Acute diazinon poisoning in sheep breeders in Sibiu County (Romania)

Horațiu Dura¹, Silviu Morar¹*, Adrian Boicean¹

Abstract: The study aims at highlighting accidental and intentional acute diazinon poisoning regarding a series of 24 cases recorded between 2006 and 2015 in Sibiu County (Romania). All exposures have been by ingestion, of which in two thirds of cases it was accidental, the rest of them being suicides. A total of 8 cases had fatal outcomes, 7 of them passing away before any resuscitation manoeuvre could have been performed. In most cases (n=21) poisoning occurred in rural people having as main activity sheep breeding. Women and men were affected in almost equal proportions. The victims belonged to all age groups, including children. In 18 of these cases, the level of education was at most secondary school. The majority of cases (n=22) occurred during peak periods of pastoral activity. The last 5 years of the study period recorded an upward trend in the number of poisoning cases.

The study demonstrates that those who practice traditional sheepherding represent a vulnerable population, given the relative isolation of such communities, the low educational level and the fact that toxic substances are routinely stored in homes (because the residential area overlaps with the occupational one).

Key Words: diazinon, accidental poisoning, suicide, sheep breeders.

Diazinon is a non-systemic organophosphate insecticide worldwide and commonly used to control agricultural soil-dwelling insects and livestock ectoparasites [1-3]. Originally, diazinon was developed in 1952 to replace the DDT insecticide [4, 5]. WHO classifies diazinon as a “moderately hazardous pesticide” or “slightly toxic” [1, 5].

Diazinon toxicity derived from its ability to combine with acetyl cholinesterase and to activate it [4-7]. Symptoms of acute toxicity include: muscarinic effects, nicotinic effects, central nervous system damage [6, 8]. In high exposures, cardiac and respiratory failure may occur, leading to death in the absence of timely treatment intervention [8, 9].

The annual incidence of pesticide poisoning in industrialized countries is estimated at 18.2/100,000 agricultural workers [10], but morbidity, mortality and their global distribution are little known and greatly under-reported [11]. Morbidity and mortality vary between different regions of the world, being significantly higher in the developing regions as a result of inadequate regulations, lack of adequate monitoring of this field, lack of staff training, and increased share of farmers and breeders in the general population [11-14].

Pesticide self-poisoning is one of the most frequently used methods of suicide worldwide. The proportion of pesticide suicides varies from 4% in the European Region to over 50% in the Western Pacific Region [15-18]. Some studies emphasize that the number of pesticide suicides directly correlates with the socio-economic level of the country or region, not with the amount of the pesticide sold in the region; these particular suicides are most frequent in the rural areas [19, 20].

Since early 1960s, many reviews raised concerns about organophosphate pesticides in general

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and diazinon in particular because of their sub-standard production and the hazards over humans and environment [2, 21]. Many industrialized countries (e.g. US, Canada, UK) phase out the indoor and outdoor residential use of diazinon [7, 21, 22], considering pesticides an “issue of concern” [23-25].

In Romania, the substance is marketed under the trade names of Diazinon, Diazinol or Neocidol 600g/L, being commercialized under prescription [26].

**MATERIALS AND METHODS**

We conducted a retrospective observational epidemiological study on a series of 24 cases of acute non-lethal and lethal diazinon poisoning registered in Sibiu County (Romania), between January 2006 and December 2015, registered in the casuistry of the Forensic Service of Sibiu County. Data were collected from the medical and forensic records (including toxicology and autopsy reports).

**RESULTS**

Between 2006 and 2015, 24 cases of acute diazinon poisoning were recorded. Sex ratio (M/F) was 1.18. Poisoning victims came mainly from rural areas (21 cases). In all cases the victims were directly connected to sheep breeding activities. Most victims (21 cases) had a low level of education (7 cases were unschooled, 8 cases with primary education and 6 cases with secondary education). Only 6 cases had high school education. There was no one with higher education in the study group (See Table 1).

All poisonings recorded during the study period were produced by the ingestion of the substance (oral entry route). There have been 15 cases of accidental (unintentional) exposure to diazinon and 9 cases of attempted suicide. Of the 24 cases of acute intoxication, 8 had fatal outcomes. Of these, 7 cases died before any manoeuvre to preserve life could have been performed and one case died later, in hospital. There have been 5 deaths among the 15 patients with accidental ingestion of diazinon (15 cases), respectively 3 deaths of those 9 cases of voluntary ingestion (see Table 2).

In terms of distribution of cases by age groups, the largest number of victims was registered in the age bracket of 50-59 years (10 cases). Two cases were identified in children (0-9 years), another two in the 20-29 year-old decade, 3 cases in 30-39-year-old-decade, 3 cases in 40-49-year-decade and 4 cases in persons over 60 years old. No case has been identified in the age bracket 10 to 19 years (see Fig. 1).

There is a constantly increasing trend in the frequency of diazinon poisoning cases during the study period. During the first 5 years of the study, 9 cases of acute poisoning were recorded (resulting in 3 deaths), with a peak frequency in 2008 (5 cases), whereas in the last 5 years of the study there were 15 cases of poisoning (that resulted in 5 deaths), with a peak frequency of 5 cases in 2015 (see Fig. 2).

<table>
<thead>
<tr>
<th>Gender</th>
<th>Place of residence</th>
<th>Education level</th>
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<tbody>
<tr>
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<td>No education</td>
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<td>13</td>
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<td>7</td>
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Table 1. Cases distribution according to gender, place of residence, education level

<table>
<thead>
<tr>
<th>Non-intentional (accidental)</th>
<th>Intentional (self-poisoning)</th>
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<tbody>
<tr>
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<tr>
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<td></td>
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<td>5</td>
<td>9</td>
</tr>
<tr>
<td>Non-lethal</td>
<td>Lethal</td>
</tr>
<tr>
<td>6</td>
<td>3</td>
</tr>
</tbody>
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Table 2. Distribution of cases by type of exposure and poisoning outcome
Seasonal distribution of poisoning reveals that the largest share of poisonings occurred during the peak periods of pastoral activity: 22 of the 24 cases of poisoning being registered during May-October (see Fig. 3).

DISCUSSIONS

Sheep breeding in Sibiu County is a century-old traditional activity that occurs mainly in households or family associations. In 2013, 4,055 households dealing with sheep breeding were registered in this county [27]. Workers are in most cases family members and day labourers. Many of the methods used for sheep breeding are traditional, sometimes empirical. Within this context, pesticides, as well as other substances used in animals' breeding are stored in households or sheepfolds, in unsuitable conditions for health safety. This can lead to accidents and to their use for suicide purposes as well. It is significant that most of the diazinon poisoning victims in the study group came from rural areas and were directly involved in the activities of animals breeding (animal keepers or members of their families).

Given that 18 of the 24 victims had secondary education at the most, and 7 of them did not have any education, it is obvious that low level of schooling is associated with a higher rate of poisonings of accidental nature. These findings are consistent with the data cited in literature, confirming that morbidity and mortality are more frequent in rural population with a low level of education and in the developing countries' population, which represent a vulnerable group [11-14, 28].

Almost two-thirds of the cases in our study were by accidental ingestion. A study conducted in Switzerland identified 60 cases of intoxication, of which only 5 cases were accidental exposures [8], as opposed to similar data from the developing countries, where the share of accidental and occupational poisoning cases is much higher [11-14]. These results prove the impact of differences between the regulatory level of agriculture and the level of education of staff in the two regions;

from this point of view, the pastoral communities in Sibiu County are closer to the model in the developing countries rather than those of the industrialized ones.

Both in unintentional poisoning, and in the intentional one, in the study group death occurred in 1 of 3 patients, while the above-mentioned study [8] reveals a mortality of 1 to 11 cases of accidental acute intoxication. Increased mortality of patients in the study group can be explained by the low accessibility of pre-hospital emergency intervention services, in the context of geographical isolation of sheep breeding communities and as a result of the rugged terrain that makes it difficult to reach these communities.

Both genders and all age groups are at risk, the most affected age brackets being the 50-59-year-decade and the 60+ year-decade, which is understandable by the fact that the younger population is oriented towards other, more modern, economic sectors and towards a less traditional lifestyle. Younger ages, including children (2 cases of 0-9 years old) still remain at risk of accidental exposure within these communities, because these toxic products are stored in the household.

CONCLUSIONS

The process of European integration of Romania has led to a significant development and harmonization of regulations in the zoo technical field, consisting of more stringent measures regarding the handling of toxic substances and the trend to restrict their use in residential areas (households). However, in the communities of traditional animal breeders (such as the sheep breeders in Sibiu County), with low educational level, who operate in conditions of relative isolation, these measures seem to have a reduced efficiency, making them vulnerable populations.

Our study shows that in the absence of a correct and sustained implementation of the regulations regarding the use of potentially toxic substances in these communities, we will not witness a decrease of the incidence of such poisonings. In order for these measures to have effect, it is necessary to take into account the specificity of these vulnerable populations, especially with regard to the overlap of the residential and occupational area, leading to the permanent storage of these substances in households that makes them accessible for accidental or suicidal use.

Both literature data and the results of our survey demonstrate that fatal and non-fatal poisoning with diazinon can be prevented through a better knowledge of how to use and store toxic substances, especially among at-risk populations.

Conflict of interest. The authors declare that they have no conflict of interest concerning this article.
References


