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Original Article

Epidemiologic characteristics of poisoning among hospitalized children in Shanxi, a north Chinese city during 2008-2013

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Abstract: Background: Intentional and unintentional poisoning is a frequently occurred injury in childhood throughout the world, which is a common reason for referrals to hospital and affecting children health profoundly. There are different patterns of poisoning due to substantial differences in socioeconomic and cultures in different countries regions, which may influence the principle of prevention and therapy. In the present study, we aimed to elucidate the epidemiologic characteristics of poisoning among hospitalization children in a region located in the north of China. Methods: This was a retrospective analysis for hospitalized poisoning children who were under 14 years old. Five hundred and forty-nine person-times who were diagnosed with poison were included. This case series study was performed over a period of 6-year (January 2008 to December 2013) in seven large tertiary hospitals at Shanxi Province. Descriptive statistics were used to analyze the patient population characteristic, for example gender, age, regions of living. Chi-squared test, nonparametric rank sum test, independent sample t-test, or ANOVA were used to analyze the characteristics of poisoning and hospitalized in groups, Furthermore, associations between each indicator of the characteristics were analyzed using Spearman's correlation analysis. Effect factors of LOS and cost were analyzed by multivariate linear regression. Results: In this study, total 549 hospitalized cases due to poisoning from January 1, 2008 to December 31, 2013 were collected. Among them, more than half were boys (56.3%) and the most children were under 5 yrs old (55.2%). Unintentional poisoning accounted for 95.8% of total cases. The common site of poisoning mainly occurred in home (95.6%) of total cases. The top three poisoning agents were drugs (47.1%), CO (21.9%) and pesticide (17.3%). Specially, the percentage of pesticide poisoning (21.4%) was found higher in rural than urban (10.6%). For the disease severity of poisoning, 50.3% were moderate with prolonged symptoms or signs. It was found that the percentage constituent of severe poisoning in intentional poisoning (47.8%) patients was significantly higher compared to that in unintentional poisoning (29.7%). The average length of stay (LOS) in the hospital was 4.82 d. The average hospitalization cost of individual poisoning case was 4170.81 yuan RMB. The results from Spearman's analysis indicated both LOS (r_s = 0.131, P < 0.01) and cost (r_s = 0.110, P < 0.01) increased with age; while the constituent of unintentional poisoning (r_s = -0.628, P < 0.001) decreased with age. Multivariable linear regression was also conducted and the result from this analysis indicated that drug poisoning, age, food poisoning, and cleaner poisoning were the main effect factors contributing to LOS among the poisoning hospitalized children. In addition, the main effect factors of cost were LOS, drug poisoning, and disease severity among the poisoning hospitalized children. The overall fatality rate was 1.5% (4.5% intentional; 1.4% unintentional). Conclusions: The younger children are the high-risk population for poisoning with the most of unintentional poisoning, and the drug is the common agent. On the other hand, in the adolescents, there are higher risks of pesticide poisoning in intentional poisoning. Moreover, in this population, the disease severity, LOS and hospitalization cost increase as well.

Keywords: Children, hospitalizations, poisoning, epidemiology

Introduction

Intentional and unintentional poisoning is a frequently occurred injury in childhood. Recently published Global Burden of Disease Study (GBD) showed that unintentional poisoning was responsible for an estimated 180,000 deaths in 2010 in worldwide. Despite various preventive measures were carried out, poisoning in children remains an important public health issue worldwide [1]. The annual report from 2014 based on national poison data system

Table 1. Characteristics of hospitalization case for poisoning in children

Characteristics	Total cases (%)	Male cases (%)	Female cases (%)	χ^2	*P*
Age (years)					
< 5	303 (55.2)	169 (55.8)	134 (44.2)	0.674	0.714
5-9	116 (21.1)	63 (54.3)	53 (45.7)		
10-14	130 (23.7)	77 (59.2)	53 (41.8)		
Regions of living					
Urban	204 (37.2)	113 (55.4)	91 (44.6)	0.105	0.746
Rural	345 (62.8)	196 (56.8)	149 (43.2)		
Seasons					
Spring	164 (29.9)	95 (57.9)	69 (42.1)	2.513	0.473
Summer	126 (23.0)	73 (57.9)	53 (42.1)		
Autumn	150 (27.3)	87 (58.0)	63 (42.0)		
Winter	109 (19.9)	54 (49.5)	55 (50.5)		
Total cases (%)	549 (100.0)	309 (56.3)	240 (43.7)		

Note: %, percentage of total cases.

(NPDS) of the American association of poison control centers indicates that poisonings result in more than 300 children hospitalization among 0-19 year olds every day in American [2]. In the UK, poisonings caused approximately 25,000 emergency department attendances in 0-4 year olds each year [3]. In 2012, there were approximately 6,500 poisoning hospitalization in 0-14, including 70% under 5 year olds in the UK [4]. In the US, despite an estimated saving of $7 to $15 for every $1 spent on poison control centers [5], non-fatal poisonings resulted in $48 million medical costs for hospitalizations and emergency department attendances for the under 5 s in 2005. Poisoning accounts for about 7% all unintentional injury in children under 5 years and is implicated in about 2% of all children deaths in the developed world, and over 5% in the developing countries [6]. There have been a lot of studies about poisoning in children from developed and developing countries [7-9]. However, substantial differences in socioeconomic and cultures in different countries cause various patterns of poisoning, for example the type of poison, age and gender distribution and patient outcome [10]. So, the epidemiological investigation specific for different countries regions was necessary to determine the extent and characteristics of the problem. To understand the local characteristic of poisoned children will help to intervene.

Because children lack knowledge of the prevention poisoning and life experience, they were more likely to suffer unintentional poisoning. Moreover, being in a special period of growth and development, children are extremely sensitive to poisonous substances, which affect their health for a long time. So, it is necessary to understand the epidemiology characteristic and outcome of poisoning among hospitalization children. Poisoning in children represented a preventable cause of morbidity and mortality. In the present study, we aimed to elucidate the epidemiologic characteristics of poisoning among hospitalization children in a region, located in north of the central region China.

Materials and methods

Cases collection

This is a retrospective cross-sectional, poison report and patient medical record review. All cases were selected from hospitalized poisoning injury children, who were less than 14 years old and admitted from January 1, 2008 to December 31, 2013 in this study. Among poisoning records found based on ICD-10 codes (X40-X49), and total 549 patients hospitalized for poisoning during this period. The information about each case was recorded in standardized forms including (1) general characteristics: medical record number, gender, age, regions of living (urban or rural), date of birth; (2) characteristics of poisoning injury: poisoning date, poisoning intent (unintentional and intentional), location of poisoning occurring (public place and in home), injury site of body, category of poisonous substances (drug poisoned, pesticide, cleaner, CO, food and others); (3) characteristics of hospitalizations: length of stay (LOS), disease severity, outcome (survival or death), and cost of hospitalization. The severity of poisoning is classified into three grades, i.e., (1) minor: mild, transient and spontaneously resolving symptoms or signs; (2) moderate: pronounced or prolonged symptoms or signs; (3) severe: severe or life-threatening symptoms or signs [11].

Ethics statement

The study was approved by the Ethics Committee for Shanxi Medical University, PR China.

Table 2. Poisoning characteristics of hospitalized children

Characteristics	N	Intents				Occurring locations*			
		Unintentional Cases (%)	Intentional Cases (%)	χ^2	*P*	Public place Cases (%)	Home Cases (%)	χ^2	*P*
Gender									
Male	309	296 (95.8)	13 (4.2)	0.001	0.981	19 (6.2)	288 (93.8)	5.188	0.023
Female	240	230 (95.8)	10 (4.2)			5 (2.1)	230 (97.9)		
Age (years)									
< 5	303	302 (99.7)	1 (0.3)	39.918	< 0.001	10 (3.3)	289 (96.7)	2.003	0.371
5-9	116	113 (97.4)	3 (2.6)			6 (5.2)	109 (94.8)		
10-14	130	111 (85.4)	19 (14.6)			8 (6.2)	120 (93.8)		
Regions of living									
Urban	204	199 (97.5)	5 (2.5)	2.444	0.118	5 (2.5)	193 (97.5)	2.669	0.102
Rural	345	327 (94.8)	18 (5.2)			19 (5.5)	325 (94.5)		
Seasons									
Spring	164	158 (96.3)	6 (3.7)	6.371	0.095	11 (6.7)	152 (93.3)	5.910	0.116
Summer	126	117 (92.9)	9 (7.1)			7 (5.6)	117 (94.4)		
Autumn	150	148 (98.7)	2 (1.3)			2 (1.4)	145 (98.6)		
Winter	109	103 (94.5)	6 (5.5)			4 (3.7)	104 (96.3)		
Total	549	526 (95.8)	23 (4.2)			24 (4.4)	518 (95.6)		

Notes: *, There were 7 children missing the information regarding occurring location. %, percentage of total cases.

All records of patient and information were anonymized and de-identified prior to analysis.

Data analysis

All the information was input into an Excel sheet, statistical analyses were performed by using the Statistical Package for the Social Sciences (SPSS), version 13.0 (SPSS, Inc., Chicago, IL, USA). The quantitative variable was expressed as the mean ± standard error (SE), while qualitative variables were expressed as frequencies and percentages. Chi-squared test or nonparametric rank sum test were used to compare differences between groups. Furthermore, associations between each indicator of the characteristics were analyzed using Spearman's correlation analysis. Effect factors of LOS/cost were analyzed by multivariate linear regression. A *p*-value < 0.05 indicates statistical significance.

Results

Characteristics of hospitalized poisoning children

From January 1, 2008 to December 31, 2013 total 549 patients hospitalized in 7 tertiary hospitals due to poisoning. Of 549 children who were recorded in hospitals with poisoning during this period, 56.3% (n = 309) were males and 43.7% (n = 240) were females with a male: female ratio as 1.3:1. The mean age of poisoning children was 5.36 years. Majority of poisoning cases were found under 5 years old (55.2%), followed by 10-14 year old (23.7%). In the distribution of region, 62.8% (n = 345) children were in rural and 37.2% (n = 204) in urban areas. The characteristics regarding occurring season show that the highest proportion of poisoning cases was in spring and the lowest in winter (**Table 1**).

Characteristics of poisoning in hospitalized children

For the intent of poisoning, majority of the cases (95.8%, n = 526) were unintentional poisoning, and the cases of intentional poisoning were 4.2% (n = 23). The significant difference was found in the distributions of poisoning intent by age groups (χ^2 = 39.918, P < 0.001). Further analysis using Spearman's analysis indicated unintentional poisoning has a negative correlation with age (r_s = -0.628, P < 0.001), suggesting with the increase of age, the constituent of unintentional poisoning declined, while intentional poisoning increase. So, the younger children higher risk of suffering unintentional poisoning than the older children. The

Table 3. Category of unintentional poisoning for hospitalization children

Characteristics	N	Categories						χ^2	*P*
		Drug Cases (%)	Pesticide Cases (%)	Cleaner Cases (%)	CO Cases (%)	Food Cases (%)	Others Cases (%)		
Gender									
Male	296	127 (42.9)	61 (20.6)	17 (5.7)	64 (21.6)	10 (3.4)	17 (5.7)	8.445	0.133
Female	230	120 (52.2)	30 (13.0)	8 (3.5)	51 (22.2)	6 (2.6)	15 (6.5)		
Age (years)									
< 5	302	152 (50.3)	52 (17.2)	18 (6.0)	50 (16.6)	5 (1.7)	25 (8.3)	25.339	0.005
5-9	113	48 (42.5)	20 (17.7)	2 (1.8)	33 (29.2)	7 (6.2)	3 (2.7)		
10-14	111	47 (42.3)	19 (17.1)	5 (4.5)	32 (28.8)	4 (3.6)	4 (3.6)		
Regions of living									
Urban	199	100 (50.3)	21 (10.6)	9 (4.5)	44 (22.1)	6 (3.0)	19 (9.5)	15.523	0.008
Rural	327	147 (45.0)	70 (21.4)	16 (4.9)	71 (21.7)	10 (3.1)	13 (4.0)		
Total	526	247 (47.0)	91 (17.3)	25 (4.8)	115 (21.9)	16 (3.0)	32 (6.1)		

Note: %, percentage of total cases.

half of unintentional poisoning children were under 5 years old (57.4%, 302/526), and was mainly attributed to the misused drugs (50.3%, 152/302). Whereas, in these intentional poisoning cases, 78.3% (19/23) poisoning children were in aged 10-14 and mainly attributed to the suicide by pesticide (self-harm). Moreover, we found that home was the important site for children poisoning occurring. Among the distribution of occurring sites, 95.6% (n = 518) in home, and only 4.4% (n = 24) in public places. There was significant difference (χ^2 = 5.188, *P* = 0.023) in the distributions of sites where poisoning occurred between boys and girls (**Table 2**). For the injury site of the body, 99.6% (n = 547) children were the multi-systems damage.

In this study, poisonous substances we found mainly included misused drug, pesticide, cleaner, CO and food poisoning. For the unintentional poisoning children, generally misuse of drug was the most common category of poisonous substances accounting to 47.0% (n = 247), CO is the secondary cause accounting to 21.9% (n = 115), and pesticide with 17.3% (n = 91). Other poisoning was in a small portion (16.8%). Further, the significant difference was found in the distributions of poisonous substances between urban and rural (χ^2 = 15.523, *P* = 0.008). Importantly, percentage of pesticide in rural (21.4%) was doubled that in urban (10.6%). In poisoning preference age, there was significant difference in the distributions of the category of poisoning substances by age (χ^2 = 25.339, *P* = 0.005). However, for children under 5 years old, who accounted for half of misused drug poisoning, but only 16% of CO poisoning. There was no difference in the other age groups in such category of poisoning substances (**Table 3**). For the 23 intentional poisoning children, the main category of poisoning substances was pesticide (65.2%, n = 15) and drug as secondary (34.8%, n = 8).

Characteristics of hospitalizations in poisoning children

For the disease severity of poisoning, half of the cases (50.3%, n = 276) were moderate with prolonged symptoms or signs, the cases of severe poisoning were 30.4% (n = 167), and only 19.3% (n = 106) children showed minor symptoms. We found in lower age group, there was greater ratio of children with mild poisoning than older age groups (χ^2 = 9.931, *P* = 0.042). The percentage of severe injury in intentional poisoning (47.8%, n = 11) was higher than in the unintentional poisoning (29.7%, n = 156, **Table 4**).

For the length of stay (LOS) of poisoning children, the average of LOS was 4.82±0.21 d. The significant difference was found in the distributions of the LOS in different age groups (*H* = 21.148, *P* = 0.012). Further, Spearman's analysis indicated that there was a positive correlation between LOS and age (r_s = 0.131, *P* < 0.01), namely, the LOS increased with age (**Figure 1B**). Also, there was a significant difference of the distributions of the LOS between

Table 4. The characteristics of hospitalizations in poisoning children

Characteristics	N	Disease severity					Length of stay (days)						Cost (yuan RMB)		
		Mild Cases (%)	Moderate Cases (%)	Severe Cases (%)	χ^2/H	*P*	≤1 Cases (%)	2-3 Cases (%)	4-6 Cases (%)	≥7 Cases (%)	χ^2/H	*P*	Mean ± SE	*t/F*	*P*
Gender															
Male	309	58 (18.8)	150 (48.5)	101 (32.7)	1.721	0.423	51 (16.5)	103 (33.3)	84 (27.2)	71 (23.0)	2.379	0.497	4027.3±279.0	-0.498	0.619
Female	240	48 (20.0)	126 (52.5)	66 (27.5)			43 (17.9)	92 (38.3)	59 (24.6)	46 (19.2)			4355.6±656.4		
Age (years)															
< 5	303	67 (22.1)	141 (46.5)	98 (31.4)	9.931	0.042	53 (17.5)	120 (39.6)	76 (25.1)	54 (17.8)	12.692	0.002	3388.9±238.5	4.249	0.015
5-9	116	22 (19.0)	68 (58.6)	26 (22.4)			15 (12.9)	46 (39.7)	26 (22.4)	29 (25.0)			4533.7±1041.7		
10-14	130	17 (13.1)	67 (51.5)	46 (35.4)			26 (20.0)	29 (22.3)	41 (31.5)	34 (26.2)			5669.4±844.5		
Regions of living															
Urban	204	50 (24.5)	95 (46.6)	59 (28.9)	5.675	0.059	45 (22.1)	82 (40.2)	37 (18.1)	40 (19.6)	14.860	0.002	3521.6±519.9	-1.529	0.127
Rural	345	56 (16.2)	181 (52.5)	108 (31.3)			49 (14.2)	113 (32.8)	106 (30.7)	77 (22.3)			4554.7±418.7		
Intents															
Unintentional	526	106 (20.2)	264 (50.2)	156 (29.7)	7.043	0.027	88 (16.7)	192 (36.5)	136 (25.9)	110 (20.9)	6.479#	0.085	4126.8±339.0	-0.644	0.520
Intentional	23	0 (0.0)	12 (52.2)	11 (47.8)			6 (26.1)	3 (13.0)	7 (30.4)	7 (30.4)			5177.5±858.6		
Total	549	106 (19.3)	276 (50.3)	167 (30.4)			94 (17.1)	195 (35.5)	143 (26.0)	117 (21.3)			4170.8±326.8		

Notes: %, percentage of total cases. #, Fisher's Exact Test: due to 2 cells (25.0%) expected count less than 5, and the minimum expected count is 3.94.

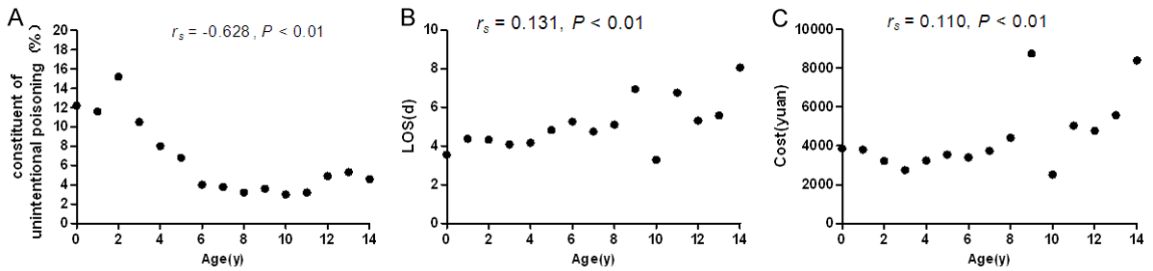

Figure 1. Correlation of age with constituent of unintentional poisoning, LOS and cost. A. The x-axis is age and the y-axis is constituent of unintentional poisoning. The constituent of unintentional poisoning had a negative correlation with age. B. The x-axis is age and the y-axis is LOS. The LOS had a positive correlation with age. C. The x-axis is age and the y-axis is cost. The cost had a positive correlation with age.

Table 5. Outcome of hospitalized poisoning children

Characteristics	N	Survived Case (%)	Death Case (%)	X^2	P
Gender					
Male	296	292 (98.6)	4 (1.4)	0.000	1.000
Female	238	234 (98.3)	4 (1.7)		
Age (years)					
< 5	303	293 (98.7)	4 (1.3)	3.641	0.112
5-9	112	112 (100.0)	0 (0.0)		
10-14	125	121 (96.8)	4 (3.2)		
Regions of living					
Urban	200	194 (97.0)	6 (3.0)	4.888	0.027
Rural	334	332 (99.4)	2 (0.6)		
Intent					
Unintentional	512	505 (98.6)	7 (1.4)	1.444	0.230
Intentional	22	21 (95.5)	1 (4.5)		
Total*	534	526 (98.5)	8 (1.5)		

Notes: *, There were 15 children missing the information regarding outcome. %, percentage of total cases.

urban and rural (χ^2 = 14.860, P = 0.002), namely, the LOS of the rural children was longer than the urban children (**Table 4**). To correct the bias from other covariates, a multivariate linear regression with LOS as dependent variable, the result from this analysis indicated that LOS were statistically significant correlations to drug poisoning, age, food poisoning, and cleaner poisoning (Supplementary Table 1), suggesting they were the main effect factors for LOS among the poisoning hospitalized children.

The total hospitalization cost of 549 poisoning children was 2,289,776 yuan RMB and the average cost was 4170.81 yuan RMB. There were significant differences in different age groups (F = 4.249, P = 0.015, **Table 4**). Then, Spearman's analysis indicated that the cost has a positive correlation with age (r_s = 0.110, P < 0.01), i.e., the cost increased with age (**Figure 1C**). Further, To correct the bias from other covariates, a multivariate linear regression with cost as dependent variable, the result from this analysis indicated that cost were statistically significant correlations to LOS, drug poisoning, and disease severity (Supplementary Table 2), suggesting they were the main effect factors for cost among the poisoning hospitalized children.

All of 534 cases, the overall fatality rate was 1.5% (n = 8) (4.5% intentional; 1.4% unintentional). In these cases, 50% (n = 4) of these cases were in 10-14 years old, and the majority (87.5%; 7/8) was unintentional poisoning. In six of these cases, poisoning agents were pesticide. Also, there was a higher fatality rate (3.0%) in urban children than rural children (0.6%) (χ^2 = 4.888, P = 0.027, **Table 5**).

Discussion

Every year, thousands of children are admitted to hospital duo to poisoning. Poisoning in children is an important health issue of children and adolescent ubiquitous in the world. For the patterns of age in hospitalized poisoning patients, the majority of reports from previous epidemiologic studies are bimodal age distribution of pediatric poisoning, with a high incidence among toddlers and a second peak during adolescence [12-15]. However, some studies indicated that there wasn't obvious pattern of age distribution in hospitalized poisoning children, except the highest prevalence of

poisoning occurred within the 0-4 years [16]. In the present investigation, 55.2% of the cases were infants and young children, with the greatest frequency around the age of 0-4 years. The age of 5-9 years had the lowest frequency of exposure to poison agents. These are consistent with the double peaks patterns of age-one peak is younger children and another is adolescent. So, the 0-4 years old is the highest risk group of poisoning among children and adolescent. For our study population, children under 5 years represent a group with particular risk, comprising over a half of the cases. In addition, those under 5 years' cases were predominantly unintentional poisonings, while intentional poisonings occurred mainly in the age of 10-14. Since age reflects individual degrees of size, physiology, behavior and cognitive development, stages of child development were highly associated with the risk of drug poisoning, such as inadvertent consumption of medicines left around the home in toddlers. Then, the percentage of intentional poisoning injury increased with age. These findings agree with those of previous reports regarding significant associations between younger children with unintentional poisoning and adolescent with intentional poisoning [17, 18]. Particularly, home is the place where of little kids spend for most of their time [19]. Therefore, it is of important to advise parents and caregivers paying more attention to the home and playground safety.

Although the drug is one of the most common poisoning agents, there are different main types of poisoning agents in different countries. In the developed countries, for example, the common agents were drug and carbon monoxide in Australian [17], cleaning agents in Israel [20]. On the other hand, the main poisoning agents for children differ in the different developing countries. For example, the common agents were kerosene and food poisoning in Nigeria [13], alcohol in Poland [21], and drug in Egypt [7] and Pakistan [22]. For our study population, the drug poisoning and carbon monoxide poisoning were the first and second top poisoning agents in children. Because the parents failed to keep the drugs safely, the children got access to the drug easily and misused. In addition, the parents usually lack the knowledge of safe drug use, so resulting in the misuse of drug. CO poisoning induced by inappropriately ventilated when using gas heating appliances, fires, and automobile exhaust fumes [23], and most of them occurred within the home [24]. Although the mortality rate and rate of CO poisoning in the pediatric group are lower than those in adult, significant neurological sequelae occur in some children [25] and affect their life quality in adulthood. The present study have also showed that many pesticide poisoning cases are in rural area where people have more chance getting access to pesticides when parents fail to keep it safe.

For the characteristic of hospitalization, we observed that around half of the total cases were moderate poisoning composing the largest proportion, followed by severe poisoning. Because the adolescents are inclined to occur the intentional poisoning, they are likely bear the severe poisoning. The previous studies show that the poisoning severity is not only affect by age, gender, but also by different socioeconomics environments [26], such as poverty, low parental education, poor maternal mental health, unemployment, and lack of health insurance [27]. So far, from the WHO, lack of reports regarding the poisoning hospitalization cost, especially in children and adolescents [28]. In our study, the median cost of hospitalization is 2,401.8 yuan RMB. As China is a developing country with large number of rural population, the cost of hospitalization will increase the family economic burden. We also found that the cost increased with age, which possibly due to adolescents' poisoning being more severe and had longer LOS. Although the incidence rates of poisoning in young children ranged from 0.02 to 2.26% [29-31], but fatal events are actually a lot less occurrence (the mortality rates at 0.6-2.8/10^6 [32-34]). In this study, there were only 8 deaths from poisoning in children from 2008 to 2013, most of them being involved in pesticide poisoning in adolescents aged 10 to 14 years. This is consistent with the data from the WHO, which reported a sharp increase of poisoning mortality at teens [28]. In addition, most of reported global death cases derived from pesticides are in the Asian region, where many people have ready access to pesticides in their daily working [35]. In rural, some farmers used waste beverage bottles for pesticide, which lead to the children misusing the pesticide.

Limitations

The cases were investigated only from the hospitalized children. The number of poisoning cases, therefore, would be higher than the 549 cases presented here. Additional cases from outpatient department reports and corresponding information were unavailable; therefore, there is a limitation in describing the overall situation of children poison.

Disclosure of conflict of interest

None.

Authors' contribution

Conceived and designed the experiments: LW, JZZ. Collect the data: YT, JRH, ZYX. Analyzed the data: LW. Wrote the paper: LW.

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References

[1] Senarathna L, Jayamanna SF, Kelly PJ, Buckley NA, Dibley MJ, Dawson AH. Changing epidemiologic patterns of deliberate self poisoning in a rural district of Sri Lanka. BMC Public Health 2012; 12: 593.

[2] Mowry JB, Spyker DA, Brooks DE, McMillan N, Schauben JL. 2014 annual report of the American association of poison control centers' national poison data system (NPDS): 32nd annual report. Clin Toxicol (Phila) 2015; 53: 962-1147.

[3] The Royal Society for the prevention of accidents. Home & leisure accident surveillance system 2002.

[4] Wynn PM, Zou K, Young B, Majsak-Newman G, Hawkins A, Kay B, Mhizha-Murira J, Kendrick D. Prevention of childhood poisoning in the home: overview of systematic reviews and a systematic review of primary studies. Int J Inj Contr Saf Promot 2016; 23: 3-28.

[5] Spiller HA, Griffith JR. The value and evolving role of the U.S. Poison control center system. Public Health Rep 2009; 124: 359-363.

[6] Jepsen F, Ryan M. Poisoning in chiledren. Curr Paediatr 2005; 15: 563-568.

[7] Azab SM, Hirshon JM, Hayes BD, El-Setouhy M, Smith GS, Sakr ML, Tawfik H, Klein-Schwartz W. Epidemiology of acute poisoning in children presenting to the poisoning treatment center at Ain Shams university in Cairo, Egypt, 2009-2013. Clin Toxicol (Phila) 2016; 54: 20-26.

[8] Bhamkar R, Seth B, Setia MS. Profile and risk factor analysis of unintentional injuries in children. Indian J Pediatr 2016; 83: 1114-1120.

[9] Hedstrom EM, Bergstrom U, Michno P. Injuries in children and adolescents-analysis of 41,330 injury related visits to an emergency department in northern Sweden. Injury 2012; 43: 1403-1408.

[10] Mohseni Saravi B, Kabirzadeh A, Asghari Z, Reza Zadeh I, Bagherian Farahabbadi E, Siamian H. Prevalence of non-drug poisoning in patients admitted to hospitals of Mazandaran university of medical sciences, 2010-2011. Acta Inform Med 2013; 21: 192-195.

[11] Wee JH, Park JH, Choi SP, Woo SH, Lee WJ, So BH, Park KN. Clinical features of emergency department patients with depression who had attempted to commit suicide by poisoning. Niger J Clin Pract 2016; 19: 41-45.

[12] Even KM, Armsby CC, Bateman ST. Poisonings requiring admission to the pediatric intensive care unit: a 5-year review. Clin Toxicol (Phila) 2014; 52: 519-524.

[13] Oguche S, Bukbuk DN, Watila IM. Pattern of hospital admissions of children with poisoning in the Sudano-Sahelian north eastern Nigeria. Niger J Clin Pract 2007; 10: 111-115.

[14] Rodrigues Mendonça D, Menezes MS, Matos MA, Rebouças DS, Filho JN, de Assis RS, Carneiro L. Acute poisoning in children in Bahia, Brazil. Glob Pediatr Health 2016; 3: 233379-4X15623243.

[15] Alanazi MQ, Al-Jeriasy MI, Al-Assiri MH, Afesh LY, Alhammad F, Salam M. Hospital performance indicators and their associated factors in acute child poisoning at a single poison center, central Saudi Arabia. Medicine (Baltimore) 2015; 94: e2339.

[16] Pillai GK, Boland K, Jagdeo S, Persad K. Acute poisoning in children. Cases hospitalized during a three-year period in Trinidad. West Indian Med J 2004; 53: 50-54.

[17] Pilgrim J L, Jenkins EL, Baber Y, Caldicott D, Drummer OH. Fatal acute poisonings in Australian children (2003-2013). Addiction 2017; 112: 627-639.

[18] Ozdemir R, Bayrakci B, Tekşam O, Yalçin B, Kale G. Thirty-three-year experience on childhood poisoning. Turk J Pediatr 2012; 54: 251-259.

[19] Sim TP, Ng KC. Childhood injuries: prevention is always better than cure. Singapore Med J 2005; 46: 103-105.

[20] Brosilow S, Miron D, Malezkey L, Zamir G, Naor O, Darawsha A, Antonelli J. Non-traumatic unintentional injuries and risk factors for hospitalization in children presenting to a pediatric

emergency department. Harefuah 2010; 149: 693-696, 750.
[21] Pawłowicz U, Wasilewska A, Olański W, Stefanowicz M. Epidemiological study of acute poisoning in children: a 5-year retrospective study in the paediatric university hospital in Bialystok, Poland. Emerg Med J 2013; 30: 712-716.
[22] Hamid MH, Butt T, Baloch GR, Maqbool S. Acute poisoning in children. J Coll Physicians Surg Pak 2005; 15: 805-808.
[23] Shie HG, Li CY. Population-based case-control study of risk factors for unintentional mortality from carbon monoxide poisoning in Taiwan. Inhal Toxicol 2007; 19: 905-912.
[24] Harduar-Morano L, Watkins S. Review of unintentional non-fire-related carbon monoxide poisoning morbidity and mortality in Florida, 1999-2007. Public Health Rep 2011; 126: 240-250.
[25] Chang YC, Lee HY, Huang JL, Chiu CH, Chen CL, Wu CT. Risk factors and outcome analysis in children with carbon monoxide poisoning. Pediatr Neonatol 2017; 58: 171-177.
[26] Wurster Ovalle V, Pomerantz WJ, Anderson BL, Gittelman MA. Severe unintentional injuries sustained by Ohio children: is there urban/rural variation? J Trauma Acute Care Surg 2016; 81 Suppl 1: S14-19.
[27] Larson K, Russ SA, Crall JJ, Halfon N. Influence of multiple social risks on children's health. Pediatrics 2008; 121: 337-344.
[28] Peden M, Oyegbite K, Ozanne-Smith J. World report on child injury prevention. WHO guidelines approved by the guidelines review committee. 2008: Geneva: World Health Organization.
[29] Donroe J, Gilman RH, Brugge D, Mwamburi M, Moore DA. Falls, poisonings, burns, and road traffic injuries in urban Peruvian children and adolescents: a community based study. Inj Prev 2009; 15: 390-396.
[30] Franklin RL, Rodgers GB. Unintentional child poisonings treated in United States hospital emergency departments: national estimates of incident cases, population-based poisoning rates, and product involvement. Pediatrics 2008; 122: 1244-1251.
[31] Naisaki A, Wainiqolo I, Kafoa B, Kool B, Taoi M, McCaig E, Ameratunga S; TRIP Project Team. Fatal and hospitalised childhood injuries in Fiji (TRIP Project-3). J Paediatr Child Health 2013; 49: 63-67.
[32] Pearson J, Jeffrey S, Stone DH. Varying gender pattern of childhood injury mortality over time in Scotland. Arch Dis Child 2009; 94: 524-530.
[33] Väli M, Lang K, Soonets R, Talumäe M, Grjibovski AM. Childhood deaths from external causes in Estonia, 2001-2005. BMC Public Health 2007; 7: 158.
[34] Pan SY, Desmeules M, Morrison H, Semenciw R, Ugnat AM, Thompson W, Mao Y. Adolescent injury deaths and hospitalization in Canada: magnitude and temporal trends (1979-2003). J Adolesc Health 2007; 41: 84-92.
[35] Gunnell D, Eddleston M, Phillips MR, Konradsen F. The global distribution of fatal pesticide self-poisoning: systematic review. BMC Public Health 2007; 7: 357.

Supplementary Table 1. Multivariable linear regression analysis* of possible predictors of LOS

Variable	Beta	S.E.	Standardized Beta	*t*	*P*	95.0% CI for Beta	
						Lower Bound	Upper Bound
Constant	5.326	0.390		13.661	< 0.001	4.560	6.092
Drug poisoning	-2.643	0.417	-0.267	-6.339	< 0.001	-3.462	-1.824
Age	0.177	0.044	0.164	4.024	< 0.001	0.091	0.264
Food poisoning	-4.075	1.207	-0.139	-3.377	0.001	-6.446	-1.705
Cleaner poisoning	-2.500	0.983	-0.106	-2.543	0.011	-4.431	-0.569

Note: $R = 0.333$, $R^2 = 0.111$, *adjusted* $R^2 = 0.104$, $F = 16.970$, $P < 0.001$. *, using stepwise.

Supplementary Table 2. Multivariable linear regression analysis* of possible predictors of cost

Variable	Beta	S.E.	Standardized Beta	*t*	*P*	95.0% CI for Beta	
						Lower Bound	Upper Bound
Constant	-4221.527	803.114		-5.256	< 0.001	-5799.105	-2643.949
LOS	1126.633	47.088	0.727	23.926	< 0.001	1034.138	1219.129
Disease severity	1171.798	324.629	0.107	3.610	< 0.001	534.120	1809.476
Drug poisoning	1060.637	466.454	0.069	2.274	0.023	144.370	1976.904

Note: $R = 0.724$, $R^2 = 0.525$, *adjusted* $R^2 = 0.522$, $F = 200.663$, $P < 0.001$. *, using stepwise.