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Accidental poisoning of preschool children from nonmedical substances, Australia

Peter O'Connor

AIHW

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Abstract

Poisoning of children aged 0-4 years (preschoolers) from nonmedicinal substances is very rarely a cause of death in Australia. Although poisoning from such substances is a common cause of admission to hospital for this age group, few cases require any surgical or other procedures and length of stay is almost always very short. This suggests that a high proportion of cases are admitted for observation following suspected ingestion of a harmful substance, rather than because of evidence of toxic effects. The incidence rate of poisoning of preschoolers from nonmedicinal substances, based on hospitalisations, was higher in the country than in the city, particularly from rodenticides and 'other plants', but also from detergents, shampoos, other cleaning and polishing agents, petrol, solvents, organophosphate insecticides, and corrosive and caustic substances. This is the first time that such differentials have been reported in the medical literature. Rodenticide poisoning's are discussed in some detail as they are common and potentially severe.

Contents

Background

Injury was first recognised as a national health priority area in 1986 (Better Health Commission, 1986). Subsequently, national goals and targets were devised for reducing the incidence and impact of injury on health. One of the indicators of the National Health Priority Areas for Injury Prevention and Control (DHFS, 1998), is the hospital separation rate due to poisoning among children aged 0-4 years (ie. preschool children). The indicator covers poisoning from medicinal and nonmedicinal substances. The Monash University Accident Research Unit have recently addressed poisoning from medicinal substances in preschoolers, and others (as yet unpublished). The present report addresses the parallel issue of poisoning from nonmedicinal substances in preschoolers.

Whilst the NHPA poisoning indicator has been framed in terms of hospital separations, the present report also addresses mortality from nonmedicinal poisoning. The data analysis is limited to the information available to the Research Centre for Injury Studies (RCIS) which consists of:

1. Deaths data provided by the Australian Bureau of Statistics.
2. Hospital separations data provided by the Australian Institute of Health and Welfare (AIHW).
3. Hospital emergency department attendance data collected by the National Injury Surveillance Unit's Injury Surveillance Information System.

A review of the international literature was undertaken, the results of which are assimilated into the discussion section of the report. For brands of rodenticide most commonly involved in emergency department attendances, the product packaging and user instructions were assessed, the results of which are included in the discussion section. Terms used are defined in a Glossary (Appendix 4).

Methods

Data sources

Deaths data

Deaths data are from the Australian Bureau of Statistics (ABS) mortality unit record data collection, 1979-97.

Case definition

The cause of each death registered in Australia is classified by the ABS according to the International Classification of Diseases (ICD). The 9th revision (ICD9) has been used for death registrations beginning in 1979. All deaths given an ICD9 "External Cause" code by the ABS, in the range E860-869 ("Accidental poisoning by other solid and liquid substances, gases, and vapours") are included in this analysis.

Data are presented according to the year in which deaths were registered. Nine percent of deaths registered in 1997 occurred in an earlier year. A similar proportion of deaths which occurred in 1997 will not have been registered until after 1998. Information on these cases is not yet available. State-specific data are presented on the basis of the state or territory in which death was registered. This is normally the one in which death occurred.

Data reliability

The chief question concerns the reliability of information about type of injury death. This depends principally on the information available in coroner's records, and on the reliability of the application of ICD9 E-codes, generally based on that information. Little empirical information is available. There is considerable potential for factors to do with information recording or coding to affect data in different ways for different states and territories. Hence, apparent differences between jurisdictions should be interpreted with caution. Beginning with 1993 registrations, coding has been centralised at the Brisbane office of the ABS.

Hospital separations data

Data sources

Hospital admission statistics are obtained from the Australian Institute of Health and Welfare (AIHW) National Hospital Morbidity Database (AIHW, 1998a). The Database includes data from public acute and Department of Veterans' Affairs hospitals, and private and psychiatric hospitals.

Case definition

Data in this Bulletin are based on the principal diagnosis, which is defined as the diagnosis to be mostly responsible for the patient's admittance to hospital, as well as the external cause associated with the occurrence of the injury. An external cause (E-code) is recorded whenever a patient has a principal or additional diagnosis of an injury or poisoning.

Principal diagnoses and E-codes are classified according to the Australian Version of the International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM). All hospital separations given an ICD-9-CM Chapter 17 "Injury and Poisoning" code for the principal diagnosis (800-999), and an associated E-code in the range E860-869 ("Accidental poisoning by other solid and liquid substances, gases, and vapours"), are included in this report.

Data on patients admitted in any one financial year but discharged in another are included for the year in which they were separated. Records for 1996-97 are for hospital separations in the period 1 July 1996 to 30 June 1997. A record is included for each separation, not for each patient, so patients who separated more than once in the year have more than one record in the database. For incidence estimates, cases transferred from one hospital to another and statistical discharges are excluded, as both are considered to be re-admissions rather than new incident cases. However, for assessment of bed days and average length of stay (ALOS), these cases are included as it is important to assess the total healthcare burden arising from the admission and re-admission of incident cases.

Data reliability

The case selection criteria of the present study are based on the approach recommended in the 1997 NHPA report (DHFS, 1998, p.102). A more recent assessment by NISU (unpublished) suggests that this approach may deliver a low estimate. However, the extent of any underestimation has not been assessed.

Hospital emergency department attendances

Over the period 1986 to 1993 inclusive, the National Injury Surveillance Unit maintained a data collection based on emergency department attendances at a convenience sample of approximately 50 hospitals throughout Australia. The Injury Surveillance Information System (ISIS) is well suited for characterising the circumstances of individual and similar groups of cases. It is not, however, amenable to accurately describing the incidence of particular types of injury in the population due to biases arising from the mix of participating hospitals, and variation in data quality and completeness.

It should be borne in mind that information about the injury event is reported by the injured person or their representative at the time of attendance in the emergency department.

Rate calculation

Population based rates are produced using ABS population data obtained from the AIHW.

Incidence rates have been calculated as cases per million of the usually resident population of Australia. ABS population data were used for this purpose. Annual rates were calculated using mid-year population estimates for each year.

All (or nearly all) episodes of hospital inpatient care are counted, so sampling errors do not apply to these data. However, the time periods used to group the cases (ie. calendar years) are arbitrary. Use of another period (eg. July to June) could result in different rates.

Time series

Time trends have been presented for the period 1993/94 to 1996/97. Hospital separations data have been classified according to the 9th revision of the International Classification of Diseases (ICD9).

Confidence intervals

Where case numbers are small, the effect of chance variation on rates can be large. Confidence intervals (95%, based on a Poisson assumption about the number of cases in a time period) have been placed around rates, where relevant, as a guide to the size of this variation. Chance variation alone would be expected to lead to a rate outside the interval only once out of 20 occasions. An extreme rate in a single period of enumeration should not be ignored simply because of a wide confidence interval - a time series may show such a rate to be part of a trend.

Urban, Rural & Remote Classification Coding

Population data held by the Australian Institute of Health and Welfare (AIHW) are sourced from the ABS Demography section and are updated as revised/new estimates become available. All population estimates currently produced by ABS are based on a usual residence concept, ie. where people usually reside, and are referred to as estimated resident populations (ERPs), with the smallest unit being the Statistical Local Area (SLA)

Because SLA boundary changes are continually occurring, concordance tables are needed to reflect the SLA boundaries used in a particular data series. These concordances are used to convert SLA data to the 7 level urban/rural/remote classification RRMA (formerly RaRA). ABS produces annual revisions of SLA boundaries on 1 July each year as part of the annual Australian Standard Geographic Classification (ASGC).

Hospital separations data available from the AIHW has a data item for place of residence, coded to the RRMA classification (AIHW, 1998b).

The categories are described in the table below.

RRMA Category	Type
M1	Capital cities
M2	Other metropolitan centre
R1	Large rural centre
R2	Small rural centre
R3	Other rural area
Rem1	Remote centre
Rem2	Other remote area

In the present report, for some comparisons, categories M1 and M2 are collectively referred to as city residents, whereas the rest are collectively referred to as country residents.

Results

Incidence of poisoning of preschool children by nonmedicinal substances

Accidental poisoning from nonmedicinal substances is an infrequent cause of death in preschool children. Over the period 1979-1997, the all ages total number of poisoning deaths (medicinal and nonmedicinal) in Australia was 4538. Sixty of these were aged 0-4 years (1%). In this age group, 27 of the deaths (45%) were due to nonmedicinal substances ie. an average of less than two cases per year over the period.

In contrast, poisoning of preschool children is a much more substantial problem when defined in terms of hospital separations. Over the period 1993/94 to 1996/97 the all ages total number of new incident cases of poisoning (medicinal and nonmedicinal), based on hospital separations data, was 53,049, of which 14,071 (27%) were aged 0-4 years. In this age group, 3896 of the cases (28%) were due to nonmedicinal substances ie. an average of nearly 1,000 cases per year over the period.

Time series trend

Given that the number of deaths is small , the following analysis has been restricted to hospital separations data.

Figure 1 shows the trend in the incidence of poisoning from nonmedicinal substances over the period 1993/94 to 1996/97. The crude rate for the age group 0-4 years ranged between 67 and 79 cases per hundred thousand of population. The time series is too short to enable comment on whether the trend is static, increasing or decreasing.

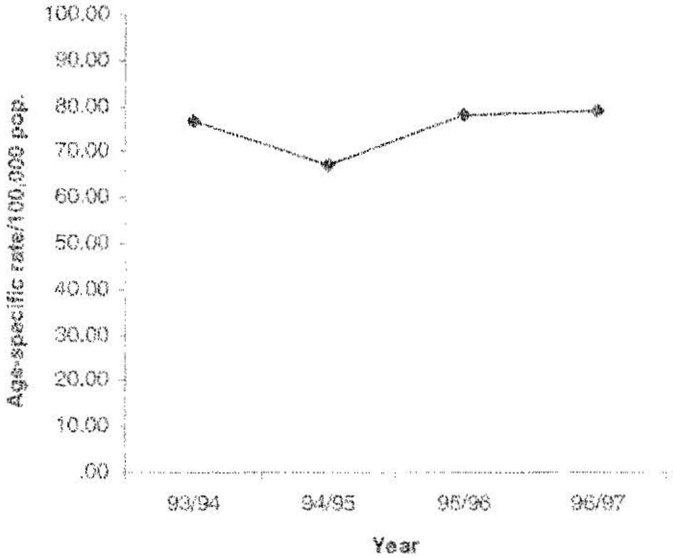

Figure 1: Estimated new incident cases of poisoning from nonmedicinal substances in children aged 0-4 years (based on hospital separations data). Australia 1993/94 to 1996/97 (crude rate for age).

Demographic features of cases

Given that the number of deaths is small, the following analysis has been restricted to hospital separations data.

Age and sex

The rate of poisoning from nonmedicinal substances peaked in the second year of life (Figure 2). Fifty eight percent of the children were male.

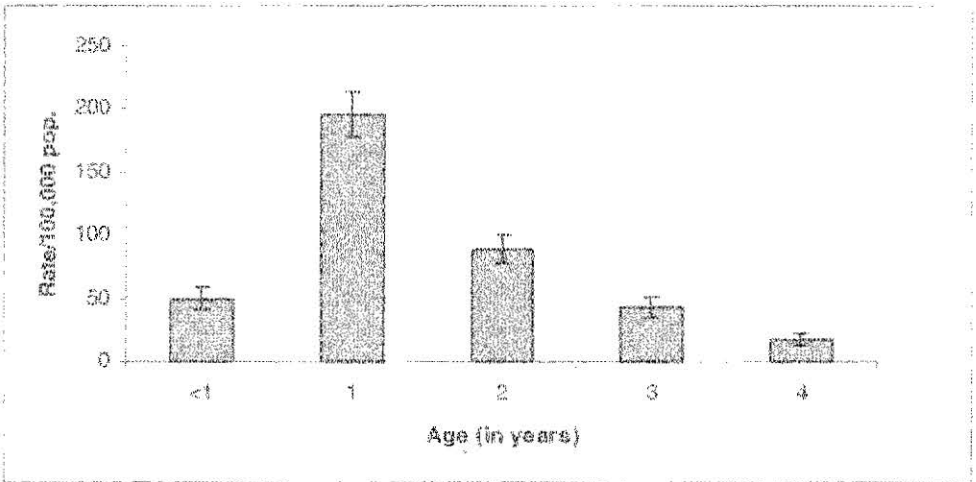

Figure 2: Estimated new incident cases of poisoning from nonmedicinal substances in children aged 0-4 years (based on hospital separations data) by individual year of age, Australia 1996/97 (crude rate for age).

Place of residence

In the hospital morbidity data collection, cases are coded on the basis of place of usual residence (SLA) to a category of the Rural and Remote Areas (RRMA) classification.

Figure 3 shows the rate of nonmedicinal poisoning to preschoolers, based on hospital separations data, by RRMA. The incidence rates were highest in rural and remote areas. The remote centre (Rem1) rate was about three time higher than the capital city (M1) rate. All of the rural and remote area rates were significantly higher, statistically, than the capital city and other metropolitan centre rates. There were no statistically significant rate differences between rural and remote areas.

Type of place of injury

Most of the poisoning's occurred at home (68%, Table 1). However, for a quarter of cases no place of occurrence was specified. The high level of unspecified cases reduces the utility of data on place of injury.

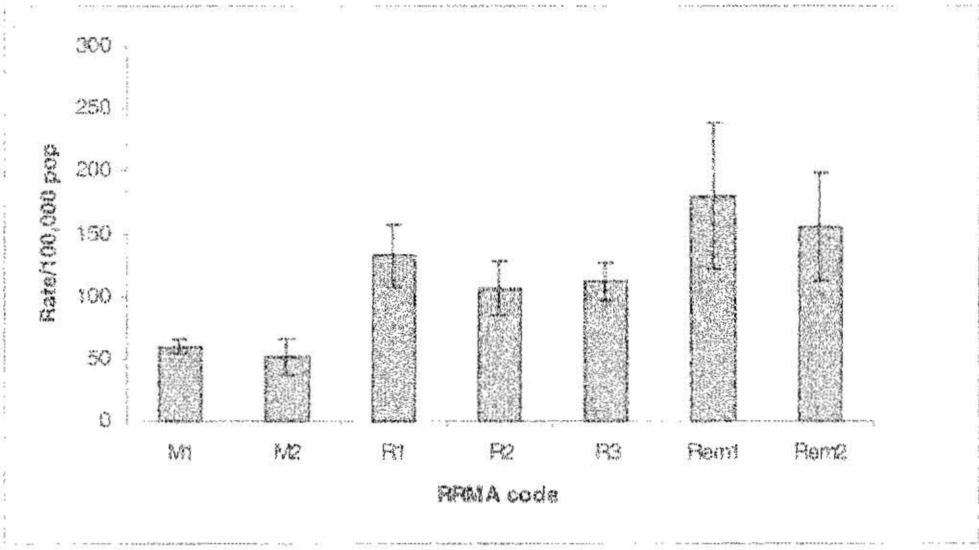

Figure 3: Estimated new incident cases of poisoning from nonmedicinal substances in children aged 0-4 years (based on hospital separations data) by location of residence (RRMA code), Australia 1996/97 (crude rate for age).

Table 1: Estimated new incident cases of poisoning from nonmedicinal substances in children aged 0-4 years (based on hospital separations data) by place of occurrence, Australia 1996/97 (case count and percentage).

Place of occurrence	Case count	Percent
Home	700	68
Farm	18	2
Industrial place	2	0
Place recreation/sport	7	1
Street/highway	1	0
Public bldg	15	1
Residential inst	6	1
Other specified	18	2
Not specified	253	25
Missing	2	0
Total	1022	100

Clinical profile

The following analysis is restricted to hospital separations data.

Length of stay in hospital

One measure of the healthcare burden of nonmedicinal poisoning in children aged 0-4 years is the total hospital bed days consumed. However, estimation of this quantity is not straightforward.

The first episode of care of a newly incident case will commence with admission to a hospital. Prior to discharge, the case may be transferred to another hospital. Each hospital only records the number of days that the case spent in their care. To determine the total bed days for an episode of care requires these to be added across hospitals. In addition, as some cases may be readmitted for further episodes of care related to the injury, these must also be added in order to calculate the total burden that arises from the newly incident cases. As there is no case linkage across hospitals in national data, the length of stay cannot be calculated for individual cases. Rather it can only be estimated in aggregate. An estimate of the total burden can be made by adding the length of stay for all separations having the relevant poisoning E-code, which will include separations of newly incident cases as well as readmissions and transfers.

The total bed days for poisoning from nonmedicinal substances in children aged 0-4 years was 1153 in 1996/97. Most of the separations had a very short stay (93% one day or less) - Figure 4.

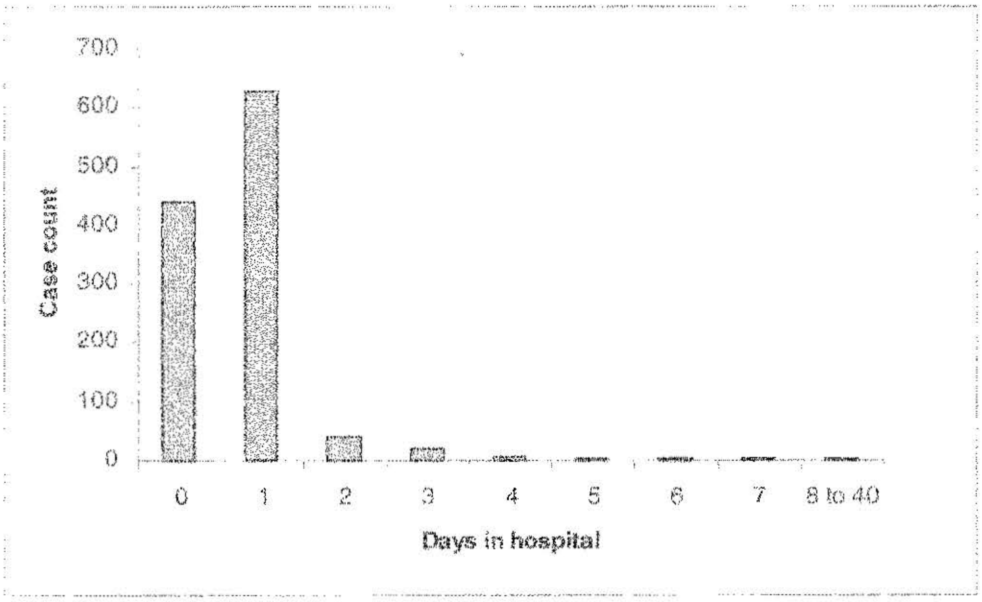

Figure 4: Distribution of bed days for separations due to cases of poisoning from nonmedicinal substances, Australia 1996/97 (separations).

Procedures

Only 8% (n=80) of estimated new incident cases required a procedure (based on 'Principal Procedure' code). The most common procedures were:

- Diagnostic procedure on the oesophagus - Other oesophagoscopy (20%, n=16 cases). This procedure was performed mainly on cases that had suspected or actual ingestion of caustic alkalis (9 cases out of 16).
- Nonoperative alimentary tract irrigation, cleaning and local instillation - Gastric lavage (14%, n=11 cases).

Type of substance

In this section, data on the substance of nonmedicinal poisoning are reported on the basis of external cause code rather than injury and poisoning code of the ICD-9-CM classification. As nearly ninety percent of cases with an external cause code for nonmedicinal poisoning had a principal diagnosis of nonmedicinal poisoning, and many of the remainder had an additional diagnosis code of nonmedicinal poisoning, there would not be much difference between results based on external cause code or injury and poisoning code. The categories of substance are essentially the same in the two sections of the ICD-9-CM classification.

Fatalities

Many of the deaths were due to agricultural and horticultural chemicals (13 cases, Table 2).

Table 2: Deaths due to poisoning from nonmedicinal substances in children aged 0-4 years (based on ABS deaths data) by type of substance, Australia (aggregated case count 1979 to 1997).

Type of substance	E-code	Case count
Synthetic detergent or shampoo	8610	2
Petroleum fuel or cleaner	8621	2
Insecticide of organophosphorus compound	8631	3
Other or unspecified insecticide	8634	2
Rodenticide	8637	1
Other or unspecified agricultural or horticultural chemical	8639	7
Caustic alkali	8642	1
Other specified plant	8654	4
Arsenic or its compounds or fumes	8663	1
Piped gas	8679	1
Liquefied petroleum gas distributed in mobile container	8680	1
Motor vehicle exhaust gas	8682	1
Unspecified carbon monoxide	8689	1
	Total	27

Hospital separations

In the first year of life, the main type of substance involved in hospital admission due to poisoning from nonmedicinals was foodstuffs and poisonous plants (Figure 5). Agricultural and horticultural chemicals and petroleum products and solvents were a more common cause amongst those aged one to four years.

A more detailed breakdown of the substances involved is presented in Table 3.

Rodenticides were one of the most common agents of poisoning in preschoolers. Other common agricultural and horticultural chemicals involved in poisoning were insecticides of organophosphate compounds and 'other and unspecified insecticides'.

Petroleum fuels and cleaners were common agents of poisoning, as were poisonous plants, corrosive and caustic substances and various types of cleaning agents

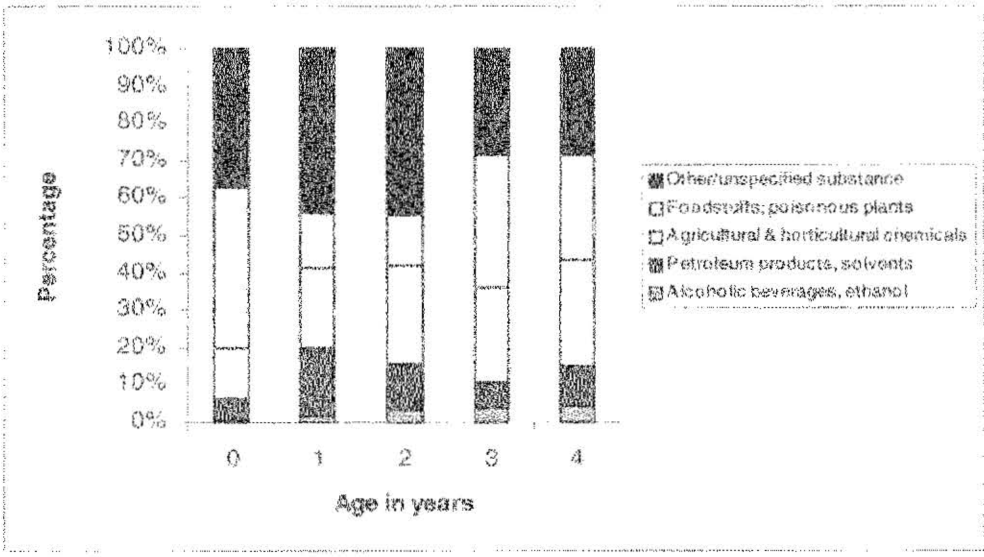

Figure 5: Estimated new incident cases of poisoning from nonmedicinal substances in children aged 0-4 years (based on hospital separations data) by type of substance and age in individual years, Australia 1996/97 (case count and percentage).

Table 3: Estimated new incident cases of poisoning from nonmedicinal substances in children aged 0-4 years (based on hospital separations data) by place of occurrence, Australia 1996/97 (case count).

Substance	External cause code	Case count
Alcohol		
Alcoholic beverages	8600	10
Other & unspecified ethyl alcohol & its products	8601	13
Methyl alcohol	8602	4
Isopropyl alcohol	8603	7
Fusel oil	8604	4
Other	8608	4
Unspecified	8609	2
Cleaning & polishing agents, disinfectants, paints and varnishes		
Synthetic detergents and shampoos	8610	31
Soap products	8611	6
Polishes	8612	5
Other cleaning & polishing agents	8613	29
Disinfectants	8614	22
Other paints & varnishes	8616	8
Petroleum products, other solvents and their vapours		
Petroleum solvents	8620	4
Petroleum fuels & cleaners	8621	57
Lubricating oils	8622	3
Petroleum solids	8623	1
Other solvents	8624	72
Unspecified	8629	4
Agricultural & horticultural chemicals (excl. plant food & fertiliser)		
Insecticides of organochlorine compounds	8630	1

Table 3: (continued)

Insecticides of organophosphate compounds	8631	42
Carbamates	8633	2
Other & unspecified insecticides	8634	76
Herbicides	8635	6
Fungicides	8636	2
Rodenticides	8637	96
Other & unspecified	8639	1
Corrosives and caustics		
Corrosive aromatics	8640	3
Acids	8641	17
Caustic alkalis	8642	43
Other	8643	54
Unspecified	8644	6
Foodstuffs and poisonous plants		
Shellfish	8651	2
Other fish	8652	5
Berries & seeds	8653	64
Other plants	8654	31
Mushrooms & other fungi	8655	35
Other food	8658	55
Unspecified	8659	19
Other & unspecified substances		
	8660-8698	174
	Total	1022

Place of residence (city versus country) and type of substance

The incidence rate of nonmedicinal poisoning in preschoolers, based on those admitted to hospital, was significantly higher amongst country[1] residents overall (Figure 6). A more detailed analysis by specific types of poison (Figures 7-13 and Appendix I) revealed the following:

- The incidence rate differences between city and country preschoolers were not statistically significant for alcoholic substances (Figure 7).
- There was a significantly higher poisoning rate for country preschoolers from synthetic detergents and shampoos (3.5 times higher than city preschoolers) and also other cleaning and polishing agents (3 times higher) - Figure 8.
- There was a significantly higher poisoning rate for country preschoolers from petroleum fuels and cleaners (3.7 times higher than city preschoolers), and other solvents (2.1 times higher) - Figure 9.
- There was a significantly higher poisoning rate for country preschoolers from insecticides of organophosphate compounds (2.4 times higher than city preschoolers), and rodenticides (3.7 times higher) - Figure 10.

[1] Place is defined according to RRMA category. Categories M1 and M2 are collectively referred to as city residents, whereas categories R1, R2, R3, Rem1 and Rem2 are collectively referred to as country residents

- There was a significantly higher poisoning rate for country preschoolers from other corrosives and caustics (2.4 times higher than city preschoolers) - Figure 11.
- There was a significantly higher poisoning rate for country preschoolers from other plants (5.2 times higher than city preschoolers) - Figure 12.

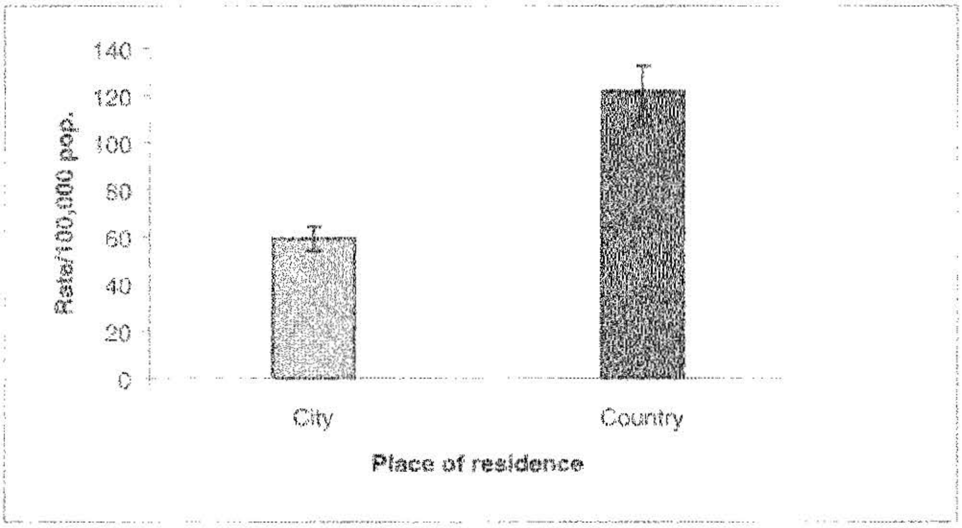

Figure 6: Estimated new incident cases of poisoning from nonmedicinal substances in children aged 0-4 years (based on hospital separations data) by place of residence (city versus country), Australia 1996/97 (crude rate for age).

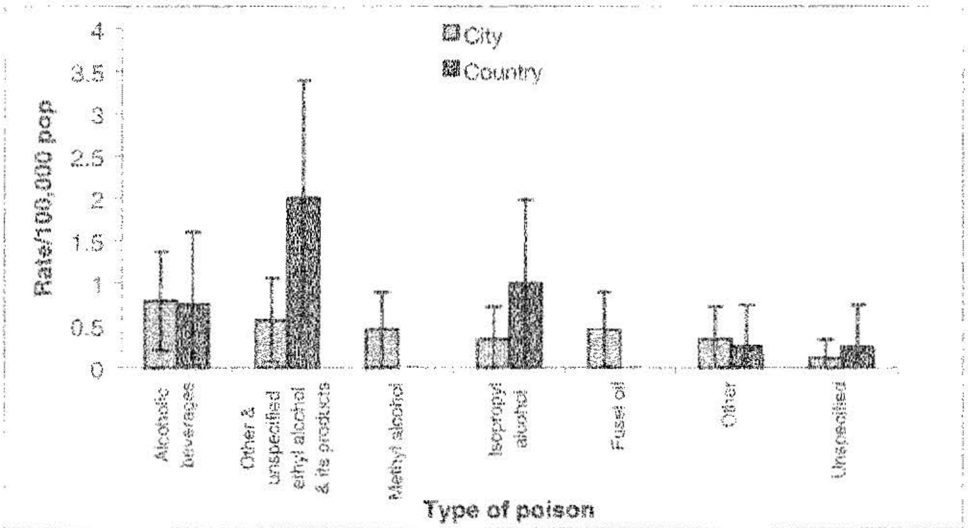

Figure 7: Estimated new incident cases of poisoning by alcoholic substances (E860) in children aged 0-4 years (based on hospital separations data) by place of residence (city versus country), Australia 1996/97 (crude rate for age).

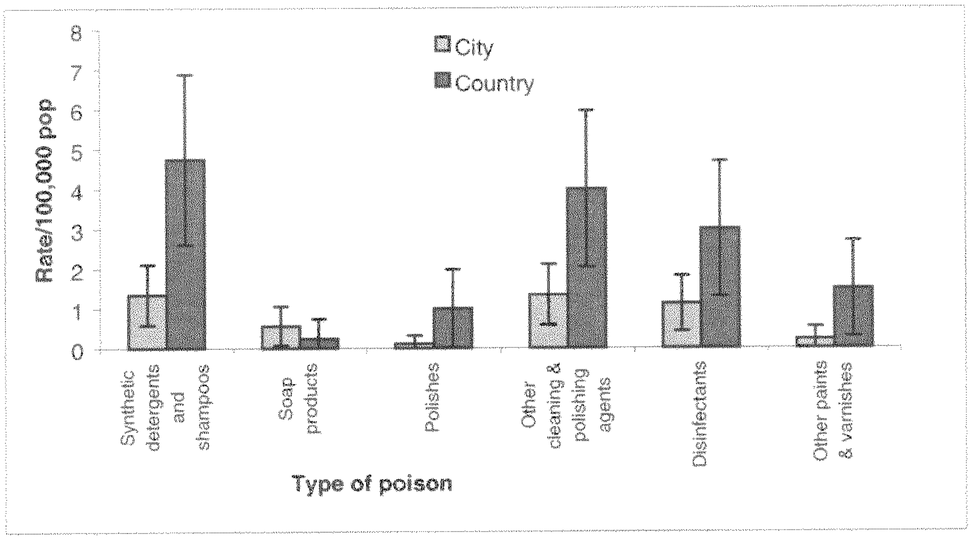

Figure 8: Estimated new incident cases of poisoning by cleaning and polishing agents, disinfectants, paints and varnishes (E861) in children aged 0-4 years (based on hospital separations data) by place of residence (city versus country), Australia 1996/97 (crude rate for age).

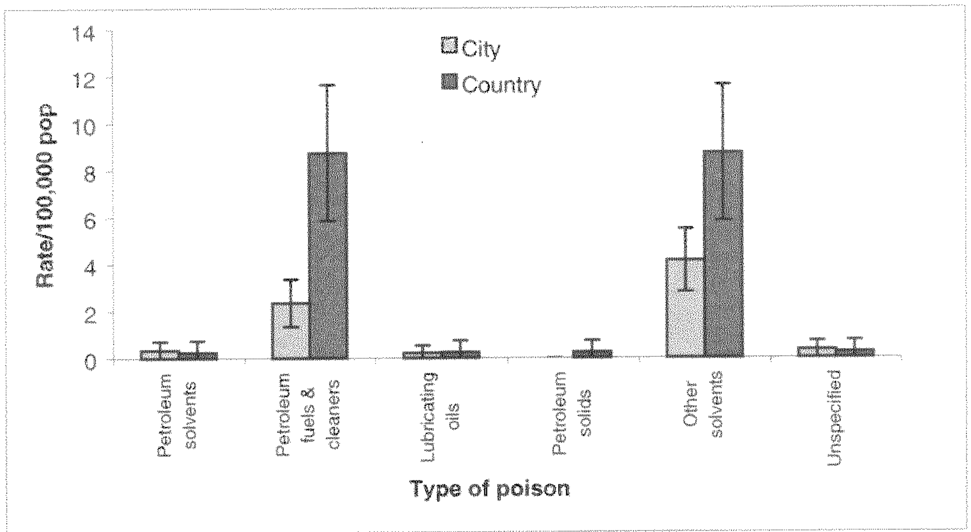

Figure 9: Estimated new incident cases of poisoning by petroleum products, other solvents and their vapors (E862) in children aged 0-4 years (based on hospital separations data) by place of residence (city versus country), Australia 1996/97 (crude rate for age).

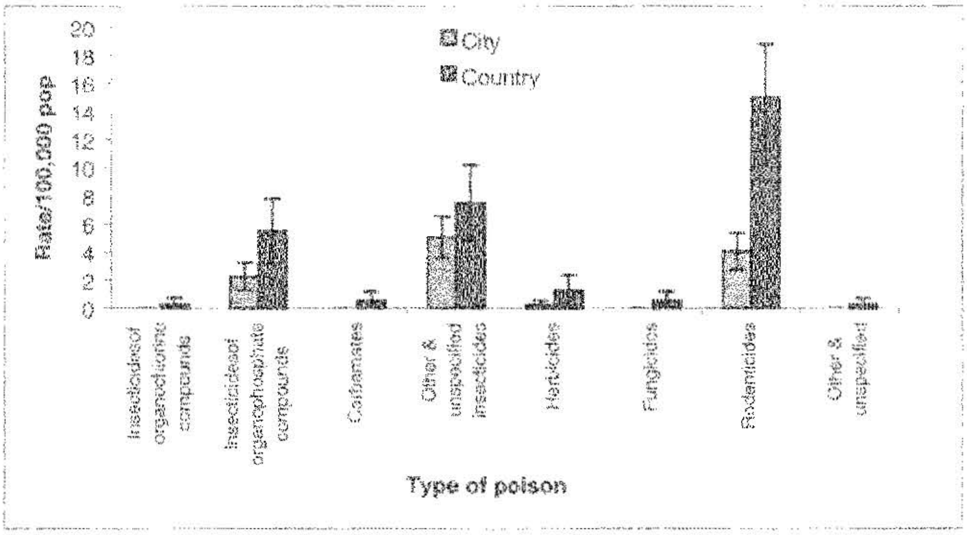

Figure 10: Estimated new incident cases of poisoning by agricultural and horticultural chemicals (E863) in children aged 0-4 years (based on hospital separations data) by place of residence (city versus country), Australia 1996/97 (crude rate for age).

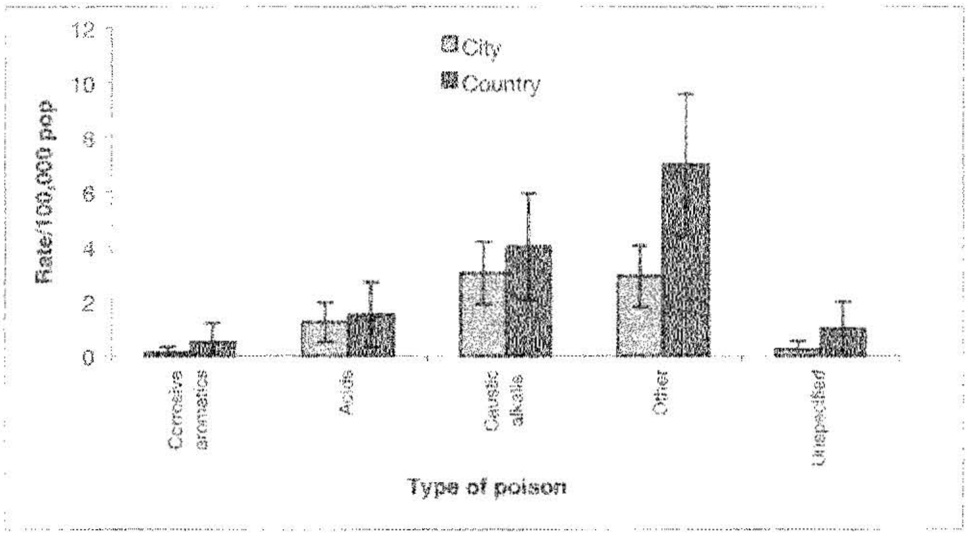

Figure 11: Estimated new incident cases of poisoning by corrosives and caustics (E864) in children aged 0-4 years (based on hospital separations data) by place of residence (city versus country), Australia 1996/97 (crude rate for age).

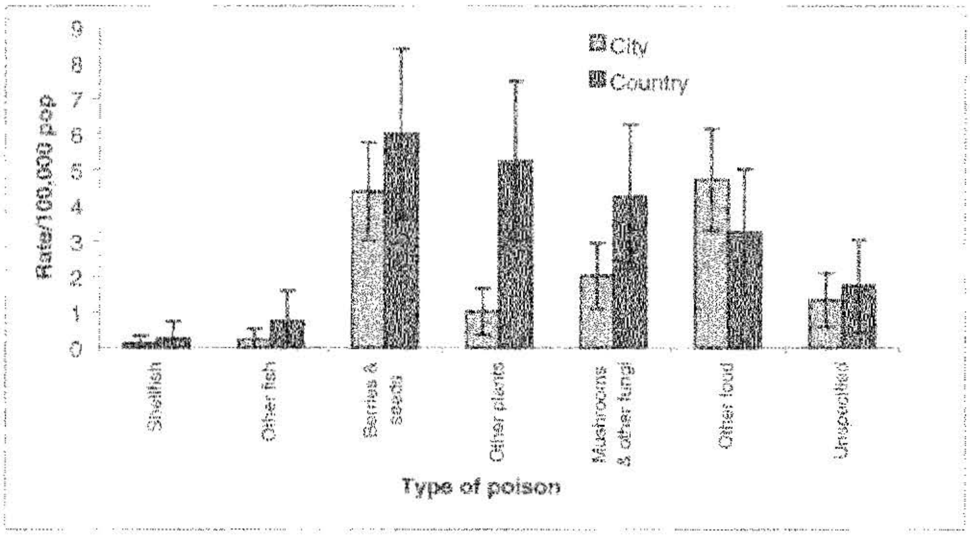

Figure 12: Estimated new incident cases of poisoning by foodstuffs and poisonous plants (E865) in children aged 0-4 years (based on hospital separations data) by place of residence (city versus country), Australia 1996/97 (crude rate for age).

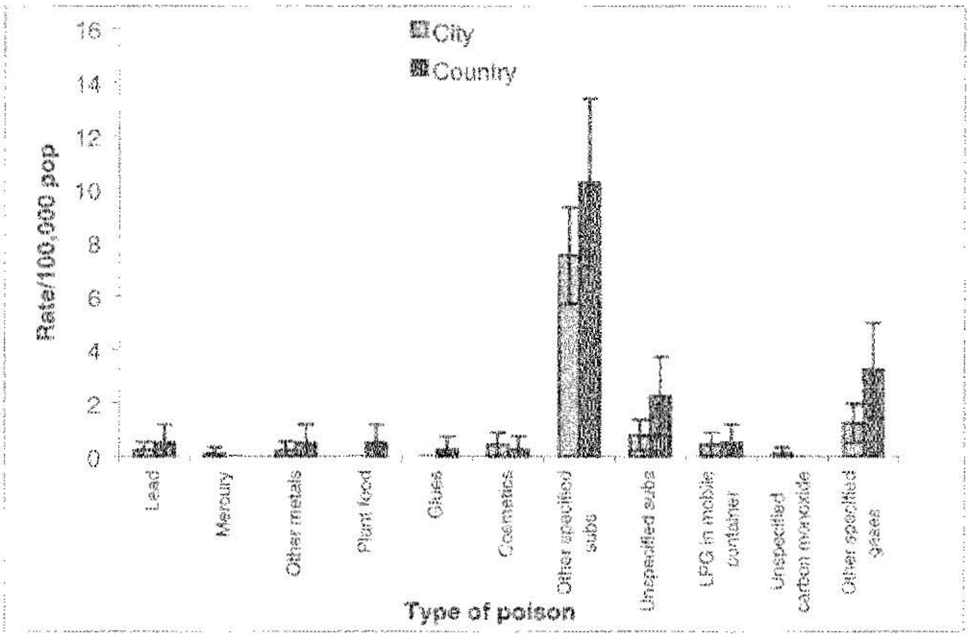

Figure 13: Estimated new incident cases of poisoning by other and unspecified solid and liquid substances (E866), gas distributed by pipeline (E867), other utility gas and carbon monoxide (E868) and other gases and vapours (E869), in children aged 0-4 years (based on hospital separations data) by place of residence (city versus country), Australia 1996/97 (crude rate for age).

Place of residence (RRMA code)

As the city versus country differences in rates of poisoning were highest for rodenticides and other plants, a more detailed breakdown according to RRMA code was undertaken for these substances.

Rodenticides

The rate of poisoning from rodenticides was significantly higher (ranging from 5 to 21 times higher) for preschoolers resident in remote areas (Rem1 and Rem2) when compared to metropolitan preschoolers (M1 and M2) - Figure 14 and Appendix 2. Their rates were also higher than other rural preschoolers (R1, R2 and R3), although these differences were not statistically significant.

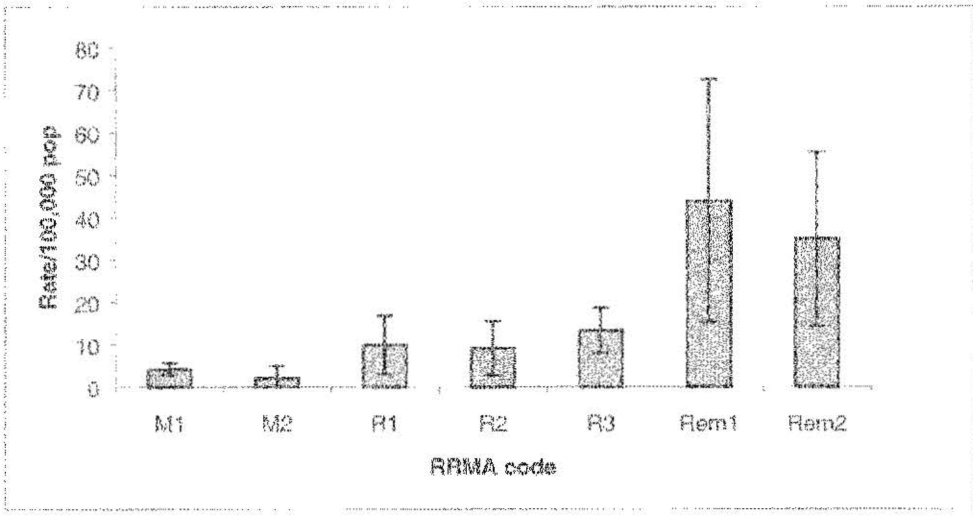

Figure 14: Estimated new incident cases of poisoning by rodenticides (E8637) in children aged 0-4 years (based on hospital separations data) by place of residence (RRMA code), Australia 1996/97 (crude rate for age).

Other plants

The rate of poisoning from 'other plants' was significantly higher (14 times higher) for preschoolers resident in 'other remote areas' (Rem2) when compared to preschoolers resident in capital cities (M1) - Figure 15 and Appendix 2. No other differences were statistically significant.

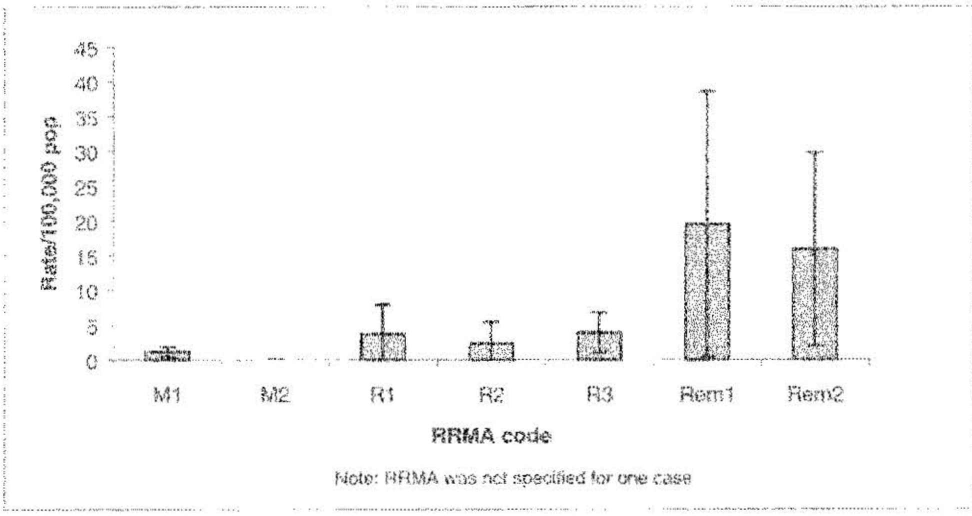

Figure 15: Estimated new incident cases of poisoning by other plants (E8654) in children aged 0-4 years (based on hospital separations data) by place of residence (RRMA code), Australia 1996/97 (crude rate for age).

Hospital emergency department attendances

The ISIS data collection cannot be used to determine incidence as there is no defined population base for the convenience sample of participating hospitals. However, it is well suited for characterising the circumstances of injury, and in particular for identifying particular products that may be hazardous. It needs to be considered that many ISIS forms were completed early in the process of care, potentially before all information was known or checked, and that the reliability of the product data provided was not independently verified. As the correct identification of a poison was important for determining the method of investigation and treatment, it was probable that the product description given by the person accompanying the child to hospital was accurate in most cases. It was of course possible that a term representing a brand name could sometimes have been used as a generic description for a class of poison rather than as the description of a specific product brand. This could have reflected the market dominance of a particular brand. A limitation of the ISIS data is that it is no longer current, data collection ceased in 1993. Product design and composition could have changed since that time, providing the potential for a change (increase or decrease) in the nature of the hazard.

As identification of specific products is a laborious task, requiring examination of the text description of the injury event, in the present report the analysis has been restricted to a specific class of nonmedicinal poison (ie. rodenticides) as they are a common agent of poisoning in preschoolers. The analysis, which is a case study, illustrates the more detailed level of information that is possible from the use of ISIS data. The analysis could be extended to other substances.

Cases were selected on the basis of the ISIS factor code for pesticide poisoning (factor code 1926), which included poisoning from rodenticides. The text string, describing the injury event, was examined to identify the rodenticide poisoning's. ISIS contained 356 recorded emergency department attendances for rodenticide poisoning to children aged 0-4 years. Of these cases, forty one percent (n= 147) were attributed to a single brand. It is not within the scope of this report to publish information on brand names.

A detailed breakdown of places of poisoning is presented in Appendix 3. The place of poisoning was specified for 273 cases (77%). Most (85%) of these occurred in the child's own home or someone else's home. Almost a quarter occurred in the kitchen; 7% in a shed, garage or other part of the yard; 6% in a lounge room, family room or living room; 4% in a bedroom or spare room; 4% in the laundry; 2% in a bathroom or toilet; 1.5% under the house; 1% in other specified rooms of the home; and 35% in some unspecified part of the house. In the home, the poisons were often located in a cupboard, including a cabinet or pantry or under the sink, (14%); behind, under or between furniture or fittings (7%); under whitegood appliances ie. a fridge, dishwasher, oven, washing machine, or dryer (4%); on the floor (3%); or elsewhere.

Fifteen percent of cases occurred in a work place.

Discussion

Poisoning of preschool children from nonmedicinal substances is very rarely a cause of death in Australia. Although poisoning from such substances is a common cause of admission to hospital for this age group (Sleet et al, 1991), the total health burden is relatively small. Few cases require any surgical or other procedures and length of stay is almost always very short. This suggests that a high proportion of cases are admitted for observation following suspected ingestion of a harmful substance, rather than because of evidence of toxic effects, a suggestion also made by Moon et al (1998). The low severity of nonmedicinal poisoning's could reflect the effectiveness of the legislative controls on the availability of poisons in Australia, a matter that is at the heart of a current review of drugs, poisons and controlled substances legislation (Galbally, 2000). An easing of the legislative controls on poisons could increase the incidence and severity of the problem. On the basis of the small current health burden that it represents, it is arguable whether poisoning from nonmedicinal substances warrants inclusion in the NHPA indicators. This does not mean that such events are not important or that they should not be prevented, only that they may not constitute as high a priority as some other injuries for some other age groups.

A high proportion of those poisoned by nonmedicinals were aged one year. Gillam et al (1995) contrast the young age of these preschoolers compared to those poisoned by medicinal substances. It has been shown that children have easier access to nonmedicinal substances, as they are commonly located at ground level (O'Connor, 1978). As children age, their ability to climb and access poisons above ground level increases. Storage of nonmedicinal substances above ground level could limit ready access by younger children but not necessarily older children.

Agricultural and horticultural chemicals were frequent agents of poisoning, particularly rodenticides. This result has been found in other Australian studies (Gillam, 1995; Parsons et al, 1996). Most preschooler rodenticide poisoning's occurred in the home, mainly in the kitchen, mainly from poison located in a cupboard. Similar results were found by Parsons et al (1996). Although not usually serious, as the amounts commonly ingested are small (Parsons et al, 1996; Muhlendahl et al, 1979), poisoning from rodenticides can be fatal. The ABS Deaths Data showed that in 1993 a toddler died in South Australia from ingesting a rodenticide. Long-acting anticoagulant rodenticides, often called "superwarfarins", are a potential problem (Smolinske et al, 1989; Chua & Friedenberg, 1998).

The case study of hospital emergency department attendances for rodenticide poisoning indicated that three brands accounted for 61% of such attendances. Two of the brands, which are in small pellet form, accounted for 52% of attendances. Although the actual chemical composition of these products may have changed since the early 1990s, when the hospital data was collected, the manner of use has not. They are designed to be placed in open bate stations. Although current packaging have warnings on the labels indicating that they should not be accessible to children, it is evident from the ISIS data that when this form of product is distributed in open bate stations by parents, children are able to gain access even when they are located in seemingly inaccessible places (eg. under the fridge). The intended manner of distribution of the form of substance constitutes a hazardous practice.

A number of prevention measures for rodenticide poisoning are discussed in the literature. The use of bittering agents is controversial. There are only limited data about whether aversive agents would have an impact either on the number or severity of paediatric ingestions (Rogers & Tenenbein, 1994). Children do not seem to have the same response as adults to bitter tastes (Bernstein & Webster, 1980). Wax block formulations have been suggested as a potential low cost alternative to pellet formulations (Parsons et al, 1996). More preferable, would be the development of a child-resistant bait station. "The advantage of this approach is that the countermeasure is part of the product manufacture and does not require any specific education, knowledge or active input from the user" (Parsons et al, 1996).

Organophosphate poisoning was responsible for the death of three preschoolers over the period 1979 to1997 and 42 hospital admissions between 1993/94 and 1996/97. There have been no Australian studies of this particular problem reported in the medical literature.

Caustic alkali's (eg. automatic dishwasher powder, oven cleaner, drain cleaner) were responsible for only one preschooler death over the period 1979 to 1997, but 43 hospital admissions. Cornish et al (1996) found that amongst cases of poisoning from automatic dishwasher powder reported to an Australian State (Victorian) Poisons Information Centre (n=61), the most common location of the ingested substance was in the dispenser on the internal surface of the door of the machine, and after operation of the machine (62% of cases). A similar result was found by Kynaston et al (1989) based on admitted cases in another State (Queensland). Cornish et al (1996) recommended alteration of the detergent to prevent caking or sludging, so that it does not remain in the dispenser after use, and redesign or relocation of the dispenser to prevent ready access by young children (all of their cases were aged between 6 and 29 months). However, as 44% of cases in the Kynaston et al (1989) study obtained the substance directly from the packet, child resistant packaging would also appear to be required.

Oesophageal stricture, is a severe potential complication after caustic ingestion. Its rate of occurrence in Australia has not been reported in the literature. However, in two European studies, this complication occurred in between five and twelve percent of cases (Lamireau et al, 1997; Bautista et al, 1997).

Plants, berries and seeds are common agents of poisoning in preschoolers. Four deaths occurred due to the ingestion of poisonous plants over the period 1979 to 1997. Unfortunately, it is not known what these types of plants were as the ABS Deaths Data does not provide such detail. However, it has been reported that the two common varieties of oleander (thevetia periviana and nerium oleander), which are common in Australian gardens, are extremely toxic (Shaw & Pearn, 1979), and should not be planted where there are young children.

An important finding of the present study was the higher rate of nonmedicinal poisoning amongst preschoolers resident in the country, particularly from rodenticides and 'other plants', but also from detergents, shampoos, other cleaning and polishing agents, petrol, solvents, organophosphate insecticides, and corrosive and caustic substances. This is the first time that city/country differentials have been reported in the medical literature and it warrants further investigation. It is unlikely that variations in hospital admission practises could explain these differentials. The external cause coding does not make a distinction about whether these substances were contained in products designed for domestic use or for agricultural, industrial or other uses. It is possible that the higher country rate is due to agricultural chemicals.

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Appendix 1

City versus country rates (estimated new incident cases, based on hospital separations data, Australia 1996/97)

		City				Country				Total
		n	Rate	CI+	CI-	n	Rate	CI+	CI-	
Alcoholic beverages	8600	7	0.79	1.37	0.20	3	0.75	1.60	-0.10	10
Other & unspecified ethyl alcohol & its products	8601	5	0.56	1.25	-0.13	8	2.00	3.38	0.61	13
Methyl alcohol	8602	4	0.45	1.22	-0.32		0.00	0.00	0.00	4
Isopropyl alcohol	8603	3	0.34	1.23	-0.55	4	1.00	1.98	0.02	7
Fusel oil	8604	4	0.45	1.22	-0.32		0.00	0.00	0.00	4
Other	8608	3	0.34	1.23	-0.55	1	0.25	0.74	-0.24	4
Unspecified	8609	1	0.11	1.65	-1.43	1	0.25	0.74	-0.24	2
Synthetic detergents and shampoos	8610	12	1.35	1.79	0.90	19	4.75	6.88	2.61	31
Soap products	8611	5	0.56	1.25	-0.13	1	0.25	0.74	-0.24	6
Polishes	8612	1	0.11	1.65	-1.43	4	1.00	1.98	0.02	5
Other cleaning & polishing agents	8613	12	1.35	1.79	0.90	16	4.00	5.96	2.04	28
Disinfectants	8614	10	1.12	1.61	0.64	12	3.00	4.70	1.30	22
Other paints & varnishes	8616	2	0.22	1.31	-0.86	6	1.50	2.70	0.30	8
Petroleum solvents	8620	3	0.34	1.23	-0.55	1	0.25	0.74	-0.24	4
Petroleum fuels & cleaners	8621	21	2.36	2.69	2.02	35	8.75	11.64	5.85	56
Lubricating oils	8622	2	0.22	1.31	-0.86	1	0.25	0.74	-0.24	3
Petroleum solids	8623		0.00	0.00	0.00	1	0.25	0.74	-0.24	1
Other solvents	8624	37	4.16	4.41	3.90	35	8.75	11.64	5.85	72
Unspecified	8629	3	0.34	1.23	-0.55	1	0.25	0.74	-0.24	4
Insecticidesof organochlorine compounds	8630		0.00	0.00	0.00	1	0.25	0.74	-0.24	1
Insecticidesof organophosphate compounds	8631	20	2.25	2.59	1.90	22	5.50	7.80	3.20	42

Carbamates	8633		0.00	0.00	0.00	2	0.50	1.19	-0.19	2
Other & unspecified insecticides	8634	45	5.05	5.28	4.82	30	7.50	10.18	4.81	75
Herbicides	8635	2	0.22	1.31	-0.86	5	1.25	2.34	0.15	7
Fungicides	8636		0.00	0.00	0.00	2	0.50	1.19	-0.19	2
Rodenticides	8637	36	4.04	4.30	3.79	60	14.99	18.79	11.20	96
Other & unspecified	8639		0.00	0.00	0.00	1	0.25	0.74	-0.24	1
Corrosive aromatics	8640	1	0.11	1.65	-1.43	2	0.50	1.19	-0.19	3
Acids	8641	11	1.24	1.70	0.77	6	1.50	2.70	0.30	17
Caustic alkalis	8642	27	3.03	3.33	2.74	16	4.00	5.96	2.04	43
Other	8643	26	2.92	3.22	2.62	28	7.00	9.59	4.41	54
Unspecified	8644	2	0.22	1.31	-0.86	4	1.00	1.98	0.02	6
Shellfish	8651	1	0.11	1.65	-1.43	1	0.25	0.74	-0.24	2
Other fish	8652	2	0.22	1.31	-0.86	3	0.75	1.60	-0.10	5
Berries & seeds	8653	39	4.38	4.63	4.13	24	6.00	8.40	3.60	63
Other plants	8654	9	1.01	1.52	0.50	21	5.25	7.49	3.00	30
Mushrooms & other fungi	8655	18	2.02	2.38	1.66	17	4.25	6.27	2.23	35
Other food	8658	42	4.72	4.95	4.48	13	3.25	5.01	1.48	55
Unspecified	8659	12	1.35	1.79	0.90	7	1.75	3.05	0.45	19
Lead	8660	2	0.22	1.31	-0.86	2	0.50	1.19	-0.19	4
Mercury	8661	1	0.11	1.65	-1.43		0.00	0.00	0.00	1
Other metals	8664	2	0.22	1.31	-0.86	2	0.50	1.19	-0.19	4
Plant food	8665		0.00	0.00	0.00	2	0.50	1.19	-0.19	2
Glues	8666		0.00	0.00	0.00	1	0.25	0.74	-0.24	1
Cosmetics	8667	4	0.45	1.22	-0.32	1	0.25	0.74	-0.24	5
Other specified subs	8668	67	7.52	7.71	7.34	41	10.25	13.38	7.11	108
Unspecified subs	8669	7	0.79	1.37	0.20	9	2.25	3.72	0.78	16
LPG in mobile container	8680	4	0.45	1.22	-0.32	2	0.50	1.19	-0.19	6
Unspecified carbon monoxide	8689	1	0.11	1.65	-1.43		0.00	0.00	0.00	1
Other specified gases	8698	11	1.24	1.70	0.77	13	3.25	5.01	1.48	24
Total		527	59.19	59.26	59.12	487	121.71	132.51	110.90	1014

Notes:

1. City population based on RRMA areas M1 plus M2 is 890370.
2. Country population based on RRMA areas R1, R2, R3, Rem1 plus Rem2 is 400146.

Appendix 2

RRMA rate differences for selected substances (estimated new incident cases, based on hospital separations data, Australia 1996/97)

Rodenticides

RRMA	*n*	Population 0-4 yrs.	Rate/100,000	CI	CI+	CI-
M1	34	795313	4.275046	1.437002	5.712049	2.838044
M2	2	95057	2.104001	2.915996	5.019997	-0.812
R1	8	80787	9.902583	6.86214	16.76472	3.040443
R2	8	87461	9.146934	6.338502	15.48544	2.808432
R3	24	179846	13.34475	5.339012	18.68376	8.005738
Rem1	9	20521	43.85751	28.65357	72.51109	15.20394
Rem2	11	31531	34.8863	20.61649	55.50279	14.26982
Total	96	1290516				

Other plants

RRMA	n	Population 0-4 yrs.	Rate/100,000	CI	CI+	CI-
M1	9	795313	1.13163	0.739332	1.870961	0.392298
M2	0	95057	0	#DIV/0!	#DIV/0!	#DIV/0!
R1	3	80787	3.713469	4.202185	7.915654	-0.48872
R2	2	87461	2.286734	3.169251	5.455984	-0.88252
R3	7	179846	3.892219	2.883396	6.775615	1.008823
Rem1	4	20521	19.49223	19.10238	38.59461	0.389845
Rem2	5	31531	15.85741	13.89963	29.75704	1.957777
Total	30	1290516				

Notes:

1. RRMA was not specified for one case.
2. CI refers to the 95% confidence interval based on a Poisson probability distribution (see Methods)
3. CI+ is the upper bound of tho CI
4. CI- is the lower bound of the CI

Appendix 3

Rodenticide poisonings reported to ISIS

Place	Part of place (% of Total)	Location in relation to objects	Number of cases	%
Own home or other domestic dwelling (84.6% of Total)	Unspecified (35.2% of Total)	Unspecified	68	24.9
		In cupboard or cabinet	13	4.8
		Behind or under cupboard/cabinet	4	1.5
		Clothes drawer	2	0.7
		Floor	8	2.9
		Under stairs	1	0.4
	Kitchen (23.8% of Total)	Unspecified	28	10.3
		Around or behind fridge	4	1.5
		Under fridge	5	1.8
		Under dishwasher	1	0.4
		Under oven	1	0.4
		Under sink	1	0.4
		Pantry or pantry floor	6	2.2
		In a cupboard	16	5.9
		Between or behind cupboards	3	1.1
	Lounge room or family room or living room (6% of Total)	Unspecified	8	2.9
		Behind TV	1	0.4
		Under lounge	1	0.4
		Behind couch	1	0.4
		In or around or behind fire place/heater	4	1.5
		Behind cabinet	1	0.4
	Dining room (0.4% of Total)	Unspecified	1	0.4
	Study (0.4% of Total)	Unspecified	1	0.4
	Bed/spare room (4.0% of Total)	Unspecified	10	3.7
		Behind cupboard	1	0.4
	Toilet or bathroom (2.2% of Total)	Unspecified	6	2.2
	Laundry (4.0% of Total)	Unspecified	8	2.9
		Under washing machine	2	0.7
		Under dryer	1	0.4

	In shed or garage or other part of yard (7.3% of Total)	Unspecified	18	6.6
		In a car	2	0.7
	Under House (1.5% of Total)	Unspecified	4	1.5
Office or shop or factory or warehouse or institution or commercial premises (15% of Total)	Unspecified (14.7% of Total)	Unspecified	40	14.7
Farm, excluding farm house (1% of total)	Unspecified (0.7% of Total)	Unspecified	2	0.7
Total			273	100.0

Appendix 4

Glossary

Preschool child: a child aged less than five years.

Bed days: the number of days that the case occupied a hospital bed.

Length of stay: the number of days that the case occupied a hospital bed.

Procedure: mode of therapy, surgery, radiology, laboratory and other diagnostic treatment of the patient.

Nonmedicinal poisoning: poisoning classified to ICD9 external cause category E860-869.

Hospital separation: a patient admitted for an episode of care.

New incident case: a patient admitted for the first time for this injury this year.

Incidence: the number of new incident cases.

Country (residence): categories R1, R2, R3, Rem1 and Rem2 of the RRMA codes are collectively referred to as country residents.

City (residence): categories M1 and M2 of the RRMA codes are collectively referred to as city residents.

Statistically significant: Where case numbers are small, the effect of chance variation on rates can be large. Confidence intervals (95%, based on a Poisson assumption about the number of cases in a time period) have been placed around rates, where relevant, as a guide to the size of this variation. A difference between two rates is said to be statistically significant if the 95% confidence intervals do not overlap. Chance variation alone would be expected to lead to a rate outside the interval only once out of 20 occasions.

INJURY RESEARCH & STATISTICS SERIES

Poisoning of children aged 0–4 years (preschoolers) from nonmedicinal substances is very rarely a cause of death in Australia. Although poisoning from such substances is a common cause of admission to hospital for this age group, few cases require any surgical or other procedures and length of stay is almost always very short. This suggests that a high proportion of cases are admitted for observation following suspected ingestion of a harmful substance, rather than because of evidence of toxic effects.

The incidence rate of poisoning of preschoolers from nonmedicinal substances, based on hospitalisations, was higher in the country than in the city, particularly from rodenticides and 'other plants', but also from detergents, shampoos, other cleaning and polishing agents, petrol, solvents, organophosphate insecticides, and corrosive and caustic substances. This is the first time that such differentials have been reported in the medical literature. Rodenticide poisoning's are discussed in some detail as they are common and potentially severe.

Accidental poisoning of preschool children from nonmedical substances, Australia