

Epidemio-toxicological profile and reasons for fatal suicidal poisoning: A record-based study in South India

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ABSTRACT

Introduction: Poisoning is the second frequent cause of suicide in India. To plan an effective intervention and awareness program, it is essential to know the sociodemographic profile, pattern, and reasons for suicide. **Objective:** We conducted this study to find the sociodemographic profile, pattern, and reasons for fatal suicidal poisoning. **Methods:** We conducted a record-based study in a tertiary hospital in Puducherry. We reviewed autopsies conducted between January 2010 and December 2014 for fatal suicidal poisoning. We extracted data using a data collection sheet for age, gender, marital status, occupation, residence, the reason for suicide, time of injury, time of death. We entered data in Microsoft Excel, and we did a descriptive analysis by using R software version. **Results:** We reviewed 3996 medicolegal autopsies, out of which 595 cases were of fatal suicidal poisoning. The mean age of the cases was 35.8 years (SD-14.6). The majority of the cases were married (74.8%) for 20–30 years (31.8%). Most of the victims were agriculture workers (22.2%), lived in a rural setting (84.4%), died during the daytime (61.2%), and in the summer season (54.5%). The most common poison used was organophosphates (48.7%), and the most common reason was family problems (30.2%). The median survival time (h) for the cases (n = 564) was 45.8 h (IQR: 16.4 to 110.6). **Conclusion:** We found fatal suicidal poisoning was common among males, young adults, married, agriculture workers/laborers, and in a rural setting. The findings help plan an effective intervention for suicide prevention in India.

Keywords: Autopsies, fatal suicide, India, poisoning, records, toxicology

Introduction

Around 8 lakh people die of suicide in the world. It is the second frequent cause of death among the 15 to 29 years. Low and middle-income countries (LMICs) account for 79% of the suicide cases in the world. In India, from 2007 to 2017, there has been a substantial increase (10.6%) in the cause of death due to self-harm.^[1] As per the National Crime Record

Bureau (NCRB) report of 2018, 134,516 people committed suicide in India, with a rate of 10.2 per 100,000 populations. As per the report, a maximum number of suicides were observed in Maharashtra (17,972), followed by Tamil Nadu (13,896). Among the union territories (UTs), Delhi had the highest suicide cases (2,526), followed by Puducherry (500). Overall, among the UTs and states, Puducherry had the second-highest suicidal rate (33.8/100,000), and Tamil Nadu had the eighth-highest rate (18.4/100,000).^[2]

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Fatal suicide means succeeding in intentionally causing one's death, and it is called fatal suicidal poisoning when done through self-administration of a poison. The most common mode of

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suicide observed in our country is hanging (49.8%), followed by poisoning (27.5%).^[2] Self-poisoning is a grave concern in India. As per an extensive survey conducted in India, the rate of fatal suicide using poison was 7.9 per 100,000/year and 13.8 per 100,000/year among females and males.^[3] There are numerous poisoning agents available in the house, shops, or workplaces. Specific steps have been taken at the state and national levels to reduce the availability and accessibility of these poisoning agents. However, this did not reduce the trend of suicides and had an insignificant impact.^[4] Gunnell *et al.*^[5] observed that 258,234 deaths from suicidal pesticide poisoning worldwide each year contributed to 30% of global suicides. Suicidal agricultural pesticide poisoning is frequent worldwide, as per Mew *et al.*^[6] Pesticides are associated with high mortality and are frequent in tropical countries. Benzodiazepines and antidepressants are common in urban areas and associated with few deaths. Antimalarial chloroquine is commonly used for self-poisoning in Africa and the Pacific region. Acetaminophen is used in many countries for self-poisoning. Domestic and industrial chemicals are a frequent cause of deaths and long-term disabilities globally. Suicidal plant poisoning is uncommon, but it is popular in some regions.^[7]

We should plan a better intervention for prevention the of fatal suicidal poisoning in India, it is essential to know the sociodemographic profile of the poisoning cases, the pattern, and the reasons for suicide. Therefore, we conducted this study to find the sociodemographic profile of the cases, the pattern of fatal suicidal poisoning, and the reasons for suicide.

Material and Methods

We conducted a record-based study in a tertiary care hospital in Puducherry. It caters to more than 15.2 million patients annually. In the hospital, around 800 autopsies are performed annually. The institutional ethical committee approved the study protocol. We retrieved the autopsy records from the Department of Forensic Medicine & Toxicology (JIPMER) from January 2010 to December 2014. We screened 3,996 medicolegal autopsy records and found 595 cases of fatal suicidal poisoning. The data were extracted by two authors independently using a data collection sheet. We collected the data for the following variables: age, gender, marital status, occupation, residence, the reason for suicide, time of injury, time of death. The authors resolved the discrepancies through consensus. The poisoning agent was identified by screening the case files and the chemical analysis report. We collected the reason for committing suicide from the suicide note, police report, and inquest report.

The data were entered in Microsoft Excel, and the analysis was done using the R software version. The characteristics of cases were considered as categorical variables and described as proportions. Descriptive analysis was for a sociodemographic profile, type of poison use. The number of fatal suicidal poisoning was sorted year-wise and was plotted in a timeline. The reason for suicide was categorized into meaningful themes.

We reported median survival time (hours) according to various poisonings agents. A Log-rank test was performed to find any statistical difference in the median survival time. *P* value < 0.05 was considered significant.

Ethics: We started the study after obtaining approval from the institute ethics committee (Reference no. JIP/IEC/SC/2015/20/810). A unique ID code was given to each case for maintaining anonymity, and the data access was limited to the authors.

Results

A total of 3,996 medicolegal autopsies were conducted between January 2010 and December 2014. Out of these autopsies, a total of 1205 fatal suicide cases (30.2%) were found, of whom 595 (49.4%) cases were of fatal suicidal poisoning. Across the years, we found a peak in the number of fatal suicidal poisoning cases (*n* = 146) in 2013 [Figure 1]. Out of the 595 cases, the majority were males (*n* = 363, 61%) and belonged to the age group of 20 to 29 years (31.8%, *n* = 189) [Table 1]. The mean age was 35.8 years (SD: 14.6). The mean age for males and females was 39.4 years (SD: 14.2) and 30.3 years (SD: 13.5), respectively. A total of 445 (74.8%) of the cases were married, 143 were unmarried (24%), and 7 were widowed/widower (1.2%).

Occupation-wise, the majority of the cases were agriculture workers (*n* = 132, 22.2%), followed by laborers (119, 20%) [Table 2]. Most of the cases were from a rural setting (*n* = 502, 84.4%) as compared to semiurban area (*n* = 50, 8.4%) and urban area (*n* = 43, 7.2%). The self-poisoning was common during the day (06.00 am to 06.00 pm, 364, 61.2%) followed by night (06.00 pm to 06.00 am, 231, 38.8%). Across the seasons, a higher proportion of suicidal poisoning cases were observed in the summer season (*n* = 324, 54.5%), followed by the rainy season (*n* = 150, 25.2%) and the winter season (*n* = 121, 20.3%). We found that the most common reason for suicide by poisoning was due to family problems (30.2%), followed by chronic illness (25%) [Table 3]. The most common reason among females was a family problem (33.2%), and among males was chronic illness (32.8%). The most common poisoning agent used was organophosphates (OPCs) – (48.7% (*n* = 290)) followed by plant origin poisoning agents – 13.6% (*n* = 81), and rodenticides – 13.4% (*n* = 80) [Figure 2].

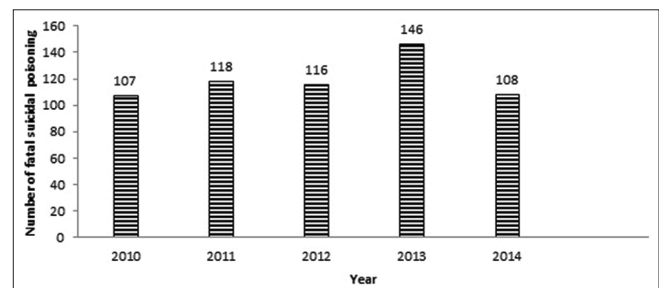


Figure 1: Distribution of fatal suicidal poisoning cases across the years

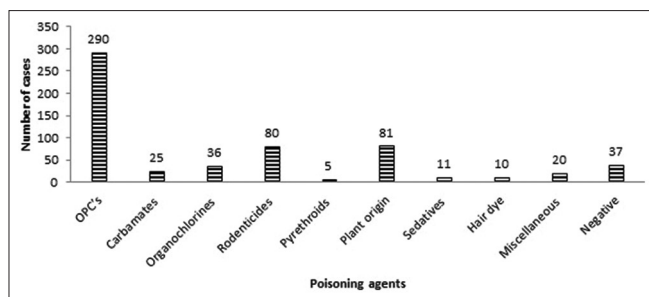


Figure 2: Distribution of poisonous substance in fatal suicides (n = 595). Abbreviations: OPC's: Organophosphate. Negative: Death due to poison but chemical analysis report is negative. Miscellaneous: Anesthetic agents, phenol, caustic, drugs, kerosene, etc.

A total of 31 cases were brought dead at the hospital, for which we didn't have data for the time of survival. The median survival (hours) for the cases (n = 564) was 45.8 h (Interquartile range [IQR]: 16.4 to 110.6). The median survival time was high for the combination of poisons (154.4 h) and low for carbamates (26.6 h) and plant origin poisons (27 h) [Table 4]. There was a significant difference between the median survival time among the groups of poisons used (Pvalue <0.001). A total of 57.8% cases of OPC poisoning (n = 159/275) and 63.6% cases of plant poisoning (n = 49/77) had died within 48 h. Thus, mortality is immediate among plant poison and OPC. In rodenticide poisoning, the mortality proportion was higher between the 3rd and 7th day (56.6%, n = 43/47), indicating that the end organ damages manifest only after the 3rd day. However, in most of the poison cases (54.6%, n = 308), the period of survival was less than 48 h.

Discussion

Poisoning is the second frequent method of suicide in India. Around 35,862 people have adopted poisoning as the method of suicide in India in 2018.^[2] However, in one study, poisoning was the leading method of suicide among both sexes in India.^[3] Poisoning was the second frequent method of committing suicide in northern India (21%)^[8] and Southern India.^[9] We found 595 (49.4%) cases of fatal suicidal poisoning out of 1205 fatal suicide. The majority of the cases were married, young adults, agriculture workers in a rural setting. Most of the suicides were during the daytime and in the summer season. The most common poison used was organophosphates, and the common reason for suicide was family problems.

Suicidal poisoning was more common in males than females. The majority of the cases were between 20 and 29 years. Jaikhani *et al.*^[10] observed 71.4% of the males and 28.6% of the females had committed suicide by poisoning. Around 39.2% of the males were between 20 and 30 years, and 54.9% were the males aged 20 and 40. About 38.3% of the females were between 20 and 30 years, and 48.9% of the females aged between 20 and 40. One more study observed suicidal poisoning was more in males (44.30%) than in females (35.54%).^[11-13] However, a study by Kanchan *et al.*^[14] showed suicidal poisoning was more

Table 1: Age and sex-wise distribution of fatal suicidal poisoning cases

Age group (years)	Males (%)	Females (%)	Total (%)
<19	16 (4.4%)	47 (20.3%)	63 (10.6%)
20-29	96 (26.4%)	93 (40.1%)	189 (31.8%)
30-39	82 (22.5%)	44 (18.9%)	126 (21.2%)
40-49	70 (19.3%)	21 (9.1%)	91 (15.3%)
50-59	61 (16.8%)	10 (4.3%)	71 (11.9%)
>60	38 (10.5%)	17 (7.3%)	55 (9.2%)
Total	363 (61%)	232 (39%)	595 (100%)

Table 2: Distribution of cases as per occupation (n=595)

Occupation	Cases n (%)
Agriculture workers	132 (22.2%)
Labourers	119 (20%)
Housewife	111 (18.7%)
Student	78 (13.1%)
Professional/skilled worker	72 (12.1%)
Unemployed	51 (8.6%)
Fisherman	11 (1.8%)
Retired/old age	21 (3.5%)
Total	595 (100%)

Table 3: Reasons for fatal suicide by poisoning (n=595)

Reason for fatal suicidal poisoning	Male cases (%)	Female cases (%)	Total cases (%)
Family problem	103 (28.4%)	77 (33.2%)	180 (30.2)
Chronic illness	119 (32.8%)	49 (21.2%)	168 (28.2)
Financial problem	60 (16.5%)	6 (2.6%)	66 (11)
Psychiatric problem	38 (10.4%)	20 (8.6%)	58 (9.7)
Academic failure	15 (4.1%)	27 (11.6%)	42 (7)
Dowry harassment	Not applicable	34 (14.6%)	34 (5.7)
Love problem	8 (2.2%)	7 (3%)	15 (2.5)
Not documented	20 (5.5%)	12 (5.2%)	32 (5.3)

Table 4: Poisoning agent used and the period of survival of the cases (n=564)

Poisonous substance	n (%)	Median survival time in hours (IQR)
Organophosphate	275 (48.8%)	45 (18.3-100.5)
Carbamates	24 (4.3%)	26.6 (10.6-56.8)
Organochlorines	32 (5.7%)	66.2 (25.3-200.1)
Rodenticides	76 (13.5%)	84.7 (24.1-139.5)
Pyrethroids	5 (0.9%)	125.6 (10.3-183.7)
Plant origin	77 (13.7%)	27 (13-64.5)
Sedatives	7 (1.2%)	68 (54.7-616.7)
Hair dye	9 (1.6%)	30.7 (13.8-69.7)
Combination of poisons	3 (0.5%)	154.4 (10.7-244.2)
Miscellaneous*	18 (3.2%)	62.3 (14.7-162.7)
Unknown/Negative**	38 (6.7%)	45.3 (10-115.2)

*Anesthetic agents, phenol, caustic, drugs, kerosene, etc., ** Death due to poison but chemical analysis report is negative

in females (38.9%) of the age group 20 to 30 years than males. Mohanty *et al.*^[15] observed the incidence of suicidal poisoning was equal in males and females. The most frequent age group of

the victims was 21 and 30 years. Senarathna *et al.*^[16] found that males and females were equally affected by suicidal poisoning. Female suicidal poisoning was common in 15–19 years. Sharma *et al.*^[17] observed 33.8% of the cases of poisoning were seen in age groups 20 to 25 years and were higher in males than females. Parekh and Gupta observed that people in the third decade of life and males were common victims of poisoning.^[18] Zhang *et al.*^[19] observed acute poisoning more in the 20–39 age group (52.7%). The female to male ratio was 1.2:1. Eddleston *et al.*^[20] found that typical patients were young (median age 25 years) of self-poisoning. According to that Rajapakse *et al.*^[21], over half of female deaths were under 25 years old and common in males (57%) Most studies reported nonfatal self-poisoning to be more common among males, with a peak age range of 10–30 years. In our study, the incidence was higher in the age group 20 to 29 years and among males; this was consistent with other studies.^[10-15,17,18,20,21] But not consistent with few studies.^[16,19] Males and 20 to 29 age groups are more affected because they are burdened with financial and family problems.

We observed that suicidal poisoning was high among married individuals. This was consistent with other studies.^[3,11-13,15,17,18,22] However, our study's percentage of married cases (74.8%) was highest among the other regional studies. Family problems, financial problems, dowry harassment are the related factors for suicide. The majority of our cases were from rural (84.4%), followed by semi-urban (8.4%) and urban (7.2%), and the finding was consistent with other studies.^[3,8,10,11,13,15,18,19,23,24] However, these studies generally classify the population as rural and urban, except for Mohanty *et al.*,^[15] who considered the rural, semi-urban, and urban. Victims were common in rural areas because of easy access to agriculture and household poisons with financial, family problems, and chronic illness as stressors.

The majority of self-poisoning was during daytime (61.2%), followed by nighttime (38.8%) in our study. A study by Dash *et al.*^[12] showed that 55.9% of the suicide happened in the daytime (6.00 am to 6.00 pm), less than the percentage of cases observed in our study. Among sex-wise distributions, 66.7% of females committed suicide in the daytime more than males.^[14] The reason behind the daytime preference for suicide may be that fewer people are available in their homes so that the victims are left unsupervised or unnoticed. Dash *et al.*^[12] suggested that the victims are subjected to significant stress and strain during the daytime, making them vulnerable to suicidal poisoning. Our finding was consistent with other studies.^[12,14,18]

Suicidal poisoning was common in the summer season, followed by the rainy season. However, many studies state that suicidal poisoning was high in summer and the rainy season. Parekh and Gupta also observed more poisoning in the rainy season.^[18] The seasonal variation may be due to the varying seasonal and climatic patterns across India. The majority of suicidal poisoning was in the summer months. It can be due to fatigue and exhaustion resulting from extreme heat conditions leading to loss of mental balance.^[12] The day length, daily temperature, daylight, and

humidity may influence mood through their influence over the rhythm of serotonin neurotransmission.^[25,26]

In our study, family problems and chronic illness were the common reason for suicide. It was consistent with Kanchan *et al.*^[14] Family Problems (37.7%), other than marriage-related issues and illness (17.7%), were the two leading causes as per the NCRB statistics 2018.^[2] Our study findings are consistent with the NCRB data.^[2] We analyzed sex-wise reasons for suicide, and many authors do not focus on such analysis. However, Mohanty *et al.*^[15] showed that financial burden (37%) and marital disharmony (35%) are the two most common reasons for suicidal poisoning. The financial burden was only the third leading cause in males in our study. At the same time, dowry harassment was the third cause in married females. Sharma *et al.*^[17] showed dowry harassment was the leading cause of suicidal poisoning among married females. Rajapakse *et al.*^[21] found that interpersonal conflict was the most commonly reported short-term stressor associated with self-poisoning. Alcohol misuse was frequent among males who self-poisoned. Rajapakse *et al.*^[27] observed that interpersonal conflict was the main reason for non-fatal self-poisoning. Alcohol use disorders and high suicidal intent were significantly more likely in males. Presence of depression and higher levels of hopelessness in both genders as a suicidal predictor. Most of the studies state that depression was the common cause of suicidal poisoning. Psychiatric illness was the fourth main and fifth main reason for suicide in males and females. Academic failures were the fourth common reason among unmarried females (especially students) than males. Thus, females are easily stressed and resort to suicide due to academic failures than males. Jackson *et al.*^[28] studied deliberate suicidal poisoning, the older and middle-aged groups and found similarities in living alone, reporting suicidal ideation/planning, and psychiatric illness. But the older-aged group was different in cognitive impairment, higher medical morbidity, a longer length of stay, and ingestion of benzodiazepines in the deliberate self-poisoning event. Marzuk *et al.*^[29] observed the psychological effect in the US after the publication of *Final Exit* in 1991 on suicides due to poisoning and suffocation by the plastic bag, which increased by 5.4% and 30.8%, respectively.

The typical agent preferred for suicidal poisoning was OPCs insecticides in both males and females. The combination of multiple agents was common in males than females. Topographically in our region, agriculture is common practice. Kanchan *et al.*^[14] had classified sex-wise preference of suicidal agents and is consistent with our study. Gupta *et al.*^[13] studied a common agent of fatal poisoning was monocrotophos (OPC). Senarathna *et al.*^[16] also reported pesticides are the most common type of poison. Eddleston *et al.*^[20] observed that pesticides (49%) were common poison. According to Rajapakse *et al.*^[21] oleander and paraquat caused 74% of deaths in people under 25 years old. Pesticide ingestion was the most commonly used method of nonfatal self-poisoning, and medicinal overdose was more common in urban areas. Rajapakse *et al.*^[27] found agrochemical poisoning was common in males and pharmaceutical drugs

in females. In another study, the common toxic agent was therapeutic drugs (32.6%), followed by pesticides (26.9%).^[19] However, rodenticides such as aluminum phosphide were the most common suicidal agent, followed by insecticides, in northern India.^[30] Parekh and Gupta observed that aluminum phosphide and quinalphos poisoning were the common causes of death.^[18] Aluminum phosphide use is for the storage of wheat in Northern India. But most of the studies highlight that OPC insecticides were the most frequently preferred agent across the country.^[11,12,14,23,30-33] As most of the population is from a rural region, there is a wide availability of insecticides and rodenticides used for farming activity. Toxic plants are also commonly seen in rural areas, and the rural population is well aware of their poisonous nature. Hence, people prefer agrochemicals and plants due to easy accessibility for suicidal poisoning.

Most of the males who resorted to suicidal poisoning were agriculture laborers or farmers. Among females, suicidal poisoning was common in housewives. Unemployed people were the third group of people among both sexes. This was similar to the findings of Singh *et al.*^[34] However, agriculture laborers and daily laborers were the distinct groups of people who resort to suicidal poisoning. As India is agricultural-based land with 70% of the population residing in rural areas, this may be the high prevalence of suicidal poisoning among farmers and agricultural laborers. This finding was similar to a study done in China.^[35] Ingestion of poison was the frequent route of administration in our study. The place of incidence was commonly indoor (93.3%), followed by farmland and public spaces. People generally resort to suicide in indoor locations with less human activity to be unnoticed and carry out the act peacefully.^[15]

We captured the sociodemographic profile, patterns, and reasons for fatal suicidal poisoning and estimated the median survival time. In the literature, most records-based autopsy studies focused only on the epidemiological, demographic, and pattern of suicidal poisoning. In addition, our research focuses on autopsy, histopathology, and toxicology analysis reports. Congestion was the frequent gross postmortem finding in most of the poison cases. Out of 595 cases, histopathology tissue samples of 221 cases correlated to poison. In 192 cases, the histopathological findings were consistent with the poison ingested. A treating physician can use the findings of survival time for various poisons for early action for management of poisoning and for communicating the prognosis to caregivers. We were unable to find the cause for a high number of fatal suicidal poisoning cases for 2013. There were few cases with unknown poisoning and found a negative toxicology analysis report. The reason may be the nature of poison, its metabolism, improper sample collection, and inadequate testing facilities.^[36] We could not find the reason for fatal suicidal poisoning for 5.3% of the cases. A verbal autopsy could have overcome this limitation. The findings from this study are to be generalized with caution and limited to the geographical setting.

Conclusion

Based on the review of 5-year autopsies records (2010 to 2014) in a tertiary hospital, we found that most of the fatal suicidal poisoning was among males, young age, married, agriculture workers/laborers, in rural areas, during the daytime, and in the summers. Furthermore, the most common poison used was organophosphates, and the most frequent reason for fatal suicidal poisoning was a family problem. These findings can help the policymaker plan effective intervention policies to reduce the fatal suicidal poisoning in India.

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Conflicts of interest

There are no conflicts of interest.

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