

Selected Topics: Toxicology

A STUDY ON DELIBERATELY SELF-POISONED IN-HOSPITAL PATIENTS IN A TERTIARY HEALTH CARE CENTER IN NORTHEAST INDIA: A CROSS-SECTIONAL REVIEW

Kaustav Bhowmick, MD,* Biswadip Ghosh, MBBS, MD,† and Shantasil Pain, MBBS, MD‡

*Department of General Medicine, North Bengal Medical College, Sushrutanagar, Darjeeling, India, †Department of General Medicine and Rheumatology, North Bengal Medical College, Sushrutanagar, Darjeeling, India, and ‡Department of General Medicine, Institute of Post-Graduate Medical Education and Research, Kolkata, India

Corresponding Address: Kaustav Bhowmick, MD, North Bengal Medical College, Clinical Tutor, Department of General Medicine, Sushrutanagar, Darjeeling 734012

Abstract—Background: The nature and profile of different modes of poisoning vary significantly in different parts of India. The assessment of the magnitude of suicidal poisoning is an area of paramount importance not only for appropriate management but also for raising social awareness and framing government policies for the prevention of same. **Objectives:** We aimed to determine the pattern of poisoning, the sociodemographic profile of patients who poison themselves, and the in-hospital outcome of self-poisoned patients over a 1-year period. **Methods:** This was a cross-sectional observational study conducted between May 2015 and April 2016 that included 492 patients >12 years of age who were admitted to our hospital after consuming poison with the intention of deliberate self-harm. Relevant history with respect to the nature and amount of poison ingested were taken and recorded, and the patients' sociodemographic profiles and outcome (as either discharge or death) were noted. **Results:** Most of the patients were 13–28 years of age (69%). Males (n = 293 [59.55%]) predominated over females and the majority were farmers (n = 193 [39.23%]). Rural cases (n = 373 [75.81%]) outnumbered urban cases. The major causes of deliberate self-harm attempts were impulsive actions (n = 442 [89.84%]). Pesticides (n = 393 [79.88%]) were the most commonly consumed poison. The overall mortality rate was 12%, with paraquat (94.74%) topping the list of fatal substances. **Conclusion:**

Young adults and males constitute majority of the population in this study. Agricultural poisons made up the bulk of the cases, mostly taken by rural population. Paraquat, an herbicide banned in several countries, had the highest mortality rate in this study. © 2019 Elsevier Inc. All rights reserved.

Keywords—agricultural poisons; deliberate self-poisoning; northeast India; outcome; sociodemographic profile

INTRODUCTION

Self-poisoning is an important public health problem all over the world. It is estimated that every year self-poisoning affects around 1 million people worldwide, and this correlates with a temporal mortality profile of 1 in 40 persons per second (1). There is a striking difference in the mortality rate of self-poisoning in the developed countries of the world, only 1–2%, compared with developing countries like India, where it is 15–30% (2). These cases account for the fourth most common cause of deaths in rural India (3). The pattern of poisoning varies from place to place depending on factors like location, accessibility and availability of poison, socioeconomic status, and cultural and religious influences. An

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awareness of the nature and depth of the problem of suicidal poisoning in a particular area is not only essential for early diagnosis and treatment of patients but is also important to raise social awareness and to develop new governmental policy for the prevention of poisoning. The nature and profile of different modes of poisoning vary significantly in different parts of India, and to our knowledge there are few studies on this subject.

Our objective was to assess the magnitude of deliberately self-poisoned patients in our institution and to determine the outcome of these patients. Specifically, we sought to determine the pattern of poisoning and the socio-demographic profile of the poisoned patients. In addition, we wanted to determine the outcome of the patients in the form of death or discharge.

MATERIALS AND METHODS

The study was carried out in the medical wards in our hospital. The study included patients who had taken poison with suicidal intent, were >12 years age, and who were admitted on Wednesday, Saturday, and every third Sunday between May 2015 and April 2016. The data of 492 patients were obtained by the following the method of 'complete enumeration'. The study subjects or their close relatives were interviewed using a predesigned and prestructured questionnaire and the parameters were studied in accordance with the objectives (Table 1). Dr. Pain framed the questionnaire and Drs. Bhowmick and Ghosh collected the relevant data during the patient's in-hospital stay. Dr. Bhowmick also analyzed the data and prepared the tables.

This was a cross-sectional observational study performed between May 2015 and April 2016. Material evidence, such as empty bottles and used tablet strips, were also collected from the patients' friends and relatives. The poisons whose nature or purpose of use could not be elicited were termed "unknown poison." Relevant pre-

existing medical conditions were noted. The cases of accidental poisoning and poisoning with homicidal intent were excluded from the study.

Statistical Package for Social Sciences software (SPSS 16.0; SPSS, Inc, Cary, NC) was used for statistical analysis. Qualitative variables were represented as percentages and relevant comparisons were performed using the chi-squared test. Quantitative variables were represented as mean with standard deviation (SD) and graphically represented with grouped frequency tables.

RESULTS

We obtained data from 492 patients belonging to different districts of North Bengal and 1 district of Bihar, India. These included Darjeeling, Jalpaiguri, Coochbehar, Uttar-Dinajpur, Dakshin-Dinajpur, Maldah, and Kishanganj.

In this study of 492 patients, the majority (182 [37%]) were 21–28 years of age. The mean age \pm SD was 26.37 ± 10.08 years. The incidence of poisoning was more common in males (60%) compared with females (40%), with a ratio of 3:2. Of 492 patients, around one-quarter (23.78%) were illiterate.

In this study, most patients (269 [54.67%]) were married. There were 6 widows, 2 widowers, and 3 were divorced. The divorced subjects were all males (Table 2). It was found that 57% of the admitted male patients were married and 51% of the admitted female patients were married. There was no significant difference between these 2 groups ($p = 0.21$).

In this study, most patients (35.37%) had a per capita family income in the range of 1000–2000 INR (\$15–30 USD). The mean \pm SD per capita income was 2704 ± 2536 INR ($\$40.79 \pm \38.26 USD; Table 3).

Farming was the most common occupation (193 [39.23%]), followed by tea garden worker (78 [15.85%]; Table 4). Service workers, who constituted 13% of the study subjects, included occupations such as security guards, Group D staffs are the lowest category Government post holders in the Secretariats, Directorates and other Government offices. They are generally semi-skilled or skilled manual workers like Guards, Peons, Sweepers etc. Most patients (373 [75.8%]) were found

Table 1. Parameters of the Objectives for Study

First Objective	Second Objective	Third Objective
<ul style="list-style-type: none"> • Chemical nature of poison • Commercial use of poison 	<ul style="list-style-type: none"> • Age at poisoning • Gender • Reasons behind the suicidal attempts • Marital status • Literacy status • Occupation of the head of the family/per capita income • Domicile pattern of the victims • Diurnal variation of intake of poison • Seasonal variation of intake of poison 	<ul style="list-style-type: none"> • Death • Discharge

Table 2. Marital Status of the Patients

Marital Status	Patients, n (%)
Married	269 (54.67)
Unmarried	212 (43.09)
Widow	6 (1.22)
Divorced	3 (0.60)
Widower	2 (0.40)
Total	492 (100.00)

Table 3. Distribution of Patients According to Per Capita Income

Per Capita Income	Patients, n (%)
<1000 INR (\$15 USD)	52 (10.57)
1000–2000 INR (\$15–30 USD)	174 (35.37)
2000–3000 INR (\$30–45 USD)	136 (27.64)
3000–4000 INR (\$45–60 USD)	53 (10.77)
4000–5000 INR (\$60–75 USD)	34 (6.91)
>5000 INR (\$75 USD)	43 (8.74)
Total	492 (100.00)

INR = Indian rupee; USD = US dollar.

to reside in rural areas. Most patients (274 [55.69%]) were found to consume poison during evening hours.

In this study, most patients (146 [29.67%]) were admitted during the summer, and the fewest number of patients (85 [17.28%]) in the autumn, which is the festive season in rural India (Table 5).

Most attempts of deliberate self-harm (442 [89.43%]) resulted from impulsive causes like a domestic quarrel, rebuke by parents or elders, abuse by friends, or a physical assault by a spouse (Table 6). The patients who attempted self-harm without any previous planning were placed under the impulsive category.

Among those with documented psychiatric illness, there were 21 patients (4.27%), 19 of whom had major depression, and 2 had schizophrenia and were under psychiatric follow-up care. The rest of the causes of attempts of self-harm were not caused by sudden impulsive behavior, and none of these patients were under any psychiatry evaluation or treatment before the suicide attempt, and therefore were placed in a separate category. These causes included bereavement (n = 10), unemployment (n = 8), losses in business (n = 6), overburdened with loans (n = 6), and recurrent pregnancy loss (n = 1).

Among the patients admitted who had attempts resulting from impulsive behavior, marital discordance (50%) topped the list, followed by rebuke by parents and teachers (22%), quarrel with siblings (11%), breakup of a premarital relationship (6%), abuse by friends (4%), quarrel with in-laws (3%), fear of failure or failure in examinations (2%), sudden massive loss of property (2%) which includes losses

Table 4. Occupation of the Head of Family

Occupation of HOF or Subject	Patients, n (%)
Farmer	193 (39.23)
Tea garden worker	78 (15.85)
Small-scale business	38 (7.72)
Laborer	22 (4.47)
Pension holder	15 (3.05)
Carpenter	12 (2.44)
Service holder	63 (12.80)
Other	71 (14.43)
Total	492 (100.00)

HOF = head of family.

Table 5. Distribution of Poisoning Patients in Different Seasons of the Year

Seasons of Year (Indian Meteorologic Department)	Patients, n (%)
Winter (Dec–Mar)	124 (25.20)
Summer (Apr–Jun)	146 (29.67)
Rainy (Jul–Sep)	137 (27.85)
Autumn (Oct–Nov)	85 (17.28)

due to fire, losses in legal cases over acquisition of land and property and lastly losses incurred in gambling.

Ninety-eight (19.71%) of these patients presented to the hospital with organophosphorus poisoning alone; 55 (11.18%) had both organophosphorus and nonorganophosphorus compound poisoning, 51 (10.37%) of whom took a combination of organophosphorus and pyrethroid (Table 7). There were 17 (3.46%) with carbamate poisoning, 6 of whom had thiocarbamates poisoning. The other common substances used in poisoning included drugs in 39 patients (7.93%), herbicides in 39 patients (7.93%), corrosive acids in 21 patients (4.42%), rodenticides in 17 patients (3.46%), and neonicotinoids in 19 patients (3.86%). The drugs used for the purpose of self-poisoning were all prescription drugs, namely amitriptyline, clonazepam, alprazolam, diazepam, clozapine, sodium valproate, phenytoin, carbamazepine, paracetamol, olanzapine, and ibuprofen. The uncommon poisonings included nitrobenzene (n = 1), aluminium phosphide (n = 1), and yellow oleander (n = 2). Among the uncommon ones, nitrobenzene and aluminium phosphide met with fatal consequences. Twenty-eight cases were considered “unknown” because despite active searching and questioning, the chemical nature or the use of poison could not be found.

In this study of 492 patients, 59 patients died (Table 8). The mortality rate of the patients admitted with attempted self-harm was about 12%. Most patients who died were from the organophosphorus group (n = 14), the organophosphorus and pyrethroid combination group (n = 17), and the paraquat group (n = 18). In this study, it was found that paraquat poisoning had a high mortality rate. Among 19 patients admitted with paraquat poisoning, 18 died (a

Table 6. Distribution of Patients According to Reasons Behind Deliberate Self-Harm Attempts

Reason Behind Self-Harm Attempts	Patients, n (%)
Major depressive episode	19 (3.86)
Schizophrenia	2 (0.04)
Bereavement	10 (2.03)
Unemployment	8 (1.63)
Incurred losses in business	6 (1.21)
Overburdened with loans	6 (1.21)
Recurrent pregnancy losses	1 (0.02)
Impulsive causes	440 (89.43)
Total	492 (100.00)

Table 7. Distribution of Patients Based on the Chemical Nature of the Ingested Poison

Chemical Nature of Poison	Patients, n (%)
Organophosphorus	98 (19.91)
Organophosphorus plus pyrethroids	51 (10.37)
Organophosphorus plus nonpyrethroid insecticide	4 (0.81)
Pyrethroid	84 (17.07)
Carbamate	17 (3.46)
Organochlorine	11 (2.24)
Fipronil (phenylpyrazole)	4 (0.81)
Emamectin benzoate (macrocyclic lactones)	7 (1.42)
Neonicotinoids	19 (3.86)
Corrosive acids	21 (4.27)
Kerosene oil	4 (0.81)
Yellow oleander seeds	2 (0.4)
Plant growth hormone	8 (1.63)
Nitrobenzene fertilizer	1 (0.2)
Fenpyroximate (phenylpyrazole)	9 (1.83)
Propargite	6 (1.22)
Hexythiazox	6 (1.22)
Flubendiamide	4 (0.81)
Medicines	39 (7.93)
Benzimidazoles	9 (1.83)
Rodenticides	17 (3.46)
Herbicide	38 (7.72)
Naphthalene	3 (0.6)
Aluminium phosphide	1 (0.2)
Benzylalkonium chloride	1 (0.2)
Unknown	28 (5.69)
Total	492 (100.00)

mortality rate of 94.74%). The mortality rate among patients taking organophosphorus and combination organophosphorus with pyrethroid was 14.29% and 33.33%, respectively. Only 1 of 11 patients admitted with carbamate poisoning died. Of 9 patients with endosulfan poisoning, 3 died.

DISCUSSION

This cross-sectional observational study was undertaken to find out the chemical nature of substances used for

Table 8. Distribution of Patients According to In-Hospital Mortality

Type of Poisoning	Patients Who Died, n	Patients in Each Group, N
Organophosphorus	14	98
Organophosphorus plus pyrethroids	17	51
Paraquat	18	19
Endosulfan (organochlorine)	3	9
Carbofuran (carbamate)	1	11
Acetamiprid (neonicotinoids)	1	4
Aluminium phosphide	1	1
Nitrobenzene	1	1
Unknown	3	28
Others	0	270
Total	59	492

attempted suicidal poisoning, their use, the sociodemographic profile of these patients, the reasons behind their suicidal attempts, and their in-hospital outcome. It was conducted over a period of 1 year between May 2015 and April 2016.

A total of 492 suicide victims were studied, 59 (12%) of whom died and 433 survived. The highest number of cases (182 [37%]) were 21–28 years of age, and the mean age was 26.37 years. Males (293 [59.55%]) predominated over females, and the male to female ratio was 3:2. In this study, most of the patients (269 [54.67%]) were married. There have been studies carried out in this country showing that most self-poisoned individuals in India are married. A study by Dash et al. showed that married people had to undergo a greater amount of stress in their day-to-day life than single males or females, which made them more susceptible to such deliberate self-harm (4). Studies from other parts of India, including Chandigarh and Rohtak, have shown similar results (5,6). In this study, we further analyzed differences in self-poisoning between married men and women. Although 57% of men and 51% of women were married, no difference based on marital status was found.

Rural patients (373 [75.81%]) outnumbered urban patients. Most of the patients (208 [42.28%]) came from the Darjeeling district. Data on the Occupation of Head of Family showed that the majority were farmers (193 [39.23%]). With reference to literacy status, it was found that one-quarter were illiterate (117 [23.78%]). Most of the patients consumed the poison during night-time hours (274 [55.69%]). Most cases (146 [29.67%]) were encountered in the summer while the fewest cases (74 [15.04%]) were seen in the winter. Most patients (174 [35.37%]) had a monthly per capita income between 1000–2000 INR (\$15–30 USD), while the average nominal per capita income of the country for the year 2016 was 9226 INR (\$139 USD) (7).

Most of the causes of attempted suicide (442 [89.84%]) were caused by the impulsive action of the patient, and they resulted from domestic quarrel, rebuke by parents or elders, abuse by friends, or physical assault by a spouse. Only 21 (4.27%) patients had documented psychiatric illness. Most (461 [93.70%]) did not have any history of previous suicide attempts. Only 25 patients (4.47%) had associated documented comorbidities that were medical, psychiatric, or mixed. Of these 25 patients, 10 had only psychiatric illness like depression, schizophrenia, or hysteria. There were 14 with reactive depression from chronic illness and 1 had alcoholic liver disease.

Among the poisons, pesticide poisoning (393 [79.88%]) was the one most frequently used, followed by prescription drugs (39 [7.93%]) and corrosive acids (21 [4.27%]). There were 2 cases of self-poisoning with

yellow oleander seeds, 3 cases of poisoning with naphthalene balls, and 1 case of nitrobenzene poisoning. Among the organophosphate poisonings, the most commonly used substance was chlorpyrifos (47 [9.55%]), followed by dimethoate (18 [3.66%]) and triazophos and phorate (15 [3.05%] each). Among the rodenticides, there were 2 unknown rat killers, 10 cases of bromadiolone poisoning, and 5 cases of zinc phosphide poisoning. Among the herbicides, the majority were paraquat or glyphosate poisonings.

In this study, the overall mortality rate was 12%. Among the 59 deaths, the highest number of deaths occurred in the 13- to 20-year-old group (22 [37.29%]), the 21- to 28-year-old group (18 [30.50%]), and the 29- to 36-year-old group (14 [23.73%]). However, there was no significant difference in mortality rate among these age groups. Among paraquat, organophosphorus, and combined organophosphorus and pyrethroid poisoning, paraquat (94.74%) had the highest mortality rate, followed by the organophosphorus and pyrethroid combination (33.33%) followed by organophosphorus poisoning (14.43%; $p < 0.001$).

Limitations

Our study provides preliminary data on the problem of poisoning in this geographic area. Like other studies, it is not free from limitations. In this study, as in most studies, the chemical nature and the commercial use of the poison was information obtained by the direct observation of the bottles brought in by a person accompanying the patient and studying the labels on them. In some cases, we had to depend on the information provided by the patient or their relatives. This information probably was not always reliable.

The outcome of death in cases of self-poisoning depends upon several factors, including the chemical nature of the poison, the amount ingested, the presence and availability of an antidote, and time elapsed before starting treatment, etc. Consequently, the deaths resulting from the poisons in our study may not accurately reflect the fatal nature of those poisons.

This study was conducted over a 1-year period because of time constraints. However, a longer duration of the same study would provide greater detail regarding the problem of self-poisoning in this region.

CONCLUSIONS

Deliberate self-harm by induced poisoning is one of the major public health problems in this part of the country. Young adults and males were the major population. Agricultural poisons constitute the bulk of substances

used, and they are mostly taken by rural people, specifically farmers and tea garden workers. New laws are needed in India to control the sale of agricultural poisons. At the same time, education of the masses should take place to spread the word on the fatal effects of various agricultural poisons as well as prescription and over the counter drugs. Compulsory in-patient psychiatric consultation should be implemented as an integral part of the management of self-poisoning to prevent future suicidal behaviors. The agents used for self-poisoning vary by region depending upon their availability. The substances used by an individual in a particular area can also be idiosyncratic. Therefore, it is important for emergency physicians to become acquainted with as many poisoning cases as possible. This study not only demonstrates the magnitude of the problem in a particular region of India but also reveals the multitude of poisons and drugs that can be used for self-harm regardless of the availability or nonavailability of their antidotes. We believe that studies like this one can help an internist or emergency physician handle individual cases based on preliminary knowledge of the poisons available in that area. The knowledge of a higher fatality rate for certain poisons compared to others will assist emergency physicians to triage poisoning cases in an overcrowded emergency department. Knowledge of the prevalence of poisoning in a particular region helps in the early proactive management of patients based on the toxidromic approach even when information on the chemical nature or amount of poison taken is not available. For example, a farmer presenting with a cholinergic toxidrome can be suspected to have ingested organophosphorus, whereas a drug addict from a night club presenting with a sympathomimetic toxidrome is likely to have an amphetamine (or ecstasy) overdose.

Paraquat (an herbicide) was found to be a striking cause of acute poisoning because of high mortality. It already has been banned in 36 countries, including Bosnia and Herzegovina, Cambodia, Ivory Coast, Kuwait, Norway, Sri Lanka, Switzerland, Syria, United Arab Emirates, and all member countries of the European Union. There were no deaths in this study associated with other herbicides, such as glyphosate or chloracetanilide compounds. We believe that this calls for stricter legislative measures over the sale and purchase of herbicides like paraquat and replacing them with other herbicide compounds that are more benign. Another striking observation in the study was the lack of mortality from pyrethroids alone as opposed to organophosphate and organophosphate-pyrethroid combination. Substitution of organophosphate and organophosphate-pyrethroid and organophosphate-pyrethroid combination with pyrethroid alone can prevent some of these deaths.

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ARTICLE SUMMARY

1. Why is this topic important?

This article addresses the important problem of self-poisoning, which is quite common in India. Proper knowledge of the prevalence and magnitude of this problem will not only help in early and appropriate management but will also pave the way for future preventive measures.

2. What does this study attempt to show?

Various poisons, including pesticides, herbicides, corrosives, rodenticides, and over the counter drugs, have been shown to be primarily consumed by patients belonging to various social and economic strata depending on the household and workplace availability of the poison(s). The high toxicity profile of certain poisons, particularly paraquat, is also an area of concern.

3. What are the key findings?

Young adults, males, and rural inhabitants, particularly farmers, were the main groups who attempted deliberate self-harm by self-poisoning, usually by impulsive acts. Pesticides were the major poison consumed. Paraquat had a high mortality rate, followed by organophosphorus-pyrethroid combination.

4. How is patient care impacted?

Knowledge of the magnitude of poisoning in a particular region helps in the early aggressive management of patients based on the toxidromic approach, even when the chemical nature or the amount of poison taken is not available. Appropriate education of the surviving patients and their relatives about the toxicity profile of certain readily available agricultural poisons together with psychological counseling of the patients may help to prevent such further acts of deliberate self-harm. The high fatality rate from paraquat self-poisoning shown in this study calls for stricter legislative measures to ban the sale and purchase of this herbicide in India and replace it with other, less harmful, herbicides.