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Patterns of Poisoning in Urban and Rural Children: A Single-Center Study

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A – research concept and design; **B** – collection and/or assembly of data; **C** – data analysis and interpretation; **D** – writing the article; **E** – critical revision of the article; **F** – final approval of article

Abstract

Background. Poisoning among children is a current issue in pediatrics. The pattern and risk factors of poisoning are heterogeneous and vary within the same country.
Objectives. The aim of the study was to analyze the determinants in the incidence and nature of poisoning between urban and rural children, in order to identify children at higher risk.
Material and Methods. The study entailed a retrospective analysis of the medical records of 848 children admitted to the Department of Pediatrics at the Medical University of Lublin, Poland, due to exposure to poison from July 2008 to December 2012. The patients were divided into urban and rural.
Results. The majority of the subjects came from urban areas (64.50%). In both groups the most numerous were children aged ≤ 5 years and 14–15 years. Among urban boys, children younger than 5 years old predominated, while among urban girls, teenagers aged 14–15 years comprised the largest group ($p = 0.00$). In the rural population children younger than 5 years were the most prevalent regardless of gender. The incidence of intentional intoxication increased with age, while the incidence of accidental poisoning decreased with age ($p = 0.00$). Among urban children there was a significant association between gender and the nature of poisoning ($p = 0.00$). The most common cause of poisoning was the use of non-pharmaceuticals, with alcohol predominating.
Conclusions. The study indicates that poisoning is more likely in urban children. Among urban children there is a bimodal gender distribution with a preponderance of pre-school boys in accidental poisoning and of teenage girls in intentional ones. However, among rural children the most prevalent was accidental poisoning by improperly stored medicines and household chemicals. Urban children commonly use alcohol and narcotics (**Adv Clin Exp Med 2016, 25, 2, 335–340**).

Key words: poisoning, children, adolescents, alcohol, medications.

Acute poisoning in children and adolescents remains an important medical problem and public health concern. According to data from the Polish National Institute of Public Health/National Institute of Hygiene (NIPH-NIH), in Poland in 2010 the total number of hospitalizations due to poisoning amounted to 46,574 out of which 30% were patients under 19 years of age. It should be highlighted that in recent years, the number of cases of poisoning among children has not decreased, but remains at almost the same level [1].

Each year in the United States more than 1 million children younger than 5 years are poisoned [2]. Despite the fact that fatal child poisonings have decreased substantially in recent decades, exposure to toxic substances is still a frequent cause of admission to pediatric departments and can lead to life-threatening complications and death [2, 3].

Poisoning incidents can be divided into two groups depending on their cause: accidental and intentional. Accidental poisoning generally involves infants and children under 5 years, with

males predominating [4–7]. During this period of life children are characterized by a natural curiosity about their environment and eagerness to improve their psychomotor skills. Accidental poisoning among younger children is closely connected with parents' recklessness [4].

Intentional poisoning mainly involves adolescents. Girls predominate among teenagers admitted to hospitals due to poisoning [5–7]. There is no single cause of self-intoxication; it can be a result of a whole sequence of stressful events in a child's life. Romantic disappointment, family problems, conflict with parents, lack of self-acceptance and problems at school generate negative emotions that can lead teenagers to thoughtless behavior and suicide attempts [8, 9].

The pattern and risk factors of poisoning in children vary in different countries and even regions of the same country. The essential issue is to determine the extent and nature of poisoning in childhood, which would allow a preventive strategy to be undertaken [10].

To the best of the current authors' knowledge, there is no pediatric toxicology department in Poland, and intoxicated children are admitted to the nearest general pediatrics departments. It therefore seems extremely important to popularize current knowledge about poisoning in children. The aim of this study was to analyze the incidence and nature of poisoning among urban and rural children in order to identify those at higher risk of specific types of intoxication and to make recommendations for prevention.

Material and Methods

The study group consisted of children admitted to the Department of Pediatrics at the Medical University of Lublin, Poland, due to exposure to toxic substances during the period from July 2008 and December 2012. During the study period, 848 children aged 1–18 years were admitted to the Department of Pediatrics due to poisoning. The patients were divided into two groups according to their place of the residence: children from rural areas and those from urban areas.

The patients' characteristics were obtained retrospectively from their medical records and included age, gender, the type of toxic substance, the reason for the exposure to the poison (intentional – i.e. self-poisoning with or without suicidal intent – or accidental) and previous poisoning incidents.

The subjects were divided into four age groups: from birth to 5 years old (Group 1), 6 to 13 years old (Group 2), 14 to 15 years old (Group 3) and 16 to 18 years old (Group 4).

The statistical analysis was carried out with STATISTICA 8 software (StatSoft, Tulsa, USA). For the analysis of the differences between the groups Pearson's χ^2 test was used; $p < 0.05$ was considered statistically significant.

Results

During the study period, there were 848 admissions to the Department of Pediatrics due to exposure to toxic substances. This constituted 13% of all admissions to the Department in that period. The highest percentage of hospitalizations for poisoning was recorded in 2008 (19.90%); however, in 2008 medical data were analyzed only from July to December. In the following two years the percentage of pediatric poisoning admissions was lower: 13.79% in 2009 and 13.77% in 2010. After that, the incidence of admissions due to poisoning decreased to 11.03% in 2011 and 11.78% in 2012.

The vast majority of subjects came from urban areas (64.50%), while one-third of the children came from rural areas (35.50%). During 2008–2011 the frequency of poisoning of rural children was about 36–37%, while in 2012 it increased to 42%.

In the study group there were 439 girls (51.77%) and 409 boys (48.23%). Poisoning was slightly more frequent among urban girls (53%) than among boys (47%). In rural children, the prevalence of poisonings among girls and boys was quantitatively identical. The differences between the rural and urban populations according to gender were statistically insignificant ($p = 0.48$).

The average age of the patients was 9.52 ± 6.07 years. The mean age among urban children (10.01 ± 5.99 yrs.) was higher than among rural children (8.63 ± 6.14 yrs.). The youngest patient was a 10-month-old rural girl admitted to the hospital due to accidental exposure to corrosive alkalis.

In the study group, children aged 5 years or younger (39.74%) were the most numerous, followed by children aged 14–15 years (30.66%), children aged 16–18 years (14.98%) and children aged 6–13 years (14.62%).

In the urban population children under 5 years were prevalent (35.83%), followed by children aged 14–15 years (32.35%). The vast majority of rural children consisted of children aged 5 years or under (46.84%), followed by children aged 14–15 years (27.57%). A detailed analysis of age groups among the urban and rural patients is presented in Table 1.

The statistical analysis showed significant differences in the gender distribution in particular groups among the urban children ($p = 0.00$). Among urban boys, children younger than 5 years

Table 1. Age groups among urban and rural children

Age group (years)	Place of residence	
	urban n (%)	rural n (%)
≤ 5	196 (35.83)	141 (46.84)
6–13	87 (15.90)	37 (12.29)
14–15	177 (32.36)	83 (27.57)
16–18	87 (15.90)	40 (13.29)
Total	547 (100)	301 (100)
	$\chi^2 = 9.99$; p = 0.02	

old predominated (45.17%), while among urban girls, teenagers aged 14–15 years constituted the largest group (40.00%). However, among both rural boys and girls the most numerous group was of subjects under 5 years (51.33% and 42.40% respectively).

Most of the poisoning incidents during the study period were accidental (56.01%); 43.99% were intentional. Accidental poisoning prevailed among both rural and urban children (61.13%; 53.20% respectively). The nature of poisoning in relation to age and place of residence is presented in Table 2. It should be emphasized that the incidence of intentional poisoning increased with age, while the frequency of accidental poisoning decreased with age (p = 0.00).

The study revealed a significant relationship between gender and the nature of poisoning among urban children (p = 0.00). Among urban girls intentional poisoning was more common (58%), while among boys accidental poisoning was more frequent (65.6%). Among rural children accidental poisoning was more frequent among both boys (68%) and girls (54%). Table 3 presents a detailed analysis of the causes of poisoning in the study group in relation to the place of residence.

In the study group, non-pharmaceutical agents were the most common causes of poisoning (58.97%). Among both urban and rural children, non-pharmaceuticals were mostly involved in male cases (70.65% and 68.67% respectively). Non-pharmaceutical substances were the most frequent causes of poisoning in children aged 6–13 years (70.98%), followed by children aged 14–15 years (63.08%), 16–18 years (57.48%), and 5 years or younger (51.92%). Non-pharmaceuticals were the most common cause of accidental poisoning (59.15%).

Table 3. Substances involved in poisoning in relation to the patients' place of residence

Cause	Urban n (%)	Rural n (%)
Medications	219 (40.0)	129 (43.0)
Non-pharmaceuticals	328 (60.0)	172 (57.0)
Alcohol	158 (28.9)	59 (19.6)
Narcotics	29 (5.3)	10 (3.3)
Solvents, fuels, oils	21 (3.8)	16 (5.3)
Pesticides	14 (2.6)	19 (6.3)
Corrosive substances	14 (2.6)	16 (5.3)
Mushrooms	13 (2.4)	8 (2.7)
Gases	18 (3.3)	8 (2.7)
Plants	6 (1.1)	5 (1.7)
Other	55 (10.1)	37 (12.3)

The most common cause of non-pharmaceutical poisoning was alcohol. Generally, it was involved in one-fourth of all the cases of poisoning. Ethanol was the cause of 80.57% cases of alcohol poisoning. In the remaining cases, the type of alcohol was not identified. Among children older than 6 years, alcohol was the most frequent cause of non-pharmaceutical poisoning. The vast majority of alcohol poisoning incidents (48.46%) occurred among children aged 14–15 years, followed by children aged 16–18 years (37.79 %) and

Table 2. The character of poisoning incidents in particular age groups according to the place of residence

Age (years)	Urban		Rural	
	accidental n (%)	intentional n (%)	accidental n (%)	intentional n (%)
≤ 5	196 (100.00)	0 (0)	141 (100)	0 (0)
6–13	39 (44.83)	48 (55.17)	26 (70.27)	11 (29.73)
14–15	37 (20.90)	140 (79.10)	14 (16.87)	69 (83.13)
16–18	19 (21.84)	68 (78.16)	3 (7.5)	37 (92.5)
	$\chi^2 = 283.39$; p = 0.00		$\chi^2 = 207.80$; p = 0.00	

6–13 years (33.87%). The youngest child intoxicated by alcohol was a 5-year-old girl. Boys predominated slightly among children intoxicated by alcohol (52.60%). Alcohol poisoning was more common among urban children (28.9%) than rural children (19.6%); this difference was statistically significant (p = 0.00).

Narcotics were the cause of 4.6% of the admissions for acute poisoning, and were more often involved in urban poisoning incidents (5.3%) than rural ones (3.3%). Nearly all of the instances of poisoning with narcotics (89.5%) occurred in children aged 14 years or older. There were four cases (10.5%) of narcotics consumption by children younger than 13 years old. The youngest child intoxicated by narcotics was a 22-month-old boy.

Common household products, including corrosive substances, solvents, fuels, oils and pesticides were frequently reported as the cause of poisoning among rural children, especially in children aged 5 years or younger.

Non-narcotic medications were the cause of poisoning in 41.03% of all cases in the study group. Pharmaceutical poisoning occurred significantly more often in girls than boys (p = 0.00) regardless of the place of residence. Medicines were the most common cause of poisoning in children aged 5 years or younger (48.07%), followed by children aged 16–18 years (42.51%), 14–15 years (36.92%) and 6–13 years (29.03%). Table 4 presents the pharmaceutical agents involved in the poisoning cases in the study group. The most common pharmaceutical poisons were non-opioid analgesics (18.39%), anti-epileptic drugs (15.23%), respiratory system drugs (12.07%) and psychotropics (10.06%).

There were 22 patients (2.59%) with a previous history of admission to the Department of Pediatrics due to poisoning; 18 of them (81.81%) were hospitalized due to subsequent self-intoxication.

Table 4. Suspected pharmaceutical agents involved in poisoning

Pharmaceuticals	n	%
Non-opioid analgesics	64	18.39
Anti-epileptics	53	15.23
Respiratory system medications	42	12.07
Psychotropics	35	10.06
Cardiovascular system medications	28	8.05
Anti-allergenics	22	6.32
Systemic hormonal preparations	10	2.87
Vitamins and microelements	10	2.87
Anti-infectives for systemic use	7	2.01
Dermatologicals	6	1.72
Alimentary tract medications	5	1.44
Other	66	18.97
Total	348	100.00

Discussion

Poisoning remains a major cause of morbidity among children in Poland and around the world. Despite child-resistant packaging, advances in health care and the development of medical awareness in the general public, the incidence of acute accidental poisoning in children has not decreased. Moreover, in recent years intentional, often suicide-related poisoning among adolescents has become a gradually increasing medical and social problem [2, 6, 7, 11, 12]. Thus, acute poisoning in childhood is a challenging problem for healthcare professionals.

During the 5-year-period of the study the mean incidence of admissions to the Department of Pediatrics at the Medical University of Lublin due to poisonings was 13.00%. According to a 5-year-retrospective study conducted at the Pediatric Hospital in Białystok, Poland, poisonings accounted for one-fourth of all admissions to the hospital emergency unit [12]. In contrast, Lamireau et al. found a decreasing incidence of poisoning at a pediatric center in France from 1989 to 1995 [5].

Urban children have generally predominated the statistics of hospitalizations due to poisoning [4, 5, 12]. The findings of the current study confirm that fact. This may be a result of more frequent direct admission to the nearest hospital to the place of residence, or – less likely – a genuinely lower incidence of poisoning among rural children [5]. It should be emphasized that the current study found a higher number of intoxicated rural children in 2012 than in previous years in the study period. This fact should undergo a detailed comparison with data from other hospitals in the Lublin macroregion.

In several previous studies, boys predominated among poisoned children [5, 7, 12, 13]. In this study, the overall incidence of poisonings was higher in girls. Moreover, the current study revealed a bimodal gender distribution of poisoning among urban children, with boys predominating among children aged ≤ 5 years and girls predominating among teenagers older than 14 years. This distinct trend has also been noted in other reports [5, 7, 14]. However, the current study showed that the most

numerous group among both rural girls and boys were children younger than 5 years old.

A characteristic age distribution in pediatric poisonings, with one peak among pre-school children and another during adolescence has been noted in a number of different studies [5–7, 13]. However, in a recent study carried out in Białystok the majority of the intoxicated children were teenagers aged 16–18 years [12].

In this study, regardless of the place of residence, the majority of poisoning incidents were classified as accidental. There was an inverse correlation between the incidence of accidental poisoning and the age of the children: The frequency of unintentional poisoning decreased as the age of the children increased. At the same time, the frequency of intentional poisonings increased with the patients' age. These findings are consistent with those of other reports [6, 7, 13, 14]. However, in the recent study in Białystok, the distinct majority of pediatric poisoning cases (75.5%) were classified as intentional [12].

Numerous studies have confirmed that non-pharmaceutical agents are the leading cause of poisoning [4, 6, 7, 12]. However, the type of poison varies in different countries or even regions of the same country. The most common non-pharmaceutical agents were cleaning products in France, corrosive substances and carbon monoxide in Turkey, cleaning products and pesticides in Taiwan, ethanol in Finland and in Białystok [5, 6, 10, 12]. In another recent Polish study conducted in Bydgoszcz, the leading non-pharmaceutical agents were household chemicals and gases [4]. In the present study, alcohol was the most common non-pharmaceutical agent involved in intoxication, more often among urban than rural children. A considerable increase in alcohol poisonings among Polish adolescents has been observed in several studies [15, 16]. Alcohol consumption is one of the most important social problems in Poland. According to the European School Survey Project on Alcohol and Other Drugs (EPSAD) in 2007, alcohol is the most popular psychoactive substance used by young Poles [17]. Moreover, an alarming phenomenon is the popularity of the consumption of narcotics or so-called designer drugs among teenagers [12]. Thus, it seems that existing alcohol-prevention strategies are inadequate. A prevention program for children and adolescents against the use of alcohol and other psychoactive substances should be implemented. In the present study, alcohol and narcotics were more often involved in intoxication among urban children than rural children.

The growing problem of children self-poisoning with drugs and other substances also requires a constructive prevention strategy and cooperation among health-care professionals, teachers and parents. Among medicines, regardless of the region of the world, the leading causes of poisoning are analgesics and drugs acting on the nervous system [5–7, 10, 13]. The results of the present study confirm that as well.

One limitation of the present study is the small study group, restricted to patients admitted to only one department at a university hospital. The retrospective nature of the study was another limitation. Therefore, the authors hope to extend the scope of the study in a future prospective study.

The authors concluded that poisoning is more common among urban children than among rural children. Among urban children, there is a bi-modal gender distribution, with a preponderance of pre-school boys in accidental poisonings and a preponderance of teenage girls in intentional intoxications. Among rural children, accidental poisoning by improperly stored medicines and household chemical substances was the most frequent. Alcohol and narcotics are more commonly involved in intoxication among urban children.

In the authors' opinion, the implementation of narrowly targeted poisoning prevention programs focused on particular risk groups seems likely to be more successful than broad diffuse prevention strategies.

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