Risk factors contributing to childhood poisoning

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Abstract

Objective: To investigate whether the lack of knowledge of toxic agents in households is a risk factor for individual unintentional childhood poisoning.

Methods: The case group (n = 25) was composed of caregivers of children under 60 months of age who underwent accidental oral poisoning and were treated at two reference hospitals in Porto Alegre, southern Brazil, and recorded in the Toxicology Information Center database. The control group (n = 25) was composed of caregivers of children matched for sex, age, and presence in their homes of the same toxic agents found in the case group, who sought emergency medical care at the same hospitals, but for other reasons. A structured questionnaire was administered to verify the following questions: sociodemographic data, clinical history, behavioral antecedents of caregivers, storage of toxic agents, history of previous poisoning accidents.

Results: The children's mean age was 31.8 months (±0.97) and mean height was 93 cm (±11). Families, in both groups, were aware of the toxic action of agents available in their homes; however, caregivers in the control group were twice as likely to have such knowledge compared to the case group. Distraction was 15 times more likely to occur among caregivers of children who underwent poisoning compared to the control group. Storage of toxic agents below 150 cm was approximately 17 times more likely to occur in the group of children who underwent poisoning compared to children in the control group.

Conclusions: Lack of knowledge of the toxic action of agents stored in households is not a risk factor for childhood poisoning. The attributable risks described in this study indicated that the elimination of other factors, such as distraction and storage below 150 cm, would lead to the prevention of 13 and 19% of poisonings in childhood, respectively.

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Introduction

Approximately 5 million people died as a result of an accident in 2000, with a mortality rate of 80.9 per 100,000 inhabitants among children under 5 years of age. Of the total, 7% were due to poisoning, this being a leading cause of emergency care.[1-3] In 2008, the American Association of Poison Control Centers' Toxic Exposure Surveillance System (AAPCC-TESS) reported 2,491,049 human poison exposure cases; 49.7% of these events occurred among children under 4 years of age.[4] However, the actual number is estimated to be around four million cases, since many poisoning cases may go unreported.[4,5] That same year, the Brazilian National Poison Data System (Sistema Nacional de Informações

Tóxico-Farmacológicas, Sinitox) of Oswaldo Cruz Foundation (Fundação Oswaldo Cruz, Fiocruz) identified that human poisoning is most often due to medicines (29% of the 81,828 recorded cases), of which 34% were unintentional. Of the 23,700 records of poisoning due to medicines, 32% (7,584) were among children aged 0 to 4 years, most of the cases occurring at home.[6] Of the 21,615 cases recorded in the Toxicology Information Center of the State of Rio Grande do Sul (Centro de Informação Toxicológica do Rio Grande do Sul, CITRS), Brazil, in 2008, 19,199 (88.8%) referred to human poison exposures, and of these, 25% involved injuries among children under 5 years of age.[7]

Children are curious, thus opening, eating and drinking what adults recognize as dangerous. Therefore, drugs and supplies are stored in inappropriate places by neglect or lack of information of parents and caregivers. The habit of self-medication leads to the consumption of drugs, increasing the availability of these agents in the home and the risk of children having access to them, thus undergoing poisoning.[8-10] Ramos et al.[11] identified characteristics of childhood poisoning, such as time of poisoning (6:01pm-10:00pm) and places where toxic agents were found (bedroom floor and/or living room). Sixty-four percent of these cases were evaluated as nontoxic or probably nontoxic, according to data obtained from CITRS Reporting Form and Medical Record.[11]

Childhood poisoning involves a complex interplay of factors related to the child, toxic substance, environment, family behavior, and/or access to health services. Thus, prevention requires greater knowledge about the specific conditions involved in childhood poisoning.

In order to obtain more information on the behavior of caregivers and children, we conducted an investigation aiming to verify whether the lack of knowledge by caregivers of toxic agents available in the home is a risk factor for individual unintentional childhood poisoning.

Method

This is a case-control study to identify lack of knowledge of the toxic action of agents available in households as a determining factor for poisonings in childhood, through a questionnaire administered to caregivers. Individual accidental childhood toxic exposure in the home (dependent variable) is any event in which individuals are exposed to an agent that may or may not result in poisoning with presence or absence of symptoms.

The research project was analyzed and approved by the Research Ethics Committees of Universidade Federal de Ciências da Saúde de Porto Alegre (UFCSPA), Santa Casa de Misericórdia de Porto Alegre, and Hospital de Pronto Socorro Municipal de Porto Alegre (HPS), Brazil.

The questionnaires were coded, reviewed and double entered into a database, with subsequent comparison to eliminate the likelihood of typing errors and quality control. The data were then analyzed using the Statistical Package for the Social Sciences (SPSS) version 13. According to the pilot study, in the case group 72.7% of children were exposed to toxic agents stored below 150 cm compared to 27.3% in the control group; for that same exposure pattern, the sample size was calculated to be 22 children in each group for a 95% confidence interval (95%CI) and 80% statistical power (odds ratio 0.14). By adding a 15% margin of error, we obtained a consecutive sample of 25 cases and 25 controls, between September 2005 and December 2006.

To compose the case group, children under 60 months of age attending the emergency departments of HPS and Hospital da Criança Santo Antônio (HCSA), in Porto Alegre, Brazil, were selected from CITRS database when recorded as undergoing individual accidental oral poisoning by agents available in their homes. The control group was composed of age-matched children, seeking care in the same emergency departments, with diagnoses other than poisoning, such as respiratory infection, among others. The emergency departments, HPS and HCSA, were selected for their representativeness of pediatric emergency care, 35.7 and 14.3%, respectively, in the city of Porto Alegre, Brazil. CITRS, in operation for over 30 years, is considered a reference center that provides toxicologic guidance, using a 24-hour telephone advice line, for management of poison exposures. This is a state public center linked to the State Foundation for Research in Health (Fundação Estadual de Produção e Pesquisa em Saúde, FEPPS), which also acts in the prevention and education of health professionals, as well as the general population. The dependent variable was defined as individual accidental poison exposure and/or poisoning.

The evaluation of risk factors for a positive poisoning event was conducted according to Ramos et al.[11] The analysis model maintained the hierarchical configuration, privileging socioeconomic determinism over other variables. The univariate analysis compared groups using the chi-square test (95%CI). Models used in the multivariate logistic regression analysis contained variables with statistical significance in the univariate analysis (p < 0.1). Independent risk factors were assessed after adjustment for confounding variables (socioeconomic and educational factors) in the same model, using both crude and adjusted odds ratio (OR). The presence of confounding bias was detected through changes in OR before and after adjustment.

Based on the frequency obtained in the multivariate analysis, in relation to the data found by Brayden for the variable "distraction," study population attributable fractions were calculated for the variables: storage of agents below 150 cm and caregiver distraction while taking care of children in their homes.[12] The attributable fraction was estimated by the formula $P_e (OR - 1) / 1 + P_e (OR - 1)$, where P_e is

the proportion of population exposure to distraction (13%), OR is the odds of disease in exposed individuals/odds of disease in non-exposed individuals.[12-14]

The parents or legal guardians signed a written consent form in the hospital, and a structured questionnaire, with 81 questions and mean duration of 20 minutes, was then administered.[11,12] The independent variables analyzed were divided into the following sections: sociodemographic data (questions regarding children's sex, age and height); children's legal guardian (educational level, socioeconomic status, degree of kinship); family composition (presence or not of other children and adults older than 50 years). Socioeconomic status was stratified into seven levels, based on the classification by the Brazilian Association of Survey Companies (Associação Brasileira de Institutos de Pesquisa de Mercado, ABIPEME).[15] These were stratified into two categories for further analysis using descriptive statistics.

Clinical history, storage site of toxic agents, and history of previous poisoning were considered as independent variables. Behavioral antecedents of caregivers were composed of six questions regarding the caregiver behavior (distraction, closely watching the children, going through a stressful period, what type of stress, among others). These data were based on a questionnaire administered by Brayden, subjected to the processes of translation and back-translation.[12]

Regarding knowledge of the toxic action of agents available in the home, the following questions were considered: storage site of the agent (box, cabinet, and box in a cabinet); height at which the agent is or was stored (above 150 cm); believe that the agent is dangerous to the child; be aware of the existence of CITRS; and analyze a list of 14 products considered dangerous to children, in which all or at least 11 possibly toxic agents should be identified. These questions were classified, according to the analysis of data obtained after collecting information from caregivers, as follows: 0 – all questions were incorrect; 1 – one incorrect question; 2 – two incorrect questions; 3 – three incorrect questions; 4 – four incorrect questions; 5 – all questions were correct.

Results

Of all children who sought emergency medical care, the mean age was 31.8±0.97 months (case: 32.6±11.9; control: 31±11.9) and mean height was 93±11 cm (case: 93.4±10.5; control: 93.6±11.7). Children's distribution according to sex was similar: 13 boys and 12 girls in both groups. Most children did not attend day care (76%).

Table 1 summarizes the results of the questionnaire, which revealed that most caregivers were the child's parents (84%), 76% of these were mothers, in both groups. Among the families interviewed, 64% in the case group and 60% in the control group belonged to lower socioeconomic classes.

Seventy-two percent of mothers of children seeking medical care after poison exposure had completed high school or higher education, whereas exposure to the same factor in the control group was 68%. Although without significant differences, families in which poisoning accidents occurred were twice as likely to have more than one child in the home. In 44% of households where childhood poisoning occurred, families were composed of at least one adult older than 50 years.

Seeking medical care after poison exposure occurred after an average of 12 hours (±3 hours and 34 minutes) in the case group. In the control group, seeking medical care occurred after 16 hours and 20 minutes (±5 hours and 25 minutes) of onset of symptoms. Poisonings were most often due to medicines (72%), more often due to centrally acting drugs. Toxic exposures were evaluated by members of the CITRS team on duty as nontoxic (12%), probably nontoxic (36%), poisoning not excluded (8%), and poisoning (44%). Of the 11 poisoning cases, 72% had mild and 18% had moderate poisoning. All children, in the case and control groups, were cured. In poisoning due to centrally acting drugs, 44% of cases required hospitalization and 67% were rated as mild or moderate poisoning.

Most caregivers believed that the agents available in the home were dangerous (82%), did not overestimate the child's ability to handle potentially toxic products (90%) and reported not to be experiencing stress (60%). The analysis of mother distraction revealed that mothers concomitantly performed household chores, such as cleaning the house (40%), cooking (15%), and taking care of another child (9%). As for the stress that mothers were experiencing, we identified problems related to difficulties at work or unemployment (40%), diseases (20%), marital problems (10%), death of relative or friend (5%), birth (5%), and others (20%).

Regarding storage of agents, products were most often found in the bedroom (56%) (Table 1).

Storage of toxic agents below 150 cm was 13 times more likely to occur in the group of children who underwent poisoning compared to children in the control group, when analyzing agents separately.

The data showed that families, in both groups, were aware of the toxic action of agents available in their homes; however, caregivers of children seeking care for reasons other than poison exposure were twice as likely to have greater knowledge compared to caregivers of children who underwent poisoning (Table 1). There is evidence of an association of behavioral antecedents of parents (distraction), storage of agents (height), and knowledge of the toxic action of agents available in the home with childhood poisoning, when controlled for the variables that make up the risk factor "lack of knowledge". We also found an association for the variable "mother's education," reclassified

Table 1 - Risk factors for childhood poisoning among children seeking emergency medical care at Hospital de Pronto Socorro Municipal de Porto Alegre and Hospital da Criança Santo Antônio, August 2005 to December 2006, Porto Alegre, Brazil

Variables	Cases (n = 25) N (%)	Controls (n = 25) N (%)	Unadjusted OR (95%CI)	Adjusted OR (95%CI)
Caregivers				
Grandfather/grandmother	3 (12) 0	1 (4)	–	–
Father/mother	20 (80)	22 (88)		
Socioeconomic level				
A and B	9 (36)	10 (40)	–	–
C, D, and E	16 (64)	15 (60)		
Mother's educational level				
Illiterate/incomplete elementary school	5 (20)	6 (24)	–	–
Elementary school	2 (8)	2 (8)		
Incomplete high school	9 (36)	6 (24)		
High school/incomplete higher education	7 (28)	8 (32)		
Higher education	2 (8)	3 (12)		
Mother's educational level				
High school/higher education	9 (36)	11 (44)	1.40 (0.39-5.09)	0.83 (0.14-4.96)
Time of accident[†]				
08:00-12:00	11 (45)	6 (25)	–	–
12:01pm-06:00pm	10 (41.7)	8 (34.6)		
06:01pm-07:59pm	3 (12.5)	10 (41.7)		
Shift of accident[†]				
Morning	11 (45.8)	6 (25)	6.11 (0.95-44.59)*	
Afternoon	10 (41.7)	8 (33.3)	4.17 (0.68-28.28)	–
Night	3 (12.5)	10 (41.7)	1	–
Daycare center				
Yes	3 (12)	9 (36)	4.13 (0.82-23.19)*	-
Other children in the home				
Yes	18 (72)	16 (64)	–	–
Adults > 50 years in the home				
Yes	11 (44)	6 (24)	–	–
Symptoms				
Yes	13 (52)	22 (88)	6.67 (1.38-37.55)*	–
Hospital admission				
Yes	11 (44)	4 (16)	–	–
Storage				
Box, cabinet, and box in a cabinet	10 (40)	18 (72)	3.86 (11.02-15.17)*	3.80 (1.15-12.49)*
Height of agent storage				
< 150 cm	20 (74.1)	7 (25.9)	10.29 (2.36-48.82)*	16.59 (2.86-96.20)*
Behavioral antecedents of caregivers				
Distraction	22 (88)	10 (40)	11.0 (2.6-46.7)*	15.39 (2.31-102.30)*
Believe that the agent is dangerous	21 (84)	20 (80)	–	–
Overestimate the child's behavior	3 (12)	2 (8)	–	–
Improper storage	13 (52)	3 (12)	7.94 (1.88-33.50)	–
Watching the child	22 (88)	10 (40)	11 (2.59-46.78)	-
Stress/social isolation	10 (40)	10 (40)	–	–
Knowledge of agent action				2.38 (1.18-4.79)[†]
0	2 (8)	3 (12)	1	
1	4 (16)	10 (40)	1.67 (0.20-14.05)	
2	7 (28)	8 (32)	0.76 (0.10-5.96)	
3	8 (32)	3 (12)	0.25 (0.03-2.32)	
4	4 (16)	0	0 (0-2.84)	
5	0	1 (4)	–	

95%CI = 95% confidence interval; OR = odds ratio.
* $p < 0.05$.
[†] N = 24.

as having studied up to incomplete high school (1) and high school up to higher education (2), as a risk factor.

Distraction was 15 times more likely to occur among caregivers of children who underwent poisoning compared to the control group (OR = 15.39; 95%CI 2.31-102.30). Storage of toxic agents below 150 cm was approximately 17 times more likely to occur in the group of children who underwent poisoning compared to children in the control group (OR = 16.59; 95%CI 2.86-96.20).

The attributable fractions were 19% for storage of agents below 150 cm and 13% for caregiver distraction while taking care of children in their homes.

Discussion

Childhood poisonings occur most often among both boys and girls under 5 years of age, with a peak between 1 and 2 years of age, due to medicines, mainly painkillers. However, in our study, there was increased frequency of poisoning due to centrally acting drugs, especially antidepressants. These events occur regardless of socioeconomic class, educational level of mothers, seasonality, age, and sex.[10,11,16,17] Studies have reported that children who are poisoned are more likely to belong to families with few social resources.[8,10]

The lack of significant difference between groups with respect to socioeconomic status of families suggests that the magnitude of this variable has no statistical power. Other factors may be attributed, such as the presence of more than one child or an adult older than 50 years in the home, caregiver distraction, and improper storage of agents. These findings run contrary to variations in the relationship between socioeconomic status and childhood injuries and to data from the literature.[18,19]

Although most mothers in the group of children who underwent poisoning had higher educational level, there was no significant difference in comparison to mothers in the control group. Similar data were found in a study on ingestion of medicines among children, conducted by Béria et al.,[20] in which 62% of mothers of children who ingested medicines had 4-10 years of schooling. It is worth mentioning that children have the habit of imitating what adults do. Toxic exposures occur as a result of various factors and understanding these factors and their interrelationships allows a better interpretation of data and more accurate preventive measures.

Accessibility (improper storage site), i.e., storage of agents below 150 cm, was 16 times more likely to occur in the case group than in the control group. This was also identified by Petridou et al.,[21] who, through a questionnaire administered to parents of hospitalized children, concluded, in their study, that absence of at least one parent appeared to be associated with poison exposures, as well as product accessibility, increasing the risk of poisoning among children.

Although most caregivers showed higher frequency for the variable "be aware of the toxic action of agents available in the home," parents of children who did not undergo poisoning were twice as likely to have greater knowledge, as well as the fact that the variable "caregiver distraction" proved to be a significant risk factor for these events. In this sense, Brayden et al.[12] found that 13% of parents were distracted at the time of the poisoning accident. The authors also noted that poisonings occur due to several factors, such as improper storage and curiosity of children. However, lack of knowledge by caregivers of the toxic action of agents available in the home and of preventive measures does not appear to be an important condition associated with poisoning between 3 and 7 years of age. Likewise, Baltimore & Meyer,[22] in a case-control study of 104 poisoned and non-poisoned children, found no significant differences in storage pattern or knowledge of toxicity of ingested substances. De Souza & Barroso,[23] as well as Nedel,[24] report that carelessness of those responsible for protection and safety of children often becomes a cause of hospital records.

The use of frequency rate ratio of risk factors in multivariate analysis allows us to calculate attributable fractions among categories, which may represent an important contribution to the projection of public health programs as they can estimate the percentage of poisoning events occurring among children, which could be reduced if exposure was reduced as well.[25,26] Thus, the results show that intersectoral collaboration is important and necessary. A possible contribution concerns behavioral changes in families of children younger than 5 years through correct storage (above 150 cm) of potentially toxic agents available in households, as well as the importance of providing caregivers guidance on distraction while taking care of children at their homes.

Medicines are usually the main cause of poisoning among children, which led to the law requirement that any medicine package and package insert must contain the warning label: *"Keep out of reach of children."* Poisoning usually occurs because these products are left within the reach of children, but also due to other factors. In the Cochrane systematic review, Kendrick et al.,[27] in relation to countermeasures and safety equipment against injuries and poisoning, reported as a variable of protection against drug poisoning the storage of medicines in enclosed spaces, such as cabinets and drawers, at a height above the waist of an adult.[27,28] However, even if these interventions prove to be effective, many children still get involved in poisoning accidents.[29-31] The fact is that, thus far, in countries such as Brazil, laws have not been sanctioned requiring the mandatory packaging with a protective cover for children: specific laws to protect children should be immediately

implemented. This study presented evidence that reinforces and provides a basis for public campaigns targeting the prevention of childhood poisoning.

Conclusion

The authors indicate that the elimination of factors such as distraction of caregivers of children under 5 years of age and storage of toxic agents below 150 cm represents the prevention of 13 and 19%, respectively, of poisonings among children aged 0 to 4 years.

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