

Deliberate self-poisoning and harm: A meticulous quest of methods in vogue

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ABSTRACT

Background: Deliberate self-poisoning and harm (DSPH) is an unabating problem with a wide variation in the methods used across the world. Hence, this study was conducted to understand the current spectrum of methods used for DSPH by patients in our geographic locality and catchment area with special emphasis on newer compounds and drugs used. **Methods:** This retrospective study included patients presenting with DSPH to the emergency department (ED) between January 2017 and December 2018. **Results:** This study included 1802 patients, with a mean age of 32 ± 12.7 years. Of the patients, 85% were in the young to middle age group (16–45 years). Agrochemicals (n = 604, 33.5%), drugs (n = 498, 27.6%), plant toxins (n = 150, 8.3%) and rodenticides (n = 145, 8%) were the predominantly used compounds. The major emergency resuscitation procedures required in the ED were intubation (n = 321, 18%), vasopressor support (n = 73, 4%) and cardiopulmonary resuscitation (n = 27, 1.4%). A quarter (23.2%) was discharged stable from the ED, whereas a further 56.5% were discharged stable after hospital admission. The in-hospital mortality rate was 3% (n = 47). Multivariate logistic regression analysis showed rodenticides (odds ratio (OR): 22.32; 95% confidence interval (CI): 8.05–61.88; $P = 0.005$) and plant poisons (OR: 23.92; 95% CI: 8.95–63.94; $P = 0.005$) to be the independent predictors of mortality. **Conclusion:** DSPH is prevalent in the highly productive young age group. Agrochemical ingestion and drug overdose are the most common methods used, whereas rodenticide and plant poisoning are associated with significant mortality.

Keywords: Deliberate self-harm, deliberate self-poisoning suicide, emergency department, intentional harm

Introduction

Deliberate self-harm refers to an act of intentionally causing physical harm to oneself to inflict bodily damage, whereas deliberate self-poisoning refers to the act of consuming harmful compounds such as drugs or chemicals without suicidal intent. Although these often impulsive acts are done without lethal intent, they could be fatal. The triggers of deliberate

self-poisoning and harm (DSPH) are usually emotional stress/depression due to family problems, workplace issues, academic failure, romantic discord or financial crisis. DSPH, a growing public health concern, remains one of the leading causes of morbidity and mortality. It accounts for a major proportion of emergency department (ED) admissions across the world. According to World Health Organization (WHO) statistics, more than a million people die globally due to DSPH every year, and DSPH also remains the second most cause of death among the highly productive age group of 19–29 years.^[1] Insecticide poisoning, plant poisoning, drug overdose and hanging are the most common methods of deliberate self-harm according to studies from South India in the past.^[2–4] Psychiatric illness remains

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a major risk factor for deliberate self-harm with Lauw *et al.*^[5] having shown a higher incidence of DSPH among adolescents with mood disorders and adjustment disorders. Over the last decade, treating DSPH has become an increasingly challenging task with newer agrochemical compounds and drugs constantly emerging in the market.^[6-10] Data on the management options and complications and of these newer compounds and drugs is minimal. Hence, this study was conducted to understand the current spectrum of methods used for DSPH by patients in our geographic locality and catchment area with special emphasis on newer compounds and drugs used.

Methodology

Study design: This retrospective study was done between January 2017 and December 2018 (two years).

Study setting: The study was conducted in the adult ED of Christian Medical College, Vellore, a large tertiary care hospital in South India. The ED is one of the largest in India, with 50 beds and more than 77,000 admissions annually.

Aim of the study: To study the profile and the outcome of patients with DSPH presenting to the ED.

Participants: The study cohort included all patients who presented with a history of DSPH to the ED. Patients who were brought dead to the ED following DSPH and charts with missing data were excluded from the study.

Data collection: The patient data was retrieved through the ED triage registry software and the hospital electronic database by the primary investigators. The code name 'deliberate self-harm' was used to search and obtain the data of patients who presented to the ED during the study period with DSPH. The variables gathered were age, sex, triage priority level, time of presentation, mode of DSPH, associated risk factors, previous history of DSPH and details of ED resuscitation and outcome.

Outcome variables: The outcome measures were the various compounds/methods of DSPH and in-hospital mortality.

Sample size: All consecutive patients who fulfilled the inclusion criteria during the two-year study period were included in the retrospective analysis.

Statistical analysis

Data were analysed using the Statistical Package for Social Sciences for Windows (SPSS Inc. Released 20017, version 23.0. Armonk, NY, USA). Continuous variables are presented as mean with standard deviation. Categorical and nominal variables are presented as percentages, and the Chi-square test was used to compare dichotomous variables. The factors associated with mortality were determined by bivariate logistic regression analysis, followed by multivariate logistic regression analysis, and their 95% confidence intervals (CIs) were calculated. For all tests, a

two-sided *P* value of less than 0.05 was considered statistically significant.

Ethical considerations

The study was approved by the Institutional Review Board (IRB Min. No. 12269 dated 25/09/2019) of Christian Medical College, Vellore. Patient confidentiality was maintained by unique identifiers and password-protected data entry software with restricted uses.

Results

During the two-year study period, a total of 143,621 patients presented to our ED with 1821 cases identified as DSPH. The incidence of DSPH was 1.3%. After applying the exclusion criteria, the final study cohort included 1802 patients [Figure 1]. The mean age was 32 ± 12.7 years, with a slight female predominance (50.9%). Of the patients, 1048 (58%) were in the age group of 16–30 years. The various DSPH methods used by different age groups are shown in Figure 2. Agrochemical consumption ($n = 604$, 33.5%) was the most common mode of DSPH used, followed by drug overdose ($n = 498$, 27.6%), plant poisoning ($n = 150$, 8.3%), rodenticide consumption ($n = 145$, 8%), hanging ($n = 144$, 8%), corrosive consumption ($n = 106$, 5.8%) and self-inflicted trauma ($n = 82$, 4.6%) [Figure 1]. A further 28 (1.5%) patients used multiple methods of DSPH. A quarter ($n = 452$, 25%) of the patients were triaged as priority level 1 at initial presentation to the ED. Baseline characteristics, including age-wise distribution, the timing of the incident and the past medical contributing history, are shown in Table 1. On studying the seasonal variation in the number of DSPH attempts, there was a slight increase in the number of attempts during the summer months of April and May [Figure 3]. Domestic fights ($n = 743$, 41%), personal issues ($n = 83$, 5%), relationship issues ($n = 57$, 3.3%), financial crisis ($n = 56$, 3.1%), health issues ($n = 41$, 2.2%), academic failure ($n = 34$, 1.8%) and workplace issues ($n = 23$, 1.2%) were the common triggers of DSPH. However, a motive could not be identified in 42.2% of the patients.

The major emergency resuscitation procedures required in the ED were intubation ($n = 321$, 18%), vasopressor support ($n = 73$, 4%) and cardiopulmonary resuscitation ($n = 27$, 1.4%) [Table 1]. All patients were evaluated and resuscitated in the ED with appropriate antidotes and general supportive care. A quarter (23.2%) was discharged stable from the ED, whereas a further 56.5% were discharged stable after hospital admission. The in-hospital mortality rate was 2.6% ($n = 47$) [Table 2].

Bivariate and multivariate logistic regression analyses were performed to determine the factors associated with mortality. Low sensorium at presentation (adjusted odds ratio (OR): 3; 95% CI: 1.19–7.67; $P = 0.005$), requirement of vasopressors (adjusted OR: 8.26; 95% CI: 3.71–18.39; $P = 0.005$), requirement of intubation (adjusted OR: 6.83; 95% CI: 2.61–17.85; $P = 0.005$), rodenticide poisoning (adjusted OR: 28.6; 95% CI: 10.36–78.92;

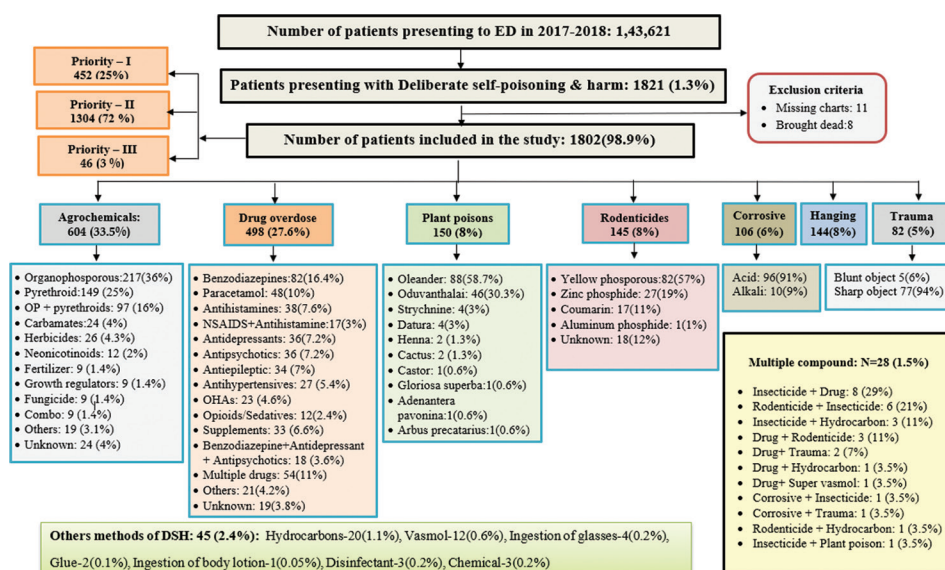


Figure 1: STROBE diagram

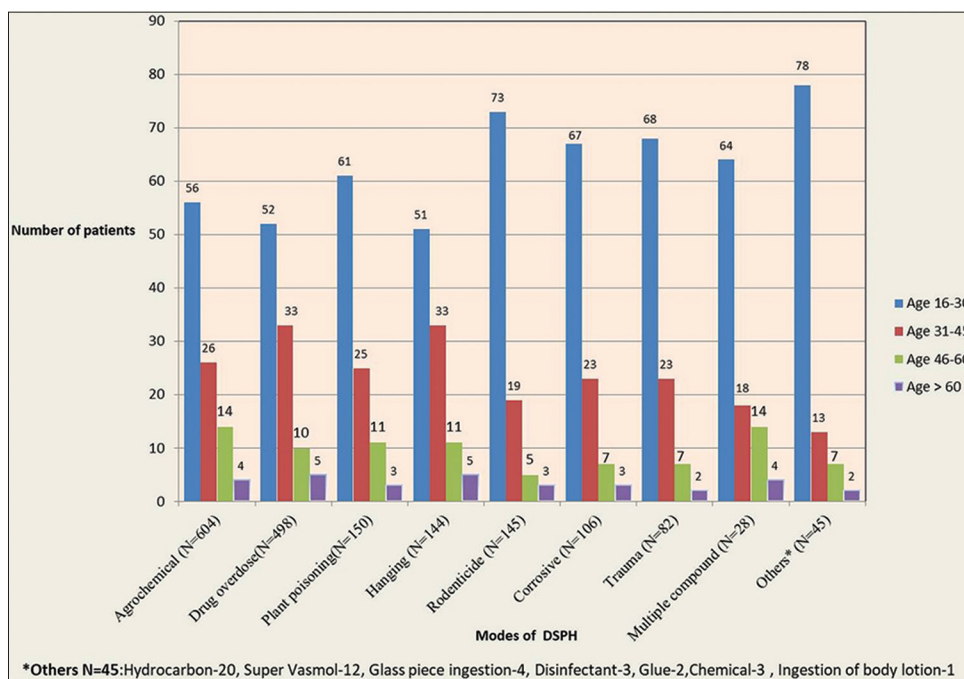


Figure 2: Age group distribution

$P = 0.005$) and plant poisoning (adjusted OR: 29.65; 95% CI: 10.94–80.32; $P = 0.005$) were found to be independent predictors of mortality [Table 3].

Discussion

This study highlights the spectrum and outcome of patients presenting with self-poisoning and self-harm to a tertiary care centre in South India. DSPH carry a significant impact on morbidity and mortality in developing countries such as India. A similar study was conducted by Jegaraj *et al.*^[2] from the same centre. The mean age showed an increase from

20 years in 2011–2013 to 32 years in our study (2017–2018). The gender ratio did not vary in the two studies. Agrochemical compound consumption and drug overdose remain the most preferred method of DSPH. However, the percentage of patients consuming agrochemical compounds decreased from 46% to 33.5%, whereas the percentage of patients consuming rodenticide compounds increased from 4.2% to 8% and hanging increased from 5.3% to 8%.^[2]

DSPH is a menace afflicting the highly productive young and middle age groups and has been a critical unabating health problem in India over decades and perhaps over centuries.^[1-3] The

younger mean age of 32 ± 12.7 years in our study is a consistent and worrisome finding also seen in many studies conducted in India.^[3] Several studies from both the developed world and the developing world showed the same pattern of young adults, particularly women being the victims of DSPH.^[11-13] In a study conducted by Senarathna et al.,^[14] an alarming 21% of patients committing DSPH were teenage girls between 12 and 19 years.

The impact on the mental health of the survivor and the relatives often lasts forever and could trigger further even more determined and grave DSPH attempts. In addition to this, the social and economic loss suffered by the society and nation due to the short- or long-term debilitation of these young adults is probably unquantifiable.

The common triggers of DSPH that we could identify in our study were domestic fights (n = 743, 41%), personal issues (n = 83, 5%), relationship issues (n = 57, 3.3%) and financial crisis (n = 56, 3.1%) among others, as shown in the results. However, we could not identify any precipitating cause in almost 40% of our patients, as this study was conducted in the ED and an antecedent history could not be obtained for all patients during the short ED stay. A large number (n = 98, 5.4%) of patients in our study had a known psychiatric illness [Table 1]. Self-poisoning is often an impulsive act with alcoholism, relationship issues and financial

Characteristics	Number (%)
Age, mean in years	32±12.7
Gender ratio (female/male)	918/884
Age group classification	
16-30 years	1048 (58)
31-45 years	484 (27)
46-60 years	194 (11)
More than 60 years	76 (4)
Time of incident of deliberate self-harm (DSH)	
8 am- pm	865 (48)
5 pm-12 am	677 (37)
12 am-8 am	260 (15)
Risk factors	
Previous history of DSPH	110 (6)
DSPH under the influence of alcohol	237 (13)
Past psychiatric illness	98 (5.4)
Referred from another hospital	1093 (61)
ED resuscitation	
Need for intubation	321 (18)
Use of vasopressors	73 (4)
Cardio-pulmonary resuscitation	27 (1.4)
Gastric lavage (n=1576)	947 (60)
Activated charcoal (n=1576)	132 (8.3)

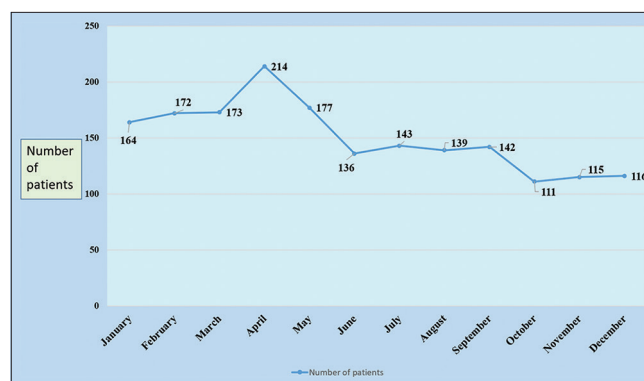


Figure 3: Seasonal pattern of DSPH in 2017 and 2018

Mode of DSPH	Number (%)			
	Discharged stable from ED n=417 (23.2%)	Discharged stable from Hospital n=1019 (56.5%)	Left against Medical advice n=319 (17.7%)	Dead n=47 (2.6%)
Agrochemical (n=604)	87 (14)	402 (67)	103 (17)	12 (2)
Drug overdose (n=498)	157 (31.5)	249 (50)	91 (18.3)	1 (0.2)
Plant poisoning (n=150)	8 (5.3)	101 (67.3)	27 (18)	14 (9.4)
Rodenticide (n=145)	10 (6.8)	88 (60.6)	34 (23.6)	13 (9)
Hanging (n=144)	31 (21)	79 (55)	30 (21)	4 (3)
Corrosive ingestion (n=106)	61 (58)	33 (31)	10 (9)	2 (2)
Trauma (n=82)	42 (51.2)	30 (36.5)	9 (11)	1 (1.3)
Multiple compounds (n=28)	4 (14.2)	16 (57.3)	8 (28.5)	0
*Others (n=45)	17 (38)	21 (47)	7 (15)	0

Variable	Dead n=47	Alive n=1755	Bivariate analysis		Multivariate analysis	
			P	OR (95%CI)	P	OR (95%CI)
Intubation	28 (59.6%)	293 (16.7%)	<0.001	7.353 (4.052-13.344)	<0.001	6.83 (2.61-17.85)
Low sensorium	23 (48.9%)	416 (23.7%)	<0.001	3.085 (1.723-5.522)	0.020	3 (1.19-7.67)
Inotropes	18 (38.3%)	55 (3.1%)	<0.001	19.185 (10.050-36.622)	<0.001	8.26 (3.71-18.39)
Plant poison	14 (29.8%)	136 (7.7%)	<0.001	5.050 (2.639-9.666)	<0.005	29.65 (10.94-80.32)
Rodenticides	13 (27.7%)	132 (7.5%)	<0.001	4.701 (2.422-9.126)	<0.001	28.60 (10.36-78.92)

liabilities consistently being shown to be antecedent factors. For example, Shokrzadeh *et al.*^[15] reported family quarrel to be the main cause of DSPH in 43.1% of patients.

The method of DSPH used by victims varies widely from place to place depending upon the availability of chemical compounds/drugs, the socioeconomic status of the community and the means of livelihood. The various forms of DSPH with their details are described below in the order of their prevalence.

Agrochemicals

Organophosphorous compounds (n = 217, 36%) were the most commonly used agrochemical compounds in this study [Figure 1]. These are highly toxic compounds with a high fatality rate as compared with the less toxic pyrethroids, carbamates and organochlorides.^[16-18] Knowledge regarding the storage and lethality of these compounds is relatively poor, whereas a paradoxical higher rate of consumption and DSPH has been noted where there is better dissipation of knowledge. Banning such compounds or having them dispensed at prescription has been tried as methods of preventing such cases, but the rapid discovery of newer compounds defeats the purpose.^[18] Our study supports this view with the increasing use of newer DSPH compounds, such as neonicotinoids, including imidacloprid and thiacloprid. Although these compounds have shown a better safety profile than their precursors, various studies and case reports have reported serious central nervous system (CNS) manifestations, respiratory failure and rarely cardiac toxicity.^[7,8]

Drug overdose

The U. S Centre for Disease Control and Prevention has pointed out that drug overdose is on the rise in both developed and developing countries. This method of DSPH, although popularly seen among the educated elite in the USA, Australia, Madrid and the urban populace of developing countries such as India and Pakistan, has a low risk of mortality.^[19,20] The common drugs used include those acting on the CNS, such as benzodiazepines, anti-epileptics and anti-depressants, sedative-hypnotics and anticonvulsants, as also seen in our study.

Cases of overdose with non-steroidal anti-inflammatory drugs (NSAIDs), such as paracetamol, have been seen as an increasing trend in both developed and developing countries due to easy availability.^[20-23] In this study, opioid compounds were used much less commonly for DSPH (n = 12, 4.2%) [Figure 1]. This finding is consistent with other studies from India, in contrast to the high incidence of opioid use for DSPH in the West.^[2,3,13]

Plant poisons

This form of DSPH is one of the oldest methods known to mankind for suicides, homicides and inducing abortions. The lack of proper knowledge of the lethality, clinical manifestations and available antidotes makes this group quite unpredictable for management. The local geo-availability of the plants poses a unique challenge for the management of DSPH in various areas.

Although uncommon in developed countries, these compounds play a major role in developing tropical countries such as India and Sri Lanka, where they are consumed with low intent but high lethality.^[24] As seen in this study in rural Tamil Nadu, yellow oleander (*Thevetia peruviana*: n = 88, 58.7%) and oduvanthalai leaves (*Cleistanthus collinus*: n = 46, 30.3%) are the most common plants consumed due to their ubiquitous distribution [Figure 1].

The sap of yellow oleander (*T. peruviana*) contains multiple potent cardiac glycosides that cause severe cardiac toxicity and death due to dyselectrolytemia and arrhythmias. Similarly, in our study, more than half of the patients with oleander poisoning had cardiac arrhythmias and required temporary pacemaker implantation with nearly one-third of them having electrolyte abnormalities at admission. The in-hospital mortality rate in our study was found to be 9% as compared with 6.7% in another study conducted in rural South India.^[25]

Self-poisoning with oduvanthalai leaf (*C. collinus*) is another typical plant poison favoured by young women in South India.^[26] The easy availability of plants and methods of preparation make it the poison of choice. Oduvanthalai leaves contain glycosides and cleistanthin A and B, which causes severe renal tubular dysfunction, cardiac toxicity and eventually death. The various methods of consumption include swallowing the crushed plant parts, ingesting a paste/juice made by pounding the plants or decocting the leaves in boiled water. Studies have shown that the later concoction was associated with significant mortality compared with the former methods.^[27]

Other rare plant poisons seen in this study were *Gloriosa superba*, *Datura stramonium* and *Strychnos nux vomica*. Intentional consumption of alkaline colchicine compounds such as the tubers of *Gloriosa superba* leads to documented cases of profound hypotension, severe coagulopathy, multiorgan dysfunction and eventually death. This form of DSPH is commonly seen in the southern part of India and Sri Lanka where it is available as an ornamental herb.^[2,24] The usage of traditional medicinal plants, including *Datura stramonium* and *Strychnos nux vomica*, for self-poisoning is common in Asian countries. *Datura stramonium* has anticholinergic properties, such as delirium, hallucination, hyperthermia and dilated pupils, rarely resulting in death. The seeds and barks of *S. nux vomica* contain extremely toxic alkaloids such as strychnine, brucine and loganin. Twitching and muscle spasms following intoxication have been reported due to the loss of the inhibitory effect of spinal interneurons, particularly strychnine. Death is due to respiratory paralysis following the involvement of the thoracic and abdominal musculature.

Rodenticide poisoning

Rodenticide ingestion is one of the common forms of self-poisoning throughout India. Used as a grain fumigant and rodenticide, the compounds of yellow phosphorous, phosphide metals (aluminium phosphide, zinc phosphide) and warfarin are the common agents that are easily available.^[3,10] Lack of

proper storage facilities causes the liberation of phosphine gas due to contact with water, which is a mitochondrial toxin that causes severe myocardial depression and lactic acidosis. There is usually only a short interval between the ingestion of phosphides and the appearance of systemic toxicity in the case of aluminium phosphide toxicity, whereas there is a latent period in zinc phosphide toxicity. The use of aluminium phosphide as DSPH is more prevalent in North India as compared with zinc phosphide compounds in South India. This choice of DSPH is different from countries in the Orient where phosphorous compounds are banned, whereas coumarin derivatives are easily available. Coumarin or superwarfarin derivatives, although less toxic than yellow phosphorous, have been reported to cause coagulopathies, which are often reversible with long-term vitamin K1 supplementation.

Corrosive ingestion

Injuries due to corrosive agents such as concentrated acids, alkalis and disinfectants have serious consequences in terms of oral and gastrointestinal damage. This colossal damage is seen both in developed and developing countries with industrial and household usage of easily available corrosives such as phenol and sodium hydroxide. High levels of morbidity in the form of extensive bowel repair surgeries and regular bouginage along with mortality due to peritonitis, mediastinitis, pneumonia and fistula formation are known to be common. A fatality rate of 55% was reported on the consumption of sulphuric acid in New Delhi, whereas hydrochloric acid was seen as the corrosive of choice in Taiwan and Morocco.^[27-29] Of the 6% who consumed corrosives in this study, about 90% opted for acids, with Harpic (10% hydrochloric acid) being the most common compound, probably due to its ease of access as a household product. Two patients succumbed to the illness following the ingestion of sulphuric acid and sodium hypochlorite, respectively.

Physical methods of self-harm

The physical methods of self-harm seen in this study include asphyxiation by hanging in about one-tenth of the patients, followed by trauma using either sharp or blunt objects. As compared with a study conducted by Vancayseele N *et al.*^[30] this study has a higher percentage of hanging as compared with trauma by sharp objects. Both these methods of DSPH were most prevalent in the young and middle age groups, i.e., 16–30 years. In this study, hanging as a method of self-harm was equally used by both men and women, whereas deliberate trauma by sharp objects was used by a vast margin by men. Self-harm prevention programmes, including self-help groups, availability of counselling services within 48 hours of a self-harm episode and increasing awareness of such help via Internet-based chats and forums, could be used as measures to reduce self-harm rates.

In this study, plant poisons and rodenticides were identified as independent causes of DSPH. The prevention of these requires a vigilant watch over the supply of phosphorous-based rodenticides and knowledge of storage and safe usage.^[31]

Restricting easy access to toxic plants, although a difficult step to undertake, would certainly decrease the incidence of deliberate plant poisoning.^[32] Supportive measures are currently the mainstay of treatment, even for lethal plants such as yellow oleander, as the recommended anti-digoxin Fab fragments are commercially not available in developing countries such as India due to their prohibitively high cost. Improving health infrastructure and taking preventive steps in limiting access to harmful compounds are the urgent needs of the hour in our quest to decrease morbidity and mortality due to DSPH.

Strengths of our study: This study comprehensively describes a very large cohort of patients presenting with DSPH, thus providing insight into the modes of DSPH used in our geographic catchment area. Multivariate logistic regression analysis of factors associated with mortality is another strength of our study.

Limitations: The data is from a single large tertiary care centre, which results in patient selection and an inherent referral pattern bias. Missing patient records and incomplete data were other limitations of our retrospective study.

Implications for practice: This study shows the current profile of the methods of DSPH and the newer compounds and methods being used for this lethal act. This data identified the predictors of mortality and the lethality of rodenticides and plant toxins compared with other relatively innocuous methods. This calls for the urgent need from medical and government administrative bodies to increase awareness, restrict access and be better equipped in managing the common, especially the newer, compounds being used for DSPH in this geographic locality.

Conclusion

Agrochemical consumption and drug overdose are the most common methods used for DSPH in our geographic locality. Rodenticides (mainly phosphorous-based compounds) and plant poisoning (oleander and oduvanthalai) are associated with significant mortality. The fact that the highly productive young to middle age group (16–45 years) comprises the vast majority of DSPH attempts is a cause of grave concern.

Research quality and ethics statement

We declare that this scientific work complies with reporting quality, formatting and reproducibility guidelines set forth by the EQUATOR Network. We also attest that this clinical investigation was determined to require Institutional Review Board/Ethics Committee review, and the corresponding protocol/approval number is IRB Min. No. 12269 dated 25/9/2019. We also certify that we have not plagiarized the contents in this submission and have done a plagiarism check.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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