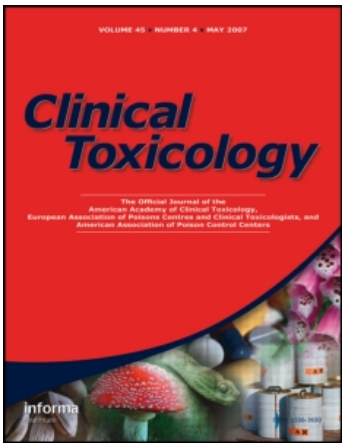

Clinical Toxicology
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713597279

Poisonings with pesticides in the Federal District of Brazil

Eloisa D. Caldas [a]; Fernanda M. Rebelo [b]; Viviane O. Heliodoro [a]; Andrea F. A. Magalhães [c]; Rafaela M. Rebelo [d]
[a] Department of Pharmaceutical Sciences, Laboratory of Toxicology, University of Brasilia, Brasilia, DF, Brazil [b] Department of Economic Assistance in Regulation, Brazilian National Health Surveillance Agency, Brasilia, DF, Brazil [c] Center of Toxicology and Assistance of the Federal District, Brasilia, DF, Brazil [d] Coordination of Environment Evaluation of Substances and Products, Brazilian Institute of Environment and Renewable Natural Resources, Brasilia, DF, Brazil

First Published:December2008

To cite this Article Caldas, Eloisa D., Rebelo, Fernanda M., Heliodoro, Viviane O., Magalhães, Andrea F. A. and Rebelo, Rafaela M.(2008)'Poisonings with pesticides in the Federal District of Brazil',Clinical Toxicology,46:10,1058 — 1063
To link to this Article: DOI: 10.1080/15563650802530443
URL: http://dx.doi.org/10.1080/15563650802530443

Clinical Toxicology (2008) **46**, 1058–1063

ISSN: 1556-3650 print / 1556-9519 online
DOI: 10.1080/15563650802530443

informa
healthcare

ARTICLE

Poisonings with pesticides in the Federal District of Brazil

ELOISA D. CALDAS[1], FERNANDA M. REBELO[2], VIVIANE O. HELIODORO[1], ANDREA F. A. MAGALHÃES[3], and RAFAELA M. REBELO[4]

[1]*Department of Pharmaceutical Sciences, Laboratory of Toxicology, University of Brasilia, Brasilia, DF, Brazil*
[2]*Department of Economic Assistance in Regulation, Brazilian National Health Surveillance Agency, Brasilia, DF, Brazil*
[3]*Center of Toxicology and Assistance of the Federal District, Brasilia, DF, Brazil*
[4]*Coordination of Environment Evaluation of Substances and Products, Brazilian Institute of Environment and Renewable Natural Resources, Brasilia, DF, Brazil*

Introduction. Pesticides are the second major cause of poisoning in Brazil, but information about the chemicals involved and the clinical management of patients is scarce. *Methods*. This study is a retrospective review of 709 pesticide cases reported to a toxicological information center from 2004 to 2007. *Results*. Over 90% of the cases occurred after accidental or self-poisoning; more than 60% of the accidents involved children up to 4 years old, mainly with domestic pyrethroid insecticides. One hundred ninety-four cases involved *chumbinho*, an illegal rodenticide known to contain acetylcholinesterase inhibitor insecticides, mainly aldicarb. In about half the cases, the individuals were admitted to hospitals. Those poisoned with acetylcholinesterase inhibitors stayed longer and most of them displayed pronounced clinical signs of poisoning (Poisoning Severity Score grades 2–4); 14 of the 18 deaths reported occurred with these products. Atropine was given to about 30% of the individuals, including to some with no cholinergic symptoms or exposed to non-acetylcholinesterase inhibitors. All 81 poisonings with coumarin were asymptomatic, but in half of the cases the individuals received vitamin K. *Conclusions*. The lack of laboratory support to confirm the chemical involved in the poisonings certainly contributed to the unnecessary antidote administration. In spite of continuing government efforts, poisoning with *chumbinho* is still a major problem in the country.

Keywords Pesticide; Acute poisoning; Organophosphate; Carbamates; Chumbinho

Introduction

Pesticide poisoning is a major public health problem in some countries. The International Labor Organization estimates that pesticides annually cause 70,000 fatal and a much larger number of non-fatal poisonings among agricultural workers (1). Gunnel et al. (2) estimated that between 233,997 and 325,907 deaths occur each year from pesticide self-poisoning, accounting for about one-third of suicides globally. Pesticide exposure represents a human health problem in developing countries, mostly because of the availability of highly toxic compounds and the unsafe use, storage, and disposal of the products (3). According to the Brazilian National Poisoning Information System (4), more than 8,000 cases of poisonings with pesticides are reported each year in the country, accounting for 34.4% of all deaths from exogenous poisoning in 2005. Pesticides were involved in 7.7% of all fatal suicides that occurred in 2005 in Brazil (5).

The Brazilian pesticide market has grown steadily in the last decades, doubling its sales between 1996 and 2006, placing it fourth in the worldwide ranking (6). By January 2008, about 1,300 formulations were registered for agricultural use in the country, 42% of which were classified by the Brazilian government as extremely or highly toxic (7). Brazil has pesticide legislation that regulates all aspects of pesticides, including registration, commerce, and use (8). Legally, no pesticide can be sold without the presentation of an agronomic prescription issued by technical personnel, and its use in the field requires formal training. However, the law is poorly enforced, especially in certain remote regions of the country. One major example of pesticide misuse is the illegal rodenticide called *chumbinho* (small shot) formulated with registered agricultural products, mainly aldicarb. In Brazil, all registered rodenticides are coumarin compounds, which include the first generation hydrocoumarin warfarin (coumafene), coumachlor, and coumatetralyl, and the second generation long-acting rodenticides (LAAR) brodifacoum and bromadiolone (9).

The aim of this study was to characterize pesticide exposures in the Federal District, a predominantly urban area.

Received 18 August 2008; accepted 6 October 2008
Address correspondence to Eloisa D. Caldas, Department of Pharmaceutical Sciences, Laboratory of Toxicology, College of Health Sciences, University of Brasilia, University Campus 70910-900, Brasilia, DF, Brazil. E-mail: eloisa@unb.br

Methods

This is a retrospective study of data on pesticide exposures reported to the Center of Toxicology and Assistance of the Federal District (CIAT-DF) between 2004 and 2007. Information gathered by the Center was put into a "report card" and transferred into an Epi-info/2000 computer program for analysis. Information included the date and circumstances of the exposure, the chemical(s) involved, sex and age of the patient, hospital admission, clinical effects, medical management, laboratory data, and outcome. Whenever information was incomplete or unclear in the Center records, additional data were obtained from the patient record at the hospital where the patient was treated. When information was not available, it was classified as ignored.

Results

A total of 709 poisoning cases involving pesticide products were reported to the CIAT-DF during the study period, 62.8% through telephone calls and 37.2% through hospital epidemiological units. The cases were evaluated together in this study. Thirteen cases also involved medications and 10 cases involved ethanol. The most common exposure route was ingestion (84%), with fewer numbers via the dermal or respiratory route. The majority of cases occurred at the domicile (91%), among individuals living in urban areas (86.3%), and among men (51.4%). Unintentional poisoning and self-poisoning accounted for 47 and 44% of the cases, respectively. Occupational poisoning occurred in 35 cases. Other known circumstances were inappropriate use (nine cases), food contamination (six cases), homicide/violence (three cases), and abortion (two cases). The circumstances were unknown in 45 cases.

Almost one-third of the cases occurred in children aged 1–4 years, 94.5% of which were unintentional exposures. Two of the nine cases in children ≤1 year of age involved homicide/violence. Most of the self-poisoning cases (54.3%) occurred in individuals aged 15–29 years; in 14 cases they were 10–14 years old. Women represented 54.2% of the self-poisoning cases; this circumstance was involved in 18 of the 23 cases where the pesticide was ingested with medications or ethanol. The majority of the cases occurring during occupational activity involved men between the ages of 20 and 39 years.

Chemicals in poisoning cases

Table 1 shows the distribution of the poisoning cases according to the circumstance and the chemical involved. A total of 51 compounds were identified from the reports; the most frequent were aldicarb, chlorpyifos, cypermetrin, and brodifacoum. In 155 cases, neither the chemical group nor the

Table 1. Chemical group/name and the circumstances involved in intoxication cases in the Federal District reported to the CIAT-DF from 2004 to 2007

Chemical group	Compound	Total	Accidental	Self-poisoning	Occupational	Others/ignored
Chumbinho[a]		*194*	*67*	*111*	*0*	*16*
Coumarin		*82*	*39*	*41*	*0*	*3*
	Brodifacoum	35	17	18	0	1
	Bromadiolone	18	11	6	0	1
	Others/ignored	28	11	17	0	1
Pyrethroid		*147*	*83*	*45*	*7*	*12*
	Cipermethrin	78	49	23	1	5
	Deltamethrin	49	22	19	3	5
	Others/ignored	20	12	3	3	2
Organophosphate		*62*	*21*	*25*	*9*	*7*
	Chlorpyrifos[b]	11	5	2	3	1
	Dichlorvos[b]	11	7	3	1	0
	Others/ignored	40	9	20	6	6
Carbamates		*24*	*9*	*9*	*5*	*1*
	Carbofuran	8	3	2	2	1
	Aldicarb	3	0	3	0	0
	Others[c]/ignored	13	6	4	3	0
Others		*52*	*19*	*18*	*10*	*5*
Ignored		*155*	*81*	*50*	*3*	*21*
	Total[d]	709	314	295	35	65

[a]Aldicarb associated or not with organophosphate.
[b]Include two associations with cypermethrin.
[c]Include three associations with cypermethrin.
[d]Total of poisoning cases.

chemical name was reported; some were identified by general terms such as rodenticide, insecticide, or poison.

More than half of the 276 cases involving rodenticides were because of self-poisoning, mainly (70.3%) with the illegal *chumbinho*, a product prepared mostly with aldicarb (Table 1). Eighty-two cases involved coumarin rodenticides, mostly brodifacoum and bromadiolone (53 cases). In at least 13 cases, other illegal rodenticides were involved, including two products reported to contain strychnine and sodium monofluoracetate, compounds not registered in Brazil.

Pyrethroid insecticides (primarily cypermethrin and deltamethrin) were mostly involved in unintentional poisonings with domestic products (Table 1). Chlorpyrifos and dichlorvos the main organophosphates (OPs), and carbofuran the main carbamate insecticide involved in the poisonings, were mostly formulated for agricultural use. The organochlorine pesticides such as aldrin, DDT (1,1,1-trichloro-2,2-bis (4-chlorophenyl)ethane), and lindane (gamma-hexachlorocyclohexane) were involved in nine poisoning cases. Other pesticides included glyphosate and almitraz, involved in 9 and 14 cases, respectively.

A total of 18 deaths were reported during the period, with a total case fatality rate (CFR) of 2.5%. Fourteen cases involved AChE inhibitors, and 10 cases involved *chumbinho*. Considering only the 280 cases involving AChE inhibitors (including seven associated with pyrethroids), the CFR was 5.0%; a similar rate was found when only the 194 *chumbinho* cases were considered (5.2%). Fifteen fatal cases were because of self-poisoning by adults between 17 and 60 years of age, including one associated with medication and one with ethanol. Three fatalities were unintentional – one involving a 3-year-old child poisoned after playing in the home garden recently treated with thiamethoxam; one involved a 9-year-old child poisoned with an unknown ant killer in the house; and the third one involved the unintentional ingestion of *chumbinho* by a male of unknown age.

Clinical symptoms and medical management

In 14 reported cases, calls were made to the Center by individuals asking how to treat the intoxication. Most of these cases involved mild exposures through respiratory or dermal route. Headache and nausea were the main symptoms reported. In general, the individuals were told to seek fresh air and/or wash the exposed body area, and to seek medical advice if the symptoms persisted.

Intoxicated individuals took between 5 min and 5 days to seek medical assistance after the first effects occurred. Almost half were admitted to hospitals where they stayed from 1 to 33 days. Fig. 1 shows the distribution of the main chemical groups involved in the reported poisoning cases, according to hospital admission and period of stay, when this information was available. Over 60% of the individuals poisoned with AChE inhibitors and coumarin compounds were admitted to hospitals, most of them staying for a maximum of 2 days. Over 20% of the individuals poisoned with AChE inhibitors who required admission to a hospital stayed for over 5 days. Thirty-six percent of the individuals poisoned with pyrethroids were admitted to a hospital, most of them staying for only one day (Fig. 1).

Table 2 shows the Poisoning Severity Score (PSS) of the reported cases based primarily on symptoms (10). Over 70% of all cases, 76.1% of the pyrethroid cases, and over 90% of the cases with ignored agent had no symptoms or signs related to poisoning (score 0) or were classified as minor severity (score 1). Over 50% of the 280 cases with AChE inhibitors

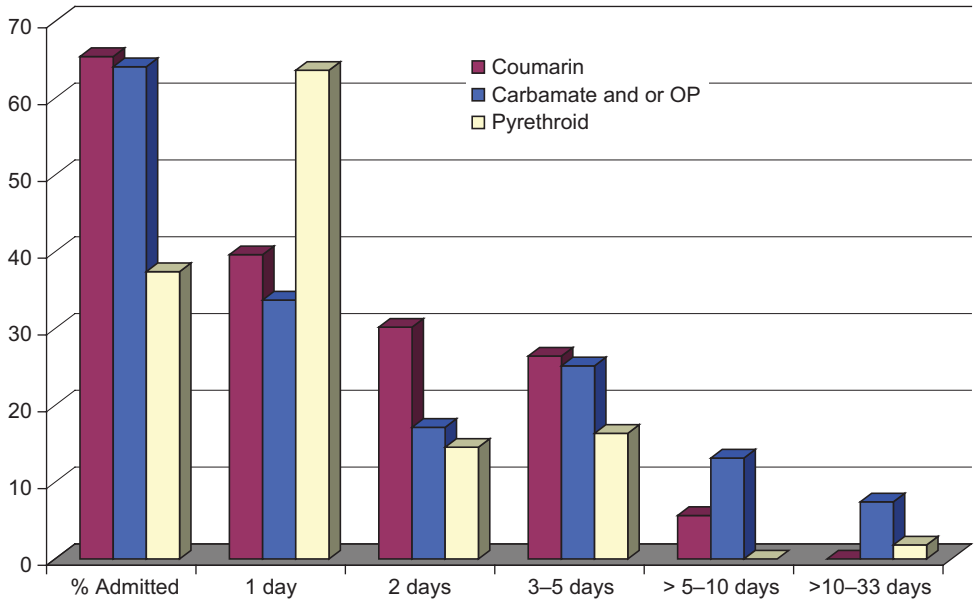

Fig. 1. Percentage of individuals admitted to hospitals (poisoned individuals) and time of stay (of individuals admitted) according to compound classes.

Table 2. Poisoning severity score

Group	(0)	Minor (1)	Moderate (2)	Severe (3)	Fatal (4)
Carbamate/OP[a]	11	124	69	62	14
Coumarin	77	5	0	0	0
Pyrethroids	22	90	12	15	1
Others	9	25	7	10	1
Ignored	43	98	9	3	2
Total (%)	162 (22.8)	342 (48.2)	97 (13.7)	90 (12.7)	18 (2.5)

(0), no symptoms or signs related to poisoning; (1), mild, transient, and spontaneously resolving symptoms; (2), pronounced or prolonged symptoms; (3), severe or life-threatening symptoms; and (4) death.
[a]Include seven associations with pyrethroid.

(carbamate and OP) were classified as moderate, severe, or fatal.

The main muscarinic symptoms reported by individuals intoxicated with AChE inhibitors were miosis, salivation, and vomiting (22–33% of the patients exposed to these compounds). Sweating and tachycardia were the main nicotinic symptoms reported, and agitation the main neurological symptom. In over 20% of the cases involving other or unknown chemicals, individuals reported cholinergic symptoms, including vomiting, miosis, bronchorrhea, tachycardia, and salivation.

The hospital medical management of patients exposed to *chumbinho*, OP, or carbamate compounds is shown in Table 3. Fifty-one patients who received atropine did not show any muscarinic symptoms, 18 of whom were exposed unintentionally, and 11 reported being exposed to non-AChE inhibitors or to unknown compounds. All 14 individuals who died after AChE inhibitor ingestion received atropine at the recommended dose (2–4 mg every 15 min), and three also received an oxime.

Typical symptoms reported by 7–19% of the individuals after oral ingestion of pyrethroids evaluated in this study included vomiting, salivation, dizziness, and nausea. Two individuals progressed to coma. The only lethal case involving pyrethroid was a pregnant woman found having convulsions, with a syringe and a commercial product containing cypermethrin next to her; she presented an injection sign in the antecubital region. The patient was admitted about 1 h later, unconscious and with severe miosis, indicating the possibility of AChE inhibitor ingestion. She was intubated and administered atropine 4 mg every 15 min intravenously. She died 6 h after admission.

None of the 82 individuals who reported being orally exposed to a coumarin rodenticide presented symptoms of coagulopathy or bleeding. Some patients showed non-specific symptoms such as vomiting, nausea, and epigastria. Prothrombin times were performed in 30 patients, and five presented prolongations. Regardless of any laboratory results, vitamin K was administered to 77 individuals, 40 of whom were exposed to coumarin compounds. Thirty-eight LAAR cases received gastric lavage, 24 of whom were children under the age of 6 years.

Discussion

The profile of pesticide poisoning cases reported to the CIAT-DF is consistent with what has been found at the national level in recent years by the SINITOX (5,11). The total CFR found here was similar to what was reported in 2005 for other areas in the Midwestern region (2.4%); at the national level, the rate was 1.8%, but reached 4.1% in the Northeastern region of the country. These rates are higher than what was found in England and other developed countries (up to 0.5%), but much lower than in some Asian countries, where the CRF for OP compounds may reach 45% (12).

Table 3. Management of patients poisoned with AChE inhibitors

	Antidote			Decontamination[a]		
Group, No. of individuals	Atropine	An oxime	Both	Gastric lavage	Activated charcoal	Both
Chumbinho, 194	122 (62.9%)	22 (11.3%)	20 (10.3%)	153 (78.9%)	52 (26.8%)	49 (25.3%)
Organophosphate, 62[b]	35 (56.4%)	16 (25.8%)	16 (25.8%)	30 (48.4%)	7 (11.3%)	7 (11.3%)
Carbamate, 24[c]	17 (70.8%)	0	0	10 (41.6%)	5 (20.8%)	5 (20.8%)

The number of individuals are expressed in percentage (%). The percentage is relative to each group of poisoned individuals.
[a]Percentage relative to those orally exposed only.
[b]Include four associations with pyrethroids.
[c]Include three associations with pyrethroids.

The number of poisoning cases reported to the Brazilian toxicological information centers, however, is highly underestimated (11,12). The under-reporting in the Federal District is clear when one compares the fatal cases involving pesticides reported to the CIAT in 2005 (three cases) with those reported to the National Mortality Information System (19 cases) (5). Hence, the data presented here may not be representative of all poisoning cases that occurred in the Federal District during the period of the study.

Chumbinho, a major product involved in the poisonings, was responsible for almost one-third of all cases with a known chemical group. This product was also the most lethal, with a CRF higher than what was found for this product in Rio de Janeiro in 1993 (4%) (13). *Chumbinho* contains primarily aldicarb (13,14), registered in Brazil for soil application on potato, coffee, sugar cane, and citrus farms. Aldicarb can only be commercialized in the states of São Paulo, Minas Gerais, and Bahia, but *chumbinho* is sold illegally with no label in most Brazilian cities. Physically, *chumbinho* is characterized as small gray-colored bullets, which can be found in the gastrointestinal tract following large ingestions (14).

This product was first introduced in the country in the city of Rio de Janeiro during the mid-1980s, and acute poisoning with this illegal product has been a major problem in many Brazilian urban centers since then. In 1993, 189 cases were referred to the Poison Control Center of Rio de Janeiro (13); between 2000 and 2002, *chumbinho* caused over 300 deaths in the city (14). In the Northeastern state of Bahia, nearly 4,000 individuals were poisoned with *chumbinho* between 2000 and 2006, mostly because of self-poisoning (15). In the Northern state of Pará, almost 80% of the 158 reported self-poisoning cases that occurred between 1998 and 2001 involved *chumbinho* (16).

In an attempt to reduce the incidence of poisonings with *chumbinho* in the country, the manufacturer of aldicarb, following recommendation from the Brazilian Government, has included a bittering agent in the product since 2002. The addition of a colorant and an emetic in the formulation has also been considered by the Government, which also increased the market control over the product (17). These actions have led sellers to use other less restricted pesticides in *chumbinho* preparation. In a study to identify the compounds present in illegal granular rodenticides sold in 2004/2005 in free markets of Belém, in the north region of the country, 55% of the 120 samples analyzed by thin layer chromatography gave positive results for carbamate, 20% for OP, 15% for carbamate and OP, and 5% for coumarin compounds (18). Currently, there are no available data to estimate whether the poisoning cases involving *chumbinho* have changed in the country in the last years or whether the use of less toxic compounds in the product has decreased its CFR. We did not find any specific trend on the number of *chumbinho* cases in the Federal District over the years; the higher CFR occurred in 2006 (13%).

Poisonings from exposure to insecticides illegally used for rodent control have been reported elsewhere. Lifshitz et al. (19) evaluated 35 cases of ingested rodenticide containing methomyl or aldicarb resulting in carbamate poisoning that occurred in Israel between 1985 and 1995. In 2001, Nelson et al. (20) reported 35 cases referred to the New York City Poison Control Center that involved the ingestion of *Tres Pasitos*, a rodenticide shown to contain aldicarb. All patients were originally from Dominican Republic, where the product is commonly available.

Diagnosis of AChE inhibitor poisoning should ideally be confirmed with an assay to measure butylcholinestease (BChE) activity in plasma or AChE in erythrocytes (10,21). In Brazilian hospitals, these assays are rarely available and in the present study, plasma BChE activity was measured in only six patients exposed to AChE inhibitors. Analytical confirmations of the involved chemicals were not performed in patient biological material or for any of the products involved in the poisoning cases. Hence, unless clinical signs clearly indicated otherwise, product information was obtained from the patient or a person responsible for the patient. In a study conducted in a Japanese Medical School Hospital, the results of analysis were consistent with the information provided by the patient in 72% of 96 cases of intoxication with pesticides; in the remaining cases, either no information was obtained upon consultation, or the results of analysis were not consistent with the information provided (22).

Over 50% of the patients exposed to AChE inhibitors displayed pronounced clinical signs of poisoning (PSS grades 2–4), but the frequency of cholinergic effects was low compared to other reports. In a study of 30 patients with confirmed ingestion of *chumbinho* admitted to the emergency of a university hospital in Rio de Janeiro, 15 to over 90% of patients showed muscarinic signs (23). Similar results were found by Saadeh et al. (24) when evaluating 70 adults poisoned with carbamate or OP pesticides. In the cases involving *Tres Pasitos* in the USA, 71% of the patients reported miosis, 54% salivation, and 51% lethargy or coma (20). It is possible that not all individuals considered having ingested AChE inhibitors in the present study were actually exposed, mainly when the cases involved preschool children (25).

In the present study, atropine was administered to 41 patients reported to be exposed to AChE inhibitors but they did not show any cholinergic signs. Eleven asymptomatic patients exposed to pyrethroids or to unknown compounds also received atropine. An oxime was administered to 22 individuals reported to have ingested *chumbinho*, a procedure not recommended for carbamate poisonings (26). All the coumarin poisoning cases evaluated in this study were asymptomatic. Asymptomatic poisonings occurred in the majority of the 16,109 cases involving coumarins in the United States (27). Clinically significant anticoagulation after a single small ingestion of coumarin compounds is actually found to be rare in most studies (28). In the guidelines recently published by the American Association of Poison Control Centers (29), gastric lavage is not recommended for patients

exposed to LAAR and decontamination should be performed only with activated charcoal; administration of vitamin K is not recommended prior to evaluation for coagulopathy. In the Federal District, almost all LAAR-poisoned patients, including accidentally exposed children, received gastric lavage and vitamin K was administered to 35 patients with either normal prothrombin time or to patients with no laboratory results.

Conclusions

This paper indicates that poisoning with the illegal rodenticide *chumbinho* is a major problem in the Federal District area, following what has been occurring in other regions of Brazil. It is unlikely that the fatal poisonings with this product will decrease in the next years unless the main insecticide used in the *chumbinho* preparation is banned in the country. The size of Brazil and a limited surveillance program make it impossible to control the use of this illegal product in the country. The present study also showed that the management of the poisoned patients in the hospital was not always adequate, mainly with the unnecessary administration of antidotes. In some cases, appropriate patient management was compromised by the lack of laboratory support to confirm the chemical involved in the poisonings.

Acknowledgments

We thank all professionals from the CIAT-DF for the assistance provided during the data gathering. Scholarship for VOH was provided by CNPq.

References

1. International Labor Organization (ILO). World Day for Safety and Health at Work 2005: A Background Paper. In: Focus Programme on Safe Work. Geneva: International Labour Office; 2005:16 pp.
2. Gunnell D, Eddleston M, Phillips MR, Konradsen F. The global distribution of fatal pesticide self-poisoning: systematic review. BMC Public Health 2007; 7:357–398.
3. Konradsen F, van der Hoek W, Cole DC, Hutchinson G, Daisley H, Singh S, Eddleston M. Reducing acute poisoning in developing countries – options for restricting the availability of pesticides. Toxicology 2003; 192:249–261.
4. Sistema Nacional de Informação de Informações Tóxico-Farmacológica (SINITOX). Fundação Oswaldo Cruz. www.fiocruz.br/sinitox/sinitox_principal_ 2005.htm. Accessed 21 October 2008.
5. DATASUS/SIM. Sistema de Informações de Mortalidade (SIM). Brazilian Ministry of Health. http://tabnet.datasus.gov.br/cgi/deftohtm.exe?sim/cnv/extuf.def. Accessed 21 October 2008.
6. Watkin S. World Crop Protection Markets. DS 247. London, UK: Agrow Reports; 2004: 178 pp.
7. Sistema de Informação de Agrotóxicos (SIA). Agência Nacional de Vigilância Sanitária (ANVISA), 2002. http://www.anvisa.gov.br/toxicologia/sia.htm. Accessed 21 October 2008.
8. Brazilian Pesticide Regulation. Decreto N° 4.074. Diário Oficial da União; Poder Executivo, 8 January 2002, Brazil.
9. Monografia de Produtos Agrotóxicos. Agência Nacional de Vigilância Sanitária (ANVISA), 2008. http://www.anvisa.gov.br/toxicologia/monografias/index.htm. Accessed 21 October 2008.
10. Persson HE, Sjöberg GK, Haines JA, Pronczuk de Garbino J. Poisoning severity score. Grading of acute poisoning. J Toxicol Clin Toxicol 1998; 36:205–213.
11. Bochner R. National Poisoning Information System – SINITOX and human intoxication by pesticides in Brazil. Cienc Saúde Colet 2007; 12:73–89.
12. Eddleston M. Patterns and problems of deliberate self-poisoning in the developed world. QJM: Int J Med 2000; 93:715–731.
13. Lima JS, Reis, CAG. Poisoning due to illegal use of carbamates as a rodenticide in Rio de Janeiro. Clin Toxicol 1995; 33:687–690.
14. Lima RK. *Chumbinho*, the Insecticide that Kill People. Rio de Janeiro: Academia de Polícia Silvio Terra. http://www.policiacivil.rj.gov.br/acadepol/ceap/artigos/artigo01.htm. Accessed 21 October 2008.
15. Santos SHJ, Barbosa MGR, Rebouças DS. Poisonings with rodenticides in the state of Bahia, Brazil. Braz J Toxicol 2007; 20(Suppl. 3):265.
16. Magalhães AFA, Moraes MC. *Chumbinho* Poisonings: Etiology and Epidemiology of the Notified Events by the Toxicological Information Center of Belém, Pará. Brazil: Federal University of Pará; 2002. Unpublished.
17. Agência Nacional de Vigilância Sanitária (ANVISA). Nota Técnica da Reavaliação de Ingrediente Ativo Aldicarbe, 2006. http://www.anvisa.gov.br/toxicologia/reavaliacao/aldicarbe.pdf. Accessed 21 October 2008.
18. Vieira JLF, Silva BA, Silva EEG. Chemical identification of granulated rodenticides market in Belém-Pará. Rev Paraense Med 2006; 20:19–21.
19. Lifshitz M, Shahak E, Sofer S. Carbamate and organophosphate poisoning in young children. Pediatr Emerg Care 1999; 15:102–103.
20. Nelson LS, Perrone J, DeRoos F, Stork C, Hoffman RS. Aldicarb poisoning by an illicit rodenticide imported into the United States: Tres Pasitos. J Toxicol Clin Toxicol 2001; 39:447–452.
21. Eddleston M, Buckley NA, Eyer P, Dawson, AH. Management of acute organophosphate pesticide poisoning. Lancet 2008; 371:597–607.
22. Matsuda K, Okamoto M, Ishihara S, Ohkawa M, Ogino R, Tohyama K, Suzuki K. Present condition of the poisoning reason substance analysis in an advanced critical care center. Chudoku Kenkyu 2006; 19:133–139.
23. Moraes ACL. Contribuição para o estudo das intoxicações por carbamatos: o caso do chumbinho no Rio de Janeiro. Escola Nacional de Saúde Pública/FIOCRUZ, 1999, 111pp.
24. Saadeh AM, Farsakh NA, Al-Ali MK. Cardiac manifestations of acute carbamate and organophosphate poisoning. Heart 1997; 77: 461–464.
25. Lévy A, Bailey B, Letarte A, Dupuis C, Lefebvre M. Unproven ingestion: an unrecognized bias in toxicological case series. Clin Toxicol (Phila) 2007; 45:946–949.
26. Eddleston M, Dawson A, Karalliedde L, Dissanayake W, Hittarage A, Azher S, Buckley NA. Early management after self-poisoning with an organophosphate or carbamate pesticide – a treatment protocol for junior doctors. Crit Care 2004; 8:R391–R397.
27. Bruno GR, Howland MA, McMeeking A, Hoffman RS. Long-acting anticoagulant overdose: brodifacoum kinetics and optimal vitamin K dosing. Ann Emerg Med 2000; 36:262–267.
28. Sue M, Hoffman RS. Anticoagulants. In: Lews R, Goldfrank RL, Flomenbaum NE, Lewin NA, Howland MA, Hoffman RS, Nelson LS, eds. Goldfrank's Toxicology Emergencies. 7th ed. New York: McGraw Hill Companies, Inc.; 2002:631–646.
29. Caravati EM, Erdman AR, Scharman EJ, Woolf AD, Chyka PA, Cobaugh DJ, Wax PM, Manoguerra AS, Christianson G, Nelson LS, Olson KR, Booze LL, Troutman WG. Long-acting anticoagulant rodenticide poisoning: an evidence-based consensus guideline for out-of-hospital management. Clin Toxicol (Phila) 2007; 45:1–22.