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ORIGINAL ARTICLE

A Retrospective Analysis on Poison Related Mortalities in a Tertiary Care Centre in Pakistan

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Abstract

Background: In Pakistan, most of the data on poisoning comes from scattered case series with data on poisoning mortality, and data is especially lacking on people of lower socioeconomic status.
We aim to shed some insight on the factors related to poisoning mortality in Pakistan in an effort to show potential measures required to reduce it.
Methods: A total of 204 cases of poisoning fatalities, occurring between May 29, 2013, and September 10, 2019, were reviewed retrospectively from the National Poison Control Centre at Karachi, Pakistan. Cases of poisoning by accident, suicide, and homicide were included and animal bites and food poisoning were excluded. Patients less than 13 years of age were excluded.
Results: From our deceased patient medical records, 67.2% were males and 32.8% were females. The mean age was 29.20 ± 13.04 years. Most of the deaths from poisoning were attributed to organophosphate consumption, mainly through the ingestion of rat killer (30.9%), dichlorvos based pesticide (23.5%), and insecticides (10.3%). A noteworthy number of the deceased patients were housewives (12.7%) and students (11%), and a significant association was seen between occupation and poison consumed (p=0.048). Treatment for most of the cases was non-specific.
Conclusion: Poisoning is a serious threat to all demographics and mortality can be attributed to substances that can be easily obtained and are widely used. This indicates a gap in safety measures and calls for tighter regulation standards.

Keywords: organophosphates, atropine, heroin, opioids

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INTRODUCTION

The 2017 update of the Global Burden of Disease found that approximately 72,400 deaths worldwide could be attributed to intentional or accidental poisoning (1). While this statistic alone demonstrates the peril, studies name poisoning as the cause of 2.4% of all patients presenting to the Emergency Department (ED) and up to 6% of all Intensive Care Unit (ICU) admissions (2-4).

Income status is a factor that pervades the epidemiology of poisoning cases. A study on the population of China found that more than three-quarters of the poisoning related deaths reported over 10 years were of people living in rural areas (5). The Global Health Observatory (GHO) believes that problems with reporting in low- and middle- income countries may actually lead to the worldwide mortality being underestimated (6).

It is important, then, to keep in mind that Pakistan is a developing country. The majority of data on poisoning comes from scattered case series, and deals with the general demographics of presenting cases. A 2016 study conducted at a tertiary care hospital in Pakistan, found that 46.1% of adult poisoning cases had suicidal intent (7). However, this study was limited by location and fees structure to the upper class. Data on poisoning mortality, especially of people of lower socioeconomic status, is lacking. The first step towards reducing the morbidity and mortality of poisoning in this country is to fully understand it. A number of non-governmental organizations (NGOs) are known to exist for the purpose of reducing the burden of poisons, and there is great potential for benefit by having more knowledge available (8). The goal of this paper is to combine the obtained social and demographic data with information available in the literature, and to present it in an actionable form.

METHODS

Our study consisted of a total of 204 cases of fatalities caused by poisons in patients aged 13 and above who reported to the emergency department of the National Poison Control Centre (NPCC) between 29/05/13 and 10/09/2019. The NPCC is a wing of the Jinnah Postgraduate Medical Centre, a government-operated tertiary-care hospital in one of the country's major cities. The institute receives cases from a

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large part of the city itself as well as cases from rural areas surrounding the city. Being government-operated, it mostly takes cases of middle- or lower-socioeconomic class patients, as the majority of upper-class patients prefer private hospitals. In addition, the NPCC also picks up cases from smaller hospitals that do not have the facilities available to manage patients once a diagnosis of poisoning has been made. Cases of poisoning by accident, suicide and homicide were included in our study, and animal bites and food poisoning were excluded.

The data was retrospectively retrieved manually by going through existing patient case records. On admission to the emergency department, details of the patient are recorded, as well as a brief history of poisoning, and a simple assessment of the patient's status. Where patients are referred from other hospitals the patient's details and all information of clinical significance is transcribed onto the hospital's own records. If an adult patient expires, the case is handed over to the office of the resident medico-legal officer, where it is reviewed and all pertinent documents are stored away as physical records. Because cases of patients of age <13 years are handled differently, we chose to not include them.

Ethical approval was received by the Institutional Review Board of JPMC. The patient case data was used as a component of this study, however all personal details pertaining to the patients were removed prior to descriptive analysis, to ensure anonymity of individuals.

The poisoning cases were analyzed on the basis of age, gender, marital status, occupation, type of poison used (organophosphates, corrosives, heavy metals etc.), interventions done (gastric lavage, activated charcoal, antidotes etc.), cause of death (cardiopulmonary arrest, renal failure etc.) and the approximate interval between onset of symptoms and death. The patients were divided into 5 categories on the basis of age: 13-18 years, 19-24 years, 25-44 years, 45-64 years and 65 or greater. The poisons were classified on the frequency of which they were used in different age groups and the cases in which the causal agent could not be determined were classified under 'unidentified'.

Data analysis was done using IBM's Statistical Package for the Social Sciences 20.0 (SPSS 20, IBM, Armonk, NY, USA). Descriptive statistics such as percentages and frequencies were used to report numerical values. Chi-square test was used to find associations between qualitative values, with p-value of <0.05 taken as significant.

RESULTS

A total of 204 deceased patients were included in the study, of which 137 (67.2%) were males and 67 (32.8%) were females. The mean age of the patients was 29.20 ± 13.04 years, and 102 (50%) were married.

Most of the poisoning cases occurred from organophosphate consumption, mainly through the ingestion of rat killer (30.9%), Typhon (23.5%), and insecticides (10.3%). Other substances that contributed to patient mortality included heroin/opioids, corrosives, heavy metals, paraphenylenediamine, cocaine, and antidepressants (Table 1).

Cardiopulmonary arrest was the main cause of death amongst patients (n-202, 99%), and 2 patients died of acute kidney injury. The mean interval between onset of symptoms and death, i.e. the time during which resuscitation was attempted, was 13.07 ± 1.71 minutes. 11.8% of patients died within 10 minutes and a further 44.1% within 15 minutes. Only 2% of patients were alive after 30 minutes.

Table 1. Classification of poisons that led to patient casualty at the NPCC in Karachi, Pakistan 2013-2019

Poison Classification	Substance Consumed	N (%)	Total N (%)
Organophosphates	Insecticides	21 (10.3)	133 (65.2)
	Typhon	48 (23.5)	
	Rat Killer	63 (30.9)	
	Unknown	1 (0.49)	22 (10.8)
Heroin/ Opioids	IV drug of abuse	18 (8.82)	
	Sleeping Pills	3 (1.47)	
	Unknown	1 (0.49)	
Corrosives (acid/ alkali)	Rat Killer	1 (0.49)	17 (8.33)
	Brake fluid	1 (0.49)	
	Methanol	8 (4.41)	
	Bleach	5 (2.45)	
	Unknown	2 (0..98)	
Heavy Metals	Insecticides	1 (0.49)	1 (0.49)
Paraphenylenediamine	Hair Dye	7 (3.43)	7 (3.43)
Cocaine	IV drug of abuse	2 (0.98)	2 (0.98)
Antidepressants	Sleeping pills	1 (0.49)	5 (2.45)
	TCA	4 (1.96)	
Unidentified		17 (8.33)	17 (8.33)

Most of the recorded occupations were students and housewives, with the unemployed, private employees, labourers and salesmen making up the rest of the record. A significant association was seen between occupation and poison consumed (p=0.048). Heroin/ Opioids were most commonly used among the unemployed (n=5, 2.5%), as compared to other occupations. Paraphenylenediamine, found in hair dye, was most commonly used among housewives (n=4, 2%). Organophosphates were the main choice of poison within all of the occupation groups (Figure 1).

Participants were categorized by age, according to Medical Subject Headings (MeSH), into adolescents (ages 13 to 18 years, n=50), young adults (ages 19 to 24 years, n=44), adults (ages 25 to 44 years, n=80), middle-aged adults (ages 45-64 years, n=26), and older adults (aged older than 65 years, n=4). A significant association was found between age and the poison consumed (p = 0.005). Organophosphates were the main choice of poison amongst all age groups. Heroin and corrosives were mainly used by adults and the middle-aged group (Table 2).

Table 2. Association between the class of poison consumed and age groups of patients reporting to the NPCC in Karachi, Pakistan 2013-2019

Poison Classification	Age Classification					
	Adolescent N (%)	Young Adult N (%)	Adult N (%)	Middle-Aged N (%)	Aged N (%)	Total N (%)
Organophosphates	42 (20.6)	35 (17.2)	41 (20.1)	13 (6.4)	2 (1.0)	133 (65.2)
Heroin/ opioid	5 (2.5)	2 (1.0)	11 (5.4)	4 (2.0)	0 (0.0)	22 (10.8)
Corrosive (acid/ alkali)	0 (0.0)	3 (1.5)	10 (4.9)	3 (1.5)	1 (0.5)	17 (8.3)
Heavy Metal	0 (0.0)	1 (0.5)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.5)
Paraphenylenediamine	1 (0.5)	1 (0.5)	5 (2.5)	0 (0.0)	0 (0.0)	7 (3.2)
Cocaine	0 (0.0)	1 (0.5)	1 (0.5)	0 (0.0)	0 (0.0)	2 (1.0)
Antidepressants	0 (0.0)	0 (0.0)	5 (2.5)	0 (0.0)	1 (0.5)	6 (2.9)
Unidentified	2 (1.0)	1 (0.5)	7 (3.4)	6 (2.9)	0 (0.0)	16 (7.8)
Total	50 (24.5)	44 (21.6)	80 (39.2)	26 (12.7)	4 (2.0)	204 (100)

$\chi 2$= 50.849, DF=28, p-value= 0.005

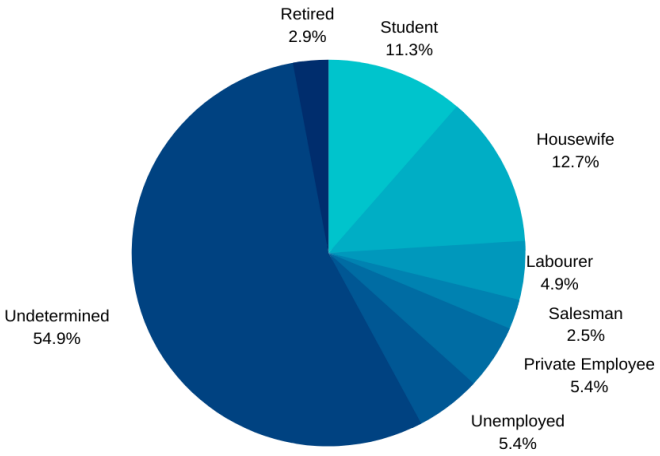

Figure 1. Occupations of patients reporting to the NPCC with lethal poison consumption in Karachi, Pakistan 2013-2019

A significant association was found between poison class and gender ($p < 0.001$). Organophosphates were most used in both groups. Heroin/ Opioid poisoning was much more common in men (n=21, 10.3%) than women (n=1, 0.5%), whereas women were more likely to die of paraphenylenediamine poisoning than men. There were no cases of antidepressant or cocaine poisoning amongst women (Table 3).

Atropine was the treatment used for most cases (n=59, 28.9%), corresponding to the high number of organophosphate poisoning cases. Atropine was also administered in one case of heroin and one case of antidepressant poisoning. For two other cases of organophosphate poisoning, epinephrine and metoclopramide were administered. Ipratropium bromide (Atrovent) nebulizer was given in cases of heroin/ opioid poisoning and a tracheostomy was performed in one case of paraphenylenediamine poisoning. For most of the cases, however, treatment was nonspecific (n=135, 66.2%).

DISCUSSION

In our study, we observed that the personal characteristics of the deceased closely resembled those reported in the literature of poisoning in other countries. More than two-thirds of patients with acute poisoning were found to be men, a statistic demonstrated in both Poland (9) and Iran (10). Unlike the sex of the patients, however, age has not been consistent among studies; a paper in Turkey (11) found the majority of patients to be below 25, while China (5) found the elderly to be most at risk. While this may be partially explained due to cultural differences, it does indicate that poisons potentially pose a threat to all demographics. Our own study reports a mean age of 29 years, albeit with a high variance.

The substance most commonly used among all age groups was found to be organophosphates. This is no surprise, as the presence of organophosphates as a poison has been apparent across the Asian subcontinent for decades, with studies in both India and Pakistan finding it to be among the more widely used substances for either suicidal or homicidal intent at different points in time (12-16). Pakistan, in particular, suffers due the widespread use of organophosphate compounds in common household items. One noteworthy finding was the use of Dichlorvos (2,2-dichlorovinyl dimethyl phosphate), an organophosphate commonly used as part of the pesticide 'Typhon'. It was implicated in 48 cases, accounting for nearly a quarter of all deaths, possibly because of its rapid-acting and highly toxic profile (17).

One previous study in Pakistan found that abuse of drugs, therapeutic or recreational, was the most common reason for mortality due to poisoning, rather than organophosphates (18). Our study found this to be the second most common cause, with a total of 29 cases being caused by either drugs of abuse or overdose of therapeutic drugs, although the latter was a small contributor. Interestingly, the identity of the patients diagnosed with a heroin overdose was not established, as they brought in to hospital by bystanders. This may suggest that the number of cases observed does not

Table 3. Association between the class of poison consumed and gender of patients reporting to the NPCC in Karachi, Pakistan 2013-2019

Poison Classification	Gender					
	Male		Female		Total	
	No.	Percentage	No.	Percentage	No.	Percentage
Organophosphates	78	38.2	55	27	133	65.2
Heroin/ opioid	21	10.3	1	0.5	22	10.8
Corrosive (acid/ alkali)	12	5.9	5	2.5	17	8.3
Heavy Metal	0	0.0	1	0.5	1	0.5
Paraphenylenediamine	2	1.0	5	2.5	7	3.2
Cocaine	2	1.0	0	0.0	2	1.0
Antidepressants	6	2.9	0	0.0	6	2.9
Unidentified	16	7.8	0	0.0	16	1.8
Total	137	67.2	67	32.8	204	100

$\chi 2$=30.952, DF=7, p-value < 0.001

represent the actual burden as it is dependent on someone being present to report the overdose.

Of the remaining cases, the only standout substances were Methanol and Paraphenyldiamine (PPD), being used in 8 and 7 cases, respectively. Alcohol intoxication being of low incidence is worth noting, especially when compared to developed countries, where it is often one of the more commonly reported causes of poisoning (9,19). This disparity may be because the distribution of alcohol as liquor is largely restricted in Pakistan. This decreases the methanol toxicity cases, which are usually linked to methanol being consumed as a contaminant of drinking alcohol. This finding may also be due to the largely Muslim area in which the hospital is situated; higher incidences of methanol poisoning in areas of Pakistan with larger Christian demographics have been documented (20). PPD is used mostly as a cheap hair dye and there is scant mention of it as a poison except in developing countries (21). It has previously been documented as a cause of suicidal poisoning among women in Pakistan (22), a finding that our study may attest to, with the majority of cases being among housewives.

One peculiar observation in our study was a total lack of cases of Aluminum Phosphide (AP) poisoning. AP poisoning was labeled as the second most common cause of unintentional injuries in a national health survey of Pakistan (23). A case study conducted in a tertiary care hospital in Lahore showed that AP poisoning was not only one of the most common but also one of the most fatal poisonings, with a mortality rate of 70%. Another study reported a mortality rate of 55-90% (24). The incidence of AP poisoning has increased greatly in recent years due to its easy accessibility and low cost. Most of the available literature on AP poisoning in Pakistan is based in Punjab with scarce documented reports in Karachi. This may show an important relationship between social and environmental factors such as the provincial region and the variation in types of poisons used.

In terms of management, all cases of suspected poisoning were subjected to immediate gastric lavage. Where enough information was present, either by a clinical history or by the patient's symptoms, to reach a diagnosis, substance-specific treatment was started. Interestingly atropine, the treatment for OP poisoning, was only administered to a quarter of the patients, even though OP poisoning accounted for more than half of all the deaths. This may have been due to an inability to quickly identify symptoms and formulate a treatment plan, or a reluctance to administer it for fear of exacerbating the patient's condition when the offending substance remains undetermined.

The management of OP poisoning has been discussed extensively in the open literature, and while there exist a wide the current accepted protocol recommends the use of atropine, diazepam, and an oxime in the treatment of an acute case (25). However, the use of oximes, particularly that of Pralidoxime (PAM), has been a subject of much controversy. A recent meta-analysis (26) determined that there was no benefit to the inclusion of pralidoxime in the treatment of OP poisonings. However, an RCT performed in 2016 found that, if administered in a dosage adjusted according to different parameters, rather than a fixed dose, pralidoxime can be a lifesaving drug (27). Despite the controversy, however, pralidoxime is still used in treatment of acute OP poisoning. Interestingly, while the use of atropine was noted for certain cases of OP poisoning, pralidoxime use was not recorded in the cases in our study.

On expiry, the mechanism of death for the vast majority of patients was noted only as a cardiopulmonary event. While not incorrect, this is vague, as the particular modes of action of the different poisons vary. For example, OP poisoning causes death by inducing a paralysis of the respiratory muscles, as well as the brain's respiratory center (25). Two cases, however, featured kidney injury so severe that it was considered directly responsible for the patients' deaths. One of these was notably due to PPD poisoning, while the other was an unidentified poison.

LIMITATIONS

There are limitations to this study. One is that the study

design was retrospective in nature. Also, the small sample size and the fact that data was obtained from only one center, despite it being centrally placed, detract from the power of the analyses. Children under the age of 13 were not included in the study, as cases of poisoning in this age groups are not processed by medicolegal officers. We were also unable to collect data on whether the poisoning was intentional or accidental. This information is an essential tool for analysing demographic data within the study itself, as well as with other studies in the literature. In addition, data on the time since poisoning was difficult to attain for the majority of cases due to factors such as insufficient clinical history, or patients that had been transferred from poorly-equipped local healthcare facilities, without an accompanying history. Another limitation is that the records did not contain socioeconomic data on the patients. That being said, the general population that visits SMC is low to middle class. Since we did not exclude patients based on history of exposure, patients with drug addictions may also be included in the sample. We analysed the poisons and their associated epidemiology without a previously decided on criteria i.e. on a post hoc basis, so poisons other than the ones mentioned are not included in the study. Finally, although the cause of death is fully confirmed by a formal autopsy in all cases, we were unable to access the records and individually parse them for information that may have been of interest.

CONCLUSION

Poisoning is a serious threat to all demographics. The mortality can by and large be attributed to substances that can be easily obtained and are widely used. This perhaps indicates a gap in safety measures, and calls for tighter regulation standards. Moreover, since the majority of cases were associated with OP poisoning, treatment standards should be looked into and updated wherever possible to be able to better manage cases. Current medical research suggests a treatment regimen supplementing the use of atropine with oximes and diazepam (22), and hospitals should look to adopting this approach, if they have not already.

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