age category)
18–30 year (C_3)	Male (A_1)	(A_1C_3, B_9C_3), (A_1C_3, B_4C_3), (A_1C_3, B_6C_3)	Males (A_1) between age group 18–30 (C_3) commit suicide due to: Unemployment (B_9), Love Affairs (B_4) and Failure in examination (B_6).
	Female (A_2)	(A_2C_3, B_8C_3), (A_2C_3, B_3C_3)	Females (A_2) between age group 18–30 (C_3) commit suicide due to: Dowry Dispute (B_8) and Cancellation/Non-settlement of Marriage (B_3).
45–50 year (C_5)	Male (A_1)	(A_1C_5, B_7C_5), ($A_1C_5, B_{10}C_5$), (A_1C_5, B_6C_5)	Males (A_1) between age group 45–60 (C_5) commit suicide due to: Bankruptcy/sudden change in Economic status (B_7), Poverty (B_{10}) and Failure in examination (B_6).
30–45 year (C_4)	Male (A_1)	(A_1C_4, B_1C_4)	Males (A_1) between age group 30–45 (C_4) commit suicide due to Family problems (B_1).
	Female (A_2)	(A_2C_4, B_3C_4), (A_2C_4, B_1C_4)	Females (A_2) between age group 30–45 (C_4) commit suicide due to: Cancellation/Non-settlement of Marriage (B_3) and Family problems (B_1).
15–18 year (C_2)	Male (A_1)	(A_1C_2, B_6C_2)	Males (A_1) between age group 15–18 (C_2) commit suicide due to Failure in examination (B_6).
	Female (A_2)	(A_2C_2, B_4C_2)	Females (A_2) between age group 15–18 (C_2) commit suicide due to Love Affairs (B_4).
Up to 14 years (C_1) and Female (A_2)	Male (A_1) and Female (A_2)	(A_1C_1, B_6C_1), (A_2C_1, B_6C_1)	Males (A_1) and Females (A_2) up to 14 years (C_1) age group commit suicide due to Failure in examination (B_6).

Study of means of suicides

Along with the risk factors for suicides, means of suicides is also an important attribute for the prevention of suicides. Fig. 11 shows % of suicides in 2014 by means adopted and gender. It is observed that

Table 2 Distribution of suicides in 2014 by causes of suicides and gender across age group

Sr. No.	Causes of suicides	A ₁ (Male)						A ₂ (Female)						Total suicides	Percent suicides
		C ₁	C ₂	C ₃	C ₄	C ₅	C ₆	C ₁	C ₂	C ₃	C ₄	C ₅	C ₆		
1	B ₁	129	625	5541	7041	3990	1297	116	716	4221	3238	1228	458	28600	35.77
2	B ₂	96	428	3756	5027	4147	2624	85	496	2299	2083	1496	1204	23741	29.69
3	B ₃	9	109	1001	753	253	48	10	136	1139	591	113	17	4179	5.23
4	B ₄	12	346	1581	429	63	10	30	511	985	193	8	0	4168	5.21
5	B ₅	5	51	967	1419	893	220	6	5	24	35	15	6	3646	4.56
6	B ₆	91	582	655	28	2	0	72	539	407	25	2	0	2403	3.01
7	B ₇	1	14	432	918	579	154	2	3	41	101	51	12	2308	2.89
8	B ₈	1	0	19	12	5	2	0	32	1707	427	44	12	2261	2.83
9	B ₉	0	48	838	724	276	79	2	9	125	84	21	1	2207	2.76
10	B ₁₀	1	9	358	589	370	92	4	8	91	117	48	12	1699	2.12
11	B ₁₁	0	15	201	343	263	52	0	5	63	87	26	12	1067	1.33
12	B ₁₂	1	13	169	218	174	83	3	26	126	75	47	46	981	1.23
13	B ₁₃	0	33	244	307	171	37	0	8	61	33	9	0	903	1.13
14	B ₁₄	2	7	85	136	98	33	7	15	55	34	12	6	490	0.61
15	B ₁₅	0	4	100	119	26	4	4	23	83	79	15	1	458	0.57
16	B ₁₆	0	0	55	59	28	8	0	10	88	77	5	3	333	0.42
17	B ₁₇	0	5	54	50	15	3	1	11	100	77	13	3	332	0.42
18	B ₁₈	0	0	3	0	3	0	4	20	29	12	2	1	74	0.09
19	B ₁₉	1	2	21	10	7	2	2	0	8	3	0	0	56	0.07
20	B ₂₀	0	0	0	0	0	0	1	10	34	11	0	0	56	0.07
Grand Total		349	2291	16080	18182	11363	4748	349	2583	11686	7382	3155	1794	79962	100

hanging (42% out of *n*), consuming poison (26% out of *n*) are the common means among males and females for suicides.

Table 5 shows the odds ratio for the means of suicides. It can be concluded that males are 5.46 times

more likely than females to commit suicide by coming under running vehicles/trains while males are 4.08 times more likely than females to commit suicide by touching an electric wire. Males are 2.52 times and 2.08 times more likely than females to commit suicide by hanging and poisoning respectively, whereas females are 1.5 times more likely to commit suicide by fire/self-immolation.

To study the pattern of association of gender and the means of suicides across age categories with respect to number of suicidal deaths, we use MCA based on separate SVDs.

Table 3 Results of MCA based on separate SVDs for Table 2 along *B* and *A* across the categories of *C*

Categories of <i>C</i>	SV	Inertia	Percent inertia
C ₁	0.1215	0.0148	3.24
	0.0417	0.0017	0.38
C ₂	0.3550	0.1261	27.62
	0.1113	0.0124	2.72
C ₃	0.3708	0.1375	30.13
	0.1431	0.0205	4.49
C ₄	0.1925	0.0370	8.12
	0.1173	0.0138	3.02
C ₅	0.1914	0.0366	8.03
	0.1207	0.0146	3.19
C ₆	0.1963	0.0385	8.44
	0.0533	0.0028	0.62
Total		0.4563	100

Exploration of the association between means of suicides and gender across Age-category of suicide victims

To study the suicidal behavior and to implement new strategies, we explore the association between the means of suicides and gender across the age category of suicide victims. We use the 3-way contingency data for 2013 given in Table 6. For 2014 such classification of number of suicidal deaths is not available. The details of categories of these variables and the labelling used in the analysis are given below.

Name of the CV	Categories of CV
Gender (A)	Male (A_1), Female (A_2)
Means of Suicides (B)	Hanging (B_1), Poisoning (B_2), Fire/Self Immolation (B_3), Drowning (B_4), Coming under running vehicles/trains (B_5), Excessive Alcoholism (B_6), Jumping (B_7), Self-electrocution (B_8), Jumping of moving vehicles or trains (B_9), Self-Infliction of Injury (B_{10}), Overdose of sleeping pills (B_{11}), Fire-Arms (B_{12}), By machine (B_{13}),
Age Category (C)	Up to 14 years (C_1), 15–29 years (C_2), 30–44 years (C_3), 45–59 years (C_4), 60 years and above (C_5),

The distribution of number of suicides by means of suicides and gender across the age group in 2013 is given in Table 6.

We perform MCA for CVs Means of suicides (B) and gender (A) across age-category (C) of suicide victims. The numerical results are summarized in Table 7. The biplot for this analysis is shown in Fig. 12.

To study the key means of suicides, we perform the subset MCA for the first five means of suicides from Table 6, since these means of suicides contribute almost 94% of the total suicides. The details of nonzero singular values, inertia and % of inertia obtained by performing subset MCA based on separate SVDs are provided in Table 8 while Fig. 13 shows the corresponding biplot, which can be well interpreted.

From the pair of biplot points (A_2C_2, B_3C_2), it is seen that Females (A_2) between age group 15–29 (C_2)

commit suicide by fire/self-immolation (B_3). The other conclusions about association of means of suicides with gender and age group from biplot in Fig. 13 are summarized in the following table.

Age group	Gender	Biplot points	Interpretation of pair of Biplot Points (Association between means of suicides and gender across age category)
15–29 year (C_2)	Female (A_2)	(A_2C_2, B_3C_2) (A_2C_2, B_1C_2)	Females (A_2) between age group 15–29 (C_2) commit suicide by: Fire/self-immolation (B_3) and Hanging (B_1).
30–44 year (C_3)	Male (A_1)	(A_1C_3, B_1C_3) (A_1C_3, B_2C_3) (A_1C_3, B_5C_3)	Males (A_1) between age group 30–44 (C_3) commit suicide by: Hanging (B_1), Poisoning (B_2) and Coming under running vehicles/trains (B_5).
	Female (A_2)	(A_2C_3, B_3C_3)	Females (A_2) between age group 30–44 (C_3) commit suicide by Fire/self-immolation (B_3).
Above 60 years (C_5)	Male (A_1)	(A_1C_5, B_2C_5) (A_1C_5, B_5C_5)	Males (A_1) above 60 years (C_5) age group commit suicide by Poisoning (B_2) and Coming under running vehicles/trains (B_5).
	Female (A_2)	(A_2C_5, B_4C_5)	Females (A_2) above 60 years (C_5) age group commit suicide by Drowning (B_4).
45–59 year (C_4)	Male (A_1)	(A_1C_4, B_5C_4) (A_1C_4, B_2C_4)	Males (A_1) between age group 45–59 (C_4) commit suicide by: Coming under running vehicles/trains (B_5) and Poisoning (B_2).
Up to 14 years (C_1)	Female (A_2)	(A_2C_1, B_3C_1) (A_2C_1, B_1C_1) (A_2C_1, B_2C_1)	Females (A_2) up to 14 years (C_1) commit suicide by: Fire/self-immolation (B_3), Hanging (B_1) and Poisoning (B_2).

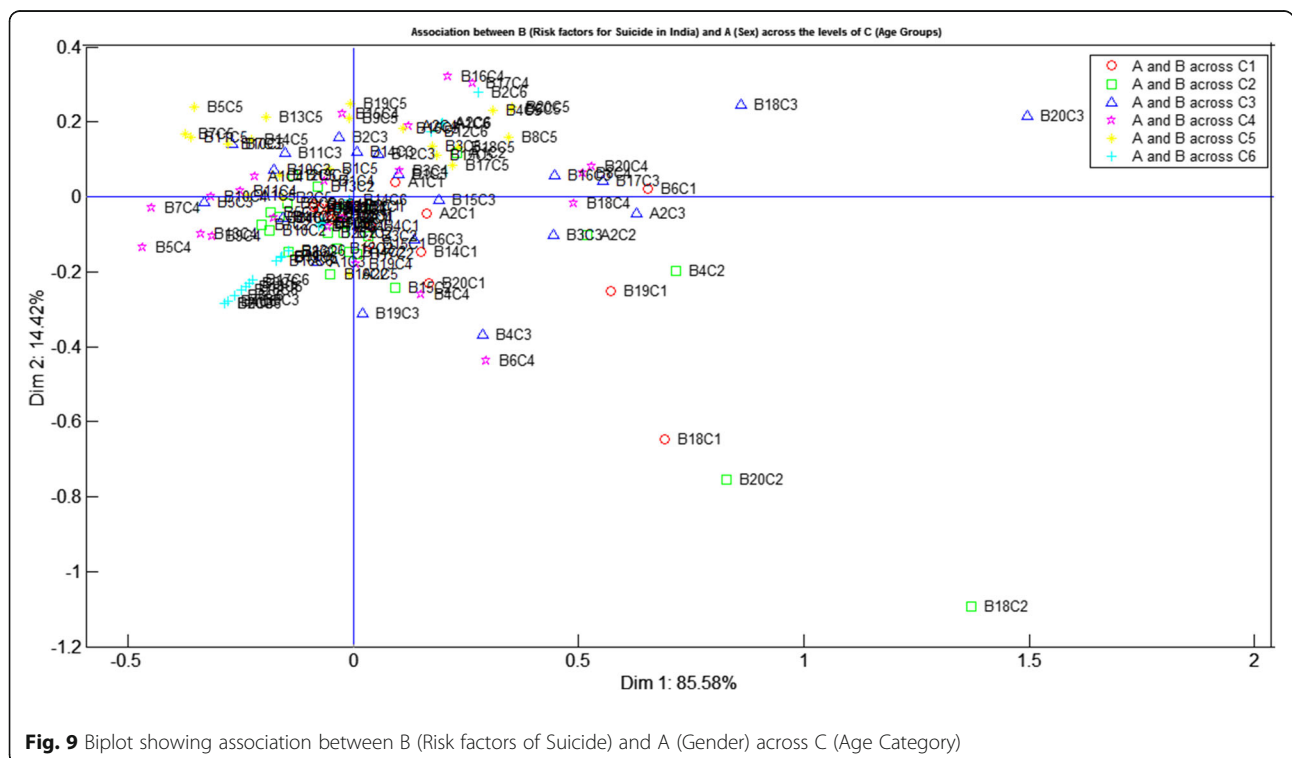


Fig. 9 Biplot showing association between B (Risk factors of Suicide) and A (Gender) across C (Age Category)

Table 4 Results of Subset MCA based on separate SVDS for Table 2 along *B* and *A* across the categories of *C*

Categories of <i>C</i>	SV	Inertia	Percent inertia
<i>C</i> ₁	0.1171	0.0137	3.17
	0.0309	0.0010	0.22
<i>C</i> ₂	0.3512	0.1233	28.53
	0.0992	0.0098	2.27
<i>C</i> ₃	0.3637	0.1323	30.60
	0.1409	0.0198	4.59
<i>C</i> ₄	0.1840	0.0338	7.83
	0.1113	0.0124	2.87
<i>C</i> ₅	0.1826	0.0333	7.71
	0.1146	0.0131	3.04
<i>C</i> ₆	0.1925	0.0370	8.57
	0.0508	0.0026	0.60
Total		0.4323	100

Exploration of the association between profession of suicide victims and gender across Age-category of suicide victims

To study the association of profession of suicide victims with age category and gender of suicide victims, we perform MCA based on separate SVDs. We consider the cross-classified data in Table 9 for analysis. The details of nonzero singular values, inertia and % of inertia obtained by performing MCA based on separate SVDs is provided in Table 10 while Fig. 14 shows the corresponding biplot.

Name of the CV	Categories of CV
Gender (<i>A</i>)	Male (<i>A</i> ₁), Female (<i>A</i> ₂)
Profession of Suicide Victim (<i>B</i>)	Self-employment (<i>B</i> ₁), House wife (<i>B</i> ₂), Service (<i>B</i> ₃), Unemployed (<i>B</i> ₄), Student (<i>B</i> ₅), Retired Person (<i>B</i> ₆)
Age Category (<i>C</i>)	Up to 14 years (<i>C</i> ₁), 15–29 years (<i>C</i> ₂), 30–44 years (<i>C</i> ₃), 45–59 years (<i>C</i> ₄), 60 years and above (<i>C</i> ₅),

From the pair of biplot points (*A*₁*C*₂, *B*₄*C*₂) it is seen that Unemployed (*B*₄) Males (*A*₁) between age group 15–29 (*C*₂) commit suicide. The other conclusions about association profession of suicide victims and gender across age category from biplot in Fig. 14 are summarized in the following table.

Age group	Gender	Biplot points	Interpretation of pair of Biplot Points (Association between profession of suicide victims and gender across age)
15–29 year (<i>C</i> ₂)	Male (<i>A</i> ₁)	(<i>A</i> ₁ <i>C</i> ₂ , <i>B</i> ₄ <i>C</i> ₂)	Unemployed (<i>B</i> ₄) Males (<i>A</i> ₁) between age group 15–29 (<i>C</i> ₂) commit suicide.
	Female (<i>A</i> ₂)	(<i>A</i> ₂ <i>C</i> ₂ , <i>B</i> ₂ <i>C</i> ₂)	House wife (<i>B</i> ₂) between age group 15–29 (<i>C</i> ₂) commit suicide.
Up to 14 years (<i>C</i> ₁)	Male (<i>A</i> ₁)	(<i>A</i> ₁ <i>C</i> ₁ , <i>B</i> ₅ <i>C</i> ₁)	Male (<i>A</i> ₁) Students (<i>B</i> ₅) up to age 14 (<i>C</i> ₁) commit suicide.
	Female (<i>A</i> ₂)	(<i>A</i> ₂ <i>C</i> ₁ , <i>B</i> ₅ <i>C</i> ₁)	Female (<i>A</i> ₂) Students (<i>B</i> ₅) up to age 14 (<i>C</i> ₁) commit suicide.
30–44 year (<i>C</i> ₃)	Male (<i>A</i> ₁)	(<i>A</i> ₁ <i>C</i> ₃ , <i>B</i> ₃ <i>C</i> ₃)	Males (<i>A</i> ₁) with profession service (<i>B</i> ₃) between age group 30–44 (<i>C</i> ₃) commit suicide.
	Female (<i>A</i> ₂)	(<i>A</i> ₂ <i>C</i> ₄ , <i>B</i> ₂ <i>C</i> ₄)	House wife (<i>B</i> ₂) between age group 45–59 (<i>C</i> ₄) commit suicide.
45–59 year (<i>C</i> ₄)	Male (<i>A</i> ₁)	(<i>A</i> ₁ <i>C</i> ₃ , <i>B</i> ₃ <i>C</i> ₃)	Males (<i>A</i> ₁) with profession service (<i>B</i> ₃) between age group 30–44 (<i>C</i> ₃) commit suicide.
	Female (<i>A</i> ₂)	(<i>A</i> ₂ <i>C</i> ₅ , <i>B</i> ₂ <i>C</i> ₅)	House wife (<i>B</i> ₂) above age 60 years (<i>C</i> ₅) commit suicide.

Results

The summary of results about risk factors, means of suicides and profession of suicide victims studied through the subset MCA are summarized in this section.

Results related to the risk factors for suicides

- Males and Females up to 14 years’ age group commit suicide due to ‘Failure in examination’.
- Males between age group 15–18 commit suicide due to ‘Failure in examination’ whereas Females within the same age group commit suicide due to ‘Love affairs’.
- Males between age group 18–30 commit suicide due to ‘Unemployment’, ‘Love Affairs’ and ‘Failure in examination’, while Females between the same age group are observed to commit suicide due to ‘Dowry Dispute’ and ‘Cancellation/Non-settlement of Marriage’.
- Males and Females between age group 30–45 commit suicide due to ‘Family problems’ while Males between age group 45–60 commit suicide due to ‘Bankruptcy/sudden change in Economic status’ and ‘Poverty’.

Results related to means of suicides

- Females between age group up to 14 years’ and 15–29 commit suicide by ‘Fire/self-immolation’, ‘Hanging’ and ‘Poisoning’.
- Males between age group 30–44 commit suicide by ‘Hanging’, ‘Poisoning’ and coming under running

Table 6 Distribution of suicides by means adopted and gender across age group in 2013

Sr. No.	Means Adopted for suicides	A ₁					A ₂					Total suicides	Percent of suicides
		C ₁	C ₂	C ₃	C ₄	C ₅	C ₁	C ₂	C ₃	C ₄	C ₅		
1	B ₁	415	12172	13862	8489	3031	391	7847	4528	2111	790	53636	44.76
2	B ₂	210	7032	8793	6428	2596	286	5458	3940	1941	941	37625	31.40
3	B ₃	60	1081	1466	770	295	143	2882	1981	811	475	9964	8.32
4	B ₄	244	1490	1737	1028	442	160	1073	763	434	275	7646	6.38
5	B ₅	42	1122	1240	1017	441	30	323	244	175	104	4738	3.95
6	B ₆	1	272	619	456	205	0	26	10	17	3	1609	1.34
7	B ₇	36	263	341	262	82	25	143	96	41	30	1319	1.10
8	B ₈	31	242	284	176	37	16	60	62	33	11	952	0.79
9	B ₉	2	186	193	100	26	0	66	46	15	3	637	0.53
10	B ₁₀	5	99	131	107	36	4	81	54	24	14	555	0.46
11	B ₁₁	3	82	109	85	31	0	95	69	31	21	526	0.44
12	B ₁₂	4	112	150	71	13	2	81	52	17	8	510	0.43
13	B ₁₃	1	23	37	17	3	1	9	6	4	1	102	0.09
Grand Total		1054	24176	28962	19006	7238	1058	18144	11851	5654	2676	119819	100

Records Bureau (SCRB) and CID of states and union territories to get correct and validated data. NCRB is continuously upgrading the suicidal/accidental death reports as per the trends and significance of the current events.

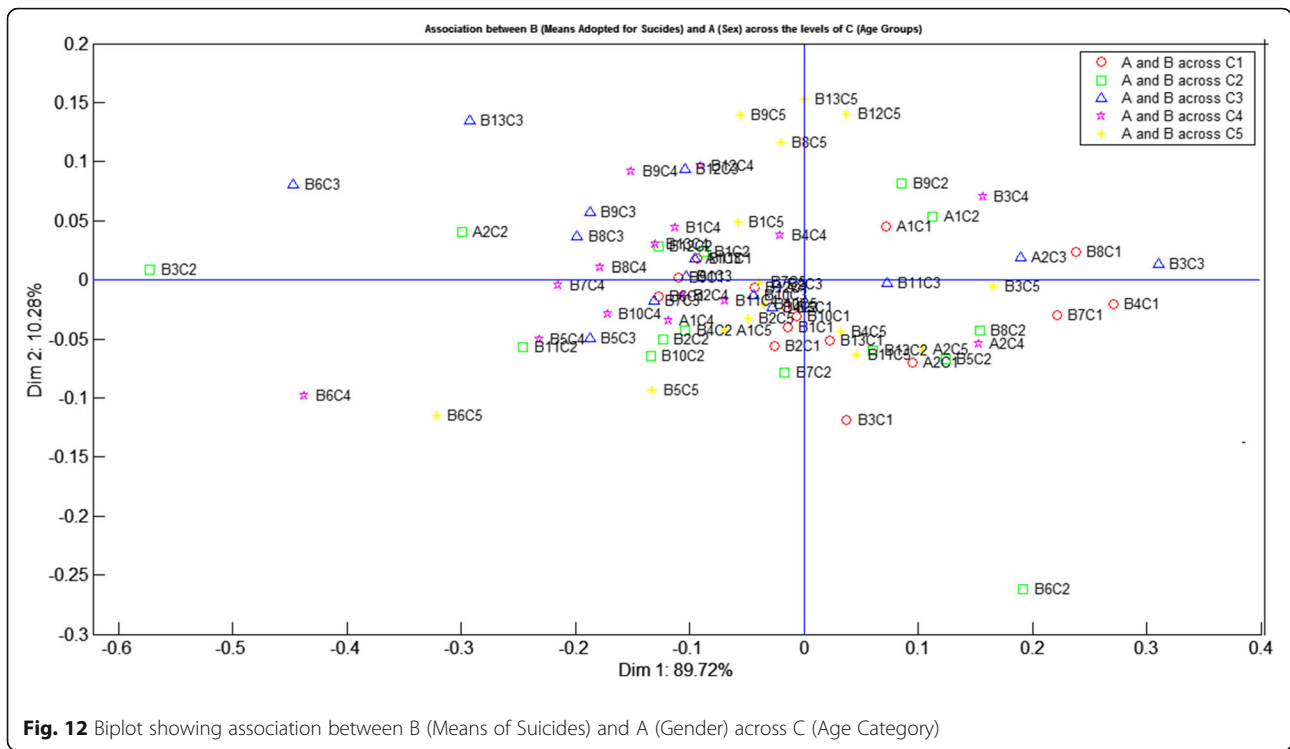
In India, the cultural, religious, geographical, socio-economic, sociodemographic diversities have significant impact on number of suicides. Due to these reasons, suicide rate varied from 0.6 (Nagaland) to 40.4 (Puducherry) between different states and union territories of India in 2014 while the all India rate of suicide is 10.6. Most of the states of the country have reported significant percentage decrease in suicides in 2014 over 2013. The number of suicides are found to be affected by social, economic, educational, professional status of the suicide victims.

Table 7 Results of MCA for Table 6 along B and A across the categories of C

Categories of C	SV	Inertia	Percent inertia
C ₁	0.0801	0.0064	6.68
	0.0545	0.0030	3.09
C ₂	0.1949	0.0380	39.54
	0.0493	0.0024	2.53
C ₃	0.1338	0.0179	18.64
	0.0181	0.0003	0.34
C ₄	0.1310	0.0171	17.85
	0.0420	0.0018	1.84
C ₅	0.0820	0.0067	7.01
	0.0489	0.0024	2.49
Total		0.0961	100

In this paper, we study the association of number of suicidal deaths in India in 2014, with some attributes. From the suicide data analysis, it is observed that the young people between age group 18–45 years commit suicide more frequently. Since, the clash of values within families is an important factor for young people in their lives and as young Indians become more progressive, their traditionalist households become less supportive of their choices pertaining to financial independence, marriage age, premarital sex, rehabilitation and taking care of the elderly. However, the proportion of suicides is relatively less in persons aged above 60 years, because taking care of the elderly has been an important part of Indian tradition. Their needs are widely recognized and addressed and they enjoy a measure of respect by virtue of their age. The proportion of male suicides is high as compared to the female suicides. In India, near about 96% of suicides are observed from low (less than 100,000) and middle-income group (100,000–500,000).

Though not all suicides in world can be prevented, some strategies can help to reduce the suicidal risks. Key elements in developing a national suicide prevention strategy are to make prevention a multisector priority that involves not only the health sector but also education, employment, social welfare, the judiciary and others. The strategy should be tailored to each country's cultural and social context, establishing best practices and evidence-based interventions in a comprehensive approach. Resources should be allocated for achieving both short-to-medium and long-term objectives, there should be effective planning and the strategy should be regularly evaluated, with evaluation findings feeding into future planning.



Conclusions

Overall the suicidal death rate in India is observed to be continuously increasing. From 1967 to 1970 suicidal death rate increased from 7.8 to 9.1. A declining trend is observed, up to 1981. Since 1982, the suicidal death rate has continuously increased from 5.9 to 11.2 in 1999. Since 1999, the overall suicidal death rate has declining trend. The percent of male suicides is observed to be more as compared to percent of female suicides since 1967.

The leading risk factors for suicides are family problems, illness, drug addiction, failure in examination, etc. Overall,

we observe that the proportion of female victims are comparatively higher under the heads dowry dispute and cancellation/non-settlement of marriage whereas the proportion of male victims are comparatively higher under the heads family problems, bankruptcy/sudden change in economic status, unemployment, poverty, etc. Family problems and illness are major issues for committing the suicides in India.

As per NCRB reports, the means of suicides varied from easily available means such as poisoning, drowning

Table 8 Results of subset MCA for Table 6 along B and A across C

Categories of C	SV	Inertia	Percent inertia
C ₁	0.0714	0.0051	6.14
	0.0542	0.0029	3.54
C ₂	0.1920	0.0368	44.41
	0.0366	0.0013	1.62
C ₃	0.1201	0.0144	17.37
	0.0111	0.0001	0.15
C ₄	0.1162	0.0135	16.29
	0.0390	0.0015	1.84
C ₅	0.0731	0.0053	6.44
	0.0426	0.0018	2.19
Total		0.0830	100

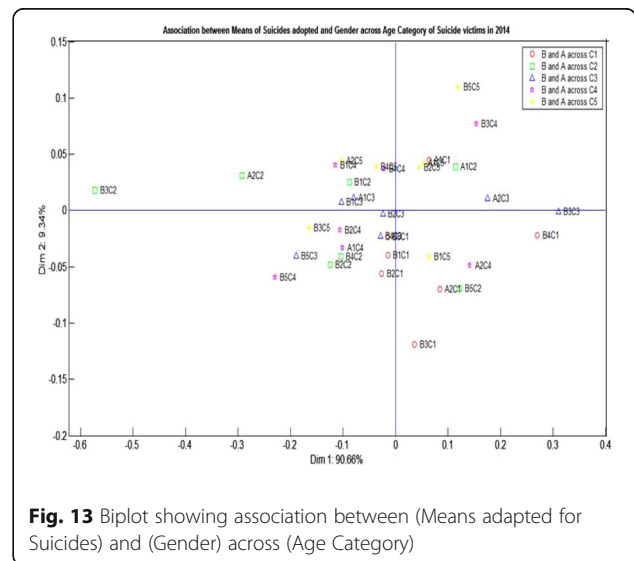


Table 9 Distribution of incidences of suicides according to the profession during 2013

Sr No	Profession of suicide victims	A ₁ (Male)					A ₂ (Female)					Total suicide	Percent of suicide
		C ₁	C ₂	C ₃	C ₄	C ₅	C ₁	C ₂	C ₃	C ₄	C ₅		
1	B ₁	259	11135	16779	11693	4467	271	2628	2191	1214	597	51234	46.58
2	B ₂	0	0	0	0	0	26	9697	7809	3546	1664	22742	20.68
3	B ₃	2	4239	5857	3624	635	8	1089	813	357	82	16706	15.19
4	B ₄	15	2776	3102	1846	532	17	698	467	234	81	9768	8.88
5	B ₅	709	3660	231	23	11	614	3064	90	16	5	8423	7.66
6	B ₆	0	0	44	175	697	0	24	19	41	117	1117	1.02
Grand Total											109990	100	

Table 10 Results of MCA based on separate SVDS for Table 9 along B and A across the categories of C

Categories of C	SV	Inertia	Percent inertia
C ₁	0.2656	0.0705	9.94
	0.0425	0.0018	0.26
C ₂	0.4658	0.2170	30.58
	0.1909	0.0364	5.13
C ₃	0.4125	0.1702	23.98
	0.1440	0.0207	2.92
C ₄	0.2991	0.0894	12.61
	0.1096	0.0120	1.69
C ₅	0.2621	0.0687	9.68
	0.1508	0.0227	3.21
Total		0.7095	100

into a well to more painful means such as hanging, fire/self-immolation, coming under running vehicles/trains, etc. Overall it is observed the means adopted by males to commit suicide are hanging, poisoning and coming under running vehicles/trains whereas females commit suicide by fire/self-immolation, drowning and hanging.

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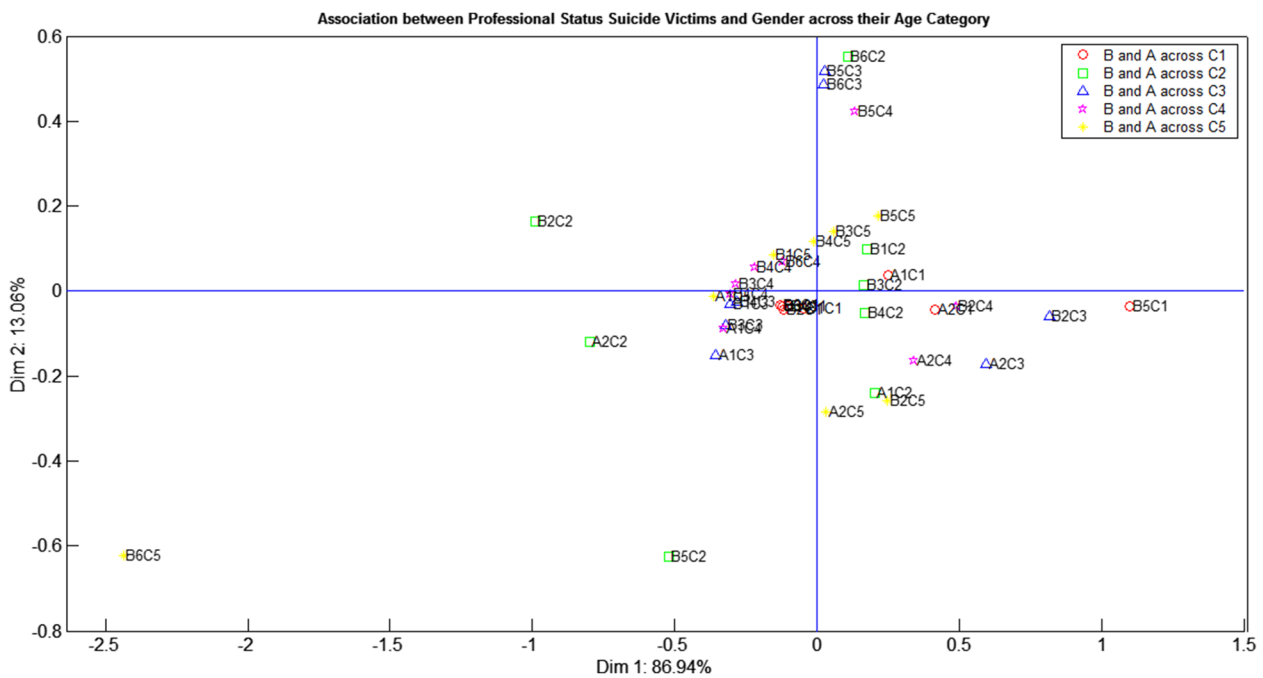


Fig. 14 Biplot showing association between B (Profession of Suicides victims) and A (Gender) across C (Age Category)

Authors' contributions

We briefly overview the recent trends in the number of suicides in India and study the risk factors and means of suicides. We explore the association of number of suicidal deaths with some attributes such as gender (sex), age category of suicide victims, profession, etc. We use odds ratio and subset multiple correspondence analysis. Based on conclusions, some strategies may be planned to prevent suicides. Both authors read and approved the final manuscript.

Ethics approval and consent to participate

Ethical guidelines were respected.

Competing interest

The authors declare that they have no conflict of interest.

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