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The Risk of Accidental Chemical Poisoning Cases among Children (⩽12 Years Old) Admitted to Hospital University Sains Malaysia: 5 Years Review

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Abstract

Unintentional poisoning has been reported to commonly occur among children. Most of the poisoning cases were attributed to the household chemical products. Hence, a retrospective analysis of medical records of chemical poisoning cases among children ≤ 12 years had been carried out to profile the background, identifying the sources, determining the probability, determining the extent of the severity and the risk of chemical poisoning. Medical records of patients admitted from 2007 to 2011 were reviewed. Data was entered and analyzed using Statistical Program for Social Sciences (SPSS) version 20.0. The records showed a total of 192 poisoning cases and 41 chemical poisoning cases involving children occurred during five years period. Cases involving males (61%) outnumbered the females (39%). The most vulnerable age group included children in 0-2 years old (68.3%) with the majority being Malays (97.6%). Most of the incidence happened in the evening (1800-2359) hours (46.3%) and in most cases (61%), children were brought to the hospital within their conscious state. Vomiting was the most common symptoms observed (34.1%). All of the patients fully recovered after the treatment. Among the category of sources, cleaning agents (39%) and fuel (31.7%) were the commonest poisoning seen with household bleach and kerosene as the main agents. Chemical poisoning had accounted for 40% from the total of children poisoning cases (103) reported in five years period. High incidences of chemical poisoning cases had been reported in 2009 (0.11). Based on PSS score, the severity of majority of the cases showed minor sign and symptoms (87.8%). This study had determined the risk for chemical poisoning cases among children ≤ 12 years admitted to HUSM within five years period. The overall risk of chemical poisoning was low for each category of sources.

Keywords: Children; Accidental chemical poisoning; Risk.

Introduction

Acute poisoning has become a significant health problem worldwide particularly in developing countries. Poisoning by accidental or deliberate ingestion, injection, or inhalation of medicinal and chemicals poisons are common medical emergencies [1,2]. Deaths due to unintentional poisoning are more common in low and middle income group of countries [3]. 24% of children under 5 years old had disability-adjusted life years lost globally to poisoning [4]. Not only in developing countries, developed countries also had serious exposure scenario to toxic agents. This is proved when U.S Poison Control Centres received more than 2.4 million reports of toxin exposure in 2003, of which 76% were by oral ingestion, 93% of the cases happened at home and 80% were unintentional [1].

Generally, accidental poisoning is more common among children, whereas most of the intentional poisoning mainly comes from young adults (15-19 years old) [5,6]. More than 1 million cases pertaining to acute poisoning among children had been reported to the Toxic Exposure Surveillance System (TESS) of the American Association of Poison Control Centres (AAPCC). These high prevalence of acute poisoning among children had been attributed to the high tendency of them especially those who were younger than 5 years old to actually taste or swallow harmful substances [7]. They are more susceptible to toxic chemicals because of immaturity of many organ systems to detoxify the poisons and their greater body surface that contribute to the fast rate of absorption through skin [8]. Medicinal and non-medicinal substances are the most common sources of childhood poisoning. Medicinal substances included analgesics, anti-inflammatory agents, psychotropic drugs such as antidepressants, and benzodiazepines related agents. Non-medicinal agents include chemicals such as organophosphates, pesticides, insecticides, organic solvents, and household cleaning products such as bleach and caustics were also found to be common causes of poisoning among children [9]. Nowadays, chemicals had becomes an important parts of our life's, ranging from sustaining human activities and developments, preventing diseases, and increasing agricultural productivity. Thus, the risk of getting poisoned by chemicals is increased as the chemicals have their own adverse effects on human health and environmental integrity [8,10]. As children are commonly stayed at home, substances that often cause poisoning are domestic products including cosmetics, personal care items, cleaning solutions, plants, foreign bodies and hydrocarbons [7]. Data from poison information centres showed that the exposures to household cleaning substances are on the higher side of the poisonings affecting children younger than 6 year olds [11].

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In response to an increasing number of chemicals poisoning and accidents involving chemicals, prevention and controlling steps are needed to overcome the situation. For such actions, epidemiology and etiology data are essential for healthcare providers to enable them to take appropriate measures for both prevention and treatment. However, in developing countries, data on epidemiology study on paediatric poisoning such as age, sex, number of siblings, socioeconomic status, type of poisonous substance, educational level, presenting symptoms and the patients' outcome are scarce compared to developed countries [6,7]. Similar patterns also had been observed in Malaysia, where annual nationwide data on poisoning patterns are scarce and incomplete. Although, the National Poison Centre received poisoning calls from around the country, but not all poison cases were referred to the centre [10]. Patterns of poisoning might be variable and changes over time between countries in Malaysia. Therefore, regional epidemiological data on poisoning are very helpful to anticipate the risk of poisoning among children for the future planning of prevention and management of poisoning and in targeting research [12].

To our best knowledge, a study had been conducted by Rahman showing the epidemiologic data on hospital admission due to chemical poisoning cases were lower than 1000 cases every year. Of all the ages represented, children were predominant throughout nine year period of retrospective study in Hospital University Sains Malaysia (HUSM) [13].

As there was a lack of local epidemiological data on poisoning, a retrospective study based on hospital admission records on chemical poisoning cases among children ≤12 years old from 2007 to 2011 was done. The primary aims of this study is to profile the background, determine the sources, the probability and the extent of the severity caused by chemical poisoning among children ≤12 years old admitted to Hospital University Sains Malaysia (HUSM) from 2007 to 2011. With this kind of information, it is hoped that the risk of chemical poisoning could be determined among children ≤12 years old in the area of Kubang Kerian, Kelantan for future research and intervention. HUSM is a 700-bed teaching hospital located at the university's branch campus and is the sole teaching hospital in the state of Kelantan [13].

Materials and Methods

Study design

The design of this study was based on the historical data of patient's (≤12 years old) medical record diagnosed with chemical poisoning from 2007 to 2011. The records were the printed one obtained from Medical Record Unit of HUSM.

Selection of patient's records

A computer-generated list of chemical poisoning cases among children ≤ 12 years old admitted to HUSM from 2007 to 2011was obtained from the Hospital Medical Record. The cases were identified using the T-codes of the International Classification of Diseases—Tenth revision (ICD-10). The selection of patient's records was based on the inclusion and exclusion criteria.

Inclusion criteria: Children with ≤12 years old**,** admitted to HUSM with suspected of chemical poisoning cases, cases admitted to HUSM from 2007 to 2011. Only records available at the time of the study will be reviewed.

Exclusion criteria: Children with chronic illnesses causing abnormal susceptibility to chemicals**,** diagnosis resulted poisoning due to overdose of drug/ medication intended for treatment, poisoning due to biological sources (food, plant materials or animal bites) and chemical poisoning due to intentional intake with the intention of suicide.

All of the records with inclusion criteria were reviewed. As all of the patient's records from 2007 to 2011 was covered based on the inclusion and exclusion criteria, sample size determination is not applicable.

Data collection

Patient's registration number of incidences for chemical poisoning cases among children (≤12 years old) from 2007 to 2011 was requested and retrieved from the Hospital Medical Record office list. Once the lists were obtained, the incidences of chemical poisoning cases were identified according to the exclusion and inclusion criteria. In order to fulfil the objectives of the study, the information from the record such as the patient's background, the incident background, the diagnosis of the patients, the sources of chemical poisoning, the sign and symptoms and the treatment of poisoning was identified and extracted from the record. The information needed was recorded in the data collection form. After all of the cases were reviewed, the data were entered into Statistical Package for Social Sciences (SPSS) version 20.0 to be analysed.

Results

There were a total of 192 poisoning cases admitted to HUSM from 2007 to 2011. From that, 103 poisoning cases involved children ≤ 12 years old. After the exclusion and inclusion criteria, 41 cases of accidental chemical poisoning involving children ≤ 12 years old had been retrieved from medical record office lists of 2007 to 2011.

Background of accidental chemical poisoning cases among children

Out of 41 cases, the males outnumbered females with ratio 1.6 to 1 with 25 cases (61%) and 16 cases (39%) respectively. Almost 69% (28 cases) of all chemical poisoning cases involved children in group of 0-2 years old. This age group continues to dominate the hospital admission during 5 years period (Table 1). Almost 98% of patients were Malay with 40 cases (97.6%). The remainder was of Chinese with only 1 case (2.4%). The time of exposure was based on the time of incident reported by the parents and family relatives. More children were poisoned with the chemicals during the evening (1800-2359) (46.3%) and the afternoon (1200-1759) (39.0%) than in the morning (0600-1159) (12.2%) and at night (2400-0559) (2.4%). Most of the children presented to the hospital with symptoms of vomiting (34.1%) followed by a group of symptoms of coughing or sore throat, shortness of breath (SOB) and cyanosis (12.2%).

Source of chemical poisoning

Cleaning agents were the most frequently ingested agent with 16 cases (39.0%). Category of fuel (kerosene/ petrol/ diesel) remain as the most of ingested agent among children ≤ 12 years old after cleaning agents (31.7%) followed by pesticides and fertilizers group (17.1%) (Table 2). In category of cleaning agents, household bleach was the main causative agent compared with the mosaic cleaner, fabric softener,

Age group	Cases	Percentage (%)
0-2 years old	28	68.3
3-6 years old	10	24.4
7-12 years old	3	7.3
Total (%)	41	100.0

Table 1: Distribution of chemical poisoning cases according to age group.

Source of chemical poisoning	Cases	Percentage (%)
Cleaning agents	16	39.0
Construction or building materials	4	9.8
Pesticides and fertilizers	7	17.1
Fuel (kerosene/petrol/diesel)	13	31.7
Others	1	2.4
Total	41	100.0

Table 2: Distribution of chemical poisoning according to the categories of source of chemical poisoning. Cleaning agents: Mosaic cleaner, fabric softener, sodium nitrite, and toilet detergents, household bleach; Construction or building materials: Thinner, superglue; Pesticides and fertilizers: Rodenticides, insecticides, paraquat; Fuel (kerosene/petrol/diesel): Kerosene, petrol; Others: Sodium silicate (material for batik production).

Years	Cases	Probability (P)
2007	14	0.14
2008	14	0.14
2009	23	0.22
2010	19	0.18
2011	33	0.32
Average	20.6	0.2

Table 3: The probability of children poisoning cases year by year in comparison to the total number of children poisoning cases admitted to HUSM from 2007 to 2011. Total number of children poisoning cases admitted to HUSM from 2007 to 2011 was 103 cases. P of children poisoning in year A = ∑ children poisoning cases in year A/103 cases.

sodium nitrite, and toilet detergents. In category of fuel, kerosene was more common than petrol. Rodenticide was the main implicated poison in pesticides and fertilizers group. In group of construction or building materials, thinner contribute the majority of the poisoning cases than superglue. Sodium silicate was the only causative agent in category of other sources of chemical poisoning.

Probability of chemical poisoning based on reported cases

As it is difficult to retrieve the total number of children cases admitted to the HUSM from 2007 to 2011, a total of 192 cases of poisoning admission from 2007 to 2011 were obtained from medical records offices lists. From that, 103 cases involved children ≤ 12 years old. Based on direct references to the actual written statement in the medical record, the probability of children poisoning cases (103) as compared to the total number of poisoning cases admitted to HUSM from 2007 to 2011 (192 cases) was 0.54. Results were reported based on the total number of children poisoning cases which is 103 cases rather than 192 cases. On the other side, the probability of children poisoning cases year by year in comparison to the total number of children poisoning cases admitted to HUSM from 2007 to 2011 (103 cases) was described as the Table 3. The probability of chemical poisoning cases among children according to the year in comparison with the total number of children poisoning cases admitted to HUSM from 2007 to 2011was described as the Table 4.

Severity of chemical poisoning cases

The severity of sign and symptoms of chemical poisoning was assigned based on the Poisoning Severity Score (PSS). In this study, most of the children (87.8%) were assigned with minor sign and symptoms as compared with the other score and 5 cases (12.2%) had assigned with no symptoms or signs (Table 5).

Risk of chemical poisoning

The risk of chemical poisoning was calculated based on the probability and the severity of the cases (Risk=Probability × PSS score) for each type of sources as represented in the Table 6. When referred to the risk calculation table (Table 7), the overall risk was low for each category of sources. Hence, the risk of chemical poisoning cases among children admitted to HUSM from 2007 to 2011 was not significant to initiate intervention and preventive action. However, it is advised for parents to be aware for the risk of their children to be poisoned with household bleach and kerosene due to an increasing number of their incidences.

Source of chemical poisoning	Number of cases					
	2007	2008	2009	2010	2011	Total
Cleaning agents	0	2	6	6	2	16
Construction materials	1	0	1	0	2	4
Pesticides and fertilizers	2	1	0	0	4	7
Fuel (kerosene/petrol/diesel)	1	5	5	2	0	13
Others	0	0	0	0	1	1
Total	4	8	12	8	9	41
Probability	0.04	0.08	0.11	0.08	0.09	0.40

Table 4: The probability of chemical poisoning cases among children according to the year in comparison to the total number of children poisoning cases admitted to HUSM from 2007 to 2011. P of CP cases among children in year .

$$A = \frac{\sum \text{Children admitted due to CP in year A}}{\sum \text{Children admitted due to poisoning}} \sum \text{Children admitted due to poisoning} = 103 \text{ cases}$$

Category of severity	Score	Cases	Percentage (%)
None	0	5	12.2
Minor	1	36	87.8
Moderate	2	0	0
Severe	3	0	0
Fatal	4	0	0
Total		41	100.0

Table 5: The percentage of accidental chemical poisoning cases reported to HUSM from 2007 to 2011 according to the respective category of severity. None (0)=No symptoms or signs; Minor (1)=Mild, transient and spontaneously resolving symptoms or signs; Moderate (2)=Prolonged symptoms or signs; Severe (3)=Severe symptoms or signs; Fatal (4)=Death.

Sources	Probability (P)	Category of probability	Mean of severity score	Category of severity
Cleaning agents	0.15	2	0.94	Minor (1)
Construction or building materials	0.04	2	1.00	Minor (1)
Pesticides and fertilizers	0.07	2	0.57	Minor (1)
Fuel (kerosene/petrol/diesel)	0.12	2	1.00	Minor (1)
Others	0.01	2	0.00	Minor (1)
Overall	0.08	2	0.88	Minor (1)

Table 6: Risk of chemical poisoning cases based on each type of sources. Mean of severity score of sources $A = \frac{\Sigma \text{severity score of agents in sources A}}{\Sigma \text{cases of agents in category of sources A}}$

Probability / Severity	1	2	3	4	5
0	Low	Low	Low	Low	Low
1	Low	Low	Low	Medium	Medium
2	Low	Low	Medium	Medium	Medium
3	Low	Medium	Medium	High	High
4	Low	Medium	Medium	High	Extreme

Table 7: Risk calculation table. Adapted from clinical risk management in community health by victorian healthcare association.

Discussion

Based on the finding from the study, male children outnumbered females with ratio 1.6 to 1, which is in the same trend with the other studies reported [14-16]. Male children are well known to be more active and restless as compared to their female counterparts and that nature could be the responsible factor of higher poisoning incidences among them [17]. The highest cases of chemical poisoning occurred among the children within 0-2 years of age group, accounting for 68.3% from all ages considered. This finding agrees with reports from Nigeria [18,19] and United State of America (USA) [20,21]. The exploration nature are synonyms with toddlers and as a consequences from this interaction with the environment, they often results in childhood accidents that form or may take the forms of poisoning [19]. Kelantan is a state located in the east coast of Malaysia with a population of about 1.6 million inhabitants and the majority of them are of Malay ethnic origin [22]. As a result, there was a Malay predominance throughout the study period.

It is anticipated that most of the poisoning usually occur late in the afternoon and in early evening as it had been regarded as the children's play time where unintentional home injuries mostly reported to occur during play time [23]. In the morning, some of them usually go to school and sleep at night, thus minimizing the chemical poisoning incidences at that hours. However, it is crucial to expect that full parental supervision is expected to be in the evening and at night, considering for the parents who worked. Thus, parental supervision is at minimum in the morning and at the afternoon due to normal working hours. Hence, the higher poisoning incidences that occurred during the supervision in the evening is in concordance with the report that a span of unsupervised time was 5 minutes or less in majority of the childhood unintentional household poisoning cases. The incident occurred when the parent or caregiver was present in the immediate area at the time of the incident. When the child was left alone, the parents mainly had involved in household duties, with only few undertaking leisure activities and on the telephone [24].

The most common sign and symptoms reported included vomiting and a group of symptoms with coughing or sore throat, shortness of breath (SOB) and cyanosis. Vomiting is expected in chemical poisoning episodes as it is one of the most frequently observed symptoms in acute poisoning cases [25]. Furthermore, respiratory symptoms like coughing are more likely to present in children poisoned with category of fuel such as kerosene and petrol. Kerosene and other hydrocarbon toxicities mainly affect the respiratory system and Central Nervous System (CNS).

The sources of poisons implicated in accidental chemical poisoning cases were grouped into several different categories. The finding also reported that household bleach was the main causative agent among the cleaning agents. As in Brazil, Europe and the United State, household cleaning products are the substances that are most commonly ingested by children aged between 0 and 4 years [26,27]. Apart from that, household bleach was easily and widely accessible to the children or even mentally handicapped person [27]. The lack of supervision from parents also contribute to the high incidences of poisoning from this group. In this study, most of the parents left their chilldren unsupervised when they were in the bathroom.

On the other side, in category of fuel, kerosene was more common than petrol. It has been reported that kerosene are largely used as a fuel and light sources in developing countries and considered as the second most common poisons ingested by children. The lack of facilities for safe storage and disposal ensures frequent unintentional poisonings [28]. Many households do not have lockable cup-boards or other proper storage facilities. As a result, paraffin is kept in open areas like under the bed or in the midst of the other family's groceries. Storage of kerosene in soft drink bottle also is the commonly observed phenomena in developing countries. In such a situation, young children readily can access the kerosene and may not be able to differentiate it from water or a cold drink due to its colour. Without standard containers with childproof or child resistant lids, young children may end up drinking from a paraffin container, as children are able to open such storage containers with ease [29,30].

Malaysia is one of the highest pesticide users (among its agricultural workers) compared to other Asian countries. In some parts of the Kelantan state,farmers are engaging in tobacco, paddy and rubber plantations. Thus, agricultural pesticides have become a common household product in many rural areas of the developing world. The relatively high use of pesticides in these populations might have contributed to the high incidence of cases admitted for pesticide poisoning seen in this study [13].

There were a total of 192 cases of poisoning admitted to HUSM from 2007 to 2011. From this figure, 103 cases (0.54) involved children ≤ 12 years. This finding was also similar to the high incidence of poisoning among children reported in the literature, with variation in the agents consumed (17). In England, poisoning admission was relatively very high among children aged 0-14 years when they accounted for 35% from the total hospital admissions for unintentional poisoning for just within two years period [31]. Among the children, 41 cases (0.40) were reported due to chemical poisoning within that five years period. It had been reported that the average of hospital admission due to chemical poisoning were less than 1000 cases every year in Malaysia which is in agreement with the finding obtained from this study [13]. Many other studies had reported the high incidences of poisoning due to household chemical products [17,32,33]. An increasing pattern of hospital admission due to chemical poisoning was observed from 2007 to 2009. During that period, an increasing used of kerosene had contributed to the high frequency of poisoning admission. As the time goes by beyond 2009, the usage of kerosene among people in Kelantan was greatly reduced as more and more people had used electricity. However, the great reduction in kerosene had been replaced with the high usage of household cleaning agents and pesticides, contributing to an increasing probability to be poisoned with both categories of sources after 2009.

Based on the PSS score, the severity of chemical poisoning cases was reported to fall in category of minor in majority of the cases. This is mostly due to the nature of the poisoning itself. Many studies had addressed that childhood poisoning usually are considered as unintentional [17,19]. Although paediatric poisonings are considered as emergencies, it had been reported that more than 85% of the cases need no medical intervention because the amount of ingestion was reported to be at minimum and not clinically significant compared with intentional poisoning [8]. This phenomenon also can be seen in this study and as a result, most of the patients had experienced with minor sign and symptoms on the day of admission.

In determining the risk of chemical poisoning among children, the risk was found to be low for the entire category of sources that had been studied. This finding was based on the probability and the severity of the incidences. This might be due to several preventive actions that had been taken among the parents and caregivers to minimize the occurrence of accidental poisoning among their children. Many household had been recommended to use the child-proven containers

for the storage of their chemicals to limit the access of the poisons to the children that contribute to be a major factor in paediatric poisoning [34]. The low risk of chemical poisoning also demonstrated the awareness level of the parents on the safety and health issue of their children that will eventually led to the proper usage and storage of the chemicals and as a result minimizing the risk of accidental chemical poisoning among children.

On the basis of the findings obtained, the present study may suggest that it is advisable for people especially parents to be aware of household bleach and kerosene due to their higher number of poisoning incidences among children. Pesticides and fertilizers might also exhibit a tendency to be the most common agents of poisoning among children. Careful attention in terms of the usage and the storage of chemicals from these categories of sources should also be given to minimizing the risk of chemical poisoning among children.

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