

# Domestic Poisoning in the Pediatric Age Group

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*Poisoning in children is a public health issue worldwide, being a "family disease", an avoidable pathology. Thus, it is the major responsibility of the family to prevent them. Young children, due to their natural curiosity, present a major risk of domestic poisoning. In the case of domestic poisoning in children about half occur in children under 6 years of age, most of them occur in the age range 1 - 4 years. Morbidity and mortality have a higher incidence in childhood. Most of the times domestic poisoning in the case of children is accidental, representing about 85%, but there are also cases of voluntary poisoning. The forensic medicine network has the task of identifying such cases, carrying out forensic expertise and forensic necropsies in the case of deaths, reporting monthly / yearly indicators on the number of deaths per year at the county / national level as well as a series of variables (age and sex groups, environment of origin, cause of poisoning and class of chemical substance), which allow dynamic analysis of time and area tendencies of various population groups, including vulnerable groups. Monitoring such cases allows the establishment of an alert system with the possibility of immediate intervention by the authorities. Within risk assessments, the number of cases of poisoning with a particular substance or class of substances is a fundamental basis for decision making and risk management.*

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Acute poisoning is a pathophysiological state caused by the accidental or voluntary entry into the body of an abnormal quantity of a substance, with the appearance of functional disorders and the injury of different tissues and organs due to the interaction between the body and the environment, the result being a disease state, with variable evolution, depending on the dose and toxicity of the absorbed substance [1]. Poisoning in children is a group of disorders caused by the voluntary or involuntary absorption by a child of a toxic substance. Poisoning in children can be accidental (often at young ages), voluntary (at puberty, adolescence), and iatrogenous (when the dose is exceeded).

Toxic is called any exogenous chemical substance or compound, which enters the body through different pathways, causes functional and structural organic alterations, expressed clinically through a pathological state. The toxicity of a substance is determined by the physical and chemical properties, dose, concentration, pathway and rate of penetration, age of the poisoned person, their body weight, health status (liver, kidney and other pathological conditions increase the toxicity of a substance), individual tolerance. The most important element of favorable prognosis is early detection.

Toxic agents can enter the body in various ways, digestive, respiratory (gases and volatile substances), skin and through conjunctival and nasal mucosa (solvents, pesticides, caustic substances, various ointments, drugs, parenteral (intramuscular, intravenous, subcutaneous) [2-4].

Reports by the antitoxic centers in the United States of America revealed for 2014 a number of 2,165,142 cases of human poisoning, of which 1,326,789 cases (61.28%) were pediatric patients [5-7]. By analyzing the demographic and circumstantial characteristics of pediatric poisoning, it was identified that the highest incidence was in the age group under 6 years of age, accounting for 47.7% of the total reported exposures, predominating accidental poisoning, and for the age range 13-19 years of age, the exposures predominated the voluntary poisonings, accounting for 26.36% of the total voluntary exposures reported. The etiology of acute poisoning was different, depending on the age groups, being dominated by cosmetics and household products in the 0-5 age group, while in the 13-19 year age group the etiology of poisoning was dominated by exposures to substances of abuse and drugs [8].

The reports of antitoxic centers in Europe are uneven. Etiology, incidence and mortality rate in case of acute child poisoning vary from one country to another and even within the same countries. In terms of age, the reports are similar to those in the United States of America, with incidence, to those in the age group younger than 5 years and those in the age group 15-19 years. The analysis of these antitoxic centers in Europe on mortality allowed a ranking of the countries according to the death rate due to acute poisoning in children, Romania occupying the 6<sup>th</sup> place of the 38 analyzed states [1].

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According to the studies published in Europe, acute poisoning is one of the main causes of hospital admission in developing countries. Also, it has been observed that the frequency of acute poisoning is increasing, becoming a public health issue and is due, on the one hand, to the development of the chemical and pharmaceutical industries, on the other hand, to the ease of purchasing certain medicines without a prescription and the lack of effective measures of prophylaxis [8- 11].

Literature on the incidence of acute poisoning in children in our country includes little data since, at present, there is no structure that quantifies the toxic exposures at national level. The first epidemiological study was conducted in Bucharest at the antitoxic center within the Children's Emergency Hospital "Grigore Alexandrescu". During this period there were registered 11,890 cases of acute poisoning in children in Bucharest and 6 counties in the south of Romania. During the 10 years (1997-2006) of the study it was noted that 78% of the total poisonings were accidental, the age group 1-4 years representing 65%, the drug poisoning prevailing 14.7% in male children and 46.3% in female children, followed by caustic poisoning 27.6% in male children and 8.7% in female children, ethyl alcohol poisoning 11.2% in male children and 3.9% in female children, cosmetic poisoning 3.4% in male children and 10.7% in female children and insecticide and raticide poisoning 2.6% in male children and 8.7 % in female children. The aetiology of drug poisoning was dominated by neurotropic drugs (benzodiazepines, barbiturates, neuroleptics, antiepileptics, antidepressants), followed by poly-drug poisonings, cardiotropic, antiemetic, analgesic and antipyretic, antihistamines, ENT product poisonings (11).

Also, between 2006-2010 a collaborative study was carried out in four antitoxic centers in our country, namely in Bucharest, Timișoara, Cluj Napoca and Iași, which allowed a national study on the epidemiology of acute poisoning in children, analyzing 6,099 cases of acute poisoning admitted and treated concluding: the most common acute poisonings were the drug-related ones, the exposure in most cases was accidental (58%), the most exposed age group in the case of the accidental acute poisoning was 1 -5 years; females were most commonly involved in voluntary exposures (82%). In the case of drug poisoning, most cases were secondary to the combination of several pharmacological agents (44%), neuroleptics (25.65%) and non-steroidal anti-inflammatory agents (8%). Non-drug etiology was dominated by acute mushroom poisoning (12.7%), followed by ethanol (11%), carbon monoxide (7.5%), household products (6.52%), and cholinesterase inhibiting insecticides (4.48%) (12- 14).

Another observational, descriptive and retrospective study in patients aged 0 and 18 years hospitalized with the diagnosis of acute poisoning, who complained hepatic impairment upon admission or during the evolution thereof, was carried out during the period 2010-2014 in the intensive care toxicology section of the Children's Emergency Hospital "Grigore Alexandrescu" in Bucharest and the pediatric nephrology and toxicology section of the Emergency Clinical Hospital for Children in Cluj Napoca. 77 patients were selected for the study, 38 patients being diagnosed and treated in the toxicology department in Cluj Napoca and 39 of the patients in the toxicology department in Bucharest, excluding patients with liver disease known prior to the toxic exposure, as well as those who, although they had have been exposed to substances with potential hepatotoxicity, have no hepatic impairment. In 66.2% of cases the ingestion was of non-medicinal toxic substances (66.2% ingestion of non-edible fungi, 15.66% of pesticide ingestion, 7 cases were acute poisoning with cholinesterase inhibiting insecticides: diazinon 5 cases, dimetoat 1 case, tomoxan 1 case), and in 33.8% of cases the ingestion was medicinal (a drug or various drug associations). Exposure to metaaldehyde, a molluscicide, was found in only one case of accidental ingestion. The study group also included a case (1.96%) of voluntary acute poisoning, by inhalation, with new psychoactive substances and 2 cases of toxic methemoglobinemia in acute nitrite poisoning. The analysis of the etiology of poisoning according to the demographic and circumstantial characteristics revealed that the non-drug etiology was statistically significantly associated with the male sex, the age group under 1 year and the accidental exposure to the toxic substance, and the drug etiology was statistically significantly associated with the voluntary exposure, female sex and the age group 15-18 years [12, 15].

A relatively recent study conducted at the Emergency Clinical Hospital for Children "Sf. Maria" Iasi over a period of 3 years (2014-2016) emphasized that 28% of the total cases of poisoning were accidental, prevailing as in the previous study mentioned drug poisoning 14.7% in male children and 46.3% in female children, followed by caustic poisoning 27.6% in male children and 8.7% in female children, ethyl alcohol poisoning 11.2% in male children and 3.9% in female children, cosmetic poisoning 3.4% in male children and 10.7% in female children and insecticide and raticide poisoning 2.6% in male children and 8.7% in female children.

It is not possible to review all substances that can cause acute poisoning in children. The most common substances for children poisoning that are most often used in the home, in the family, in the household are: medicines, cosmetics, nail polish, perfumes, toothpaste, bleaching agents, dish detergents, cleaning agents for furniture, thaw or antifreeze products, turpentine, kerosene, briquette gas, paint thinners, solvents, gardening products, especially insecticides, pest and weed control products, batteries, water (from domestic pipes, minerals, wells), carbon monoxide (CO), methane gas, toxic plants, alcohol, food, nicotine [15, 16].

In acute poisoning with drugs in children at the top of the list is paracetamol, taken together with other drugs that contain the same substance. Acetaminophen is a frequently incriminated etiologic agent, accounting for over 15% of all cases of acute liver failure, followed by tuberculostatics, antiepileptics or other drugs (for hypertension or ischemic

heart disease) with hepatotoxic potential (5%) [17]. All medicines, including vitamins, taken in high doses can cause poisoning. It is possible for a child to die from liver disease even when ingested five vitamins for adults, which contain iron [18- 20].

In Romania between 1997 and 2006, a study was conducted on the hepatic impairment in acute drug poisoning in children within the toxicology and intensive care section of the Emergency Clinical Hospital for Children "Grigore Alexandrescu" in Bucharest. As a result of this study, 6453 cases of acute poisoning were reported, 3464 (53%) being acute drug poisoning. In 6 patients, hepatic impairment was due to ingestion of paracetamol or in combination with aspirin (0.17%) [12]. During the years 2003-2012, another study was conducted within the toxicology and intensive care section of the Emergency Clinical Hospital for Children "Grigore Alexandrescu" in Bucharest and within the nephrology-toxicology section in Cluj regarding renal impairment in the case of acute poisoning which ascertained the association of the hepatic impairment in 45 cases, 26 cases evolving towards acute liver failure [6]. The study conducted in 2010-2014 in the toxicology section of the intensive care clinic of the Emergency Hospital for Children "Grigore Alexandrescu" in Bucharest and the section of pediatric nephrology and toxicology within the Emergency Clinical Hospital for Children in Cluj Napoca highlighted that the drug etiology of single-drug poisoning is dominated by paracetamol (50%), followed with a much lower frequency by isoniazid poisoning (11.5%), valproic acid (7.7%), clozapine-like neuroleptics (3.8% ) and colchicine (3.8%). Of the total cases analyzed in the study, 7.8% were multi-drug poisoning, paracetamol being, in this context as well, the most commonly identified drug: co-ingestion of paracetamol, ibuprofen and acetylsalicylic acid; paracetamol, chlorpheniramine, pseudoephedrine and metamizole; paracetamol, ketoprofen and ampicillin. In multi-drug poisonings the patients have combined both paracetamol as such and medicines whose trade name differs, but all having in composition paracetamol: antinevralgic: combination of paracetamol with acetylsalicylic acid, parasinus: paracetamol, chlorphenamine, pseudoefedrine. Only 3 of the poisonings in which paracetamol was involved were accidental, due to parents' failure to appropriately store the drugs, the rest being voluntary poisoning [21- 23].

Cosmetics: Nail polish contains a large amount of flatates (dibutyl phthalate - DBP being a naphthalene derivative), the foundation and the shades contain heavy metals (mercury, lead, arsenium, nickel, etc.) and parabens (methyl, propyl, butyl, isobutyl, ethyl), shampoo and hair conditioner contain triclosan, sodium lauryl sulfate (SLS), parabens, diethanolamine (DEA - cocamides, lauramide, monoethanolamide, triethanolamide) and petrolatum (petroleum jelly), creams may contain DEA, parabens, triclosan, aluminum, lipstick and lip gloss can contain parabens, petrolatum and heavy metals (especially lead), deodorants and antiperspirants can contain aluminum and triclosan, toothpaste can contain aluminum, triclosan, and due to fluoride toothpaste can be extremely harmful if ingested in large quantities by children [24- 26], perfume may contain phthalates), baby soaps may contain formaldehyde (or preservatives that release formaldehyde - DMDM Hidantoin, Diazolidinyl urea, Imidazolidinyl urea, Methenamine, Quaternium-15, Bronopol, Sodium hydroxymethylglycinate), baby oils may contain mineral oils (by-products resulting from petroleum refining).

Household detergents and fuels: bleaching agents, dishwashing agents, toiletries or pipe broaching contain sodium hypochlorite (chlorine) which is a hazardous chemical, with an extremely irritating odor found in many cleaning products, and the use of such products for cleaning and disinfecting the surfaces of the house can cause inhalation of vapors or accidental swallowing of the products. If the chlorine is mixed with ammonia they produce poisonous gas. Ammonia is also in the form of capsules with odorous salts that can mistakenly pass as candy [27-29].

Furniture polishes are a very broad category (hydrocarbons) which includes gasoline, kerosene, lamp oil, motor oil, briquette fuel and paint thinner, and ingested hydrocarbons are among the leading causes of death from poisoning in children.

Gardening products, especially insecticides, pest and weed control products can cause poisoning not only through ingestion, but can enter the human body also through the skin or eyes or be inhaled.

Naphthalene is a highly volatile aromatic hydrocarbon used in households as an insecticide (for moths). It can be absorbed by the respiratory (inhalation) or digestive tract (swallowing) most commonly in children, at a dose of 30g coma appears, often followed by convulsions.

Cases of acute poisoning with nitrates in infants and even deaths are still reported, the main source being the soil composition, which is naturally characterized by increased nitrate/ nitrite concentrations. Nitrates and nitrites are ubiquitous in soil, water (underground, surface), vegetables, milk and dairy products, meat products, food additives under the name of "E" (E249, E250, E251, E252 etc). Acute nitrate poisoning, well water poisoning, infant cyanosis, acute infantile methemoglobinemia or baby blue syndrome, is the first consequence of the consumption of well water contaminated with nitrogenous substances by children 0-1 years old, water used to prepare powder milk. Almost all cases of methemoglobinemia of toxic origin are encountered in the first 3 months of life, especially in premature newborns. Children under the age of three compared to older children and adults are much more susceptible, cyanosis which does not disappear when given oxygen (easily visible only in the palms, plants, lips or mucous membranes or intense and generalized, with a "slate", gray or even black hue) being the main symptom, but there is the possibility of suffocation and even death.

Common sources of Carbon monoxide (CO) which is a deadly gas can be by burning car fuel, lawnmowers, industrial furnaces, fireplaces and grills, generally fuel-based items are designed to reduce the risk carbon monoxide poisoning, but these may malfunction or may be misused.

Ingestion of toxic plants (the fruits, seeds or roots of many common plants) is poisonous: the pomegranate, henbane, jimsonweed, azalea, daffodil, begonia, lady's glove, iliacae, iris, teardrop, Lingonberry, mistletoe, morning glory, lily, even some indoor plants are toxic - rhododendron, ivy. Ingesting any piece of wild mushroom can be very harmful.

Alcohol (several types of alcohol) is used in various household cleaning products. Methanol is used in antifreeze, windscreen washes, paints, enamels and silk solvents, other types of alcohol are used in mouth water, in cleansers, perfumes, aftershaves, colonics, antibacterial liquid soaps, antiseptics, disinfectants. Certain types of sweets and food extracts such as vanilla and almond essence can contain alcohol and can be harmful to children. Specific for children is the metabolism rate, twice as fast as in adults, of 30 mg/ dl/ h. For children, the lethal dose is considered to be 3 g/ kg, but cases of death have been reported at both much lower and much higher service concentrations, so we can conclude that the lethal dose may vary. An adolescent may be in a coma at an average blood alcohol level of 32 mmol (1.5 g / l) - 41 mmol (1.9 g / l). Children aged 1-13 years eliminate ethanol twice as fast as adults, with blood alcohol lowering by 5-9 mmol/ h, or 0.2 g/ kg/ h, but immature alcohol-dehydrogenase in children below the age 5 years limits the elimination of ethanol. Mouth water can contain 7-27% alcohol (out of 100 ml content 7-27 ml is pure alcohol), perfumes can contain 25-95% alcohol [30].

Nicotine poisoning usually occurs in children who accidentally chew nicotine chewing gum (most often belonging to their parents) or apply nicotine patches out of curiosity. Refillable electronic cigarettes and refill bottles are, in most cases, open systems, which allow direct access to liquids containing nicotine. Nicotine is an alkaloid found in tobacco plants. It is a stimulant that acts on the parasympathetic nervous system and is the main cause of dependence on tobacco products. Nicotine, a drug that easily determines addiction, under conditions of sufficiently high doses also determines the toxicity (lethality) by all routes of exposure. In its opinion on the reclassification of nicotine, the Committee for Risk Assessment (CRA) of the European Chemicals Agency considered that 5 mg per kg of body weight was a justified estimate for acute toxicity of nicotine through oral exposure. This value of Acute Toxicity Estimate (ATE) is of the same order of magnitude as that presented by Mayer (2014), who estimated the lower limit that causes death to be 0.5–1 g of ingested nicotine, corresponding to an oral LD 50 dose of 6.5–13 mg per kg of body weight in humans. This value translates into a dose of 390–780 mg of nicotine for an adult weighing 60 kg and 65–130 mg for a child weighing 10 kg. Depending on the limits set in the DPT, electronic cigarette refillable devices may contain up to 40 mg of nicotine, and refill vials may contain up to 200 mg of nicotine. Therefore, there is a particularly risk for young children if they accidentally swallow refill fluid, especially from a refill bottle. Deadly poisoning of young children in the US and Israel has been reported in the media due to refill fluids. The PRECISE study ordered for DG Health and Food Safety analyzed 277 nicotine poisoning cases reported at toxicology centers in eight EU Member States (Austria, Hungary, Ireland, Lithuania, the Netherlands, Portugal, Sweden and Slovenia), over the period January 2012 - March 2015. It was found that 87.3% of cases were associated with refill fluids, 0.7% with disposable electronic cigarettes, and 12% with unknown product types (which can be partially explained by their high market share). Of the cases studied, 71.3% were accidental poisoning. Overall, 67.5% of cases occurred after ingestion of refill fluid. From a demographic perspective, 33,2% of the cases involved children up to five years old, 9.7% young people aged 6-18, and 57% adults over 18 years old. As for the consequences, 23.7% of the cases required hospital admission and 6.8% involved a moderate or major effect.

## Conclusions

Generally speaking, a person can be poisoned with almost any substance consumed or inhaled excessively, including water, when we consume too much water and hyponatremia occurs, dilution of sodium in the body and thus appears water poisoning.

In pediatric practice, acute poisoning of the child is an important issue both because of its frequency and because of its severity. It represents one of the major medical emergencies in children, and 1/3 of such poisonings are deadly.

Accidental poisoning is prevalent in children, compared to the adult where most of them are voluntary, for suicide purposes. Most poisonings in children occur under the age of 5. Under the age of 1, drug poisoning predominates, due to overdose or their inappropriate use. Accidental poisoning with various household substances predominates between 1-5 years of age: detergents, shampoo, soap, various household solvents, disinfectants, etc.

In order to prevent poisoning, it is recommended to read the package leaflet, the cautions, its correct use and the first aid instructions in case of poisoning with the respective substance, the elaboration of national programs to inform the population about the increased toxic potential of these toxic substances, the need to impose measures that allow strict control of the accessibility of patients to medicines, as well as the usefulness of information campaigns on their significant toxic potential.

Accidental poisoning can be prevented by legislative, educational and epidemiological measures.

The legislative measures may include prohibiting the manufacture of toxic toys, the obligation to mention "toxic" in the case of hazardous chemicals, the use of less attractive packaging for hazardous chemicals, the prohibition of using lead in colors intended for painting.

The educational measures are made through the continuous education of the general public, by means of information: press, radio, television, leaflets.

The medical-sanitary personnel can intervene in the actions of sanitary education, during the consultations in the medical center.

The family has the role of gradually moving from the protective attitude to the educational-pedagogical one.

The epidemiological measures consist in the dynamic knowledge of the frequency and distribution of cases of poisoning in children, from a certain territory, at certain times of the year.

In order for waters in wells to be used for drinking purposes, it must qualitatively comply with the legislation in force and ensure the minimum required daily quantity for the inhabitants served. In cases where the natural feeding of infants is not possible, mothers in at-risk areas are recommended to use still water/ non-carbonated table water for the preparation of powdered milk. By boiling, the nitrate concentration in the well water increases, due to water evaporation. So this process provides the microbiological quality of the water, but not the chemical one. It is necessary to increase the level of information and educate the population on the importance of using "safe water".

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