

ORIGINAL PAPER

SAFE STORAGE OF HOUSEHOLD SUBSTANCES TO PREVENT CHILD POISONING

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Abstract

Aim: The objective was to determine whether hazardous substances are safely stored in households. **Design:** A descriptive cross-sectional study was performed. **Methods:** The sample comprised 300 parents of children attending 20 selected kindergartens. A non-standardized questionnaire developed by the study authors was used. Statistical analyses were carried out using the general linear model, chi-square test, Wilcoxon test, binomial distribution, Kruskal-Wallis test and Mann-Whitney U test. **Results:** Parents act to prevent unwanted cases of child poisoning in the home setting. There was a statistically significant difference in how household substances were stored ($p < 0.001$). The largest group of hazardous household substances were cleaners (2,644), of which 676 (26%) in the reach of children. A total of 5,550 hazardous substances were found in households, including 1,215 (22%) items that could be accessed by children. There was a statistically significant differences ($p = 0.0484$) in the number of substances in the reach of children between parents with the lowest level of education and those with tertiary education. The field of education, type of housing and place of residence had no effect on the proportion of substances unsafely stored in the home setting. **Conclusion:** Parents keep household substances out of the reach of children to prevent unwanted cases of poisoning. There are substances, however, that are not considered as toxic by parents.

Keywords: children, parents, poisoning, prevention, substances.

Introduction

Accidental poisoning is relatively common in childhood. Most frequently (80–90%), children get poisoned within the home environment (Proudfoot et al., 2003; Childhood Poisoning, 2009), in a garage, garden or park (Mrázová, 2008). The severity of poisoning depends on the amount and concentration of the poison, its absorption rate, metabolism and elimination rate (Dobiáš, 2007). Factors determining the severity of poisoning and its outcome are interrelated. They include the type of poison, dose, formulation, route of exposure, age of the child, presence of other poisons, state of nutrition of the child and the presence of other diseases and injuries (Peden et al., 2008).

The age groups most at risk for poisoning are toddlers aged 1–3 years (in particular those aged 24–28 months) and preschool children between the ages of 4 and 6 (Truellová, 2009). The risk is particularly increased in boys 1 to 4 years old (Fleisher, Ludwig, 2010). *In the process of discovering the world around them, children*

observe (Childhood Poisoning, 2009) that adults eat attractive looking pills often resembling their favorite candies, use bottles with tempting labels or of interesting shapes. Although parents are informed that hazardous substances must not be refilled into glass or plastic beverage bottles, gasoline, kerosene, oils and corrosives continue to be stored in other containers (Olchava, 2007).

According to Gut (2005), the most common poisonous substances are paracetamol, household cleaners, cough and cold medicines, bleach, fruits of plants, alcohol, contraceptives, antibiotics, benzodiazepines, vitamins, acetylsalicylic acid, antiasthmatics, non-steroidal anti-inflammatories, rodenticides, kerosene and other petrochemicals, cosmetics, antidepressants, laundry detergents and mushrooms.

The World Health Organization states that poisoning is the third leading cause of unintentional death in the European Region. Each year, approximately 3,000 children aged 0–14 years die of acute poisoning, with 90% of poisonings happening in people's homes (Childhood Poisoning, 2009).

According to Bauer and Steiner (2009), poisoning accounts for 4% of all injuries leading to death. In 2012, the Czech Poison Control Center responded

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to 14,711 urgent queries concerning poisoning, of which 7,684 were related to children under 15 years of age and 8,137 to those younger than 18 years (Rakovcová, 2013). By 2016, the number of phone calls rose to 16,996, of which 60% were queries about child poisoning (Toxikologické informační centrum). Between 2009 and 2013, a total of 8,438 child injuries (polytrauma, home, school, traffic, sports, intentional and leisure injuries) were reported to the Czech Injury Registry including 216 cases (2.6%) of poisoning by other specified chemical or other substances, 85 cases (1%) of poisoning by solid substances, 73 cases (0.9%) of poisoning by liquid substances, 37 cases (0.4%) of poisoning by gaseous substances and 8 cases (0.1%) of poisoning by unspecified chemical or other substances (Prevence dětských úrazů...). So far, a total of 14,191 injuries have been registered, including 966 cases of poisoning (6.8%) (Úrazový registr ČR).

In poisoning prevention, an important role is played by education of family members and their children. The role of health professionals in preventing child injuries is irreplaceable, constituting a part of the system of prevention in which all components of society participate. Health professionals should provide parents with both oral and written information and report data to be used for planning prevention in programs that increase safety (Safe Community, Healthy Town). Health professionals may also recognize high-risk activities, settings and products causing injuries. They may also influence child injury rates by being more concerned about unexplained repeated injuries. Also important are home visits and regular medical examinations. Health professionals should teach parents to create a safe home for their children. During regular medical examinations, they may focus on a particular topic corresponding with the child's age and discuss potentially hazardous situation with the parents (Benešová, 2008).

Aim

The objective was to determine whether hazardous substances or are safely stored in households.

Methods

Design

A descriptive cross-sectional study was carried out.

Sample

The study comprised parents ($n = 300$) of children attending kindergartens in Opava ($n = 19$) and Šenov u Ostravy ($n = 1$). The main inclusion criteria were

ages between 2 and 5 years and parents' willingness to participate in the study.

Data collection

The method used was quantitative research. Data were obtained using a non-standardized in-house questionnaire containing items on storage of cleaners, cosmetics, chemicals, garden chemicals, poisonous houseplants and other hazardous substances to be found in the home environment. The questionnaires with explanatory letters for children's parents were distributed to all the kindergartens. Completed questionnaires were either handed in to kindergarten teachers or put into designated boxes on the premises. A total of 811 questionnaires were distributed, of which 350 were completed (43.16% response rate); of those, fifty contained incomplete data and were excluded. Thus, a total of 300 questionnaires were statistically analyzed.

Data analysis

Descriptive data analysis was performed using absolute (n) and relative (%) frequencies and the arithmetic mean (M). The studied parameters were compared with respect to selected factors using the general linear model, non-parametric chi-square test, Wilcoxon one- and two-sample tests, binomial distribution, Kruskal-Wallis and Mann-Whitney tests. The statistical tests were assessed at a 5% level of significance. The analyses were performed using the R2.14.0. and Stata v. 10 statistical packages.

Results

Among all parents participating in the survey ($n = 300$), 271 (90%) were mothers and 29 (10%) were fathers. As for their education, 163 parents (54%) had secondary education, 87 (29%) had tertiary education and 50 (17%) had elementary or vocational education. The mean age of parents was 33.81 years ($SD = 4.38$; range 21–46).

Proportion of safely to unsafely stored household substances

The chi-square and Wilcoxon tests showed statistically significant differences ($p < 0.001$) in proportions of safely and unsafely stored substances in the home environment. Table 1 shows hazardous substances found in households and their accessibility. The largest group of hazardous household substances were cleaners ($n = 2,644$), of which 676 (26%) were in the reach of children. The freely accessible cleaners were mainly laundry detergents ($n = 144$; 49%), fabric softeners ($n = 119$; 45%) and dishwasher detergents ($n = 85$; 40%). Another large group was cosmetics ($n = 803$), with 261 (33%) freely accessible items. Cosmetics was

dominated by toners, cleansers, eau de toilette, aftershaves, mouthrinses and perfumes. Chemicals (n = 315) were in the reach of children in 4 cases (1.26%). The largest subgroup was paint thinners and solvents. Garden chemistry (n = 203) was freely accessible in 5 cases (2%). The largest subgroup was fertilizers. The second largest group of hazardous substances were other substances/items (n = 1,510), of which 231 (15%) were in the reach of children. The largest subgroup was alcohol (n = 283), freely

accessible in 84 cases (30%). The last group of hazardous items were poisonous houseplants (n = 75); in 38 cases (51%), they were in the reach of children. Most frequently, those were *Dieffenbachia* (n = 7; 12%) and *Scindapsus* (n = 9; 45%). Although *Datura* was only found in 9 households, it was most accessible (n = 7; 78%). A total of 5550 hazardous substances were reported in households, with 1,215 (22%) being in the reach of children.

Table 1 Household substances and their accessibility

Substances		In households n = 300	%	Freely accessible	% a
cleaners	fabric softeners	265	88	119	45
	furniture polishes	154	51	18	12
	laundry stain removers	221	74	40	18
	drain cleaners	233	78	7	3
	limescale removers	181	60	20	11
	dishwasher detergents	215	72	85	40
	laundry detergents	296	99	144	49
	bathroom cleaners	233	78	51	22
	glass cleaners	274	91	59	22
	detergents	286	95	103	36
	cleaners and disinfectants	286	95	30	10
	total	2,644		676	26
cosmetics	perfumes	292	97	113	39
	cleansers, toners, eau de toilette, aftershaves, mouthrinses	294	98	124	42
	nail polish removers	217	72	24	11
	total	803		261	33
chemicals	gasoline	92	31	1	1
	antifreeze	100	33	2	2
	paint thinners, solvents	123	41	1	1
	total	315		4	1
garden chemicals	pesticides	79	26	1	1
	fertilizers	124	41	4	3
	total	203		5	2
poisonous houseplants	<i>Dieffenbachia</i>	21	7	12	7
	<i>Datura</i>	9	3	7	78
	<i>Phaseolus</i>	15	5	7	45
	<i>Philodendron</i>	10	3	3	30
	<i>Scindapsus</i>	20	7	9	45
	total	75		38	51
others	alcohol	283	94	84	30
	button batteries	142	47	31	22
	lamp oils	51	17	4	8
	tobacco, tobacco products	80	27	12	15
	matches	219	73	22	10
	medicines	290	97	15	5
	essential oils	106	35	19	18
	potassium manganate	84	28	4	5
	rodenticides	36	12	2	6
	kerosene	24	8	1	4
	gel candles	100	33	25	25
	sparklers	95	32	12	13
	total	1,510		231	15
	total	5,550		1,215	22

% – a relative frequency of accessibility

Ways of safe storage of household substances

Most frequently ($n = 195$; 65%), hazardous substances were kept in a high place out of the reach of children. The second most common answer was a locked cabinet ($n = 90$; 30%). Some parents ($n = 13$; 4%) used child safety locks. Two parents (1%) used none of the above ways (Table 2).

Sociodemographic factors and their impact on the proportion of unsafely stored substances

The Wilcoxon two-sample and Mann-Whitney tests found no statistically significant differences in the proportion of unsafely stored substances with respect to their parents' field of education ($p = 0.0646$), type of housing ($p = 0.9282$) and place of residence ($p = 0.4525$). Parents with non-healthcare education had a smaller mean proportion of unsafely stored

substances ($M = 22$) than those with healthcare education ($M = 29$). The proportion was also smaller in parents living in houses ($M = 22$) as compared with those living in flats ($M = 23$). Finally, the proportion was smaller in those living in rural areas ($M = 19$) than in those living in urban areas ($M = 23$). The Kruskal-Wallis test revealed a statistically significant difference ($p = 0.0484$) in the proportion of unsafely stored substances depending on parents' level of education. The study found statistically significant differences in percentages of unsafely stored substances depending on parents' level of education, with those with tertiary education having the highest proportion of substances in the reach of children as compared with their counterparts with elementary or vocational education (Table 3).

Table 2 Ways of safe storage of household substances

Ways of storage	n	%
unsafe storage	2	1
in a locked cabinet/drawer	90	30
in a high place / out of the reach of children	195	65
a safety lock	13	4
total	300	100

Table 3 Sociodemographic factors and their impact on the proportion of unsafely stored substances

	n	mean	p-value
Level of education			0.0484
elementary, vocational	50	17	
secondary	163	23	
tertiary	87	25	
total	300	23	
Field of education			0.0646
healthcare	270	22	
non-healthcare	30	29	
total	300		
Type of housing			0.9282
house	113	22	
flat	187	23	
total	300		
Place of residence			0.4525
urban	280	23	
rural	20	19	
total	300		

Discussion

Child poisoning is often dealt with in the context of preventing injuries in childhood but authors do not specifically consider its prevention (Biçer et al., 2007; Ribens, 2008; Sahin et al., 2011; Kendrick, 2013). The presented study aimed at assessing preventive measures implemented by parents to prevent potential poisoning with substances stored in the home environment. The survey focused on preschool children attending kindergartens as

statistics and studies have shown that children aged 2–5 years are most at risk of poisoning (Andiran, Sarikayalar, 2004; Watson et al., 2005; Akhtar, Rani, Al-Anezi, 2006; Akin et al., 2011; Sahin, Carman, Dinleyci, 2011). At this age, children are unable to recognize hazardous substances (Ahmed et al., 2010). The study found statistically significant differences in percentages of unsafely stored substances depending on parents' level of education, with those with tertiary education having the highest proportion

of substances in the reach of children as compared with their counterparts with elementary or vocational education. Some authors (Baaker, 2010; Manzar et al., 2010) reported higher rates of child poisoning in households of parents with lower levels of education. In their study, Zarezadeh and Bahrampour (2011) claimed that children of parents with at least a bachelor's degree got poisoned less frequently than children of other parents. The present study found no significant differences with respect to the field of education (healthcare/non-healthcare), type of housing (house/flat) or place of residence (urban/rural); however, parents living in villages had lower percentages of unsafely stored substances than those in urban areas. Zarezadeh and Bahrampour (2011) stated that although most children lived in towns and cities, a majority of cases of poisoning with petroleum products were village children. The largest group of hazardous substances in the present study were cleaners. Of those, laundry detergents, fabric softeners and dishwasher detergents were in the reach of children in almost one half of the cases. According to Rakovcová (2013), the second most common cause of child poisoning is ingestion of cleaners, laundry detergents or disinfectants that are freely accessible in a large number of households, as confirmed by other authors as well (Čapková, 2006; Rezková, Okrajek, 2009; Novotná, Knezović, Tůma, 2010). Watson et al. (2005) reported that in the US, toxic substances contained in household cleaners are an important factor of unintentional child poisoning in the home setting.

The second largest group hazardous household substances were other substances or items (alcohol, button batteries, lamp oils, tobacco and tobacco products, matches, medicines, essential oils, potassium manganate, rodenticides, kerosene, gel candles and sparklers) which were not in the reach of children in most cases. Among those, alcohol was most accessible, either as alcohol beverages or in perfumes, eau de toilette, mouthrinses, toners and glass cleaners. Several authors (Boledovičová et al., 2011; Čapková, 2006; Novotná, Knezović, Tůma, 2010; Toráčová, 2008) give examples of alcohol being made accessible or inadequately stored (refrigerators, unlocked cabinets, etc.) and thus often being the cause of poisoning, mainly in adolescents (Plevová, Hlávková, 2016).

Although some authors (William et al., 2005; Gálová, 2007; Zarezadeh, Bahrampour, 2011; Rakovcová, 2013) claim that unintentional child poisoning often stems from ingestion of cosmetics and personal care products, most parents in the present study stored these substances safely.

Parents were rather careful about chemicals as these were in the reach of children on only very rare cases. This is consistent with a survey by Boledovičová et al. (2011) who found that chemicals caused poisoning in “only” 6 cases (8.7%). Also Rakovcová (2013) reported that poisoning with these substances was uncommon.

By contrast, poisonous houseplants were freely accessible in a large proportion of households. These were dominated by *Dieffenbachia*, *Scindapsus* and *Datura*. The danger was also mentioned by Čapková (2006) stating that children are constantly at risk of intoxication with poisonous houseplants. Similarly, Gálová (2007) listed some decorative and poisonous houseplants among risk factors for poisoning.

Sethi et al. (2008) pointed to the fact that children are at a higher risk for poisoning if hazardous substances are inadequately stored and in the reach of children. We found that most parents keep hazardous substances in a high place, out of the reach of children. However, even this may be considered inadequate (e.g. in cases when children may use chairs or other pieces of furniture to reach items stored in high places). A small percentage of parents stored hazardous substances in locked cabinets/drawers or used child safety locks. This may be considered the most ideal way of storing such items. In only two cases, parents admitted that they kept hazardous substances in a completely unsafe manner. A study by Novotná, Knezović and Tůma (2010) showed that 40% of parents kept substances in a place that was high enough to prevent children from reaching them, 13% of parents stored items in locked cabinets and in 36% of cases, storage was unsafe. Manzar et al. (2010) reported that in as many as 76% of cases, parents made toxic substances easily accessible. Ahmed et al. (2010) found that of 200 hazardous substances, only 40 were kept in the original packages. In most cases, kerosene and bleach were stored in non-alcoholic beverage containers. Čapková (2006) concluded that only one-third of parents kept medicines, laundry detergents and other chemicals in safe places out of the reach of children. Medicines in particular should be locked away (Olchava, 2007). Similar preventive measures may be applied to cleaners (Čapková, 2006) and other substances potentially causing poisoning. In her study, Toráčová (2008) concluded that in more than three-quarters of households, medicines were inadequately stored. In the vast majority of cases, medicines were kept in unlocked cabinets or drawers. Gutierrez, Negrón and García-Fragoso (2011) listed preventive intervention implemented by parents:

storing foods and household substances in separate places (87% of cases), keeping hazardous substances in the original packages (83%), reading information on safe storage (35%), keeping medicines out of the reach of children (80%), using child safety locks (35%), using safety lids (66%) and disposing of expired medicines into toilets (49%). The study showed that parents mostly relied on keeping medicines and other hazardous substances in high places or out of the reach of children but did not use safety lids and locks. Watson et al. (2005) reported that in as many as 77% of cases, poisoning occurred in children's own homes. Akhtar, Rani and Al-Anezi (2006) pointed to the fact that 97% of child poisoning cases were caused by substances found in the home environment. The so-called Haddon Matrix lists individual risk factors for child poisoning prior to, during and after the event. The pre-event risk factors include a child's age, developmental factors and gender as well as parental supervision. Other factors include ease of opening package, attractiveness of substance, inadequate labeling, inadequate storage, absence of locking devices on cabinets and thus exposure to hazardous substances. Finally, important factors are lack of regulations and standards for toxic products and their packaging, poverty and, last but not least, lack of awareness of toxicity and poisoning risks among parents. During the event, roles are played by parents not noticing the child's unusual behavior, toxicity of the substance and its structure, places where the child can ingest substances without being seen and lack of awareness of parents of how to react to poisoning. The post-event risk factors comprise the child's inability to communicate the incident, lack of access to a poison control center, ingestion of a substance without an antidote, lack of pre-hospital, acute and rehabilitation care, as well as no poison control center or lack of information on how to contact the center and lack of access to emergency medical care (Peden, 2008).

Rezková and Okrajek (2009) pointed to the fact that safe storage of hazardous substances is the most easily available and inexpensive measure to prevent child poisoning. Consistently with other authors (Manzar et al., 2010; Pillitteri, 2010; Gutierrez, Negrón, García-Fragoso, 2011; Maklad et al., 2012), we underline the importance of poisoning prevention not only focused on parents but also being an integral part of preventive counselling from healthcare providers in childhood. Parents' active approach to prevention of poisoning may even often save their children's lives (Čapková 2006).

Conclusion

In conjunction with the increasing consumption of alcoholic beverages and illicit drugs and easy access to medicines and various chemical substances in the environment, the incidence of poisoning has steadily increased. As a result, intoxication is a common emergency in pediatric medicine. At the same time, the range and types of poisoning tend to change (Gut, 2005). Poisoning is much more dangerous to children as they have a faster metabolism and are less able to neutralize toxic substances (Frišová, 2006). Most frequently, poisoning occurs in the home environment. This may be explained by the specificity of childhood as well as the fact that children spend most of their time at home. And this is where dangerous substances and items may often be found. Peden et al. (2008) noted that the home and its surroundings may be dangerous, particularly for children as they are naturally curious and tend to explore things in and around their homes. Therefore, poison control centers receive many queries concerning acute poisoning. Children are admitted to hospitals after unintentional ingestion of household substances, medicines or pesticides. However, most of these unintentional may be prevented. It was our aim was to underline the seriousness of the situation by reporting particular findings on whether parents prevent poisoning by keeping potentially hazardous substances out of the reach of children. We found that despite preventive measures implemented by parents to prevent unintended child poisoning in homes, a considerable proportion of hazardous substances are not safely stored.

Ethical aspects and conflict of interest

The survey was carried out in accordance with all ethical aspects and the respondents were explained its nature, purpose and objective of the study. The obtained data were kept anonymous and there was no conflict of interest.

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Author contribution

Conception and design (IP, MN), data collection (MN), data analysis and interpretation (MN, IP), drafting the manuscript (IP), critical revision of the manuscript (IP, MN), final approval of the manuscript (IP).

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