Epidemiology of Organophosphate Poisoning in the Tshwane District of South Africa

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ABSTRACT

BACKGROUND: Organophosphate poisoning is a major public health problem in South Africa. Individuals get exposed to organophosphate in both the domestic and industrial spheres.

METHOD: A cross-sectional study was conducted using retrospective, secondary data of organophosphate poisoning cases over a 3-year period, reported at the Tshwane District surveillance office. Data were analysed using Microsoft Excel, and Epi Info version 7 was used for descriptive statistics.

RESULTS: A total of 207 cases were reported with ages ranging from 10 months to 59 years. Most of the cases were men (58.9%). Intentional poisoning accounted for 51% of cases. Unintentional poisoning accounted for 21.7% of cases, and 26.5% of cases had unknown circumstances of poisoning. A significant number (50.2%) of intentional poisonings were suicide related. Nonsuicidal cases accounted for 47.4% of cases, and deliberate unlawful poisoning accounted for 2.4% of cases. The mortality rate for the whole group was 3.4%.

CONCLUSIONS: Improvement in data collection on organophosphate poisoning is essential to properly measure the burden of the problem. More effective regulatory controls for pesticide use are needed in South Africa.

KEYWORDS: Organophosphate poisoning, surveillance, gender, suicide, policy, public health intervention

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Introduction

Organophosphate poisoning is a major public health problem in developing countries, resulting in significant morbidity and mortality.[1] Although the actual incidence of organophosphate poisoning is difficult to establish due to challenges of collecting data for surveillance, it is estimated to cause 250 000 to 350 000 deaths per year globally.[2,3]

There has been a marked increase in organophosphate poisoning in developing countries due to the widespread use, which makes it readily available and leads to indiscriminate handling and storage accompanied by lack of awareness of the consequences of poisoning.[4] Individuals are exposed to organophosphates during domestic and industrial use, such as insecticides, nerve gases, ophthalmic agents, and herbicides. Extensive use, and availability, of pesticides in South Africa increases the chances of poisoning and long-term health effects.[5,6]

South Africa has a routine notification system for reporting on notifiable medical conditions. The notification system is a passive surveillance system. The notification of certain medical conditions is mandatory in terms of the National Health Act.[7] Organophosphate poisoning is one of these notifiable health-related conditions. The medical practitioner or nurse practitioner who diagnoses the condition is obliged by law to complete a Notification of Medical Condition form which contains patient details (address, age, gender, and ethnic group) and details of the medical condition (date of onset and place of onset). The system is thus a paper-based system, and the form is then submitted to the district office.

Organophosphate poisoning is the most common pesticide poisoning in developing countries.[8] There have been few studies done in South Africa on organophosphate poisoning. Most of the works have been done in Cape Town in the Western Cape Province. There is a need for studies in other provinces, such as Gauteng Province, as the community is exposed to organophosphate in the marketplace and occupationally as farmworkers. Although data relating to organophosphate poisoning are routinely collected in Tshwane District, no systematic analysis has been performed in recent years, mainly due to staff shortages and lack of expertise. This lack of analysis and the need to determine the extent of the problem in Tshwane District were raised at a management meeting at the district office, and this study was undertaken at the request of the District Manager.

Organophosphate products, such as insecticides and pesticides, continue to be accessible at marketplaces in the district without proper monitoring.

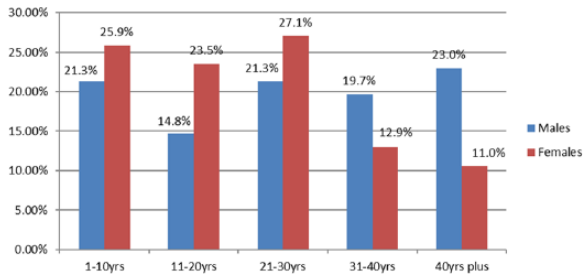

Figure 1. Organophosphate poisoning by age group and gender (n = 207).

Research Methodology

This was a cross-sectional study. These cases were reported to the surveillance office at Tshwane District, Gauteng Province, in terms of the National Health Act[7] that requires notification of organophosphate poisoning. The variables in the data collection tool included age, gender, circumstances of poisoning, subdistrict where it happened, season of occurrence (using the epidemiologic calendar), and outcome after poisoning. The data reviewed were from January 2012 until December 2014. Data were captured from health facilities such as community health centres and hospitals (health care workers such as medical doctors and professional nurses complete a paper-based notification form which is then sent to the surveillance officer via fax or scanned email). One of the problems often encountered with disease notification systems is that of underreporting; this is also true for the South African notification system. Unfortunately, no recent studies have been done to estimate the degree of underreporting in South Africa. The data were analysed using Excel spreadsheets and thereafter analysed using Epi Info version 7 to calculate descriptive statistics. Ethics approval for the study was obtained from the Medunsa Research Ethics Committee of the Faculty of Health Sciences of the University of Limpopo.

Results

Records of 207 reported cases were reviewed retrospectively. Most of the organophosphate poisoning cases reported were men (58.9%). However, women below 30 years were significantly affected by organophosphate poisoning (Figure 1). The ages of poisoning cases ranged from 10 months to 59 years (Table 1).

Intentional poisoning with organophosphates occurred in 51.7% of the cases, with 21.7% of cases being accidental and 26.6% of cases of unknown circumstances. In this study, 'unknown circumstances' represents cases that were indicated as unknown and those with missing information. The data had no information related to organophosphate poisoning due to occupational exposure. A significant number (50.2%) of the intentional poisonings were suicide related. Nonsuicidal cases accounted for 47.3% of cases, and deliberate unlawful poisoning accounted for 2.4% of cases. Information indicating collaboration with police services for cases of unlawful poisoning was also not available. The mortality rate for the whole group was 3.4% (Tables 1 and 2).

Table 1. Frequency of study variables.

STUDY VARIABLES	FREQUENCY	PERCENTAGE
Age range (n = 207), y		
1-10	48	23.2
11-20	38	18.3
21-30	49	23.7
31-40	35	16.9
40+	37	17.9
Gender (n = 207)		
Female	85	41.1
Male	122	58.9
Circumstances of poisoning (n = 207)		
Accidental	45	21.7
Intentional	107	51.7
Unknown	55	26.6
Intentions related to poisoning (n = 207)		
Suicide	104	50.2
Nonsuicidal	98	47.3
Deliberate unlawful poisoning	5	2.4
Outcome (n = 207)		
Survived	200	96.6
Died	7	3.4

Table 2. Frequency of study variables by gender.

CIRCUMSTANCES OF POISONING (N = 207)	MALE, %	FEMALE, %
Accidental	20.5	23.5
Intentional	53.3	49.4
Unknown	26.2	27.1
Suicidal behaviour		
Suicidal (n = 104)	61.5	38.5
Nonsuicidal (n = 98)	56.3	43.7
Outcome		
Survived (n = 200)	98.4	94.1
Died (n = 7)	1.6	5.9

Most of the notified organophosphate poisoning cases occurred in persons under the age of 40 years (79.8%) (Figure 1).

Most of the notified cases were from the public sector facilities (88.4%), whereas the private sector reported only 11.6% of the cases. Suicidal ideation was found in 50.2% of all the cases.

Table 3. Organophosphate poisoning associated with suicidal ideation at subdistrict level (n = 104).

GEOGRAPHIC AREA	PERCENTAGE
Subdistrict 1	50.9
Subdistrict 2	23.2
Subdistrict 3	8.3
Subdistrict 4	1.9
Subdistrict 5	0
Subdistrict 6	15.7
Subdistrict 7	0

Table 4. Seasonal variation of organophosphate poisoning at Tshwane District.

SEASONS	FREQUENCY	PERCENTAGE
Summer	53	25.6
Autumn	47	22.7
Winter	50	24.2
Spring	57	27.5

Of the suicidal cases, 50.9% were from subdistrict 1 (Table 3). A significant number of the poisoning cases were from the township areas where a large number of people are from the lower socioeconomic group. The seasonal variations of organophosphate poisoning occurred in spring and summer, which were 27.5% and 25.6%, respectively, at Tshwane District (Table 4). Intentional poisoning occurred predominantly at the beginning of the week on Sundays (21.5%) and Mondays (21.5%).

Discussions and Conclusions

Organophosphate poisoning surveillance data from this study show that more men (58.9%) than women (50.2%) were affected, with 50.2% of the cases related to suicide. However, women below 30 years of age were significantly affected by organophosphate poisoning. These findings are consistent with a previous South African surveillance study over a decade ago, which reported 67% of cases being men and more than 50% suicide related.[9]

No cases of organophosphate poisoning associated with occupational exposure were notified at Tshwane District. South African farmworkers have been reported as having a high risk of suicide using pesticides as they have access to them.[10] Occupational exposure may be underreported where farmworkers are exposed to agricultural stock remedies. This may result in policymakers focusing on suicide-related poisoning.[9] Another Tanzanian study indicated that 59.8% of cases were men. The number of cases related to occupational exposure was very small in both studies.[8] Another reason that none of the reported cases were linked to occupational exposure may be the fact that Tshwane District is not a major agricultural area.

Two studies which confirm male predominance in organophosphate poisoning are from Sri Lanka and Taiwan with 57% and 64.9% of cases, respectively.[11,12] However, in a South African and a Taiwanese study, there were more female cases of acute poisoning with pesticides where most were related to organophosphate poisoning.[13,14]

This study found that 51.7% of organophosphate poisonings were intentional, whereas 21.7% were accidental and 26.6% had unknown circumstances. Similarly, a study from India showed 64.6% of cases of intentional poisoning, 34.4% of accidental poisoning, and 1% of unknown circumstances.[2] In contrast, a study in Nicaragua focusing on acute poisoning reported that 90% were related to occupational exposure and 7% to domestic exposure, whereas only 3% were related to intentional exposure.[15]

Accidental organophosphate poisoning is more common among children due to household pesticides[2,16] or occupational exposure. In this study, 23.2% of cases were children between the ages of 1 and 10 years. This correlates well with previous South African studies.[13,16] It is of serious concern that in this study deliberate unlawful poisoning accounted for 2.4% of cases, with 4 of the 7 fatalities being children under 10 years of age.[16,17,18,19] There was no indication whether there was collaboration with the police services to resolve the cases concerned.

When the results were stratified according to subdistricts, it was found that more than 80% of the cases were from semirural subdistricts, especially subdistrict 1. Subdistrict 1 has been reported as has having limited economic and employment opportunities. The residents in subdistrict 1 are from the lower socioeconomic grouping and are predominantly black Africans. This link with socioeconomic status was also found in other studies from Sri Lanka and China.[11,20]

In this study, seasonal variations of organophosphate poisoning occurred predominantly in spring and summer, which were 27.5% and 25.6%, respectively, at Tshwane District. The increase could be related to agricultural work that escalates during rainfall seasons at Tshwane District, which is spring, continuing to the summer season. Intentional poisoning occurred predominantly at the beginning of the week on Sundays (21.5%) and Mondays (21.5%). This could be due to anxiety to start something new, such as a new week, especially for individuals who are vulnerable and feeling depressed.

In this study, there was a case fatality rate of 3.7%, which is in keeping with another South African study which had a case fatality rate of 2.4% and also correlates with other developing countries.[12,15,21]

One problem encountered with this study was the amount of incomplete information in the surveillance reports. The study was done using data gathered via a passive disease-reporting system which is known for underreporting. Most often, this is the result of lack of knowledge or diligence in

health workers or time constraints in an overburdened health system. Thus, although the results obtained in the study give some insight into the existing problem in Tshwane District, they should be interpreted with some caution. Should there have been significant underreporting in the District, the magnitude of the problem could be far greater.

Another limitation of the study was its retrospective, cross-sectional study design which limits causal inferences. The study does not include all the districts in South Africa, and hence, the results cannot be generalised. However, the study provides essential information on organophosphate poisoning surveillance, circumstances around the poisoning, and fatality rates in Tshwane District.

Recommendations

There is need for strengthening of the surveillance system for pesticide poisoning (including organophosphates) in all districts in South Africa. Surveillance should be strengthened in both the public and private sector facilities, and there must be intersector collaboration to properly monitor the problem. Surveillance systems should be able to link the poisoning cases to the supply area and name of the product involved. The better the surveillance system, the more the community will benefit from targeted interventions. There is a need for research into the extent of underreporting in the current notification system, as well as on the reasons cases are not reported.

There is need for community awareness about organophosphate poisoning, especially in the highly affected areas. Better regulatory control of pesticide handling and use will also reduce the burden of pesticide poisoning.

This problem is still underresearched in South Africa, and further studies are needed so that robust intervention can be put in place.

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Author Contributions

LLR conceived and designed the experiment, analysed the data, and wrote the first draft of the manuscript. PGDR contributed to the writing of the manuscript, agree with manuscript results and conclusions, jointly developed the structure and arguments for the paper, made critical revisions, and approved the final version. All authors reviewed and approved the final manuscript.

Disclosures and Ethics

As a requirement of publication, author(s) have provided to the publisher signed confirmation of compliance with legal and ethical obligations including, but not limited to, the following: authorship and contributorship, conflicts of interest, privacy and confidentiality, and (where applicable) protection of human and animal research subjects. The authors have read and confirmed their agreement with the ICMJE authorship and conflict of interest criteria. The authors have also confirmed that this article is unique and not under consideration or published in any other publication, and that they have permission from rights holders to reproduce any copyrighted material. Any disclosures are made in this section. The external blind peer reviewers report no conflicts of interest.

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