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# EPIDEMIOLOGICAL CHARACTERISTICS OF CHILDREN'S POISONING WITH HOUSEHOLD SUBSTANCES - RETROSPECTIVE STUDY

**NICOLAI NISTOR[1,2], DRAGOȘ CRAUCIUC[1,3], TATIANA IOV[3], EDUARD CRAUCIUC[1,4*], DIANA POPOVICI[1,4], CRISTINA JITĂREANU[2], LOREDANA LILIANA HURJUI[1,5], ANDRA IRINA BULGARU-ILIESCU[1]**

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**Abstract.** Poisoning with household substances is responsible for a significant morbidity in children. The objective of this study is to specify the epidemiological characteristics of accidental and voluntary poisoning with these products at pediatric age. The study was observational, retrospective and included acute intoxication by ingestion of household substances in children aged 0-18 years hospitalized in The Regional Toxicology Center of the Emergency Hospital for Children "St. Maria "Iasi. The study group included 230 children admitted in the last 6 years with this diagnosis. Data were obtained from patient observation sheets, centralized and subsequently processed statistically. Knowing the epidemiological aspects of these poisonings can contribute to the elaboration and application of appropriate prevention strategies

## INTRODUCTION

Acute poisoning in children is a worldwide public health problem, but it can be avoided. The major responsibility for preventing this lies with the family (Iov, T., et al, 2019). Acute intoxication in children is very different from that of the adults in the ways it happens, the incriminating toxins, the methods of approach and especially the consequences. The child with acute intoxication is never a miniature adult; they react totally differently at the impact with different toxic substances. The most important difference with regard to child versus adult poisoning is the causative agent. While in adults, drug-related toxins (antidepressants, sedatives, anxiolytics) are most often incriminated, in children non-drug toxins, including household substances, are prevalent (Qazy, M. & Saqib, N., 2018). Epidemiological studies on acute intoxication in children have found that the most frequent risk factors are the small age, poor level of family education and low socio-economic status. In the pediatric age there is a bimodal distribution with a peak frequency in the young child (accidental intoxication especially in boys) and the second peak in adolescence (voluntary intoxication predominantly in girls (Fan, A.Y., et al, 2013).

The products used in the household are often within the reach of children in the age group 1-5, the age at which they explore the environment. The main toxic substances in this category are in the kitchen, bathroom and toilet. Household products are usually beautifully colored liquids that tempt children. At this age they are hyperactive and express their exploratory behavior, but they are too young to realize which substances are dangerous (Calello, D.P. & Henretig, F.M., 2014).

In the last years there has been a permanent change in the spectrum of toxic substances incriminated in accidental or voluntary intoxication in children, which requires the permanent information of the doctors on its epidemiological aspects. Although in most cases acute poisoning with these substances is benign, in some cases, especially when ingesting corrosive substances containing strong acids or bases, severe chemical burns can occur in the digestive tract starting from the mouth to the stomach. Corrosives are included in the composition of solutions for cleaning household objects, strippers and decanters. In addition to accidental poisoning at an early age, these solutions are also involved in adolescent voluntary intoxication, sometimes with the purpose of commiting suicide (Faz, A.A., et al, 2017).

The identification and documentation of the epidemiological aspects in these intoxications are of particular importance for the application of appropriate preventive measures (Prasadi, G.A.M., et al, 2018).

The objective of this study was to determine the risk factors in accidental or voluntary intoxications in children.

The high frequency of acute intoxication in the age group 1-4 can be explained by the following aspects:

- after one year of age children begin to walk, explore the environment, start to open the cabinets and examine their contents;
- the tendency of the child is to introduce the new objects he examines into the mouth cavity;
- the skill level increases, and the child begins to easily unscrew the caps of medicine bottles or other containers;

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- parents' negligence in storing and using the toxic substances; they are either kept in containers similar to those containing food or juices, or they are not stored properly, or when used they become accessible to the child.
- Hydroelectrolytic disorders are often encountered in the acute intoxication of the child, some of which are due to the toxicity. Knowing these hydroelectrolytic disorders and their proper treatment helps reduce mortality in children with acute intoxication.

## MATERIAL AND METHOD

We conducted an observational, retrospective study on acute intoxication with household substances in children aged 0-18, hospitalized in the Regional Toxicology Center of the Emergency Clinical Hospital for Children "Sf. Maria" Iasi. The study group included 230 children admitted in the period 1.01.2014 - 31.12.2019 with the diagnosis of poisoning by ingesting one of the products in this class. Children with inhalation poisoning as well as those who could not specify the toxic substance ingested were excluded from the batch. The data obtained from the patient observation sheets were centralized in a SPSS 18.0 database and subsequently processed, taking into account the relative risk (RR) and the confidence interval 95% (CI 95%).
Data obtained from patients' files was gathered and processed in a SPSS 18.0 database. Discrete variables were expressed as number and proportion. The comparison of the groups for the categorical variables was done by the Chi square test ($\chi 2$), the significance threshold being $P=1$. We evaluated the relative risk (RR) and the 95% confidence interval (CI 95%), following statistical interpretation: $RR>1$, the variable represents a risk factor; $RR=1$, the variable represents an indifferent factor. The statistical signification was accepted at a value of $P<.05$. The study was approved by the Ethics Committee of the Hospital.

## RESULTS AND DISCUSSIONS

During the study period, a total of 2915 children with acute intoxication were admitted, of which 230 (7.8%) were intoxicated with household substances. Over the course of the 6 years, the percentage of poisonings with household substances from the total poisoning ranged from 6.8% in 2015 to 8.6% in 2018 (Table I).

**Table I.** Annual distribution of the number of intoxications with household substances from the total number of intoxications

| Year | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|
| Total number of intoxications | 529 | 528 | 510 | 480 | 464 | 404 |
| Number of cases of intoxication with household substances | 42 (7.9%) | 36 (6.8%) | 43 (8.4%) | 36 (7.5%) | 40 (8.6%) | 33 (8.2%) |

The frequency of intoxication with household substances varies from country to country and remains difficult to assess because in many cases it is a benign intoxication for which patients do not show up for a medical consult. Over the 6 years, the average percentage of the cases involving household substances was 7.8% in the context of the decrease in the last years of the total number of poisonings. The frequency is slightly above the 7.6% reported by Lee et al., 2019 and lower but statistically insignificant compared to two other studies reporting 10.2% by Huynh et al., 2018 and 10% Devaranavadagi et al., 2017 respectively. Another study based on the prospective collection of telephone calls for various poisonings found that 10% of them involved household substances (Williams, H., et al., 2012).
Intoxications with more common household substances were accidental (168/73%) compared to voluntary (62/27%). Table II presents the demographic aspects of accidental poisoning with these substances in the study group.

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**Table II.** Distribution of accidental intoxication by age, gender and environment

| Age | < 1 year old | 1 -2 years old | 2-3 years old | 3-4 years old | 4-5 years old | >5 years old | Male | Female | From the urban area | From the rural area |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of cases | 5 | 42 | 61 | 28 | 14 | 18 | 104 | 64 | 52 | 116 |
| Percentage | 3% | 25% | 36% | 17% | 8.3% | 10.7% | 62.5% | 37.5% | 31% | 69% |

Most cases of accidental poisoning with household substances have been found at the age of 2-3 years old (36%). Other studies report that at this age intoxications with such substances were more common, as well (Manzar, N., et al., 2010). There are also studies that found the highest frequency (39%) at the age of 1-2 (Vilaçaa, L., et al., 2020). In the study group, these intoxications were more frequent in female children and in those living in rural areas.
Voluntary poisoning was registered in 62 patients. The average age at which these poisonings were reported was 15 ± 2.05 years old.

**Table III.** Distribution of voluntary intoxications by gender and environment.

| | Male | Female | From the urban area | From the rural area |
|---|---|---|---|---|
| Number of cases | 14 | 48 | 28 | 34 |
| Percentage | 21.5% | 78.5% | 45.2% | 54.8% |

These poisonings, sometimes use for committing suicide, were more common in girls (78.5%), in line with the current trend of voluntary intoxication in adolescents, which is 73.6% (Sheridan, D., et al., 2019). There was a slight predominance in children living in rural areas.
The main household substances involved in acute intoxication in children in this group are detergents, liquid soap, shower gel, body deodorizers, nail polish and solvents, strippers and detergents, sewage products, household pesticides and ethylene glycol (table IV).
The ingested household products can be corrosive, irritating or just foaming. They have four forms: liquids, gels, solids and powders (Fieux, F., et al., 2013). In the accidental poisonings of the study group, detergents (58 cases) were most frequently involved. Most detergents contain anionic surfactants and various additives. Their toxic action is achieved by more or less severe digestive irritation depending on the amount ingested. In recent years, they are commonly used packed in cushions containing 32-50 ml of concentrated liquid detergent, wrapped in a water-soluble membrane, providing a correct dose for washing machines or dishes and a reduction in packaging size (Settimi L, et al., 2018). Second as frequency, decapitators and decanters (22 cases) and household pesticides (20 cases) were involved. We noticed smaller percentages of poisoning with sewage products, liquid soap, shower gel, ethylene glycol, body deodorizers, nail polish and solvents.

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**Table IV.** Involving household substances in accidental and voluntary intoxication in children

| **Type of intoxication** | **Accidental poisoning** | **Voluntary poisoning** | **Chi²** | **p** | **RR** A-accidental V-voluntary | **CI 95%** |
|---|---|---|---|---|---|---|
| **Toxic substances involved** | 168 | 62 | | | | |
| Detergents | 58 (34.5%) | 16 (25.8%) | 1.20 | 0.272 | $1.34_A$ | 0.84-2.14 |
| Liquid soap | 14 (8.3%) | 0 (0%) | 5.48 | 0.019 | $8.33_A$ | 4.15-12.5 |
| Shower gel | 12 (7.1%) | 0 (0%) | 4.65 | 0.031 | $7.14_A$ | 3.25-11.0 |
| Body deodorizers | 10 (6.0%) | 0 (0%) | 3.84 | 0.050 | $5.95_A$ | 2.37-9.53 |
| Nail polish and solvents | 5 (3.0%) | 0 (0%) | 1.88 | 0.171 | $2.98_A$ | 0.41-5.55 |
| Strippers and descaling agents | 22 (13.1%) | 14 (22.6%) | 3.07 | 0.800 | $1.72_V$ | 0.94-3.15 |
| Products for draining the sewerage | 15 (8.9%) | 10 (16.1%) | 2.41 | 0.120 | $1.81_V$ | 0.86-3.81 |
| Household pesticides | 20 (11.9%) | 18 (29.0%) | 9.59 | 0.002 | $2.44_V$ | 1.38-4.30 |
| Ethylene glycol | 12 (7.1%) | 4 (6.5%) | 0.06 | 0.804 | $1.15_A$ | 0.38-3.43 |

Accidental poisoning with liquid soap (RR=8.33; CI95%: 4.15-12.5), shower gel (RR=7.14; CI 95%: 3.25-11.0) and body deodorizers (RR=5.95; CI95%: 2.37-9.53) presents a significantly increased risk in the young child, while poisoning with nail polish and solvent (RR = 2.98; 95% CI 0.41-5.55) presents a risk about 3 times higher, but the result cannot be extrapolated to the general pediatric population. In the voluntary intoxication, only five types of household substances were involved, which in descending order were household pesticides (18 cases), detergents (16 cases), strippers and decanters (14 cases), sewage products (10 cases) and ethylene glycol (4 cases). In these voluntary poisonings, a large number of corrosive substances were involved and they can cause severe damage to the digestive tract. The severity of these lesions depends on the chemical characteristics of the substance involved (acid or base), its dilution, the amount ingested and its presentation form (solution, tablets, granules or flakes) (Nițescu, V., 2015). In all cases of ingestion of such substances, it is essential to call an antitoxic center, as the composition and concentration of these products are sometimes not clearly specified on labels and they may be made of several corrosive agents or contain substances with systemic toxicity (Fieux, F., et al., 2013). The cases of poisoning by ingestion of corrosive substances in the study group were treated in the acute stage but we do not know the number of those with late complications, as they were followed in the pediatric gastroenterology section. The most common late complication is post-caustic esophageal stenosis, which occurs 3 weeks after ingestion. A study that was conducted on a large group of children with ingestion of caustic substances found the presence of esophageal stenosis in 13.5% of cases (Karaman, I., et al., 2015). The involvement of ethylene glycol in 12 cases of accidental poisoning and 4 cases of voluntary poisoning should also be mentioned. It is part of several chemicals available to children in the home environment, the most popular being antifreeze and brake fluid. Although the cases in our group have evolved favorably, sometimes these intoxications have severe or even

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fatal prognosis. The toxic dose in children is 0.7 ml*kg$^{-1}$ and the lethal dose is 1.5 ml*kg$^{-1}$ (Furnica, C., et al., 2017).

Although it includes a significant number of patients, this study has some limitations. One of them is the retrospective character, the analyzed data being obtained from the observation sheets of the admitted patients, a method that is far from perfect. Another limitation is the inclusion in the study only of the children admitted with intoxication with household substances, but there were patients with benign forms, who were taken care of at home or in the emergency room, without being admitted.

## CONCLUSIONS

Acute intoxications with household substances accounted for 6.8% of all cases of intoxication in children admitted during the respective period, 73% being accidental. The products involved were varied, most commonly being detergents, but corrosive substances that cause severe digestive damage were also found in a significant percentage. Knowing the epidemiological aspects of these poisonings can contribute to the elaboration and application of appropriate prevention strategies

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1. University of Medicine and Pharmacy "Grigore T. Popa" Iași, România
2. Pediatric Department "St. Mary" Children Emergency Hospital, Iași, România
3. The Institute of Forensic Medicine, Iași, România
4. "Elena Doamna" Iași Clinical Hospital
5. Department of Morpho-Functional Sciences II, Discipline of Physiology

* crauciuc@yahoo.com