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Current Status of Rodenticide Intoxication in Brazil: A Preliminary Survey from 2009 to 2011

Solange Papini[1] and Lia Emi Nakagawa[2*]
[1]Supervisão de Vigilância em Saúde Vila Mariana-Jabaquara; Secretaria da Saúde do Município de São Paulo; São Paulo - Brasil. [2]Laboratório de Toxicologia; Instituto Biológico; São Paulo - Brasil

ABSTRACT

The chemical control of rodents with anticoagulant products, especially derivatives of the coumarin chemical group, is legally authorised in Brazil. These products provide effective control and are safe for humans. However, the use of illegal 'rodenticides' has increased in many Brazilian cities recently, accompanied by increased numbers of suicides, homicides, and intoxications. The National Toxicology Information System (Sinitox) registers the number of rodenticide intoxications, including suicides, but does not differentiate between the legal and illegal rodenticides. Intoxications by rodenticides outnumber those by illicit drugs and pesticides. A survey of data from 2005–2011 revealed an average of about 3,800 intoxications per year, about 60% of which were suicides. Many of these intoxications probably involved illegal rodenticides, some with unknown chemical compositions, which confound the data on rodenticide intoxication. This evaluation of Sinitox data highlighted the need to ensure the proper use of the term 'rodenticide' when registering intoxication cases. Intoxication by-products that are not rodenticides, but are erroneously used for this purpose, should be classified separately to improve the quality of information.

Key words: Coumarin, Aldicarb, Paraffin block, Pellet, Powder, '*Chumbinho*'

INTRODUCTION

Large cities provide good conditions for the establishment and proliferation of synanthropic animals, especially where infrastructure (e.g. sanitation, housing) is inadequate (Masi et al. 2009). Among these animals, rodents present a particular in Brazil under such conditions due to their transmission of leptospirosis. Three species with distinct ecological niches are present (*Rattus norvegicus*, *R. rattus*, and *Mus musculus*), but all adapt readily to different environmental conditions, have high reproductive rates and are associated with several human diseases (Rao et al. 2003; Silva et al. 2003).

Rodents are usually associated with dirt, disease, and death, and their extermination is, thus, needed. People typically expect health authorities to resolve rodent problems. Control of these animals has been approached through environmental management (reducing the availability of food and shelter) (Keiner 2005; Papini 2012) and rodenticide application, especially when the infestation is large (Fundação Nacional de Saúde, Brazil 2002). Currently, the most frequently used rodenticides are coumarins, formulated as pellets, paraffin blocks, and powders (Association of Official Analytical Chemists 2002; Fundação Nacional de Saúde, Brazil 2002). These compounds are toxic to the animals if consumed (Fundação Nacional de Saúde, Brazil 2002).

In Brazil, the chemical control of rodents with anticoagulant products, especially derivatives of the coumarin chemical group, is legally

*Author for correspondence: nakagawa@biologico.sp.gov.br

authorised. The active ingredients and formulations of these products are registered in the National Health Surveillance Agency's (Agência Nacional de Vigilância Sanitária) database. These products provide effective control because animals die a few days after contact with the bait. Thus, the animals do not associate the bait with death and continue to consume or exposed to the product, enabling the extinction of the entire colony. Coumarins are safe for humans because they have low concentrations and they have available antidotes too. Papini et al. (2009a; 2011a; 2012) confirmed the molecular stability of the active ingredients (bromadiolone and brodifacoum) in paraffin block and pellet formulations (legal rodenticides) and demonstrated the efficacy of paraffin block formulations over a 10-week period. These studies proved the efficacy of legal products in rodent control.

The use of illegal 'rodenticides', mainly containing agricultural pesticides, is an important cause of mortality in many Brazilian cities (Silva et al. 2010). These products appeal to people because they kill animals immediately upon contact, but they negatively affect the colony control because few animals die and many others refuse the bait. Rats are intelligent and able to associate other animals' deaths with the toxic product. If dominant animals in the colony see young and old rats die after product ingestion, they will refuse the product (Papini 2012).

Most illegal 'rodenticides' are highly toxic and contain active ingredients such as aldicarb (carbamate), known locally as '*chumbinho*' ('the little plumber'). In 2007, a rat extermination effort killed several other animal species in the São Paulo zoo, probably due to the use of illegal products. As about 90% of requests for sanitary control (Papini et al. 2009b) are due to rodents and the use of rodenticides is widespread, this study examined the incidence of rodenticide poisoning in humans in Brazil in 2005–2011.

MATERIALS AND METHODS

Data about rodenticide intoxication occurring in humans between 2005 and 2011 were collected from the National Toxicology Information System (Sistema Nacional de Informações Toxicológicas [Sinitox]) of the Oswaldo Cruz Foundation. The main objective of Sinitox is to collect and enable the analysis of data about poisoning cases occurring nationally. These cases are registered by the National Network of Centres for Toxicological Information and Assistance (Rede Nacional de Centros de Informação e Assistência Toxicológica), comprising 35 units in 19 states of Brazil. Sinitox registers the number of rodenticide intoxication cases, including suicides, but does not differentiate between the legal and illegal rodenticides. *t*-tests (α = 0.05) was used to examine the differences among the regions and form of intoxications and simple linear regression to examine the relationship between the increased numbers of intoxications and suicides.

RESULTS AND DISCUSSION

Rodenticide intoxication cases outnumbered those due to illicit drugs and pesticides during the study period (Sistema Nacional de Informações Toxicológicas 2012). Table 1 presents the annual incidence of rodenticide poisoning and a subset of suicide cases from 2005 to 2011. There was a large number registered cases of suicides during this period, representing about 60% of rodenticide intoxication cases in Brazil. The numbers of suicides by rodenticide increased in 2011 (Sistema Nacional de Informações Toxicológicas 2012).

Table 1- Annual incidence of rodenticide intoxications, included suicides, in Brazil from 2005 to 2011 (data from Sistema Nacional de Informações Toxicológicas 2012).

Year	Intoxication	Suicide
2005	4,404	2,514
2006	4,732	2,816
2007	4,446	2,607
2008	3,008	1,843
2009	2,506	1,362
2010	3,346	2,537
2011	4,209	3,188
Total	26,651	16,867

The percentage of suicides in Brazil increased from 2009 to 2010 (Fig. 1), coinciding with the increased use of non-rodenticides to eliminate the rapidly growing population of rodents. These products are readily available at low cost in many cities, enabling their use for other purposes. According to National Health Surveillance Agency, the aldicarb organophosphate insecticide used as rodenticide was related approx. 60% intoxication cases by pesticide in Brazil all the years, being a serious public health problem (Cintra 2012).

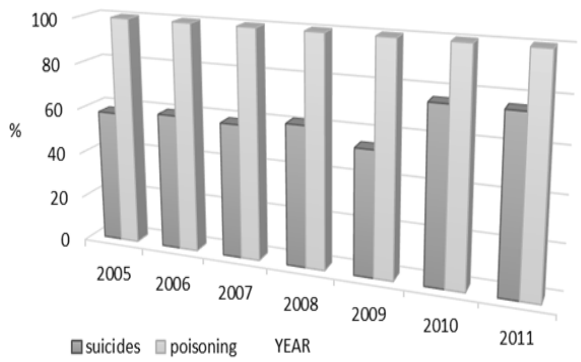

Figure 1 - Trends in rodenticide intoxication in Brazil from 2005 to 2011 (data from Sistema Nacional de Informações Toxicológicas 2012).

Table 2 shows the geographic distribution of pesticide intoxication cases by type in 2009 (Sistema Nacional de Informações Toxicológicas 2012). The relative proportions of accidents and suicides did not differ among the regions (p = 0.07). Although pesticides were not classified according to active ingredient or chemical group and rodenticides were not classified as pesticides, this information was still considered useful for comparative purposes because rodenticides were pesticides.

Table 2- Regional distribution of pesticide intoxication cases by type in Brazil in 2009. Rodenticide intoxications are not included here.

	Accident	Improper use	Suicide	Other	Total
North	162	1	75	14	252
Northeast	284	4	822	29	1,139
Southeast	2,766	54	2,021	346	5,187
South	1,737	2	808	66	2,613
Midwest	1,039	18	887	281	2,225
Total	5,988	79	4,613	736	11,253

In 2005, 2006, 2007 and 2008, there were 14,648 15,909, 15,377 and 11,356 respectively, intoxication rodenticide cases in the Brazil (Sistema Nacional de Informações Toxicológicas 2012), showing similar situation in these years.

Table 3 shows the distribution of rodenticide intoxication cases in 2009; about 50% of cases were accidents and 40% were suicides. The relative proportions of accidents and suicides did not differ among the regions (p = 0.601).

Table 3 - Regional distribution of rodenticide intoxication cases by type in Brazil in 2009.

	Accident	Improper use	Suicide	Other	Total
North	29	0	18	4	51
Northeast	68	0	138	6	212
Southeast	378	0	614	48	1,040
South	337	0	327	9	673
Midwest	217	0	265	11	493
Total	1,066	0	1,362	75	2,506

These data indicated that an average of about 3,800 rodenticide intoxications occurred annually in Brazil in 2005–2011, about 60% of which were suicides. Probably, the recent increase in the number of rodenticide-related intoxications, including suicides (Fig. 1) related to the increased availability of illegal products. The trends of all poisonings and the subset of suicides were closely correlated (84%). On the streets of São Paulo, Brazil's largest city, it is common to see vendors of illegal rodenticides. The use of products containing coumarin are not to commit suicide and infrequently lead to accidental intoxication, probably due to the availability of an antidote, low concentration, and the delayed haemorrhagic effect. Cazenave et al. (2005) and Dantas et al. (2013) reported carbamate (known as '*chumbinho*') as the chemical substance used most frequently in suicides. Furthermore, the unknown chemical content of many illegal rodenticides confounds the intoxication data, but many cases are likely due to the use of illegal products, the effects of which users may not recognise. Thus, nearly all the registered suicides and many other intoxications almost certainly represent illegal rodenticide use.

About 50% of pesticide intoxications due to accidents (n = 1,465) and improper use (n = 24), and 42% (n = 850) of pesticide-related suicides in Brazil between 2005 and 2011 occurred in São Paulo state, although the data did not reflect this distribution (data not shown; Sistema Nacional de Informações Toxicológicas, 2012). In 2009, about 50% (n = 225) of rodenticide-related accidents and 62% (n = 379) of suicides occurred in São Paulo state (data not shown; Sistema Nacional de Informações Toxicológicas 2012).

Poor sanitary supervision in São Paulo city could be a factor contributing to the increased number of intoxications. The removal of illegal rodenticides from the streets and the investment by the authorities in public education regarding the

dangers of these products are condition necessary for controlling this problem. However, in the current context of illegal rodenticide availability, the registration of rodenticide should be necessary to identify the real cause of intoxication in each case.

CONCLUSIONS

It is necessary that the 'rodenticide' should be properly defined. Intoxication by the products that are not rodenticides, but are erroneously used for this purpose, should be classified separately (whether the intoxicant is known or unknown) to improve the quality of information about rodenticide intoxication in Brazil.

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