Notification of pesticide poisoning in the western Cape, 1987 - 1991

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Abstract **There is a paucity of data on pesticide-related morbidity and mortality in South Africa. A review of notifications to the western Cape office of the Department of National Health and Population Development from 1987 to 1991 was undertaken to describe the epidemiological profile of pesticide poisoning in the region. Two hundred and twenty-five cases of pesticide poisoning were identified, of which the majority were from rural areas. Farmers, farm workers and their families were most frequently involved in poisoning events, which included accidents arising outside of work-place production (44%), self-inflicted injury (35%) and direct occupational contamination (11%). Farm pesticide stores were the most frequent source of pesticide and a seasonal variation in the trend of poisoning events could be discerned; this corresponded to agricultural spraying practices in the region. The mortality rate was significantly higher among those with self-inflicted injury, particularly farm workers. A concurrent review of hospital admissions for 1991 found that 78% of cases had not been notified. In view of the key role of surveillance in reducing pesticide-related morbidity and mortality, a call is made to improve notification of pesticide poisoning so as to facilitate control of an important potential public health problem.**

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Despite their role in protecting crops and maintaining food production, pesticides pose considerable health risks to those exposed both occupationally and environmentally. The World Health Organisation estimates that 1 million unintentional acute poisonings occur worldwide every year, with between 5 000 and 20 000 fatalities.[1] In underdeveloped countries the major causes of pesticide-related morbidity and mortality are occupational exposure among rural workers[1-4] and suicide.[2,4-6] Accurate description of the extent of the problem is prevented by the absence of data on poisonings in many rural settings, and by the problem of underreporting.[1,2,4-6]

Research data available in South Africa on the extent of health problems related to pesticides and other agrichemicals, and on their usage and control, are scant. Poisoning caused by paraquat and organophosphate insecticides have been reported to be an important reason for admission to respiratory intensive care units of hospitals[7] while incidents of pesticide poisoning made up 9 - 13% of Poison Centre consultations at Red Cross Children's Hospital in Cape Town in 1987.[8] A similar study of childhood poisoning in the Orange Free State in 1988 found that 12% of poisonings involved pesticides.[9]

In terms of the Health Act, pesticide poisoning is a notifiable condition. Between 100 and 150 cases were notified in 1990 and 1991, with a case-fatality rate of about 7%.[10,11] However, incidence rates in South Africa based on notification are difficult to establish because of undernotification.[12,13] A study of registered deaths in 1977 found that fewer than 5% of deaths found to be due to pesticide poisoning at the Salt River police mortuary in Cape Town had been notified[14] while a review of records at a small rural western Cape hospital found that only 10% of the 90 cases of pesticide poisoning seen at the hospital in 1989 and 1990 had been notified.[15] Similarly, published reports of Poison Centre data from Bloemfontein,[9] Cape Town[8] and Johannesburg[15] include numbers of consultations for possible pesticide poisoning far in excess of national notifications.

In the absence of clear information on the extent and risk of acute poisoning, it is difficult to plan public health intervention aimed at controlling this important potential health hazard. To address this need for information, a review of all pesticide poisonings notified to the Western Cape Regional Office of the Department of National Health and Population Development (DNHPD) between 1987 and 1991 was undertaken. The study aimed (*i*) to describe the incidence and demographic profile of fatal and non-fatal pesticide poisonings in the western Cape; (*ii*) to identify any patterns in the circumstances surrounding pesticide poisoning, in particular, whether the incident was farm-related; and (*iii*) to identify any risk factors pertinent to primary and secondary prevention of poisonings.

In a separate exercise, a survey of all Cape Provincial Administration (CPA) and province-aided hospitals in the western Cape ($N = 55$) was undertaken to ascertain the number of hospital admissions for pesticide poisoning in 1991 and to gauge the extent of undernotification.

Methods

All cases of pesticide poisoning notified to the regional director of the DNHPD are referred to the local authority health inspectorate for investigation of the circumstances of the poisoning. Reports are then centralised at the regional office of the DNHPD. This study reviewed reports for the years 1987 to 1991. Data on the age, gender, educational level, residence and occupation of all subjects who suffered pesticide poisonings were collected, as well as information on the type and the source of pesticide involved, and whether the outcome was fatal. The immediate circumstances surrounding the event were recorded in terms of whether: (*i*) the poisoning was occupational, accidental or self-inflicted; and (*ii*) whether it occurred on a farm or at a site independent of a farm.

In order to assess patterns in the circumstances of poisonings, data on farm workers and non-farm workers were analysed separately. Included in the former category were farmers, those employed as farm workers and

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their families, while the category of non-farm worker included those subjects who were not connected with a farm in any way. Additional variables considered in the attempt to establish a pattern were the source of the poison, the immediate circumstances giving rise to the poisoning and seasonal variations in poisoning incidence.

The criterion for a child was an age of 16 years or younger. Where there was uncertainty about the chemical responsible for the poisoning, the local authority health inspector identified the most likely chemical implicated. Data were collected by a single trained reviewer (S.R.).

Superintendents of CPA- and province-aided hospitals in the western Cape region (Fig. 1) were surveyed by means of a postal questionnaire for details of patients admitted for pesticide poisoning in the period January to December 1991. A response rate of 91% was achieved. Teaching hospitals, particularly Tygerberg and Groote Schuur Hospitals, which do not form part of the administrative western Cape region of the CPA, were not included.

Differences in proportion of categorical data were compared by means of χ^2-tests, and odds ratios (ORs) were calculated as measures of association with 95% confidence intervals.[16] Exact limits were used where the cells in contingency tables were small.[16]

Results

Two hundred and twenty-five cases of pesticide poisoning were notified between 1987 and 1991. Table I lists the number of cases by year, and Fig. 1 shows the geographical distribution of notifications. Over 80% of cases notified were reported from rural areas of the western Cape.

TABLE I.
Pesticide poisonings in the western Cape — notifications to DNHPD, 1987 - 1991

Year	No. of poisonings
1987	58
1988	44
1989	36
1990	28
1991	50

Data on 9 subjects missing.

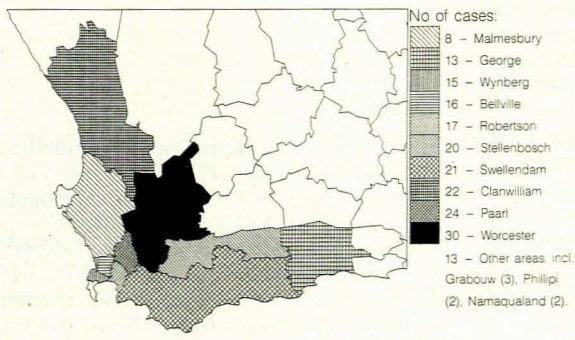
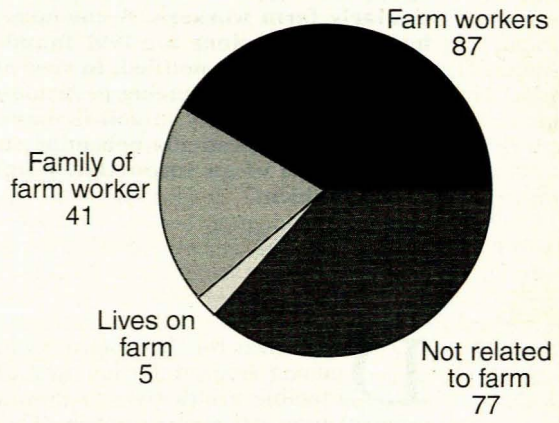


FIG. 1.
Geographical distribution of pesticide poisoning notifications, 1987 - 1991.

Age and gender distribution of cases are shown in Fig. 2. Thirty per cent of cases involved children 16 years old or younger, and 18% involved pre-school children. Males constituted 70% of all cases and 65% of children under 6 years of age. Only 12% of patients were white, the majority (78%) being coloured.

FIG. 2.
Demographic characteristics of pesticide notifications, 1987 - 1991.

The majority of cases (61%) of poisoning involved farm workers, farmers or their families (Fig. 3). This percentage was similar for children (66%) and included 7 who were reported to be farm workers. The commonest pesticide types implicated in poisoning events were organophosphates (68%), carbamates (9%) and organochlorines (5%). In only 6% of cases was the chemical responsible entirely unknown.



No data available on 8 subjects.

FIG. 3.
Characteristics of subjects.

The circumstances of poisonings are summarised in Fig. 4 and the seasonal variation in cases is shown in Fig. 5. Seventy-one per cent of childhood poisonings were accidents, but a small number were the result of occupational exposure (7%) and self-inflicted injury (5%). A seasonal variation was noted in the incidence of notified poisonings, with a rise from September to February, and a single peak in May. Analysis of this trend in respect of subgroups was not possible given the small numbers in the sample.

The commonest source of a poison was reported to be a farm pesticide store (40%), particularly where poisonings involved farm workers; the percentage was sometimes as high as 80%. For non-farm-related poisonings the commonest sources were household stock (49%) or over-the-counter purchases at a shop or co-operative (30%). Sources of poison in cases of childhood poisoning were evenly divided between farm stores (41%) and purchase in a shop (41%). However, among farm children who were poisoned, the most frequent source was the farm pesticide store (74%; $N = 23$). Only 10% of poisonings overall could be traced to an over-the-counter purchase.

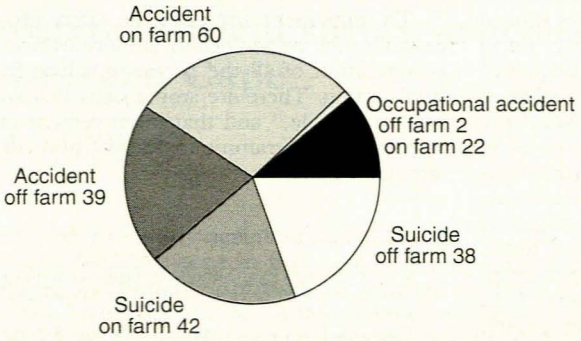


FIG. 4.
Circumstances of pesticide poisoning, 1987 - 1991.

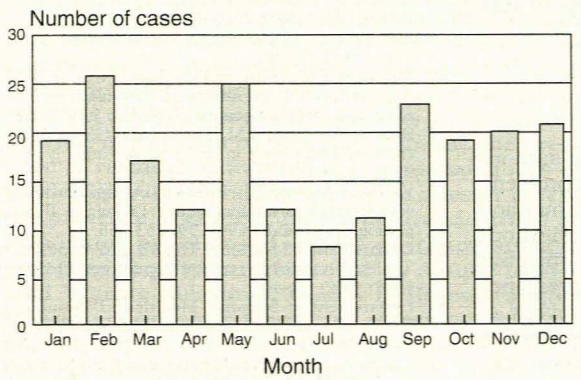


FIG. 5.
Seasonal variation in pesticide poisoning.

The overall case-fatality rate among notified poisonings was 12% and the rate among farm poisonings (14,6%) was not significantly different from that of non-farm poisonings. Among children, the case-fatality rate was 4% and was significantly lower than that of adults (OR = 0,26; 95% CI = 0,05 - 0,91). The risk of a fatal outcome was significantly higher in a suicide attempt (OR = 3,34; 95% CI 1,36 - 8,29) than in non-self-inflicted poisonings. Among those with a self-inflicted injury, the risk of a fatal outcome was higher among farm workers than others (OR = 4,13; 95% CI 1,06 - 19,36). The majority of patients (97%) received treatment within 48 hours of the event and there was no relationship between the duration until treatment and (*i*) likelihood of a fatal outcome; (*ii*) the age of the subject; and (*iii*) the type of subject.

Of the 17 cases in which the responsible pesticide could not be accurately identified, 11 were farm-related, a proportion not significantly different from that for the non-farm population. Fifty-nine per cent of adult farm workers who were involved in a poisoning had 5 years or less of schooling while the equivalent percentage for non-farm workers was 22%. This difference was statistically significant (OR = 5,55; 95% CI = 2,23 - 14,14).

Of the 135 cases of pesticide poisoning admitted to CPA hospitals in 1991, only 30 (22%) notifications could be traced at the DNHPD regional offices. A further 20 cases were reported by the hospitals as having been notified, but no notification could be traced.

Discussion

Surveillance has been identified by the WHO as a key element in control of the problem of acute pesticide poisoning.[1] Evidence in this study, consistent with experience elsewhere in South Africa[12,14,15] and overseas,[1,4,6,17] suggests that notification consistently underestimates the extent of acute poisoning events. This underreporting factor can be used to estimate the true incidence of pesticide poisoning, with population estimates for the region[18] as denominator and the number of yearly notifications as numerator. In this study, the population incidence rates for pesticide poisoning in the region for the years 1987 to 1991 would range from about 4/100 000 (1990) to 8,7/100 000 (1987) with the most recent rate being 7/100 000 in 1991. On the basis of census data for the denominator,[18] the incidence rate in 1991 for farm workers was approximately 25/100 000 and for the rural population of the region, 23/100 000.

However, hospital admissions for pesticide poisoning may represent a particular sub-population that are more likely to be notified than those patients who do not reach hospital.[4,17] For example, private practitioners may, for various reasons, be less likely to notify poisoning events.[19] Moreover, the survey was based on hospital self-reporting with the likely effect that hospitals may have tended to err on the side of overstatement of notification.

It is apparent that pesticide poisoning is a problem of the farming areas with over 80% of cases being reported from rural areas of the western Cape. While the western Cape contains only 11% of the total population and 17% of farm workers in the country,[18] 37% of all notified poisonings nationally in 1991[10] were reported from the region. There appear to be three patterns in the profile of pesticide poisoning: (*i*) accidental poisoning of adults and children, involving both a farm worker group and people unconnected with farms; (*ii*) self-inflicted injury among adults; and (*iii*) occupational poisoning involving adult farm workers.

Accidental poisoning constitutes 40% of reported notifications and 70% of childhood poisonings. Sources of poison were frequently farm stores, but, for non-rural subjects, purchase from a retailer was an important source. Self-inflicted injury remains an important concern in pesticide safety. Almost one-half of adult notifications involved suicide attempts, and there was a significantly higher risk of fatal outcome with self-inflicted injury compared with other causes, particularly in farm workers, who constituted more than one-half of the patients with self-inflicted injury. Unauthorised access to farm stores is clearly an important point of intervention to prevent pesticide mortality and morbidity. The higher risk of a fatal outcome among farm workers may be related to the larger quantities and higher concentrations kept in pesticide stores, and does not appear to be explained by possible delays in treatment.

Workplace poisoning in the course of occupational exposure forms a small but significant proportion of cases. It should be noted that many of the accidental events that occur on farms are indirectly linked to occupation, through access, location and familiarity. Such events should also be addressed in promoting workplace safety in the agricultural sector. There is a growing worldwide realisation of the diversity of work-related disease and of the many different ways in which work may impact on human health.[20]

Prevention of childhood poisoning should be an important target of pesticide safety programmes in public health. While poisoning accidents have been recognised as an important risk for children, there were also 4 cases of self-inflicted injury and 5 cases of work-related poisoning, reflecting the use of child labour in the agricultural setting. Studies overseas have identified children as particularly vulnerable to workplace pesticide poisoning.[3]

The above data locate the problem of notified pesticide poisoning primarily in the agricultural setting,

where farm workers as a group had much lower education levels than other patients with poisoning. Farm workers, farmers or their families were most frequently involved in accidents, both immediately in the course of their work and outside of formal work. They were also involved in 50% of the self-inflicted injury cases in which they experienced a poorer outcome. Farm stores were the most important source of the poison and seasonal variation in the patterns of poisoning suggest a trough in winter (Fig. 5). This trend appears to follow the seasonal pattern of use of pesticides on the grape and fruit farms that form the major component of the region's agricultural sector, and may reflect greater opportunity for access during the spraying season. The presence of a peak in May could be traced partly to the occurrence of two multi-case accidents in 1988 and 1991 involving accidental ingestion of pesticides. The data were too sparse to analyse sub-populations of subjects meaningfully.

Conclusion

Improved surveillance will enable public health authorities to assess more accurately the extent of the problem, identify important areas for preventive programmes and evaluate the impact of such interventions. Methods employed in other countries to achieve this objective have included the use of Poison Centre Surveillance Networks,[21,22] the use of hospital records,[23] review of statutory medical illness reports[24] and the introduction of active surveillance that relies on cholinesterase testing.[25]

Data in this study have identified patterns in poisoning events that require intervention, particularly with regard to access to chemicals. Given undernotification, it is unclear whether these patterns are generalisable to less severe cases that are less likely to be notified. In response to the results of this and other studies, a pilot surveillance project in a selected rural area of the western Cape is planned, which aims to develop a method to improve surveillance for pesticide poisoning.[26]

In addition, the health inspectors of the local authority remain the key health care promoters in the control and prevention of pesticide poisoning. Their vigilance and follow-up of notified cases, rapport with the farming community, and liaison with general practitioners can play an invaluable role in improving awareness and preventing future incidents. To optimise the running of a surveillance programme, documentation and reporting should be made as concise and useful as possible, and to some extent, improvements in these areas have been made with the introduction of a new form (Epidemiological Investigation: Toxicology, DNHPD, Pretoria, 1993).[26] Such changes will assist in meeting the WHO recommendations for establishing a standardised reporting system that will distinguish intentional from unintentional poisonings, and that will identify preventable factors.[1]

To implement any pesticide safety programme successfully, the public health authorities need to have the co-operation of all the parties involved in the agricultural setting. There are ample signs that such co-operation is possible,[26] and that improvement in surveillance as part of a programme to address pesticide safety is an attainable goal.

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