BMJ Open

BMJ Open is committed to open peer review. As part of this commitment we make the peer review history of every article we publish publicly available.

When an article is published we post the peer reviewers' comments and the authors' responses online. We also post the versions of the paper that were used during peer review. These are the versions that the peer review comments apply to.

The versions of the paper that follow are the versions that were submitted during the peer review process. They are not the versions of record or the final published versions. They should not be cited or distributed as the published version of this manuscript.

BMJ Open is an open access journal and the full, final, typeset and author-corrected version of record of the manuscript is available on our site with no access controls, subscription charges or pay-per-view fees (http://bmjopen.bmj.com).

If you have any questions on BMJ Open's open peer review process please email info.bmjopen@bmj.com

BMJ Open

Characteristics of acute poisoning cases admitted to a tertiary hospital in Shenyang, China

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2018-021881
Article Type:	Research
Date Submitted by the Author:	25-Jan-2018
Complete List of Authors:	Zhang, YaJie; Shengjing Hospital of China Medical University Yu, Boxin; Shengjing Hospital of China Medical University Wang, Nana; Shengjing Hospital of China Medical University Li, Tiegang; Shengjing Hospital of China Medical University,
Keywords:	Acute poisoning, Intentional poisoning, Pesticides, Toxic agents, Suicide

SCHOLARONE™
Manuscripts

For peer review only

Characteristics of acute poisoning cases admitted to a tertiary hospital in Shenyang, China

Yajie Zhang,[1] Boxin Yu,[2] Nana Wang,[3] Tiegang Li[4,*]

1. Emergency Department, Shengjing Hospital of China Medical University, Shenyang 110004, China

2. Gerontology Department, Shengjing Hospital of China Medical University, Shenyang 110004, China

3. Endocrinology Department, Shengjing Hospital of China Medical University, Shenyang 110004, China

4. Emergency Department, Shengjing Hospital of China Medical University, Shenyang 110004, China

Corresponding author:

* Tiegang Li, M.D., Emergency Department, Shengjing Hospital of China Medical University, No. 36, Sanhao Street, Heping District, Shengyang, China, 110004

E-mail: litg@sj-hospital.org

For peer review only

Abstract

Objectives: It is crucial to have up-to-date information on the patterns of acute poisoning in a tertiary medical center in northeast China in order to properly manage poisoning events. This retrospective study was conducted with the aim of analyzing the characteristics of acute poisoning patients admitted to the emergency department (ED). **Study design:** Cross-sectional design with data from the hospital information system (HIS). **Methods:** Over a five-year period from January 2012 to December 2016, the hospital records of patients aged more than 11 years old admitted to the ED, were retrospectively reviewed and analyzed. **Results**: In total, 5009 patients aged ≥11 years presented to the ED with acute poisoning during the study period. The average age of the patients was 36.03 ± 15.13 years and over half of the patients (52.72%) were in the age group 20-39 years. The ratio of females to males was 1.18. Patients with poisoning lived more in rural area than in urban area. The majority of patients consumed poison intentionally (78.8%) versus unintentionally (20.3%). Males were more commonly poisoned by drug abuse than females, but females outnumbered males in suicidal poisoning. The most common form of poison-intake was ingestion (86.16%) (oral intake) followed by inhalation (11.78%) (nasal intake) and contact (1.96%) (dermal intake).The **five** most common toxic agent group involved in descending order were therapeutic drugs(32.62%), pesticide(26.88%), alcohol (20.71%), noxious gas(11.4%), and chemicals (3.61%).The hospital mortality rate was 1.28% with 64 deaths. **Conclusions:** The present data provides an insight into the trends in acute drug poisoning. The pattern of acute poisoning in Shenyang altered significantly compared to that of ten years ago.

Keywords:

Acute poisoning; Intentional poisoning; Pesticides; Toxic agents; Suicide

Strengths and limitations of this study:

Cross-sectional design involved with over 5,000 poisoning cases in 5 consecutive years.

This study, through multiple perspectives' analysis, provides an up-to-date profile of

For peer review only

acute poisoning for poisoning prevention and rescue.

Although the sample size for the study is large, retrospective nature makes it difficult to obtain the whole information of all poisoning cases, which brought into the bias. Considering that some of mild and particularly serious poisoning cases fail to seek for medical help, outcomes of the study may differ from the actual fact.

1 Introduction

Acute poisoning is defined as acute exposure (less than 24 hrs) to the toxic substance.[1] Acute poisoning is a major public and preventable health issue contributing to morbidity and mortality in many parts of the world. It is estimated that poisoning events are responsible for more than one million illnesses annually.[2,3] Low mortality contrasts with high morbidity in acute poisoning; however, patients who attempt suicide usually have higher mortality.[4-6] As the most common form of fatal self-harm in rural Asia, poisoning accounts for more than 60% of deaths.[7]

China is a developing country and is changing from an agricultural to an industrialized economy. In recent years, the number of acute poisoning cases in China has continued to increase[8], so that now poisoning and injury have entered the top five causes of death.[9] Of various type of poisonings, pesticide poisonings were more common in most regions of China while pharmaceutical poisonings were the main type of poisoning in the developed region or city, such as Shanghai.[9-13] Shengyang, is the provincial capital of Liaoning, the biggest city in Northeast China and the national regional central city, with estimated population more than 8.1million. Liaoning is an industrial province, but agriculture is still the important economic sector. The major crops in this region are corn and rice. The heavy use of pesticides such as organophosphorous compounds by farmers may increase the risk of poisoning events in this area.[14] A previous investigation in this region from 1997 to 2007 showed that (i) medicine was the most common agent (41.4%), followed by pesticides (15.2%), alcohol (14.1%), carbon monoxide (12.5%) and food (9.7%); (ii) the major medicine was sedative/hypnotic and the major pesticide was organophosphates; (iii) mortality decreased from 2.05% to 0.37% over the 10-year study period, with an average

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

mortality rate of 1.0%. [15]

In the last few decades, China has witnessed significant advancements in the fields of agriculture, industrial technologies and medical pharmacology. These advancements have been paralleled with remarkable changes in the trends of acute poisoning, [16] and led to the development and easy accessibility of a vast number of toxic agents including pesticides, therapeutic drugs and other chemicals. Thus, the toxic agents associated with morbidity and mortality and the pattern of acute poisoning, which vary from place to place and over time, are expected to change. Therefore, there is a constant need to obtain up-to-date information on acute poisoning for planning rational use of resources and for evaluating public health interventions. The aim of this retrospective and descriptive study was to describe the clinical and sociodemographic patterns of acute poisoning in the medicine emergency department of Shengjing Hospital of China Medical University, a tertiary care center.

2 Methods

This retrospective and descriptive study based on hospital records was carried out in the Shengjing Hospital of China Medical University in Shenyang, China. Shengjing hospital is one of the regional tertiary care hospitals in northeast China with 3 hospital areas, and covers the whole Liaoning province and some area of neighboring provinces. Moreover, Liaoning Poisoning Diagnosis and Treatment Center (PDTC) is established in ED of Shengjing hospital on July 2011, and ED owns specialized toxicology unit, hence many patients with poisoning who seek for treatment visit or are referred to this hospital. We reviewed all records of poisoning cases admitted to the ED over 5 consecutive years from January 2012 to December 2016. Cases of animal bites (snake, insect) for its infrequency and chronic poisoning were excluded from the study. Research ethical approval was obtained from Shengjing hospital institutional ethics committee before the study commence.

Relevant medical records were obtained from the electronic hospital information system (HIS). The HIS is an electronic system used in the clinic to record patient information. From HIS, patient information including personal information, present

For peer review only

history, past history, diagnosis, treatment and prognosis can be obtained. Demographic data including age, gender, place of residence, diagnosis, type of exposure (intentional or non-intentional), type of toxic agent (the common name or trade name are indicated, where available), duration of hospital stay and the outcome of treatment (whether the patient survived or died) were collected and documented on a structured form. The circumstance of poisoning was deduced from the patients' history. If patients were poisoned because of being in the environment where toxic substance (e.g.: CO) exist it was categorized as environmental poisoning. The overdoses of medicine or being given the wrong drug, taking the wrong drug in error, or taking a drug inadvertently were categorized as misuse. The side effect of herbs or health-products was categorized as adverse reaction. In addition, cases of suicide and drug abuse were classified as intentional poisoning. If information was unavailable it was categorized as unknown. Diagnosis was routinely made on the basis of the generic name of the toxic agent, i.e. organophosphate compounds. The toxic agent was categorized as unknown when no suspected toxic agent was reported in the patient history.

Microsoft Excel 2007 was used to perform descriptive statistical analyses of the data. The average age was presented as the mean ± standard deviation (SD). The rate was compared using the chi-square test and used as the inferential statistic.

3 Results

A total of 5,375 cases of poisoning (age ≥11 years of age) from 829,808 entries were obtained from the HIS from 1 January 2012 to 31 December 2016. Of these, 366 were identified as animal bites (10) and chronic poisoning events, leaving a total of 5009 unique cases that met our criteria. Descriptive information including age, gender, type and route of exposure, place of residence, length of hospital stay, and outcome of the poisoned patients are summarized in Table 1.

Table 1. Demographic characteristic of poisoned patients admitted to ED from 2012 to 2016.

For peer review only

Variables categories	N	%
Age group		
11~19	557	11.12
20~29	1547	30.88
30~39	1094	21.84
40~49	817	16.31
50~59	575	11.48
60~69	267	5.33
⩾70	152	3.04
Gender		
Male	2296	45.84
Female	2713	54.16
Type for exposure		
Intentional	3947	78.8
Accidental	1017	20.3
Unknown	45	0.9
Route of exposure		
Ingestion (oral)	4316	86.16
Inhalation (nasal)	590	11.78
Contact (dermal)	98	1.96
Other	5	0.1
Place of residence		
Urban	2442	48.22
Rural	2568	51.27
Unknown	26	0.51
Length of hospital stay		
<48h	367	7.33
<1week	3219	64.26
>1week	1423	28.41
Outcome		
Recovery	1416	28.27
Relative recovery	3319	66.26
Death	64	1.28
Others (LAMA or refer to other center)	274	5.47
Total	5009	100.00

* LAMA : Left Against Medical Advice

3.1 Age and gender

As shown, of these 5009 cases, 2713(54.2%) were recognized as female, and 2296 (45.8%) were determined as male, and the ratio of male to female was 1:1.18.In this study, the youngest patient was 11 years old, while the oldest patient was 92 years

For peer review only

old. The mean age of all patients was 36.03 ± 15.13 years. The mean age of male and female patients was 36.41 ± 14.95 years and 35.71 ± 15.27 years, respectively. The most vulnerable patients were aged 20-29 years (30.88% of cases), followed by patients aged 30-39 years (21.84% of cases) and 40-49 years (16.31% of cases) (Figure 1). There was statistically significant gender difference (male and female) between different age groups of poisoned patients ($p < 0.05$). According to table 2, the most predominant group of toxic agent consumed by 20-29 age-groups was therapeutic drugs (579 cases, 37.1% of poisonings in 20-29 age-groups). Among them, sedatives & hypnotics (169 cases) plus analgesics (120 cases) accounted for over a half. Alcohol and pesticides are ranked two and third place, taking up 28.1% and 19.5% respectively. From the perspective of the single substance poisoning, alcohol poisoning are the most frequent. There was statistical significance between the age and type of exposure ($p < 0.001$). Most cases of intentional poisoning with 855 suicidal-attempt cases and 446 abuse cases were seen in young adults (20-29 years old). (Figure 2)

Table 2 Distribution of toxic agents consumed by 20-29 age-group people from 2012 to 2016

Toxic agents category	N	Group percentage	Total percentage	Direct percentage*
Therapeutic drugs	**579**	**100.00**	**37.12**	**35.37**
Sedatives & hypnotics	169	29.19	10.83	35.88
Analgesics	120	20.73	7.69	44.28
Mixed drugs	92	15.89	5.90	34.20
Cold and cough preparations	64	11.05	4.10	39.26
Antipsychotics	35	6.04	2.24	28.00
Cardiovascular drugs	22	3.80	1.41	19.64
Other drugs	29	5.01	1.86	30.21
Antimicrobials	27	4.66	1.73	41.54
Traditional Chinese medicine	21	3.63	1.35	32.81
Alcohol	**439**		**28.14**	**42.25**
Pesticides	**304**	**100.00**	**19.49**	**22.54**
Paraquat	133	43.75	8.53	20.65
Rodenticide	66	21.71	4.23	25.48
Organophosphate	45	14.80	2.88	19.40
Other	48	15.79	3.08	30.00
Unknown	12	3.95	0.77	22.22
Fumes/gases/vapors	**138**		**8.85**	**24.13**

For peer review only

Chemicals	**33**	**2.12**	**18.23**
Food	**16**	**1.03**	**18.18**
Other substance	**16**	**1.03**	**47.06**
Unknown	**35**	**2.24**	**34.31**
Total	**1560**	**100.00**	**31.19**

Direct percentage*: the ratio of the same toxic agent consumed by twenties people to all age-group people

3.2 Type for exposure

Table 3 shows the reasons for toxin exposure in these patients. It was noted that intentional exposure occurred in the overwhelming majority of poisonings (3947, 78.8%), followed by accidental exposure (1107, 20.3%), unknown reason (45, 0.9%). Intentional poisoning was mainly due to suicide (2842, 56.74%) followed by drug abuse such as alcohol and antitussive (1105, 22.06%).There was a significant association between intentional exposure (suicide versus abuse) and gender, where women were involved in more suicidal poisonings than men; 63.4% for women versus 35.2% for men ($p < 0.001$). Poisoning due to drug abuse showed the opposite trend; 70.7% for males versus 29.3% for females ($p < 0.01$). The most substances used were therapeutic drugs and pesticides for suicidal attempt and alcohol for abuse. CO poisoning (about 80% of cases) was the most common in environmental poisonings, and pesticides poisoning (20%) was less common. Therapeutic drugs were overdose or taken mistakenly by females.

Table 3 Type for exposure of all cases by gender

Reason	Male		Female		Total	
	N	%	N	%	N	%
Intentional:	**1822**	**79.36**	**2125**	**78.33**	**3947**	**78.80**
Suicide	1040	45.30	1802	66.42	2842	56.74
Abuse	782	34.06	323	11.91	1105	22.06
Accidental:	**451**	**19.64**	**566**	**20.86**	**1017**	**20.30**
Environmental	303	13.20	387	14.26	690	13.78
Misuse	97	4.22	106	3.91	203	4.05
Food poisoning	35	1.52	53	1.95	88	1.76
Adverse reaction	16	0.70	20	0.74	36	0.72
Unknown:	**23**	**1.00**	**22**	**0.81**	**45**	**0.90**
Subtotal	**2296**	**100.00**	**2713**	**100.00**	**5009**	**100.00**

For peer review only

3.3 Route of exposure

Among the various routes of exposure, ingestion was the most common (86.16 %), followed by inhalation (11.78%) and contact (1.96%).

3.4 Common Substances in Human Exposures

The most prevalent substance categories are shown in Table 4 and are listed by frequency of exposure in these patients. This ranking shows the direction where prevention efforts should be focused, as well as the types of poisonings our hospital regularly manages. It is crucial to know whether exposure to these toxic agents is increasing or decreasing. The overall trend of poisoning events was down. The four most common toxic agent group in decreasing order were therapeutic drugs, pesticides, alcohol, fumes/gases/vapors, 676 (13.47%) patients consumed two or more toxic agents. However, when it came to specific substance, alcohol, paraquat, CO and sedatives and hypnotics were the first four toxic agents.

For peer review only

Table 4 The distribution of toxic agent over the five years.

Toxic agent category	2012		2013		2014		2015		2016		Total		
	N	%	N	%	N	%	N	%	N	%	N	%	Total %
Therapeutic drugs	**302**	**100**	**394**	**100**	**325**	**100**	**310**	**100**	**304**	**100**	**1637**	**100**	**32.62**
Sedatives & hypnotics	101	33.44	141	35.79	79	24.23	68	21.94	82	26.97	471	28.77	9.39
Analgesics	50	16.56	67	17.01	62	19.02	53	17.1	39	12.83	271	16.55	5.40
Mixed drugs	42	13.91	63	15.99	53	16.26	52	16.77	59	19.41	269	16.43	5.36
Cold and cough medicines	31	10.26	26	6.6	37	11.35	42	13.55	27	8.88	163	9.96	3.25
Psychotropics	16	5.3	23	5.84	23	7.08	27	8.71	36	11.84	125	7.64	2.49
Cardiovascular drugs	15	4.97	27	6.85	22	6.75	26	8.39	22	7.24	112	6.84	2.23
Other drugs	15	4.97	21	5.33	24	7.38	20	6.45	15	4.93	96	5.86	1.91
Antimicrobials	19	6.29	12	3.05	15	4.6	8	2.58	11	3.62	65	3.97	1.30
Traditional Chinese medicine	13	4.3	14	3.55	11	3.37	14	4.52	13	4.28	65	3.97	1.30
Pesticides	**241**	**100.00**	**278**	**100.00**	**307**	**100.00**	**273**	**100.00**	**250**	**100.00**	**1349**	**100.00**	**26.88**
Paraquat	97	40.25	133	47.84	149	48.53	142	52.01	123	49.20	644	47.74	12.83
Rodenticide	50	20.75	55	19.78	60	19.54	49	17.95	45	18.00	259	19.20	5.16
Organophosphate	56	23.24	44	15.83	48	15.64	46	16.85	38	15.20	232	17.20	4.62
Other	24	9.95	32	11.51	41	13.36	28	10.26	35	14.00	160	11.86	3.19
Unknown	14	5.81	14	5.04	9	2.93	8	2.93	9	3.60	54	4.00	1.08
Alcohol	**203**		**227**		**226**		**182**		**201**		**1039**		**20.71**
Fumes/gases/vapors	**70**		**144**		**103**		**119**		**136**		**572**		**11.40**
Chemicals	**25**		**47**		**46**		**32**		**31**		**181**		3.61
Food	**20**		**9**		**15**		**35**		**9**		**88**		1.75
Other substance	**7**		**11**		**8**		**10**		**14**		**50**		1.00
Unknown	**22**		**24**		**17**		**19**		**20**		**102**		2.03
Subtotal	**890**		**1134**		**1047**		**980**		**965**		**5018**		**100.00**

For peer review only

3.4.1Therapeutic drug categories

The therapeutic drug poisoning showed a slight decreased trend across the consecutive five years in spite of a high number in 2013. A total of 1637 cases had therapeutic drug poisoning. Among these cases, 28.77% involved sedatives and hypnotics poisoning, which were the most commonly employed drugs, followed by analgesics (16.55%) and cold and cough preparations (9.96%). Mixed drug poisoning was found in approximately 16.43% of patients. The rate of psychotropics poisoning was increasing over the five years. Cardiovascular drugs, antimicrobials, traditional medicine and other drugs showed relatively stable trend. Drug poisoning was more common in both males and females aged 20-29 years with suicidal attempt (Figure 3). However, drug poisoning was significantly more frequent in females than males (71.9% vs. 28.1%).

3. 4.2 Pesticide categories

The pesticide poisoning presented a growing trend from 2012 to 2015 but decreased in 2016. A total of 1349 cases were observed to have pesticide poisoning. Among these cases, the predominant pesticide poison taken was paraquat (47.74% of cases), followed by rodenticide (19.20%), organophosphate (17.20%) and other pesticides (11.86%). A slightly higher number of males (683 cases) than females (666 cases) had pesticide poisoning. There were two peaks on the distribution of age and gender in pesticide poisoning, one in 20-29 years old and another in 40-49 years old for both males and females (Figure 4). Eighty-eight percentage of pesticide poisoning occurred with suicidal attempt, but males exposed 5% more accidental pesticide poisoning than females. Pesticide poisoning was most frequent during the month of July.

3.4.3 Alcohol and Fumes/gases/vapors

There was a stable trend in the alcohol poisoning. Males were predominant population in alcohol poisoning and were approximately 2.5 times more than females. The 20-29 years old were exposed more to alcohol poisoning than any other age groups. (Figure 5) In addition, less one percent of alcohol poisoning cases were found

For peer review only

to be accompanied by other poisonings. Fumes/gases/vapors poisoning displayed an increasing trend as a whole even though there was a decrease from 2013 to 2014. Among these cases, CO poisoning was the dominating toxic agent. Major age group exposed to CO poisoning was 20-39 years old and females' exposure was more common. Majority of poisoning events occurred in winter.

3.5 Treatment and Outcome

Gastric lavage, administration with activated charcoal, infusion and dieresis therapy, hemoperfusion were regulatory treatment for those poisonings through ingestion. Hemodialysis was performed depending on the situation. Special antidotes, naloxone for alcohol poisoning, Vitamin K1 and acetamide for rodenticide poisoning, were given when needed. All patients with organophosphorous poisoning were treated with atropine and pralidoxime. For those poisoning with no specific antidotes available, symptomatic treatment was administered. In addition, hyperbaric oxygen therapy for CO poisoning was performed for all cases.

A total of 4945 patients were discharged from the hospital, including 1416 cases with complete recovery, 3319 cases with relative recovery, and 274 cases that left out of hospital during treatment or transferred to other central hospital. The hospital mortality rate was 1.28% with 64 deaths including 36 females and 28 males. The fatality ratio was 1.33% for female patients and 1.22% for male patients. More than half of the fatality cases (n=33) occurred in 40-59 age groups. Sixty-eight percentages of dead cases were patients living in urban areas. 51cases of death were with intentional purpose and 11cases of death were accidental, and in two cases, the type of poisoning was unknown. The associated agent involved in mortality was paraquat (33 cases), therapeutic drugs (16 cases), organophosphate (6 cases), food poisoning (4 cases), CO poisoning (2 cases), alcohol (1case) and two cases with unidentified poisons.

4. Discussion

Acute poisoning is one of the most frequent causes of visits to the ED and is a threat to public health. The annual rate of ED visits associated with poisoning varies

For peer review only

widely across the world, and ranges from 0.07% to 0.7%.[17,18] Studies in western countries have reported annual rates of ED visits associated with poisoning of approximately 0.26%.[18,19] In the present study, this rate was about 0.65%, and a similar percentage (0.64%) was seen in Bulent' research.[20] As it is not common practice for many poisoned patients to seek medical help in health care institutions, the annual rate of ED visits associated with poisoning recorded by hospitals may be misleading. Therefore, the actual number of poisoning cases may be more than that recorded, and the accurate statistical data for poisonings is not easy to estimate. Developed countries also have similar problems in obtaining meaningful poisoning statistics even though they are equipped with advanced systems to collect population health data .[21]

This study concluded that the incidence of poisoning in females was slightly higher than that in males, especially among young adults aged 20-29 years, with a female-to-male ratio of 1.18:1. Similar findings have also been reported in Beijing, China [22] (1.23:1) and Sari, Iran [16] (1.16:1). In contrast, male preponderance has been found in some other countries. [23, 24] The most likely explanation for the high number of poisoning in women is that they are emotionally fragile, more susceptible to stress, which can lead to overreacting behaviors.

The findings of this study showed a difference in poisoning based on age and indicated that the most affected age group was the 20-29 group (30.82%) with a secondary peak in the 30-39 group (21.88%). Both intentional and accidental poisoning were common in males and females aged 20-29 years, which is consistent with previous findings in China[15,22] and in other countries [16,25-26]. The fact that poisoning is more common among young adults reflects their vulnerability to stress, possibly due to failure or frustration in love or exams, maladjustment and inability to cope with the high expectation of parents. Overall, this group of people is not emotionally stable or mature enough to tolerate extreme mental or physical pressure.

Intentional poisoning was the predominant cause of poisoning(78.8%) in the current study, an observation that is consistent with those made in other studies.[25,27] Our study indicated of the whole of poisoning cases, a large proportion were suicidal

For peer review only

in nature, which was decreased compared to previous study[15]. In spite of the decline in the suicidal rate, suicide attempt still is the primary reason for poisoning because of the general acknowledgment that poisons terminate life with minimal suffering.[28,29] We found a lot of suicidal behaviors were initiated after an acute interpersonal conflict. It was consistent with a multivariate analysis about suicide reason in a research performed in China, which revealed that marriage frustration, work and learning problem, family fanaticism and conflict, somatic disease, and history of mental disorders were all significantly associated with suicide attempts. [30]

Our study pointed out that pharmaceutical drugs were the most frequently employed toxic agents. Pharmaceutical poisoning comprised 32.6% of the various drug poisonings observed in the present study, of which sedatives and hypnotics (28.78%) were the most frequently ingested agents. Similar pattern was also seen in previous study, compared to which there appeared a decline in sedatives and hypnotics poisoning in our study [17]. This decline may be connected with the implementation of drug-control that patients can only access these drugs with a doctor's prescription. However, a rise were seen in usage of analgesics, cold and cough medicines, mixed drugs, as well as cardiovascular drugs, making it not the same as before. This may be explained by the easy availability of pharmaceuticals due to the numerous drugstores in China, poor psychological well-being and mental fragility among populations. Additionally, we found the frequency of psychotropic drugs poisonings were growing, which indicated that mental disorder played a part in poisoning events and should be gave attention.

Poisoning with pesticide products has been occurring relatively frequently for some time, as can be observed in published papers from different countries. [27, 29] The incidence of this poisoning varies geographically and historically. Pesticide was the second leading cause of acute poisoning, accounting for 26.57% of all poisoning cases, the frequency increasing a lot compared to the before.[17] There are two reasons: first, suicide by pesticide poisoning still remains a priority for suicide in China, although suicides related to pesticide poisoning in China have continuously declined from 2006 to 2013.[31] Previous studies have shown that highly lethal pesticides are a common

For peer review only

method used for suicide in rural China.[32.33] Our study finding that as high as eighty-eight percents of pesticide poisoning occurred with suicidal attempt also confirmed that. Second, pesticides are used extensively and unsafely in agriculture, industry, and home storage causing toxicity due to intentional and accidental exposure.[33]The quantity of pesticide use is large and ever-increasing, growing from 1.28million ton in 2001 to 1.81 million ton in 2014[34]. Liaoning, as a major agriculture province, bears a mount of proportion of pesticide consumption to protect crops and increase food production [35]. Owing to the respective nature, we didn't get the detailed information about the use and storage of pesticides in patients' home. However, we found about twelve percent of pesticide poisoning were accidental, of which males exposed 5% more accidental pesticide poisoning than females, and almost all these cases occurred when they were working in the fields. This indirectly indicates the influence of unreasonable use and poor self-protection on poisoning. In the present study, paraquat was the most frequently implicated agent among the pesticides, and a similar pattern was found in a study in northeast China which showed an increasing trend [36], whereas a decreasing trend was found in Korea [37]. Compared to the previous pattern, the most common pesticide products have changed from organophosphates to paraquat. Organophosphates have fallen behind the rodenticide to the third place. Studies carried out in other parts of China showed that organophosphates were the most frequently used pesticides [11]. This imparity is related to difference of the social-economic and geographical conditions. Previous studies have revealed that season-specific agricultural activities contribute to the change in the incidence of pesticide poisoning throughout the year, and the high incidence of pesticide poisoning is related to the easy accessibility of pesticides during the farming season.[38] Our results indicated that pesticide poisoning, both intentional and accidental, was common in June and in July, during the farming season in Liaoning, with 181 cases and 208 cases, respectively, but was less common in winter.

Not surprisingly, our study found that alcohol poisoning was common and found in 20.7% of our cases. This value was increased compared to the before. This change

For peer review only

can be explained by rapid social and economic development, urbanization, increasing alcohol production, and alcoholic beverage commercials in the mass media, which all led to the growing alcohol consumption.[39] According to a set of data the annual per-capita alcohol consumption of Chinese adults in 2012 was 3 liters.[40] Some findings reported elsewhere in China had higher number of alcohol poisonings.[41] Whereas the value in studies that involved the alcohol poisoning in other countries showed a lower proportion [42-45]. This kind of discrepancy is partially related to the disparity in alcohol consumption habits between different countries and districts. In Chinese culture, people often urge companions to drink as much as possible so that they can construct social connections and establish a happy and congenial atmosphere. [46] This can also explain the gender difference as men are more engaged in social intercourse than women. Except for wildly practiced social drinking, solitary drinking was also common for stress reduction and coping among Chinese. [47]

The current data showed that the fourth leading cause of acute poisoning was fumes/gases/vapors (mainly CO), decreasing from 12.5% to less than 11.4% in spite of remaining in fourth place. This reduction is related to the improvement of dwelling conditions and preventive education about CO poisoning. With the improvement of heating measures and the advancing of the fuel switching project from coal to natural gas in rural areas, further decline in CO poisoning is expected in rural areas in China. There was a significant association between residency and month and reason for exposure to CO. Rural residents are more susceptible to CO poisoning than urban citizens, as local residents in remote villages in northern China use stoves to keep warm in winter, which can result in gas leaks due to a chimney jam and lack of ventilation, and are common causes of CO poisoning in these areas. In contrast, CO poisoning in urban citizens may be explained by eating barbecued food and hotpot, a very famous traditional Chinese cuisine; both require charcoal as fuel. In addition, almost all CO poisoning cases in our study were accidental with the exception of one case which was a suicide.

5. Conclusion and Suggestions

For peer review only

The present data provide additional insight into the epidemiology of acute poisoning in Shenyang. The findings demonstrated that more females than males had acute poisoning and the most vulnerable age group was the young-adult group aged 20-29. We also observed that the majority of poisoning cases were intentional, particularly suicidal in nature, and accidental poisonings were nonnegligible. Our study indicated that therapeutic drugs were the most commonly used toxic agent group, followed by pesticides, alcohol and noxious gas. Additionally, alcohol was the first substance that caused most single substance poisoning. In conclusion, the pattern of acute poisoning in Shenyang altered significantly compared to that of ten years ago.

Some suggestions are proposed based on the present study and include the following:

- Vulnerable groups such as females, young-adult group should deserve special consideration for their weak bearing capacity.
- Further investment is required to promote public health education on the rational use and safe storage of toxic agents as well as self-protection to reduce accidental poisoning.
- The agenda of addressing the upward trend of prevalence and alcohol and drug use should capture increasing attention.
- Patients who attempt suicide must undergo psychiatric consultation as soon as possible. Early psychiatric consultation and identification may minimize the risk of further self-harm in suicidal cases.
- Lastly, relevant policies and regulations should be formulated and initiated immediately to restrict access to toxic agents, especially pesticide for its high toxicity.

Acknowledgment

Contributors: TG Li developed and directed the study. NN Wang conceived and designed the survey questions on poisoning. BX Yu coordinated data collection and carried out data cleaning. YJ Zhang performed the statistical analysis and drafted the

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

manuscript. All authors drafted, edited and approved the final manuscript.

Ethical approval: Research ethical approval was obtained from Shengjing hospital institutional ethics committee before the study commences.

Funding: This work was supported by the National nature science foundation of China (No. 81301627 and No.81500628) .We would like to appreciate the staff of library for their contribution in providing language help.

Competing interests: The Authors declare that there is no conflict of interest.

Data sharing statement: No additional data sharing available.

References

1. Kalseen CD, Andur MO, Doull J. Casarett and Doull's Toxicology. Newyork: Macmillan, 1986:10-17.
2. Senarathna L, Buckley AN, Jayamanna SF, et al. Validity of referral hospitals for the toxicovigilance of acute poisoning in Sri Lanka.[J] Bull World Health Organization, 2012, 90(6):401–76.http://dx.doi.org/10.2471/BLT.11.092114
3. Güloğlu C, Kara IH. Acute poisoning cases admitted to a university hospital emergency department in Diyarbakir, Turkey. Human and Experimental Toxicology, 2005, 24(2):49-54.http://dx.doi.org/10.1191/0960327105ht499oa
4. Plooy WJD, Jobson MR, Osuch E, et al. Mortality from traditional medicine poisoning: A new perspective from analyzing admissions and deaths at Ga-Rankuwa Hospital[J]. South African Journal of Science, 2001, 97(3): 70.
5. Ellis JB, Krug A, Robertson J, et al. Paraffin ingestion: The problem. [J]. South African Medical Journal, 1994, 84(11): 727-730
6. Abebe M. Organophosphate pesticides poisoning in 50 Ethiopian patients. [J] Ethiopian Medical Journal, 1991, 29(3): 109-118.
7. Konradsen F, Van d H W, Cole D C, et al. Reducing acute poisoning in developing countries--options for restricting the availability of pesticides.[J]. Toxicology, 2003, 192(2-3):249.http://dx.doi.org/10.1016/S0300-483X(03)00339-1
8. Yumeng Tang, MS, Lan Zhang, et al. Unintentional Poisoning in China, 1990 to 2015: The Global Burden of Disease Study 2015.[J] AmJ Public Health. 2017;

For peer review only

107:1311–1315. http://dx.doi.org/10.2105/AJPH.2017.303841

9. Liu QH, Jiang DF. Research Status of Acute Poisoning in China.[J] Journal of Occupational Health and Damage, 2011; 26:238–9. (inChinese). https://dx.doi.org/10.3969/j.issn.1006-172X.2011.04.016
10. Sc J Z M, Ping X P D, Sc X Z B, et al. Acute Poisoning Types and Prevalence in Shanghai, China, from January 2010 to August 2011[J]. Journal of Forensic Sciences, 2014, 59(2):441-446. https://dx.doi.org/10.1111/1556-4029.12334
11. Zhang M, Fang X, Zhou L, et al. Pesticide poisoning in Zhejiang, China: a retrospective analysis of adult cases registration by occupational disease surveillance and reporting systems from 2006 to 2010[J]. BMJ Open, 2013, 3(11):e003510. http://dx.doi.org/10.1136/bmjopen-2013-003510
12. Wang B S, Chen L, Li X T, et al. Acute Pesticide Poisoning in Jiangsu Province, China, from 2006 to 2015[J]. Biomed Environ Sci, 2017, 30(9):695-700. https://dx.doi.org/10.3967/bes2017.094
13. Ge XM, Jiang DF, Liu QH. Epidemiological study on 6011 cases of the acute poisoning during 2005～2009 year in Guangxi[J]. CHINESE JOURNAL OF NEW CLINICAL MEDICINE. 2011;4(8):699-701. (in Chinese) http://dx.doi.org /10.3969 /j.issn.167 4-3806.2011.08.02
14. Sharma BR, Bangar S. Management of common poisoning: changing trends and challenges.Indian Internet Journal of Forensic Medicine & Toxicology,2005; 3(1).
15. Zhao M, Ji XP, Wang NN, Liu SY, Wang YZ. Study of poisoning pattern at China Medical University from 1997 to 2007. Public Health,2009;123:454–5. https://dx. doi.org/10.1 016/j.puhe.2009.04.010
16. Ahmadi A, Pakravan N, Ghazizadeh Z. Pattern of acute food, drug, and chemical poisoning in Sari City, Northern Iran.[J]. Human and Experimental Toxicology, 2010, 29(9):731-738.http://dx.doi.org/10.1177/0960327110361501
17. Hanssens Y, Deleu D, Taqi A. Etiologic and demographic characteristics of poisoning: a prospective hospital-based study in Oman. Journal of Toxicology Clinical Toxicology, 2001, 39: 371? / 80.http://dx.doi.org/10.1081/CLT-100105158

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

18. Thomas SH, Bevan L, Bhattacharyya S, et al. Presentation of poisoned patients to accident and emergency departments in the north of England.[J] Human and Experimental Toxicology, 1996, 15[6]:466–470.http://dx.doi.org/10.1177/096032719 60500602

19. McCaig L F, Burt C W. Poisoning-related visits to emergency departments in the United States 1993–1996.[J]. Journal of Toxicology Clinical Toxicology, 1999, 37(7): 817–826.http://dx.doi.org/10.1081/CLT-100102460

20. Ergun B, Cevik A A, Ilgin S, et al. Acute drug poisonings in Eskisehir, Turkey: A retrospective study [J]. Turkish Journal of Pharmaceutical Sciences, 2013, 10(2):303-312.

21. Meredith T J. Epidemiology of poisoning [J]. Pharmacology and Therapeutics, 1993, 59(3):251-6.http://dx.doi.org/10.1016/0163-7258(93)90069-P

22. Zhigang Z, Peiyi Z, Jianming G. Epidemiological analysis of 560 cases of acute poisoning. Beijing Med 2007;29:708–19.(in Chinese) https://dx.doi.org/10.3969/j.issn.0253-9713.2007.12.017

23. Thalappilli MC, Jimmy A. A profile of acute poisonings: A retrospective study[J]. Journal of the Scientific Society, 2015, 42(3):156-160.http://dx.doi.org/10.4103/0974-5009.165547

24. Malangu N. Acute poisoning at two hospitals in Kampala-Uganda. Journal of Forensic Legal Medicine, 2008,15(8):489-92.http://dx.doi.org/10.1016/j.jflm.2008.04.003

25. Ramesha KN, Rao KB, Kumar GS. Pattern and outcome of acute poisoning cases in a tertiary care hospital in Karnataka, India. Indian Journal of Critical Care Medicine, 2009, 13:152-5.http://dx.doi.org/10.4103/0972-5229.58541.

26. Khadka SB, Ale SB. A study of poisoning cases in emergency Kathmandu Medical College Teaching Hospital.[J] Kathmandu University Medical Journal, 2005,3:388-91.

27. Bundotich JK, Gichuhi MM. Acute poisoning in the Rift Valley Provincial General Hospital, Nakuru, Kenya: January to June 2012[J]. Official Journal of the South African Academy of Family Practice/primary Care, 2015, 57(3):1-5.

For peer review only

http://dx.doi.org/10.1080/20786190.2014.97544

28. Thomas M, Anandan S, Kuruvilla PJ, et al. Profile of hospital admissions following acute poisoning--experiences from a major teaching hospital in south India.[J]. Adverse Drug Reactions and Toxicological Reviews, 2000, 19(4):313-7.: http://dx.doi.org/10.1258/td.2011.110398
29. Tufekci IB, Curgunlu A, Sirin F. Characteristics of acute adult poisoning cases admitted to a university hospital in Istanbul [J]. Human and Experimental Toxicology, 2004, 23(7): 347-51.http://dx.doi.org/10.1191/0960327104ht460oa
30. Zhao CJ, Dang XB, Su XL, et al. Epidemiology of Suicide and Associated Socio-Demographic Factors in Emergency Department Patients in 7 General Hospitals in Northwestern China[J]. Medical Science Monitor International Medical Journal of Experimental & Clinical Research, 2015, 21:2743-2749. http://dox.doi.org/10.12659/MSM.894819
31. Page A, Liu S, Gunnell D, et al. Suicide by pesticide poisoning remains a priority for suicide prevention in China: analysis of national mortality trends 2006–2013[J]. Journal of Affective Disorders, 2016, 208:418.https://doi.org /10.1016/j.jad. 2016.10.047.
32. Zhang J, Xu HL. The effects of religion, superstition, and perceived gender inequality on the degree of suicide intent: a study of serious attempters in China. Omega: Journal of Death and Dying. 2007, 55(3):185–197. http://dx.doi.org/10.2190/OM.55.3.b
33. .Zhang X, Li HS, Zhu QH, Zhou J, Zhang S, Zhang L, Sun CY. Trends in suicide by poisoning in China 2000–2006: age, gender, method, and geography. Biomedical and Environmental Sciences.2008; 21:253–256.http://dx.doi.org/10. 1016/S0895-3988(08) 60038-0
34. Wang J, Li Y, Wang X, et al. Status Quo of Pesticide Use in China and Its Outlook [J]. Agricultural Outlook, 2017, 13(2):56-60. https://dx.doi.org/10.3969/j.issn.1673-3908.2017.02.012
35. Chen SY, Wang HF, Yin Y. The reporting system of acute pesticides poisoning and general situation of pesticides poisoning in China. Zhonghua Lao Dong Wei

For peer review only

Sheng Zhi Ye Bing Za Zhi 2005;23:336–9 (in Chinese)

36. Zhang S, Zheng Q, Zhang PS, et al. Epidemiological study of 357 acute paraquate poisoning cases [J]. Chinese Journal of Health Statistics, 2013, 30(2):251-252.(in Chinese)
37. Lee JW, Hwang IW, Kim JW, et al. Common Pesticides Used in Suicide Attempts Following the 2012 Paraquat Ban in Korea [J]. Journal of Korean Medical Science, 2015, 30(10):1517-21.http://dx.doi.org/10.3346/jkms.201 5.30.10.1517.
38. Mohamed F, Manuweera G, Gunnell D, et al. Pattern of pesticide storage before pesticide self-poisoning in rural Sri Lanka.[J] BMC Public Health, 2009, 9:405. http://dx.doi.org/10.1186/1471-2458-9-405
39. Guan-Sheng MA, Zhu DH, Xiao-Qi HU, et al. The drinking practice of people in China. Ying Yang Xue Bao. 2005;27(5):362–365.(in Chinese) https://dx.doi.org/10.13325 /j.cnki.acta.nutr.sin.2005.05.003
40. National Health and Family Planning Commission of the People's Republic of China. China national nutrition and chronic disease status report [in Chinese]. 2015. Available at: http://www.nhfpc.gov.cn/jkj/s5879/201506/4505528e65f3460fb88685081ff158a2. shtml. Accessed December 15, 2016.
41. Yuan T, Fan Q, Tang X Z, et al. Analysis of acute poisoning in 640 cases[J]. Practical Clinical Medicine, 2009, 10(11):27-27. http://dx.doi.org/10.3969/j.issn. 1009-8194.2009.11.010
42. Thapa SR, Lama P, Karki N, et al. Pattern of poisoning cases in Emergency Department of Kathmandu Medical College Teaching Hospital.[J]. Kathmandu University Medical Journal, 2008, 6(2):209-213.
43. Lapatto-Reiniluoto O, Kivistö K T, Pohjola-Sintonen S, et al. A prospective study of acute poisonings in Finnish hospital patients [J]. Human and Experimental Toxicology, 1998, 17(6):307-11.http://dx.doi.org/10.1177/096032719801700604
44. M. Balai-Mood. Pattern of acute poisonings in Mashhad, Iran 1993-2000.[J]. Journal of Toxicology Clinical Toxicology, 2004, 42(7):965. http://dx.doi.org /10.1081 /CLT-200042550

For peer review only

45. Jayasinghe NRM, Foster JH. Deliberate self-harm/poisoning, suicide trends. The link to increased alcohol consumption in Sri Lanka. Arch Suicide Research 2011, 15(3):223–237. http://dx.doi.org/10.1080/13811118.2011.589705

46. Li YC, Jiang Y, Zhang M, et al. Drinking behavior among men and women in China: the 2007 China Chronic Disease and Risk Factor Surveillance. Addiction. 2011; 106(11):1946–1956. http://dx.doi.org/10.1111/j.1360-0443.2011.03514.x

47. Hussong, A. Further refining the stress-coping model of alcohol involvement. Addict. Behav.2003,28, 1515–1522 https://doi.org/10.1016/S0306-4603 (03)00072-8

Fig. 1 Distribution of all poisoning cases by age and gender
Fig. 2 Intention for 20-29 age-group cases from 2012to 2016
Fig. 3 Distribution of therapeutic drugs poisoning by age and gender
Fig. 4 Distribution of pesticide poisoning by age and gender
Fig. 5 Distribution of alcohol and fumes poisoning by age and gender (A-Male means Alcohol poisoning for Male; F-Male means Fumes/gas/fog poisoning for Male.)

For peer review only

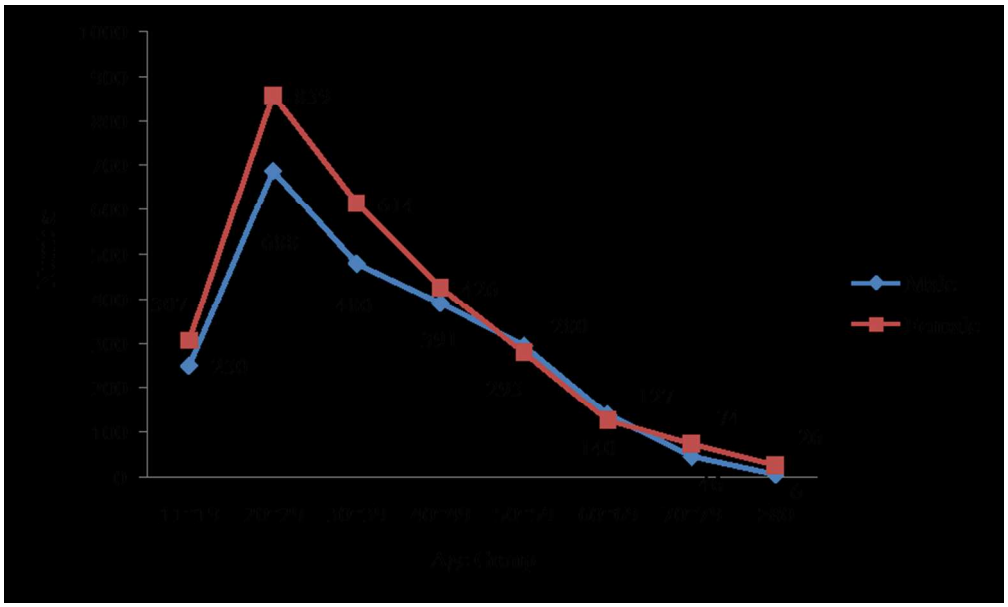


Fig. 1 Distribution of all poisoning cases by age and gender

151x90mm (150 x 150 DPI)

eview only

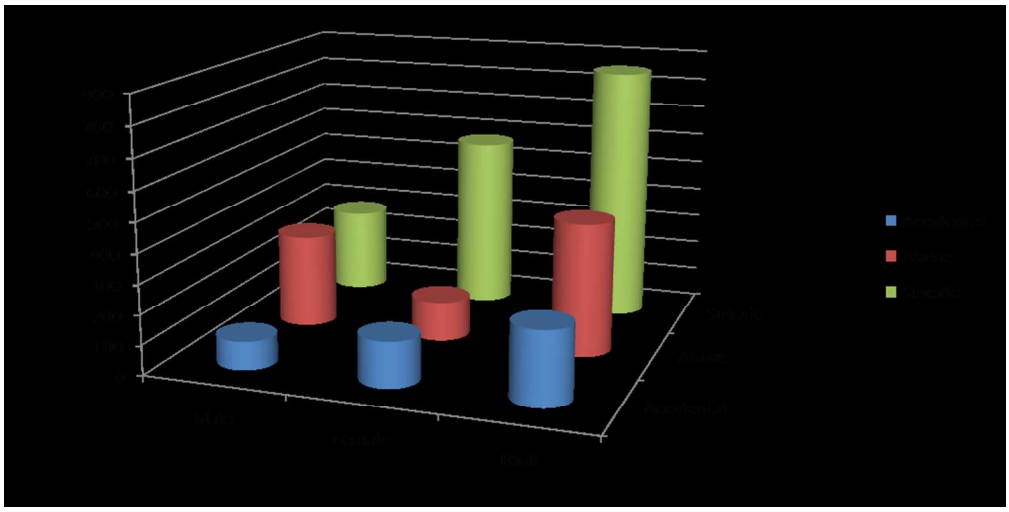


Fig. 2 Intention for 20-29 age-group cases from 2012to 2016

180x90mm (150 x 150 DPI)

For peer review only

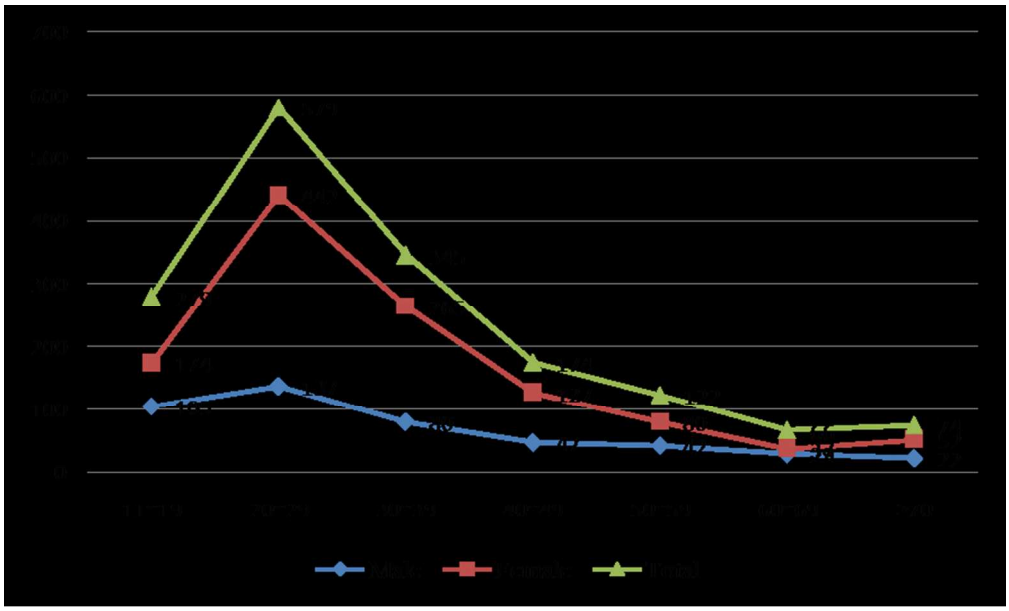


Fig. 3 Distribution of therapeutic drugs poisoning by age and gender

150x90mm (150 x 150 DPI)

eview only

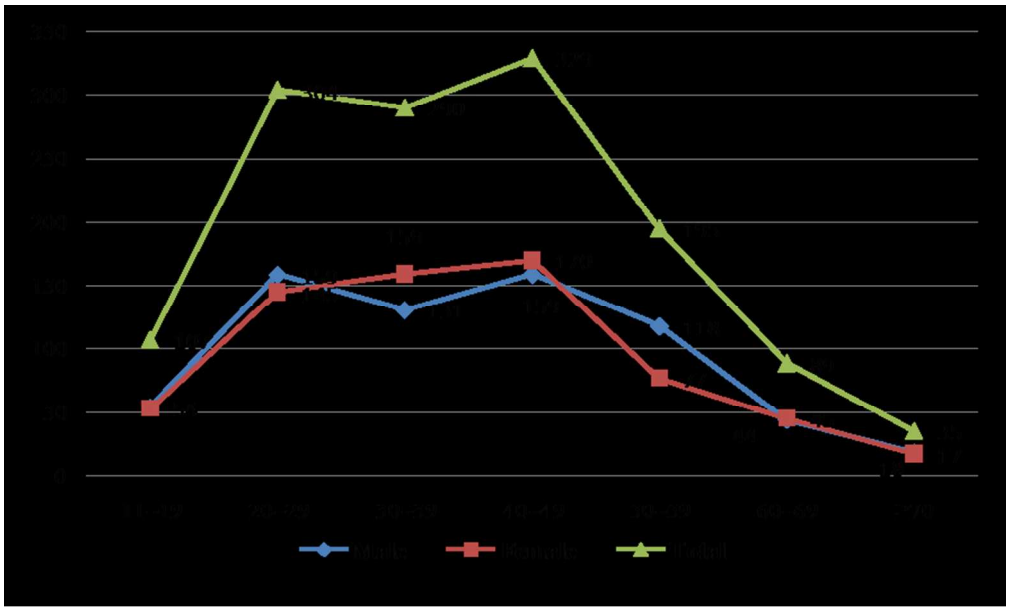


Fig. 4 Distribution of pesticide poisoning by age and gender

150x90mm (150 x 150 DPI)

eview only

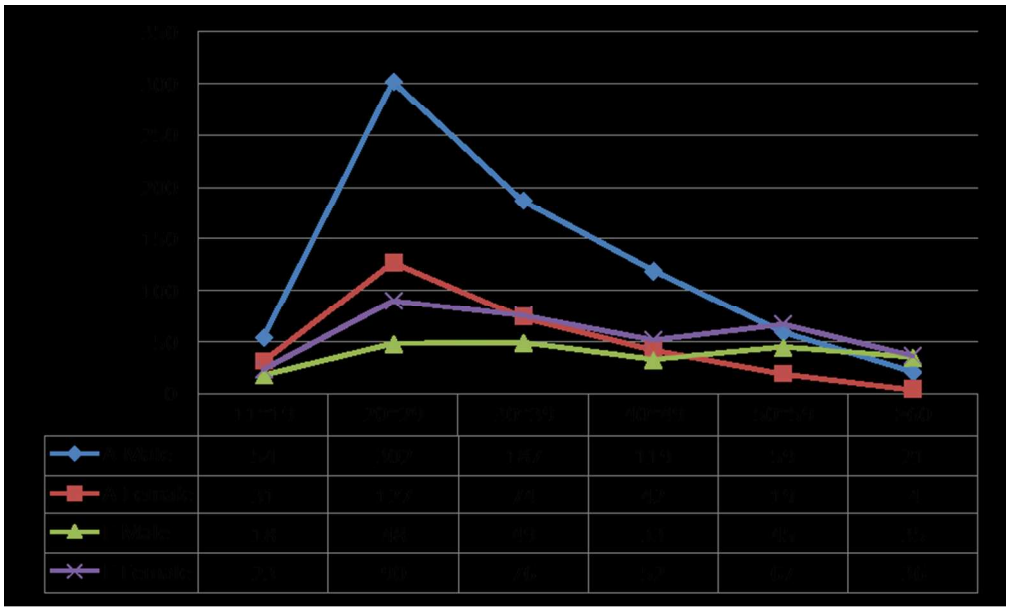


Fig. 5 Distribution of alcohol and fumes poisoning by age and gender (A-Male means Alcohol poisoning for Male; F-Male means Fumes/gas/fog poisoning for Male.)

150x90mm (150 x 150 DPI)

For peer review only

BMJ Open

Acute poisoning in Shenyang, China: a retrospective and descriptive study from 2012 to 2016

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2018-021881.R1
Article Type:	Research
Date Submitted by the Author:	27-Mar-2018
Complete List of Authors:	Zhang, YaJie; Shengjing Hospital of China Medical University Yu, Boxin; Shengjing Hospital of China Medical University Wang, Nana; Shengjing Hospital of China Medical University Li, Tiegang; Shengjing Hospital of China Medical University,
Primary Subject Heading:	Emergency medicine
Secondary Subject Heading:	Emergency medicine, Epidemiology, Public health
Keywords:	Poisoning, Carbon Monoxide Poisoning, Pesticides, Paraquat, Suicide

SCHOLARONE™
Manuscripts

For peer review only

Acute poisoning in Shenyang, China: a retrospective and descriptive study from 2012 to 2016

Yajie Zhang,[1] Boxin Yu,[2] Nana Wang,[3] Tiegang Li[4,*]

1. Emergency Department, Shengjing Hospital of China Medical University, Shenyang 110004, China

2. Gerontology Department, Shengjing Hospital of China Medical University, Shenyang 110004, China

3. Endocrinology Department, Shengjing Hospital of China Medical University, Shenyang 110004, China

4. Emergency Department, Shengjing Hospital of China Medical University, Shenyang 110004, China

Corresponding author:

* Tiegang Li, M.D., Emergency Department, Shengjing Hospital of China Medical University, No. 36, Sanhao Street, Heping District, Shengyang, China, 110004

E-mail: litg@sj-hospital.org

For peer review only

Abstract

Objective: It is crucial to have up-to-date information on the patterns of acute poisoning in a tertiary medical center in northeast China to properly manage poisoning events. The objective of this study was to analyze the characteristics of acute poisoning patients admitted to the emergency department (ED) and to roughly compare with the previous study.

Design: Retrospective and descriptive study.

Setting: Cases diagnosed as poisoning admitted to ED. Data were collected from the hospital information system (HIS) in Shengjing hospital from January 2012 to December 2016, China.

Participants: All cases aged ≥ 11 years old with a diagnosis of acute poisoning.

Results: In total, 5009 patients aged ≥11 years presented to the ED with acute poisoning during the study period. The average age of the patients was 36.03 ± 15.13 years and over half of the patients (52.72%) were in the age group 20-39 years. The ratio of females to males was 1.18:1. Patients with poisoning lived more in rural area than in urban area. The majority of patients consumed poison with suicidal attempts (56.74%). Males were more commonly poisoned by drug abuse than females, but females outnumbered males in suicidal poisoning. The most common form of poison-intake was ingestion (86.16%) (oral intake).The five most common toxic agent group involved in descending order were therapeutic drugs(32.62%), pesticides(26.88%), alcohol (20.71%), noxious gas(11.4%), and chemicals (3.61%). Sedatives/hypnotics in therapeutic drugs and paraquat in pesticides was the most common toxic agent, respectively. The hospital mortality rate was 1.28% with 64 deaths.

Conclusions: The results of this study indicate a need for strengthening the education about and management of the rational and safe use of drugs in Shenyang.

Keywords:

Poisoning; Carbon Monoxide Poisoning; Pesticides; Paraquat; Suicide

For peer review only

Strengths and limitations of this study:

Cross-sectional and retrospective design involved with over 5,000 poisoning cases in 5 consecutive years.

Although the sample size for the study is large, retrospective nature makes it difficult to obtain the whole information of all poisoning cases, which brought into the bias.

Statistics of a single centre teaching hospital-based study, though with three branches, might not present reflection of the generalized and precise situation in this region.

1 Introduction

Acute poisoning is defined as acute exposure (less than 24 h) to the toxic substance.[1] Acute poisoning is a major public and preventable health issue contributing to morbidity and mortality in many parts of the world. It is estimated that poisoning events are responsible for more than one million illnesses annually.[2,3] Low mortality contrasts with high morbidity in acute poisoning; however, patients who attempt suicide usually have higher mortality.[4-6] As the most common form of fatal self-harm in rural Asia, poisoning accounts for more than 60% of deaths.[7]

China is a developing country and is changing from an agricultural to an industrialized economy. In recent years, the number of acute poisoning cases in China has continued to increase[8], so that now poisoning and injury have entered the top five causes of death.[9] Of various type of poisonings, pesticide poisonings were more common in most regions of China while therapeutic drugs poisonings were the main type of poisoning in the developed region or city, such as Shanghai.[9-13] Shenyang, is the provincial capital of Liaoning, the biggest city in Northeast China and the national regional central city, with estimated population more than 8.1million.[14] Liaoning is an industrial province, but agriculture is still the important economic sector. The major crops in this region are corn and rice. The heavy use of pesticides such as organophosphorous compounds by farmers may increase the risk of poisoning events in this area.[15] A previous investigation in this region from 1997 to 2007 showed that (i) medicine was the most common agent (41.40%), followed by pesticides (15.20%), alcohol (14.10%), carbon monoxide (12.50%) and food (9.70%); (ii) the major

For peer review only

medicine was sedative/hypnotic and the major pesticide was organophosphates; (iii) mortality decreased from 2.05% to 0.37% over the 10-year study period, with an average mortality rate of 1.00%. [16]

In the last few decades, China has witnessed significant advancements in the fields of agriculture, industrial technologies and medical pharmacology. These advancements have been paralleled with remarkable changes in the trends of acute poisoning, [17] and led to the development and easy accessibility of a vast number of toxic agents including pesticides, therapeutic drugs and other chemicals. Thus, the toxic agents associated with morbidity and mortality and the pattern of acute poisoning, which vary from place to place and over time, are expected to change. Therefore, there is a constant need to obtain up-to-date information on acute poisoning for planning rational use of resources and for evaluating public health interventions. The aim of this retrospective and descriptive study was to describe the clinical and sociodemographic patterns of acute poisoning and to compare with previous findings in the medicine emergency department of Shengjing Hospital of China Medical University, a tertiary care center.

2 Methods

This retrospective and descriptive study based on hospital records was carried out in the Shengjing Hospital of China Medical University in Shenyang, China. Shengjing hospital is one of the regional tertiary care hospitals in northeast China with 3 hospital areas, and covers the whole Liaoning province and some area of neighboring provinces. Moreover, Liaoning Poisoning Diagnosis and Treatment Center (PDTC) was established in ED of Shengjing hospital on July 2011, and ED owns specialized toxicology unit, hence many patients with poisoning who seek for treatment visit or are referred to this hospital. We reviewed all records of poisoning cases admitted to the ED (including cases referred to ED from other wards) over 5 consecutive years from January 2012 to December 2016. Patients admitted to the ED with a diagnosis of drug poisoning, aged ≥ 11years, were enrolled for this study. The diagnosis was established by patients' history, physical examination, routine and

For peer review only

toxicological laboratory evaluation. Cases of poisoned patients < 11 years admitted to pediatrics ward, animal bites (snake, insect) for its infrequency and chronic poisoning were excluded from the study. Research ethical approval was obtained from Shengjing hospital institutional ethics committee before the study commence.

Relevant medical records were obtained from the electronic hospital information system (HIS). The HIS is an electronic system used in the clinic to record patient information. The poisoning cases were retrieved through searching HIS using the following keywords: poisoning, alcohol, carbon monoxide and organophosphate. Demographic data including age, gender, place of residence, diagnosis, type of exposure (intentional or accidental), type of toxic agent (the common name or trade name are indicated, where available), duration of hospital stay and the outcome of treatment (whether the patient survived or died) were collected and documented on a structured form. The circumstance of poisoning was deduced from the patients' history.

The toxic agent was classified as therapeutic drugs, pesticides, alcohol, poisonous fumes/gases/vapors, chemicals, food, other substance and unknown. The subgroup of toxic agents was categorized based on the indications for use. The mixed drugs were defined as two or more drugs being ingested. The toxic agent was categorized as unknown when no suspected toxic agent was reported in the patient history.

Type for exposure was classified as suicidal, abusive, accidental and unknown. (1)An exposure due to the inappropriate use of drugs for self-destruction was categorized as suicidal. (2)An exposure due to the intentional improper or incorrect use of a drug in which the victim was likely attempting to achieve a euphoric or psycho-tropic effect was categorized as abusive. (3)Accidental was classified as environmental poisoning, misuse, food poisoning and adverse reaction. ①If patients were poisoned because of being in the environment where toxic substance (e.g.: CO) exist it was categorized as environmental poisoning. ②The overdoses of medicine or being given the wrong drug, taking the wrong drug in error, or taking a drug

For peer review only

inadvertently were categorized as misuse. ③An exposure resulting from the ingestion of edible items was categorized as food poisoning. ④The side effect of herbs or health-products was categorized as adverse reaction. (4)If information was unavailable it was categorized as unknown.

Gastric lavage, activated charcoal, intubation, infusion and dieresis therapy, hemoperfusion were standard treatment protocols for those poisonings through ingestion. Hemodialysis was performed when indicated. Special antidotes, naloxone for alcohol poisoning, Vitamin K1 and acetamide for rodenticide poisoning, were given as indicated. For those poisoning with no specific antidotes available, symptomatic treatment was administered.

Conditions where patients recovered with normal symptoms, signs and laboratory findings on discharge were categorized as recovery. Conditions where patients recovered with normal symptoms and signs but the laboratory findings were abnormal or not available on discharge were categorized as relative recovery.

Microsoft Excel 2007 was used to perform descriptive statistical analyses of the data. The average age was presented as the mean ± standard deviation (SD). To evaluate the differences, chi-square test was performed using SPSS for Windows, version 21.0. A p value of less than 0.05 was considered to be significant.

Patient and Public Involvement: patients and/or public were not involved.

3 Results

A total of 5,375 cases of poisoning (age ≥11 years of age) from 829,808 entries were obtained from the HIS from 1 January 2012 to 31 December 2016. Of these, 366 were identified as animal bites (10) and chronic poisoning events, leaving a total of 5009 unique cases that met our criteria. These cases were 0.60% of all emergency admissions. Descriptive information including age, gender, type and route of exposure, place of residence, length of hospital stay, and outcome of the poisoned patients are summarized in Table 1.

Table 1 Demographic characteristic of poisoned patients

admitted to ED from 2012 to 2016.

For peer review only

Variables categories	N	%
Age group		
11~19	557	11.12
20~29	1547	30.88
30~39	1094	21.84
40~49	817	16.31
50~59	575	11.48
60~69	267	5.33
⩾70	152	3.03
Gender		
Male	2296	45.84
Female	2713	54.16
Type for exposure		
Suicidal	2842	56.74
Abusive	1105	22.06
Accidental	1017	20.30
Unknown	45	0.90
Route of exposure		
Ingestion (oral)	4316	86.16
Inhalation (nasal)	590	11.78
Contact (dermal)	98	1.96
Other	5	0.10
Place of residence		
Urban	2415	48.21
Rural	2568	51.27
Unknown	26	0.52
Length of hospital stay		
<48h	367	7.33
<1week	3219	64.26
>1week	1423	28.41
Outcome		
Recovery	1416	28.27
Relative recovery	3255	64.98
Referral to other center	198	3.95
Left against medical advice	76	1.52
Death	64	1.28
Total	5009	100.00

3.1 Age and gender

As shown, of these 5009 cases, 2713(54.20%) were recognized as female, and 2296 (45.80%) were determined as male, and the ratio of male to female was 1:1.18. In this study, the youngest patient was 11 years old, while the oldest patient was 92

For peer review only

years old. The mean age of all patients was 36.03 ± 15.13 years. The mean age of male and female patients was 36.41 ± 14.95 years and 35.71 ± 15.27 years, respectively. The most vulnerable patients were aged 20-29 years (30.88% of cases), followed by patients aged 30-39 years (21.84% of cases) and 40-49 years (16.31% of cases) (Figure 1). There was statistically significant gender difference (male and female) between different age groups of poisoned patients (χ^2=28.19, p<0.001).

According to table 2, the most predominant group of toxic agent consumed by 20-29 age-groups was therapeutic drugs (579 cases, 37.35% of poisonings in 20-29 age-groups). Among them, sedatives & hypnotics (169 cases) plus analgesics (120 cases) accounted for over a half. Alcohol and pesticides were ranked two and third place, taking up 27.68% and 19.61% respectively. There was a statistical gender difference at suicide and drug abuse in 20-29 age-groups (χ^2=140.29, χ^2=167.69, p < 0.001). Most cases of intentional poisoning with 855 suicidal-attempt cases and 446 abuse cases were seen in young adults (20-29 years old). (Figure 2)

Table 2 Distribution of toxic agents consumed by 20-29 age-group people from 2012 to 2016

Toxic agents category	N	Group percentage	Total percentage	Direct percentage*
Therapeutic drugs	**579**	**100.00**	**37.35**	**35.37**
Sedatives & hypnotics	169	29.19	10.90	35.88
Analgesics	120	20.73	7.74	44.28
Mixed drugs	92	15.89	5.94	34.20
Cold and cough preparations	64	11.05	4.13	39.26
Antipsychotics	35	6.04	2.26	28.00
Cardiovascular drugs	22	3.80	1.42	19.64
Other drugs	29	5.01	1.87	30.21
Antimicrobials	27	4.66	1.74	41.54
Traditional Chinese medicine	21	3.63	1.35	32.81
Alcohol	**429**		**27.68**	**41.29**
Pesticides	**304**	**100.00**	**19.61**	**22.54**
Paraquat	133	43.75	8.58	20.65
Rodenticide	66	21.71	4.26	25.48
Organophosphate	45	14.80	2.90	19.40
Other	48	15.79	3.10	30.00
Unknown	12	3.95	0.77	22.22
Fumes/gases/vapors	**138**		**8.90**	**24.13**
Chemicals	**33**		**2.13**	**18.23**

For peer review only

Food	**16**	**1.03**	**18.18**
Other substance	**16**	**1.03**	**47.06**
Unknown	**35**	**2.26**	**34.31**
Total	***1550****	**100.00**	**31.19**

Direct percentage*: the ratio of the same toxic agent consumed by twenties people to all age-group people

1550*: Among 1550 cases, 3 cases were calculated tautologically for a combination of alcohol poisoning and other drugs poisoning.

3.2 Type for exposure

Table 3 shows the reasons for toxin exposure in these patients. It was noted that suicidal exposure occurred in the overwhelming majority of poisonings (2842, 56.74%), followed by abusive exposure (1105, 22.06%), accidental exposure (1017, 20.30%) and unknown reason (45, 0.90%). There was a significant gender difference in suicide and abuse: females were involved in more suicidal poisonings than males: 63.41% for females versus 36.59% for males (χ^2=226.09, p <0.001); poisoning due to drug abuse showed the opposite status: 70.77% for males versus 29.23% for females (χ^2=354.97, p<0.001). The most substances used were therapeutic drugs and pesticides for suicidal attempt and alcohol for abuse. CO poisoning (about 80% of cases) was the most common in environmental poisonings, and pesticides poisoning (20%) was less common. Therapeutic drugs were overdose or taken mistakenly by females.

For peer review only

1

Table 3 Type for exposure of all cases by gender

Type for exposure	Male		Female		Total		Chi-square test	
	N	%	N	%	N	%	$\chi 2$	*p*
Suicidal	1040	45.30	1802	66.42	2842	56.74	**226.086**	**0.000**
Abusive	782	34.06	323	11.91	1105	22.06	**354.968**	**0.000**
Accidental:	451	19.64	566	20.86	1017	20.30	1.143	0.285
Environmental	303	13.20	387	14.26	690	13.78	1.622	0.203
Misuse	97	4.22	106	3.91	203	4.05	0.323	0.570
Food poisoning	35	1.52	53	1.95	88	1.76	1.327	0.249
Adverse reaction	16	0.70	20	0.74	36	0.72	0.028	0.866
Unknown:	23	1.00	22	0.81	45	0.90	0.509	0.476
Subtotal	**2296**	**100.00**	**2713**	**100.00**	**5009**	**100.00**		

For peer review only

3.3 Route of exposure

Among the various routes of exposure, ingestion was the most common (86.16 %), followed by inhalation (11.78%) and contact (1.96%).

3.4 Common Substances in Human Exposures

The most prevalent substance categories are shown in Table 4 and are listed by frequency of exposure in these patients. This ranking shows the direction where prevention efforts should be focused, as well as the types of poisonings our hospital regularly manages. The four most common toxic agent group in decreasing order were therapeutic drugs, pesticides, alcohol, fumes/gases/vapors, 676 (13.47%) patients consumed two or more toxic agents. However, when it came to specific substance, alcohol, paraquat, CO and sedatives and hypnotics were the first four toxic agents.

For peer review only

Table 4 The distribution of toxic agent over the five years.

Toxic agent category	2012		2013		2014		2015		2016		Total		
	N	%	N	%	N	%	N	%	N	%	N	%	Total %
Therapeutic drugs	**303**	**100**	**394**	**100**	**326**	**100**	**310**	**100**	**304**	**100**	**1637**	**100**	**32.62**
Sedatives & hypnotics	101	33.33	141	35.79	79	24.23	68	21.94	82	26.97	471	28.77	9.39
Analgesics	50	16.50	67	17.01	62	19.02	53	17.1	39	12.83	*271*[*]	16.55	5.40
Mixed drugs	42	13.86	63	15.99	53	16.26	52	16.77	59	19.41	269	16.43	5.36
Cold and cough preparations	31	10.23	26	6.6	37	11.35	42	13.55	27	8.88	163	9.96	3.25
Psychotropics	16	5.28	23	5.84	23	7.06	27	8.71	36	11.84	125	7.64	2.49
Cardiovascular drugs	15	4.95	27	6.85	22	6.75	26	8.39	22	7.24	112	6.84	2.23
Other drugs	16	5.28	21	5.33	24	7.36	20	6.45	15	4.93	96	5.86	1.91
Antimicrobials	19	6.27	12	3.05	15	4.60	8	2.58	11	3.62	65	3.97	1.30
Traditional Chinese medicine	13	4.29	14	3.55	11	3.37	14	4.52	13	4.28	65	3.97	1.30
Pesticides	**241**	**100.00**	**280**	**100.00**	**308**	**100.00**	**272**	**100.00**	**248**	**100.00**	**1349**	**100.00**	**26.88**
Paraquat	97	40.25	134	47.86	149	48.38	141	51.84	123	49.60	644	47.74	12.83
Rodenticide	50	20.75	55	19.64	60	19.48	49	18.01	45	18.15	259	19.20	5.16
Organophosphate	56	23.24	44	15.71	48	15.58	46	16.91	38	15.32	232	17.20	4.62
Other	24	9.95	33	11.79	42	13.64	28	10.29	33	13.31	160	11.86	3.19
Unknown	14	5.81	14	5.00	9	2.92	8	2.94	9	3.63	54	4.00	1.08
Alcohol	**203**		**227**		**226**		**182**		**201**		**1039**		**20.71**
Fumes/gases/vapors	**70**		**144**		**103**		**119**		**136**		**572**		**11.40**
Chemicals	**25**		**47**		**46**		**32**		**31**		**181**		3.61
Food	**20**		**9**		**15**		**35**		**9**		**88**		1.75
Other substance	**8**		**11**		**7**		**10**		**14**		**50**		1.00
Unknown	**22**		**24**		**17**		**19**		**20**		**102**		2.03
Subtotal	**892**		**1136**		**1048**		**979**		**963**		***5018***[*]		**100.00**

For peer review only

271*：Including 13 cases of opioids poisoning.

5018*: 9 cases were calculated tautologically, of which 7 cases had a combination of alcohol poisoning and other drugs poisoning, and 2 cases had a combination of CO poisoning and other drugs poisoning.

3.4.1Therapeutic drug categories

The therapeutic drug poisoning showed a slight decreased trend across the consecutive five years in spite of a high number in 2013. A total of 1637 cases had therapeutic drug poisoning. Among these cases, 28.77% involved sedatives and hypnotics poisoning, which were the most commonly employed drugs, followed by analgesics (16.55%) (including 13 cases of opioids poisoning) and cold and cough preparations (9.96%). Mixed drug poisoning was found in approximately 16.43% of patients. The rate of psychotropics poisoning was increasing over the five years. Cardiovascular drugs, antimicrobials, traditional medicine and other drugs showed relatively stable trend. Drug poisoning was more common in both males and females aged 20-29 years with suicidal attempt (Figure 3). However, drug poisoning was significantly more frequent in females than males (71.90% vs. 28.10%).

3. 4.2 Pesticide categories

The pesticide poisoning presented a growing trend from 2012 to 2015 but decreased in 2016. A total of 1349 cases were observed to have pesticide poisoning. Among these cases, the predominant pesticide poison taken was paraquat (47.74% of cases), followed by rodenticide (19.20%), organophosphate (17.20%) and other pesticides (11.86%). A slightly higher number of males (683 cases) than females (666 cases) had pesticide poisoning. There were two peaks on the distribution of age and gender in pesticide poisoning, one in 20-29 years old and another in 40-49 years old for both males and females (Figure 4). Eighty-eight percentage of pesticide poisoning occurred with suicidal attempt, but males exposed 5% more accidental pesticide poisoning than females. Pesticide poisoning was most frequent during the month of July.

3.4.3 Alcohol and Fumes/gases/vapors

There was a stable trend in the alcohol poisoning. Males were predominant

For peer review only

population in alcohol poisoning and were approximately 2.5 times more than females. The 20-29 years old were exposed more to alcohol poisoning than any other age groups. (Figure 5) In addition, less one percent of alcohol poisoning cases were found to be accompanied by other poisonings. Fumes/gases/vapors poisoning displayed an increasing trend as a whole even though there was a decrease from 2013 to 2014. Among these cases, carbon monoxide poisoning was the dominating toxic agent. Major age group exposed to CO poisoning was 20-39 years old and females' exposure was more common. Majority of CO poisoning events occurred in winter.

3.5 Treatment and Outcome

It was noted that gastric lavage and activated charcoal were respectively administrated in 72.54% (n=3634) cases and 64.76% (n=3244) cases to prevent absorption of toxic agents. 7.69% of cases (n=385) received hemodialysis treatment. All patients with organophosphorous poisoning (n=232) were treated with atropine and pralidoxime. In addition, hyperbaric oxygen therapy for CO poisoning was performed for all cases (n=556).

A total of 4945 patients were discharged from the hospital, including 1416 cases with complete recovery, 3255 cases with relative recovery, 347 cases with referral to another institution, and 253 cases that left out of hospital during treatment. The hospital mortality rate was 1.28% with 64 deaths including 36 females and 28 males. The fatality ratio was 1.33% for female patients and 1.22% for male patients. More than half of the fatality cases (n=33) occurred in 40-59 age groups. Sixty-eight percentages of dead cases were patients living in urban areas. 51cases of death were with suicidal attempt and 11cases of death were accidental, and in two cases, the type of poisoning was unknown. The associated agents involved in death were paraquat (33 cases), therapeutic drugs (16 cases), organophosphate (6 cases), food poisoning (4 cases), CO poisoning (2 cases), alcohol (1case) and two cases with unidentified poisons.

3.6 Comparison with Previous Findings

The female-to-male ratio was 1.5:1 in that study and 1.18:1in this study. Similar to the previous report; the most vulnerable patients were aged 20-29 years, but the

For peer review only

ratio in that study was 37.10% and higher than ours. The major route of exposure was ingestion in both study with a percentage of 86.16% in our study and 81.8% in that study. As for the type for exposure, 69.60% with suicidal exposure and 29.70% with accidental exposure was presented in that study, higher than our results. The most common toxic agent was the same in both studies, therapeutic drugs, followed by pesticides, alcohol and CO and the counterpart percentage 41.40%, 15.20%, 14.10% 12.50% in that study and 32.62%, 26.88%, 20.71%, 11.40% in this study. The major medicine was sedative/hypnotic (27.50%) and the major pesticide was organophosphates (8.00%) in that study. The major medicine was sedative/hypnotic (9.36%) and the major pesticide was paraquat(12.83%). An average mortality rate of 1.0% was found in that study and 1.28% in this study.

4. Discussion

Acute poisoning is one of the most frequent causes of visits to the ED and is a threat to public health. The annual rate of ED visits associated with poisoning varies widely across the world, and ranges from 0.07% to 0.7%.[18,19] Studies in western countries have reported annual rates of ED visits associated with poisoning of approximately 0.26%.[19,20] In the present study, this rate was about 0.60%, and a similar percentage (0.64%) was seen in Bulent' research.[21] As it is not common practice for many poisoned patients to seek medical help in health care institutions, the annual rate of ED visits associated with poisoning recorded by hospitals may be misleading. Therefore, the actual number of poisoning cases may be more than that recorded, and the accurate statistical data for poisonings is not easy to estimate. Developed countries also have similar problems in obtaining meaningful poisoning statistics even though they are equipped with advanced systems to collect population health data .[22]

This study concluded that the incidence of poisoning in females was slightly higher than that in males, especially among young adults aged 20-29 years, with a female-to-male ratio of 1.18:1. Similar findings have also been reported in Beijing, China [23] (1.23:1) and Sari, Iran [17] (1.16:1). In contrast, male preponderance has been

For peer review only

found in some other countries. [24, 25] The most likely explanation for the high number of poisoning in females is that they are emotionally fragile, more susceptible to stress, which can lead to overreacting behaviors.[26-28]

The findings of this study showed a difference in poisoning based on age and indicated that the most affected age group was the 20-29 age-group (30.82%) with a secondary peak in the 30-39 age-group (21.88%). Both intentional and accidental poisoning were common in males and females aged 20-29 years, which is consistent with previous findings in China[16,23] and in other countries[29-31]. The fact that poisoning is more common among young adults reflects their vulnerability to stress, possibly due to failure or frustration in love or exams, maladjustment and inability to cope with the high expectation of parents.[32,33] Overall, this group of people is not emotionally stable or mature enough to tolerate extreme mental or physical pressure.[34,35]

Intentional poisoning (suicide+abuse) was the predominant cause of poisoning(78.8%) in the current study, an observation that is consistent with those made in other studies.[30,36] Our study indicated of the whole of poisoning cases, a large proportion were suicidal in nature, which was decreased compared to previous study. This change may be related to the benefit of socioeconomic achievement and prosperity, such as higher employment and more educational opportunities, which may have contributed to the reduction of suicide rates in China.[37] In spite of the decline in the suicidal rate, suicide attempt still is the primary reason for poisoning because of the general acknowledgment that poisons terminate life with minimal suffering.[38,39].

Our study pointed out that therapeutic drugs were the most frequently employed toxic agents. The similar pattern that therapeutic drugs were the most common cause of acute poisoning was seen in developed and some developing parts and countries.[40-45] Regarding the subgroup of therapeutic drugs, sedatives/hypnotics were common in Taiwan, Hong Kong, Iran and Finland, while analgesics were reported to be the most frequently ingested drugs in Turkey and USA. Pharmaceutical poisoning comprised 32.6% of the various drug poisonings observed in the present study, of

For peer review only

which sedatives and hypnotics (28.78%) were the most frequently ingested agents. Similar pattern was also seen in previous study, compared to which there appeared a decline in sedatives and hypnotics poisoning in our study [16]. This decline may be connected with the implementation of drug classification control that patients can only access these drugs with a doctor's prescription.[46] However, a rise were seen in usage of analgesics, cold and cough medicines, mixed drugs, as well as cardiovascular drugs, making it not the same as before. This may be explained by the easy availability of pharmaceuticals due to the numerous drugstores in China, inadequate supervision of government, insufficient knowledge about rational use of analgesics[47], increase of incidence of cardiovascular disease[48], poor psychological well-being and mental fragility among populations.[49] Additionally, we found the frequency of psychotropic drugs poisonings were growing, which indicated that mental disorder played a part in poisoning events and should be gave attention.

Poisoning with pesticide products has been occurring relatively frequently for some time, as can be observed in published papers from different countries. [36, 39] The incidence of this poisoning varies geographically and historically [50]. Several studies conducted in India, Sri Lanka and Bangladesh showed a pesticide-dominating poisoning pattern, and organophosphates were the most common pesticide.[51-53] Pesticide was the second leading cause of acute poisoning in this study, accounting for 26.57% of all poisoning cases, the frequency increasing a lot compared to the before.[16] There are two reasons: first, suicide by pesticide poisoning still remains a priority for suicide in China, although suicides related to pesticide poisoning in China have continuously declined from 2006 to 2013.[54] Previous studies have shown that highly lethal pesticides are a common method used for suicide in rural China.[55,56] Our study finding that as high as eighty-eight percents of pesticide poisoning occurred with suicidal attempt also confirmed that. Second, pesticides are used extensively and unsafely in agriculture, industry, and home storage causing toxicity due to intentional and accidental exposure.[56]The quantity of pesticide use is large and ever-increasing, growing from 1.28million ton in 2001 to 1.81 million ton in 2014[57]. In the present study, paraquat was the most frequently implicated agent among the pesticides, and a

For peer review only

similar pattern was found in a study in northeast China which showed an increasing trend [58], whereas a decreasing trend was found in Korea [59].

Not surprisingly, our study found that alcohol poisoning was common and found in 20.7% of our cases. This value was increased compared to the before. This change can be explained by rapid social and economic development, urbanization, increasing alcohol production, and alcoholic beverage commercials in the mass media, which all led to the growing alcohol consumption.[60] According to a set of data the annual per-capita alcohol consumption of Chinese adults in 2012 was 3 liters.[61] Some findings reported elsewhere in China had higher number of alcohol poisonings.[62] Whereas the value in studies that involved the alcohol poisoning in other countries showed a lower proportion [41,63-65]. This kind of discrepancy is partially related to the disparity in alcohol consumption habits between different countries and districts. In Chinese culture, people often urge companions to drink as much as possible so that they can construct social connections and establish a happy and congenial atmosphere. [66] This can also explain the gender difference as men are more engaged in social intercourse than females. Except for wildly practiced social drinking, solitary drinking was also common for stress reduction and coping among Chinese. [67]

The current data showed that the fourth leading cause of acute poisoning was fumes/gases/vapors (mainly CO), decreasing from 12.5% to less than 11.4% in spite of remaining in fourth place. This reduction is related to the improvement of dwelling conditions and preventive education about CO poisoning. With the improvement of heating measures and the advancing of the fuel switching project from coal to natural gas in rural areas, further decline in CO poisoning is expected in rural areas in China. There was a significant association between residency and month and reason for exposure to CO. Rural residents are more susceptible to CO poisoning than urban citizens, as local residents in remote villages in northern China use stoves to keep warm in winter, which can result in gas leaks due to a chimney jam and lack of ventilation, and are common causes of CO poisoning in these areas. In contrast, CO poisoning in urban citizens may be explained by eating barbecued food and hotpot, a well-known traditional Chinese cuisine; both require charcoal as fuel.[68] In addition,

For peer review only

almost all CO poisoning cases in our study were accidental with the exception of one case which was a suicide.

In our study, the rate of patients staying in hospital for less than 48h is small compared with other studies, it was related to that patients with poisoning usually were asked to remain in the observing room (available in our ED) for 48h to 72h in consideration of complex doctor-patient environment in China.

5. Conclusion and Suggestions

The present data provide additional insight into the epidemiology of acute poisoning in Shenyang. The findings demonstrated that more females than males had acute poisoning and the most vulnerable age group was the young-adult group aged 20-29. We also observed that the majority of poisoning cases were intentional, particularly suicidal in nature, and accidental poisonings were nonnegligible. Our study indicated that therapeutic drugs were the most commonly used toxic agent group, followed by pesticides, alcohol and noxious gas. In addition, the pattern of acute poisoning was slightly altered when roughly compared to that of ten years ago. Poisoning due to analgesics and cold and cough preparations overpast poisoning due to psychotropics in therapeutical drugs poisoning. Meanwhile, poisoning due to paraquat and rodenticide exceeded poisoning due to organophosphate in pesticide poisoning.

Some suggestions are proposed based on the present study and include the following:

- Vulnerable groups such as females, young-adult group should deserve special consideration for their weak bearing capacity.[37]
- Further investment is required to promote public health education on the rational use and safe storage of toxic agents as well as self-protection to reduce accidental poisoning.[7]
- The agenda of addressing the upward trend of prevalence and alcohol and drug use should capture increasing attention.
- Patients who attempt suicide must undergo psychiatric consultation as soon as

For peer review only

possible. Early psychiatric consultation and identification may minimize the risk of further self-harm in suicidal cases.[69]

- Lastly, relevant policies and regulations should be formulated and initiated immediately to restrict access to toxic agents, especially pesticide for its high toxicity.[70]

Limitations

Our study was primarily limited by its retrospective nature, which resulted in missing patient data. Another limitation was that statistics of a single centre teaching hospital-based study, though with three branches, might not present reflection of the generalized and precise situation in this region. Hence, a more extensive data collection and analysis from other general hospitals in the region can depict the regional poisoning pattern more accurately. In addition, the comparison between two studies was rough because of the absence of data standardization.

For peer review only

Acknowledgment

Contributors: TG Li developed and directed the study. NN Wang conceived and designed the survey questions on poisoning. BX Yu coordinated data collection and carried out data cleaning. YJ Zhang performed the statistical analysis and drafted the manuscript. All authors drafted, edited and approved the final manuscript.

Ethical approval: Research ethical approval was obtained from Shengjing hospital institutional ethics committee before the study commences.

Funding: This work was supported by the National nature science foundation of China (No. 81301627 and No.81500628) .We would like to appreciate the staff of library for their contribution in providing language help.

Competing interests: The Authors declare that there is no conflict of interest.

Data sharing statement: No additional data sharing available.

References

1. Kalseen CD, Andur MO, Doull J. Casarett and Doull's Toxicology. Newyork:

Macmillan, 1986:10-17.

2. Senarathna L, Buckley AN, Jayamann a SF, et al. Validity of referral hospitals for the toxicovigilance of acute poisoning in Sri Lanka.[J] Bull World Health Organization, 2012, 90(6):401–76.http://dx.doi.org/10.2471/BLT.11.092114
3. Güloğlu C, Kara IH. Acute poisoning cases admitted to a university hospital emergency department in Diyarbakir, Turkey. Human and Experimental Toxicology, 2005, 24(2):49-54.http://dx.doi.org/10.1191/0960327105ht499oa
4. Eddleston M. Patterns and problems of deliberate self-poisoning in the developing world[J]. Qjm Monthly Journal of the Association of Physicians, 2000, 93(11):715-731. https://doi.org/10.1093/qjmed/93.11.715
5. Gunnell D, Eddleston M, Phillips M R, et al. The global distribution of fatal pesticide self-poisoning: Systematic review[J]. BMC Public Health, 2007, 7(1):357. https://doi.org/10.1186/1471-2458-7-357
6. SM Shah, PD Asari, J Amin. CLINICO-EPIDEMIOLOGICAL PROFILE OF PATIENTS PRESENTING WITH ACUTE POISONING.[J] IJCRR. 2016; 8(13): 35-41
7. Konradsen F, Van d H W, Cole D C, et al. Reducing acute poisoning in developing countries--options for restricting the availability of pesticides.[J]. Toxicology, 2003, 192(2-3):249.http://dx.doi.org/10.1016/S0300-483X(03)00339-1
8. Yumeng Tang, MS, Lan Zhang, et al. Unintentional Poisoning in China, 1990 to 2015: The Global Burden of Disease Study 2015.[J] AmJ Public Health. 2017; 107:1311–1315. http://dx.doi.org/10.2105/AJPH.2017.303841
9. Liu QH, Jiang DF. Research Status of Acute Poisoning in China.[J] Journal of Occupational Health and Damage, 2011; 26:238–9. (inChinese). https://dx.doi.org/10.3969/j.issn.1006-172X.2011.04.016
10. Zhang J, Xiang P, Zhuo X, et al. Acute poisoning types and prevalence in Shanghai, China, from January 2010 to August 2011.[J]. Journal of Forensic Sciences, 2014, 59(2):441-6. http://dx.doi.org/10.1111/1556-4029.12334
11. Zhang M, Fang X, Zhou L, et al. Pesticide poisoning in Zhejiang, China: a retrospective analysis of adult cases registration by occupational disease

For peer review only

surveillance and reporting systems from 2006 to 2010[J]. BMJ Open, 2013, 3(11):e003510. http://dx.doi.org/10.1136/bmjopen-2013-003510

12. Wang B S, Chen L, Li X T, et al. Acute Pesticide Poisoning in Jiangsu Province, China, from 2006 to 2015[J]. Biomed Environ Sci, 2017, 30(9):695-700. https://dx.doi.org/10.3967/bes2017.094
13. Ge XM, Jiang DF, Liu QH. Epidemiological study on 6011 cases of the acute poisoning during 2005～2009 year in Guangxi[J]. Chinese Journal of New Clinical Medicine, 2011,4(8):699-701. (in Chinese) https://dx.doi.org/10.3969/j.issn.1674-3806.2011.08.02
14. The 2010 population census of the People's Republic of China. Available at: http://www.stats.gov.cn/tjsj/pcsj/rkpc/6rp/indexch.htm
15. Chataut J, Adhikari R K, Sinha N P, et al. Pattern of organophosphorous poisoning: a retrospective community based study.[J]. Kathmandu University Medical Journal, 2011, 9(34):31.
16. Zhao M, Ji XP, Wang NN, Liu SY, Wang YZ. Study of poisoning pattern at China Medical University from 1997 to 2007.[J] Public Health,2009,123:454–5. http://dx. doi.org/10.1 016/j.puhe.2009.04.010
17. Ahmadi A, Pakravan N, Ghazizadeh Z. Pattern of acute food, drug, and chemical poisoning in Sari City, Northern Iran.[J]. Human and Experimental Toxicology, 2010, 29(9):731-738.http://dx.doi.org/10.1177/0960327110361501
18. Hanssens Y, Deleu D, Taqi A. Etiologic and demographic characteristics of poisoning: a prospective hospital-based study in Oman. Journal of Toxicology Clinical Toxicology, 2001, 39: 371? / 80.http://dx.doi.org/10.1081/CLT-100105158
19. Thomas SH, Bevan L, Bhattacharyya S, et al. Presentation of poisoned patients to accident and emergency departments in the north of England.[J] Human and Experimental Toxicology, 1996, 15[6]:466–470.http://dx.doi.org/10.1177/096032719 60500602
20. McCaig L F, Burt C W. Poisoning-related visits to emergency departments in the United States 1993–1996.[J]. Journal of Toxicology Clinical Toxicology, 1999,

For peer review only

37(7): 817–826.http://dx.doi.org/10.1081/CLT-100102460

21. Ergun B, Cevik A A, Ilgin S, et al. Acute drug poisonings in Eskisehir, Turkey: A retrospective study [J]. Turkish Journal of Pharmaceutical Sciences, 2013, 10(2):303-312.
22. Meredith T J. Epidemiology of poisoning [J]. Pharmacology and Therapeutics, 1993, 59(3):251-6.http://dx.doi.org/10.1016/0163-7258(93)90069-P
23. Zhigang Z, Peiyi Z, Jianming G. Epidemiological analysis of 560 cases of acute poisoning. Beijing Med 2007;29:708–19.(in Chinese) https://dx.doi.org/10.3969/j.issn.0253-9713.2007.12.017
24. Thalappilli MC, Jimmy A. A profile of acute poisonings: A retrospective study[J]. Journal of the Scientific Society, 2015, 42(3):156-160.http://dx.doi.org/10.4103/0974-5009.165547
25. Malangu N. Acute poisoning at two hospitals in Kampala-Uganda. Journal of Forensic Legal Medicine, 2008,15(8):489-92.http://dx.doi.org/10.1016/j.jflm.2008.04.003
26. Canetto SS. Women and suicidal behavior: a cultural analysis.[J] Am J Orthopsychiatry, 2008, 78(2):259–266. http://dx.doi.org/10.1037/a0013973
27. Weiyuan C. Women and suicide in rural China.[J] Bull World Health Org, 2009, 87(12):888–889. http://dx.doi.org/10.2471/BLT.09.011209
28. Qin P, Mortensen PB. Specific characteristics of suicide in China.[J] Acta Psychiatr Scand,2001, 103(2):117–121. http://dx.doi.org/10.1034/j.1600-0447.2001.00008.x
29. Nair PK, Revi NG. One-Year Study on Pattern of Acute Pharmaceutical and Chemical Poisoning Cases Admitted to a Tertiary Care Hospital in Thrissur, India. Asia Pac J Med Toxicol,2015,4:79-82.
30. Ramesha KN, Rao KB, Kumar GS. Pattern and outcome of acute poisoning cases in a tertiary care hospital in Karnataka, India. Indian Journal of Critical Care Medicine, 2009, 13:152-5.http://dx.doi.org/10.4103/0972-5229.58541.
31. Bari MS, Chakraborty SR, Alam MMJ, et al. Four-Year Study on Acute Poisoning Cases Admitted to a Tertiary Hospital in Bangladesh: Emerging Trend of

For peer review only

Poisoning in Commuters. Asia Pac J Med Toxicol 2014;3:152-6

32. Fergusson D M, Woodward L J, Horwood L J. Risk factors and life processes associated with the onset of suicidal behaviour during adolescence and early adulthood.[J]. Psychological Medicine, 2000, 30(1):23. http://dx.doi.org/10.1017/S003329179900135X
33. Zhao CJ, Dang XB, Su XL, et al. Epidemiology of Suicide and Associated Socio-Demographic Factors in Emergency Department Patients in 7 General Hospitals in Northwestern China[J]. Medical Science Monitor International Medical Journal of Experimental & Clinical Research, 2015, 21:2743-2749. http://dx.doi.org/10.12659/MSM.894819
34. Zhang J, Jia CX. Suicidal intent among young suicides in rural China.[J] Arch Suicide Res,2011,15(2):127–139.http://dx.doi.org/10.1080/13811118.2011.565269
35. Cash SJ, Bridge JA. Epidemiology of youth suicide and suicidal behavior. Curr Opin Pediatr,2009, 21(5):613–619. http://dx.doi.org/10.1097/MOP.0b013e32833063e1
36. Bundotich JK, Gichuhi MM. Acute poisoning in the Rift Valley Provincial General Hospital, Nakuru, Kenya: January to June 2012[J]. Official Journal of the South African Academy of Family Practice/primary Care, 2015, 57(3):1-5. http://dx.doi.org/10.1080/20786190.2014.97544
37. Wang C W, Chan C L W, Yip P S F. Suicide rates in China from 2002 to 2011: an update[J]. Social Psychiatry & Psychiatric Epidemiology, 2014, 49(6):929-941. http://dx.doi.org/10.1007/s00127-013-0789-5
38. Thomas M, Anandan S, Kuruvilla PJ, et al. Profile of hospital admissions following acute poisoning--experiences from a major teaching hospital in south India.[J]. Adverse Drug Reactions and Toxicological Reviews, 2000, 19(4):313-7.: http://dx.doi.org/10.1258/td.2011.110398
39. Tufekci IB, Curgunlu A, Sirin F. Characteristics of acute adult poisoning cases admitted to a university hospital in Istanbul [J]. Human and Experimental Toxicology, 2004, 23(7): 347-51.http://dx.doi.org/10.1191/0960327104ht460oa
40. JB Mowry, DA. Spyker, DE Brooks, et al. 2014 Annual Report of the American

For peer review only

Association of Poison Control Centers' National Poison Data System (NPDS): 32nd Annual Report.[J] Clinical Toxicology, 2015, 53:10, 962-1147. http://dx.doi.org/10.3109/15563650.2015.1102927

41. Lapatto-Reiniluoto O, Kivistö K T, Pohjola-Sintonen S, et al. A prospective study of acute poisonings in Finnish hospital patients [J]. Human and Experimental Toxicology, 1998, 17(6):307-11.http://dx.doi.org/10.1177/096032719801700604
42. Moradi M, Ghaemi K, Mehrpour O. A hospital base epidemiology and pattern of acute adult poisoning across Iran: a systematic review[J]. Electronic Physician, 2016, 8(9):2860-2870. http://dx.doi.org/10.19082/2860
43. Kavalci C, Demir A, Arslan E D, et al. Adult Poisoning Cases in Ankara: Capital City of Turkey[J]. International Journal of Clinical Medicine, 2012, 03(7):736-739. http://dx.doi.org/10.4236/ijcm.2012.37A129
44. Lee H L, Lin H J, Yeh S Y, et al. Etiology and outcome of patients presenting for poisoning to the emergency department in Taiwan: a prospective study.[J]. Human & Experimental Toxicology, 2008, 27(5):373-379. http://dx.doi.org/10.1177/0960327108094609
45. Lam S M, Lau A C, Yan W W. Over 8 years experience on severe acute poisoning requiring intensive care in Hong Kong, China[J]. Human & Experimental Toxicology, 2010, 29(9):757-65. http://dx.doi.org/10.1177/0960327110361753
46. Liu CG, Jin F, Yuan GH. The History and Expectation of Classification Management of Drugs in China.[J] Chinese Journal of Pharmacovigilance,2013, 10(6):348-351. http://dx.doi.org/10.3969/j.issn.1672-8629.2013.06.009
47. Yu SY, Shang FF, Huang K.Status Quo and Countermeasures Research on Categorization Management of Medicine.[J] Chinese Pharmaceutical Affairs,2016, 30(1):32-34.http://dx.doi.org/10.16153/j.1002-7777.2016.01.005
48. Chen WW, Gao YL, Liu LS, et al. Summary of China cardiovascular disease report 2016. Chinese Circulation Journal, 2017, 32(6):521-530. http://dx.doi.org/10.3969/j.issn.1000-3614.2017.06.001
49. Wu P, Li L P, Jin J, et al. Need for mental health services and service use among high school students in China[J]. Psychiatric Services, 2012, 63(10):1026.

For peer review only

http://dx.doi.org/10.1176/appi.ps.201200090

50. Jeyaratnam J. Acute pesticide poisoning: a major global health problem.[J]. World health statistics quarterly. Rapport trimestriel de statistiques sanitaires mondiales, 1990, 43(3):139-144.

51. Jaiprakash H, Sarala N, Venkatarathnamma P N, et al. Analysis of different types of poisoning in a tertiary care hospital in rural South India[J]. Food & Chemical Toxicology An International Journal Published for the British Industrial Biological Research Association, 2011, 49(1):248-250. http://dx.doi.org/10.1016/j.fct.2010.10.026

52. Van Der Hoek W, Konradsen F: Analysis of 8000 hospital admissions for acute poisoning in a rural area of Sri Lanka. Clin Toxicol 2006, 44(3):225–231. http://dx.doi.org/10.1080/15563650600584246

53. Howlader M, Hossain M, Morshed M, et al. Changing Trends of Poisoning in Bangladesh[J]. Journal of Dhaka Medical College, 2011, 20(1):51-56

54. Page A, Liu S, Gunnell D, et al. Suicide by pesticide poisoning remains a priority for suicide prevention in China: analysis of national mortality trends 2006–2013[J]. Journal of Affective Disorders, 2016, 208:418.https://doi.org /10.1016/j.jad. 2016.10.047.

55. Zhang J, Xu HL. The effects of religion, superstition, and perceived gender inequality on the degree of suicide intent: a study of serious attempters in China. Omega: Journal of Death and Dying. 2007, 55(3):185–197. http://dx.doi.org/10.2190/OM.55.3.b

56. Zhang X, Li HS, Zhu QH, Zhou J, Zhang S, Zhang L, Sun CY. Trends in suicide by poisoning in China 2000–2006: age, gender, method, and geography. Biomedical and Environmental Sciences.2008; 21:253–256.http://dx.doi.org/10. 1016/S0895-3988(08) 60038-0

57. Wang J, Li Y, Wang X, et al. Status Quo of Pesticide Use in China and Its Outlook [J]. Agricultural Outlook, 2017, 13(2):56-60. https://dx.doi.org/10.3969/j.issn.1673-3908.2017.02.012

58. Zhang S, Zheng Q, Zhang PS, et al. Epidemiological study of 357 acute paraquate

For peer review only

poisoning cases [J]. Chinese Journal of Health Statistics, 2013, 30(2):251-252.(in Chinese)

59. Lee JW, Hwang IW, Kim JW, et al. Common Pesticides Used in Suicide Attempts Following the 2012 Paraquat Ban in Korea [J]. Journal of Korean Medical Science, 2015, 30(10):1517-21.http://dx.doi.org/10.3346/jkms.201 5.30.10.1517.
60. Guan-Sheng MA, Zhu DH, Xiao-Qi HU, et al. The drinking practice of people in China. Ying Yang Xue Bao. 2005;27(5):362–365.(in Chinese) https://dx.doi.org/10.13325 /j.cnki.acta.nutr.sin.2005.05.003
61. National Health and Family Planning Commission of the People's Republic of China. China national nutrition and chronic disease status report [in Chinese]. 2015. Available at: http://www.nhfpc.gov.cn/jkj/s5879/201506/4505528e65f3460fb88685081ff158a2. shtml. Accessed December 15, 2016.
62. Yuan T, Fan Q, Tang X Z, et al. Analysis of acute poisoning in 640 cases[J]. Practical Clinical Medicine, 2009, 10(11):27-27. http://dx.doi.org/10.3969/j.issn. 1009-8194.2009.11.010
63. Thapa SR, Lama P, Karki N, et al. Pattern of poisoning cases in Emergency Department of Kathmandu Medical College Teaching Hospital.[J]. Kathmandu University Medical Journal, 2008, 6(2):209-213.
64. M. Balai-Mood. Pattern of acute poisonings in Mashhad, Iran 1993-2000.[J]. Journal of Toxicology Clinical Toxicology, 2004, 42(7):965. http://dx.doi.org /10.1081 /CLT-200042550
65. Jayasinghe NRM, Foster JH. Deliberate self-harm/poisoning, suicide trends. The link to increased alcohol consumption in Sri Lanka. Arch Suicide Research 2011, 15(3):223–237. http://dx.doi.org/10.1080/13811118.2011.589705
66. Li YC, Jiang Y, Zhang M, et al. Drinking behavior among men and women in China: the 2007 China Chronic Disease and Risk Factor Surveillance. Addiction. 2011; 106(11):1946–1956. http://dx.doi.org/10.1111/j.1360-0443.2011.03514.x
67. Hussong, A. Further refining the stress-coping model of alcohol involvement. Addict. Behav.2003,28, 1515–1522 https://doi.org/10.1016/S0306-4603 (03)0

For peer review only

0072-8

68. Xue J, Sun Q, Wang Y, et al. Features of Carbon Monoxide Poisoning in China[J]. Iranian Journal of Public Health, 2013, 42(10):1192-1193.

69. Linehan MM, Korslund KE, Harned MS et al. Dialectical behavior therapy for high suicide risk in individuals with borderline personality disorder: a randomized clinical trial and component analysis. JAMA Psychiatry, 2015; 72: 475–82 http://dx.doi.org/10.1001/jamapsychiatry.2014.3039

70. Gunnell D, Eddleston M, Phillips M R, et al. The global distribution of fatal pesticide self-poisoning: Systematic review[J]. Bmc Public Health, 2007, 7(1):357. http://dx.doi.org/10.1186/1471-2458-7-357

Fig. 1 Distribution of all poisoning cases by age and gender
Fig. 2 Intention for 20-29 age-group cases from 2012to 2016
Fig. 3 Distribution of therapeutic drugs poisoning by age and gender
Fig. 4 Distribution of pesticide poisoning by age and gender
Fig. 5 Distribution of alcohol and fumes poisoning by age and gender (A-Male means Alcohol poisoning for Male; F-Male means Fumes/gas/fog poisoning for Male.)

For peer review only

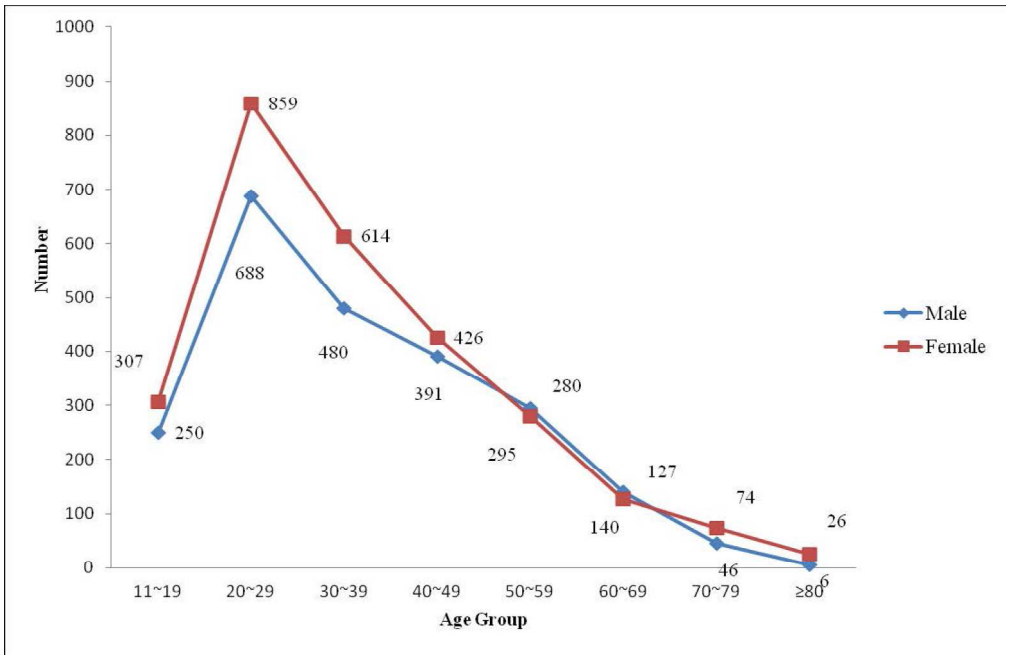


Fig. 1 Distribution of all poisoning cases by age and gender

188x122mm (300 x 300 DPI)

view only

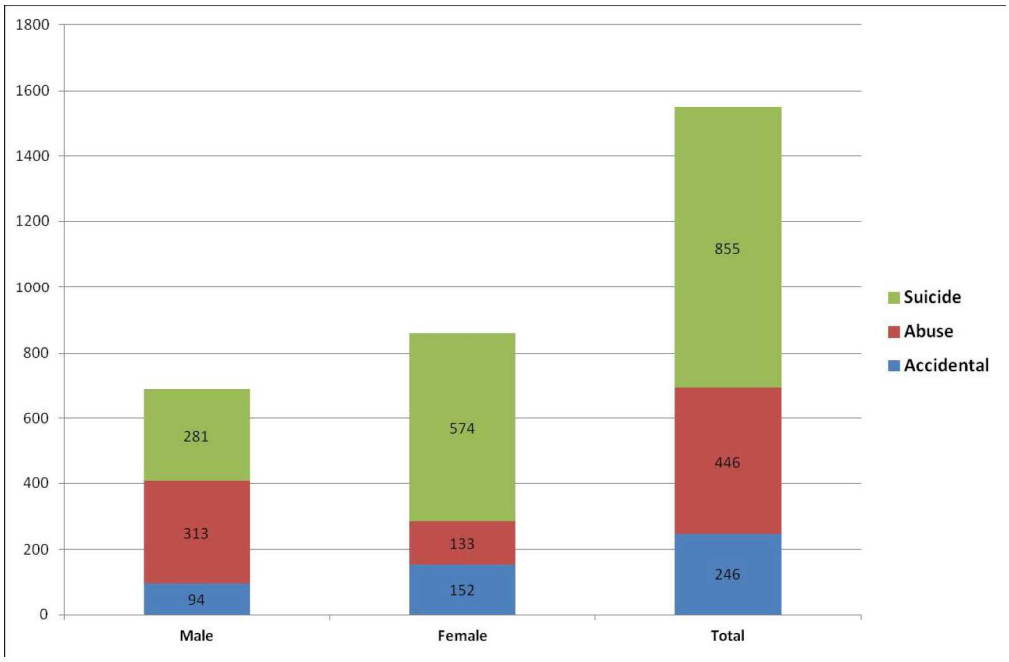


Fig. 2 Intention for 20-29 age-group cases from 2012to 2016

216x140mm (300 x 300 DPI)

view only

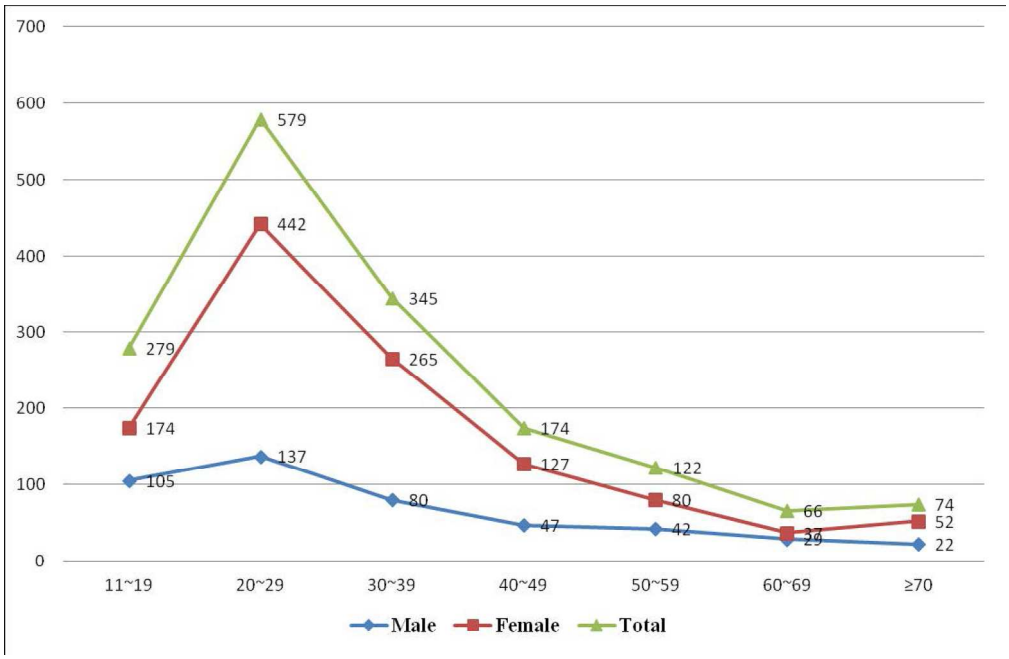


Fig. 3 Distribution of therapeutic drugs poisoning by age and gender

188x122mm (300 x 300 DPI)

view only

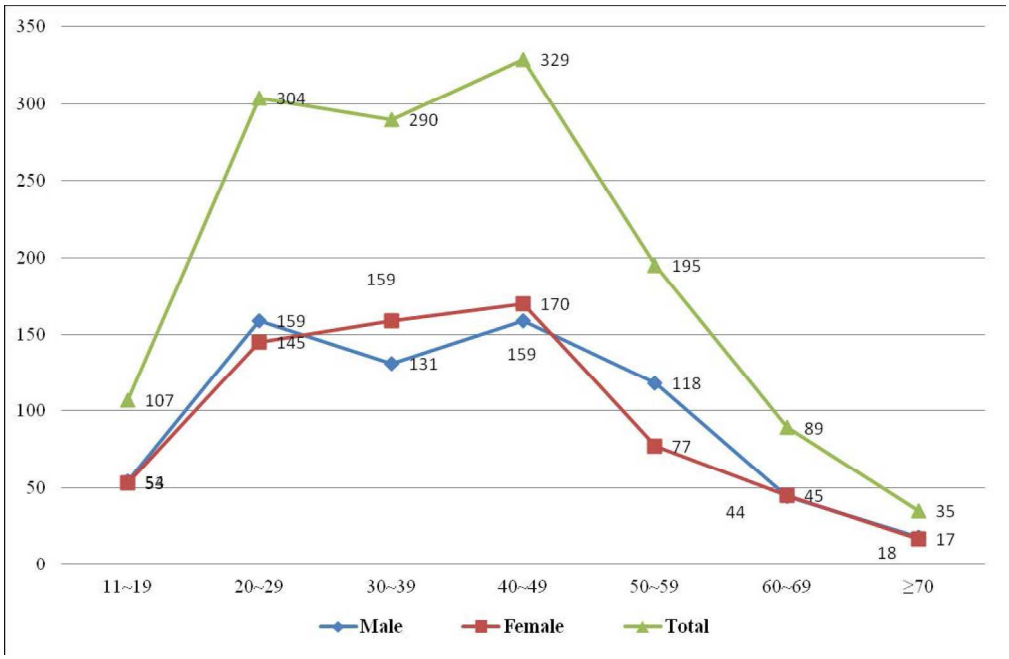
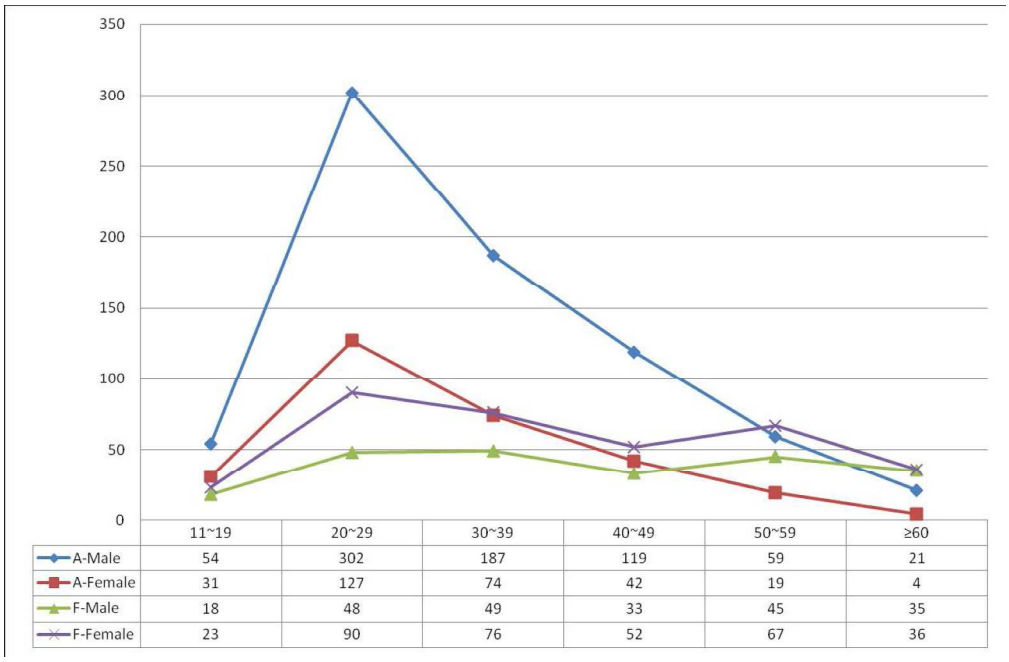


Fig. 4 Distribution of pesticide poisoning by age and gender

188x122mm (300 x 300 DPI)

view only



	11~19	20~29	30~39	40~49	50~59	≥60
A-Male	54	302	187	119	59	21
A-Female	31	127	74	42	19	4
F-Male	18	48	49	33	45	35
F-Female	23	90	76	52	67	36

Fig. 5 Distribution of alcohol and fumes poisoning by age and gender (A-Male means Alcohol poisoning for Male; F-Male means Fumes/gas/fog poisoning for Male.)

216x140mm (300 x 300 DPI)

For peer review only

BMJ Open

Acute poisoning in Shenyang, China: a retrospective and descriptive study from 2012 to 2016

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2018-021881.R2
Article Type:	Research
Date Submitted by the Author:	27-Apr-2018
Complete List of Authors:	Zhang, YaJie; Shengjing Hospital of China Medical University Yu, Boxin; Shengjing Hospital of China Medical University Wang, Nana; Shengjing Hospital of China Medical University Li, Tiegang; Shengjing Hospital of China Medical University,
Primary Subject Heading:	Emergency medicine
Secondary Subject Heading:	Emergency medicine, Epidemiology, Public health
Keywords:	Poisoning, Carbon Monoxide Poisoning, Pesticides, Paraquat, Suicide

SCHOLARONE™
Manuscripts

For peer review only

Acute poisoning in Shenyang, China: a retrospective and descriptive study from 2012 to 2016

Yajie Zhang,[1] Boxin Yu,[2] Nana Wang,[3] Tiegang Li[4,*]

1. Emergency Department, Shengjing Hospital of China Medical University, Shenyang 110004, China

2. Gerontology Department, Shengjing Hospital of China Medical University, Shenyang 110004, China

3. Endocrinology Department, Shengjing Hospital of China Medical University, Shenyang 110004, China

4. Emergency Department, Shengjing Hospital of China Medical University, Shenyang 110004, China

Corresponding author:

* Tiegang Li, M.D., Emergency Department, Shengjing Hospital of China Medical University, No. 36, Sanhao Street, Heping District, Shengyang, China, 110004

E-mail: litg@sj-hospital.org

For peer review only

Abstract

Objective: It is crucial to have up-to-date information on the patterns of acute poisoning in a tertiary medical center in northeast China to properly manage poisoning events. The objective of this study was to analyze the characteristics of acute poisoning patients admitted to the emergency department (ED) and to compare these characteristics with those in a previous study.

Design: Retrospective and descriptive study.

Setting: Cases diagnosed with poisoning admitted to ED. Data were collected from the hospital information system in Shengjing Hospital, China from January 2012 to December 2016, China.

Participants: All cases aged ≥ 11 years old with a diagnosis of acute poisoning.

Results: In total, 5009 patients aged ≥11 years presented to the ED with acute poisoning during the study period. The average age of the patients was 36.0 ± 15.1 years and over half of the patients (52.7%) were in the age group 20-39 years. The ratio of females to males was 1.18:1. Patients with acute poisoning mainly lived in rural areas rather than urban areas. The majority of patients consumed poison with suicidal attempts (56.7%). Males were more commonly poisoned by drug abuse than females, but females outnumbered males in suicidal poisoning. The most common form of poison intake was ingestion (86.2%) (oral intake).The five most common toxic agent groups in descending order were therapeutic drugs (32.6%), pesticides (26.9%), alcohol (20.7%), fumes/gases/vapors (11.4%), and chemicals (3.6%). Sedatives/hypnotics in the therapeutic drugs group and paraquat in pesticides group was the most common toxic agents, respectively. The hospital mortality rate was 1.3% with 64 deaths.

Conclusions: The results of this study indicate the need to strengthen education regarding management of the rational and safe use of drugs in Shenyang.

Keywords:

Poisoning; Carbon Monoxide Poisoning; Pesticides; Paraquat; Suicide

For peer review only

Strengths and limitations of this study:

The cross-sectional and retrospective study design involved with over 5,000 poisoning cases in 5 consecutive years.

Although the sample size in this study is large, its retrospective nature makes it difficult to obtain complete information in all poisoning cases, which introduced bias.

Statistics of a single centre teaching hospital-based study, even with three branches, may not reflect the precise situation in this region.

1 Introduction

Acute poisoning is defined as acute exposure (less than 24 h) to the toxic substance.[1] Acute poisoning is a major public and preventable health issue contributing to morbidity and mortality in many parts of the world. It is estimated that poisoning events are responsible for more than one million illnesses annually.[2,3] Low mortality contrasts with high morbidity in acute poisoning; however, patients who attempt suicide usually have higher mortality.[4-6] As the most common form of fatal self-harm in rural Asia, poisoning accounts for more than 60% of deaths.[7]

China is a developing country transitioning from an agricultural to an industrialized economy. In recent years, the number of acute poisoning cases in China has continued to increase[8], and both poisoning and injury are now two of the top five causes of death.[9] Of the various types of poisoning, pesticide poisoning is more common in most regions of China, while therapeutic drugs poisoning is the main type of poisoning in developed regions or cities, such as Shanghai.[9-13] Shenyang, is the provincial capital of Liaoning, the biggest city in Northeast China and the national regional central city, with an estimated population of more than 8.1million.[14] Liaoning is an industrial province, but agriculture is still an important economic sector. The major crops in this region are corn and rice. The widespread use of pesticides such as organophosphorous compounds by farmers may increase the risk of poisoning events in this area.[15] A previous investigation in this region from 1997 to 2007 showed that (i) medicine was the most common agent (41.4%), followed by pesticides

For peer review only

(15.2%), alcohol (14.1%), carbon monoxide (12.5%) and food (9.7%); (ii) the major medicine was sedatives/hypnotics and the major pesticide was organophosphates; (iii) mortality decreased from 2.05% to 0.37% over the 10-year study period, with an average mortality rate of 1.0%. [16]

In the last few decades, China has witnessed significant advancements in the fields of agriculture, industrial technologies and medical pharmacology. These advancements have been paralleled by marked changes in the trends of acute poisoning, [17] and has led to the development and easy accessibility of a vast number of toxic agents including pesticides, therapeutic drugs and other chemicals. Thus, the toxic agents associated with morbidity and mortality and the pattern of acute poisoning, which vary from place to place and over time, are expected to change. Therefore, there is a constant need to obtain up-to-date information on acute poisoning for planning rational use of resources and for evaluating public health interventions. The aim of this retrospective and descriptive study was to describe the clinical and sociodemographic patterns of acute poisoning in the medicine emergency department (ED) of Shengjing Hospital of China Medical University, a tertiary care center, and to compare these patterns with previous findings.

2 Methods

This retrospective and descriptive study based on hospital records was carried out in the Shengjing Hospital of China Medical University in Shenyang, China. Shengjing Hospital is one of the regional tertiary care hospitals in northeast China with three hospital areas, and covers the entire Liaoning province and some areas of neighboring provinces. Moreover, Liaoning Poisoning Diagnosis and Treatment Center was established in the ED of Shengjing hospital on July 2011, and the ED has a specialized toxicology unit. Hence many patients with poisoning who seek treatment visit or are referred to this hospital. We reviewed all records of poisoning cases admitted to the ED (including cases referred to ED from other wards) over 5 consecutive years from January 2012 to December 2016. Patients admitted to the ED with a diagnosis of drug poisoning, aged ≥ 11years, were enrolled in this study. The

For peer review only

diagnosis was established by patients' history, physical examination, routine and toxicological laboratory evaluation. Poisoned patients < 11 years admitted to the pediatric ward, and those with animal bites (snake, insect) due to infrequency and chronic poisoning were excluded from the study. Research ethical approval was obtained from Shengjing hospital institutional ethics committee before study commencement.

Relevant medical records were obtained from the electronic hospital information system (HIS). The HIS is an electronic system used in the clinic to record patient information. Poisoning cases were retrieved by searching the HIS using the following keywords: poisoning, alcohol, carbon monoxide (CO) and organophosphate. Demographic data including age, gender, place of residence, diagnosis, type of exposure (suicidal, abusive, accidental and unknown), type of toxic agent (the common name or trade name are indicated, where available), duration of hospital stay and the outcome of treatment (whether the patient survived or died) were collected and documented on a structured form. The circumstances of poisoning were deduced from the patients' history.

The toxic agent was classified as a therapeutic drug, pesticide, alcohol, poisonous fume/gas/vapor, chemical, food, other substance and unknown. The subgroup of toxic agents was categorized based on the indications for use. Mixed drugs were defined as the ingestion of two or more drugs. The toxic agent was categorized as unknown when no suspected toxic agent was reported in the patient history.

Type of exposure was classified as suicidal, abusive, accidental and unknown As follows: (1) Exposure due to the inappropriate use of drugs for self-destruction was categorized as suicidal. (2)Exposure due to the intentional improper or incorrect use of a drug in which the victim was likely attempting to achieve a euphoric or psycho-tropic effect was categorized as abusive. (3)Accidental was classified as environmental poisoning, misuse, food poisoning and an adverse reaction. ①If patients were poisoned due to being in an environment where a toxic substance (e.g.

For peer review only

CO) was present this was categorized as environmental poisoning. ②An overdoses of medicine or being given the wrong drug, taking the wrong drug in error, or taking a drug inadvertently were categorized as misuse. ③Exposure due to the ingestion of edible items was categorized as food poisoning. ④The side effect of an herb or health product was categorized as an adverse reaction. (4)If information was unavailable the cause of poisoning was categorized as unknown.

Gastric lavage, activated charcoal, intubation, infusion and dieresis therapy, and hemoperfusion were standard treatment protocols for poisonings caused by ingestion. Hemodialysis was performed when indicated. Special antidotes, naloxone for alcohol poisoning, Vitamin K1 and acetamide for rodenticide poisoning, were given as indicated. For poisoning with no specific available antidotes, symptomatic treatment was administered.

Patients with normal symptoms, signs and laboratory findings on discharge were categorized as recovery. Patients with normal symptoms and signs but the laboratory findings were abnormal or unavailable on discharge were categorized as relative recovery.

Microsoft Excel 2007 was used to perform descriptive statistical analyses of the data. The average age was presented as the mean ± standard deviation (SD). To evaluate the differences, chi-square test was performed using SPSS for Windows, version 21.0. A p value of less than 0.05 was considered significant.

Patient and Public Involvement: patients and/or public were not involved.

3 Results

A total of 5,375 cases of poisoning (age ≥11 years of age) from 829,808 entries were obtained from the HIS from 1 January 2012 to 31 December 2016. Of these, 366 were identified as animal bites (10) and chronic poisoning events, leaving a total of 5009 unique cases that met our criteria. These cases comprised 0.6% of all emergency admissions. Descriptive information including age, gender, type and route of exposure, place of residence, length of hospital stay, and outcome of the poisoned patients are summarized in Table 1.

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Table 1 Demographic characteristic of poisoned patients admitted to ED from 2012 to 2016.

Variables categories	N	%
Age group		
11~19	557	11.12
20~29	1547	30.88
30~39	1094	21.84
40~49	817	16.31
50~59	575	11.48
60~69	267	5.33
⩾70	152	3.03
Gender		
Male	2296	45.84
Female	2713	54.16
Type for exposure		
Suicidal	2842	56.74
Abusive	1105	22.06
Accidental	1017	20.30
Unknown	45	0.90
Route of exposure		
Ingestion (oral)	4316	86.16
Inhalation (nasal)	590	11.78
Contact (dermal)	98	1.96
Other	5	0.10
Place of residence		
Urban	2415	48.21
Rural	2568	51.27
Unknown	26	0.52
Length of hospital stay		
<48h	367	7.33
<1week	3219	64.26
>1week	1423	28.41
Outcome		
Recovery	1416	28.27
Relative recovery	3255	64.98
Referral to other center	198	3.95
Left against medical advice	76	1.52
Death	64	1.28
Total	5009	100.00

3.1 Age and gender

Of the 5009 cases included, 2713(54.2%) were recognized as female, and 2296

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

(45.8%) were determined as male, and the ratio of male to female was 1:1.18. In this study, the youngest patient was 11 years old, while the oldest patient was 92 years old. The mean age of all patients was 36.0 ± 15.1 years. The mean age of male and female patients was 36.4 ± 15.0 years and 35.7 ± 15.3 years, respectively. The most vulnerable patients were aged 20-29 years (30.9% of cases), followed by patients aged 30-39 years (21.8% of cases) and 40-49 years (16.3% of cases) (Figure 1). There was a statistically significant gender difference (male and female) between the different age groups of poisoned patients (χ^2=28.19, p<0.001).

The predominant group of toxic agents consumed by the 20-29 age group was therapeutic drugs (579 cases, 37.4% of poisonings in the 20-29 age group) (Table 2). Of these, sedatives/hypnotics (169 cases) plus analgesics (120 cases) accounted for over half. Alcohol and pesticides were ranked second and third, accounting for 27.7% and 19.6%, respectively. There was a statistically significant gender difference at suicide and drug abuse in the 20-29 age group (χ^2=140.29, χ^2=167.69, p < 0.001). Most cases of intentional poisoning with 855 suicide attempts and 446 abuse cases were seen in young adults (20-29 years old). (Figure 2)

Table 2 Distribution of toxic agents consumed by 20-29 age-group people from 2012 to 2016

Toxic agents category	N	Group percentage	Total percentage	Direct percentage*
Therapeutic drugs	**579**	**100.00**	**37.35**	**35.37**
Sedatives & hypnotics	169	29.19	10.90	35.88
Analgesics	120	20.73	7.74	44.28
Mixed drugs	92	15.89	5.94	34.20
Cold and cough preparations	64	11.05	4.13	39.26
Antipsychotics	35	6.04	2.26	28.00
Cardiovascular drugs	22	3.80	1.42	19.64
Other drugs	29	5.01	1.87	30.21
Antimicrobials	27	4.66	1.74	41.54
Traditional Chinese medicine	21	3.63	1.35	32.81
Alcohol	**429**		**27.68**	**41.29**
Pesticides	**304**	**100.00**	**19.61**	**22.54**
Paraquat	133	43.75	8.58	20.65
Rodenticide	66	21.71	4.26	25.48
Organophosphate	45	14.80	2.90	19.40
Other	48	15.79	3.10	30.00

For peer review only

Unknown	12	3.95	0.77	22.22
Fumes/gases/vapors	**138**		**8.90**	**24.13**
Chemicals	**33**		**2.13**	**18.23**
Food	**16**		**1.03**	**18.18**
Other substance	**16**		**1.03**	**47.06**
Unknown	**35**		**2.26**	**34.31**
Total	***1550****		**100.00**	**31.19**

Direct percentage*: the ratio of the same toxic agent consumed by twenties people to all age-group people

1550*: Among 1550 cases, 3 cases were calculated tautologically for a combination of alcohol poisoning and other drugs poisoning.

3.2 Type of exposure

Table 3 lists the reasons for toxin exposure in these patients. It was noted that suicidal exposure occurred in the overwhelming majority of poisonings (2842, 56.7%), followed by abusive exposure (1105, 22.1%), accidental exposure (1017, 20.3%) and unknown reason (45, 0.9%). There was a significant gender difference in suicide and drug abuse: females were involved in more suicidal poisonings than males: 63.4% for females versus 36.6% for males (χ^2=226.09, p <0.001); poisoning due to drug abuse showed the opposite status: 70.8% for males versus 29.2% for females (χ^2=354.97, p<0.001). The main substances used were therapeutic drugs and pesticides for suicide attempts and alcohol for abuse. CO poisoning (~ 80% of cases) was the most common environmental poison, and pesticides poisoning (20%) was less common. Therapeutic drugs were taken mistakenly or in overdose by females.

For peer review only

1

Table 3 Type for exposure of all cases by gender

Type for exposure	Male		Female		Total		Chi-square test	
	N	%	N	%	N	%	$\chi 2$	*p*
Suicidal	1040	45.30	1802	66.42	2842	56.74	**226.086**	**0.000**
Abusive	782	34.06	323	11.91	1105	22.06	**354.968**	**0.000**
Accidental:	451	19.64	566	20.86	1017	20.30	1.143	0.285
Environmental	303	13.20	387	14.26	690	13.78	1.622	0.203
Misuse	97	4.22	106	3.91	203	4.05	0.323	0.570
Food poisoning	35	1.52	53	1.95	88	1.76	1.327	0.249
Adverse reaction	16	0.70	20	0.74	36	0.72	0.028	0.866
Unknown:	23	1.00	22	0.81	45	0.90	0.509	0.476
Subtotal	**2296**	**100.00**	**2713**	**100.00**	**5009**	**100.00**		

For peer review only

3.3 Route of exposure

Among the various routes of exposure, ingestion was the most common (86.2 %), followed by inhalation (11.8%) and contact (2.0%).

3.4 Common Substances in Human Exposures

The most prevalent substance categories are shown in Table 4 and are listed by frequency of exposure in these patients. This ranking shows the direction in which prevention efforts should be focused, as well as the types of poisonings our hospital regularly manages. The four most common toxic agent groups in decreasing order were therapeutic drugs, pesticides, alcohol, fumes/gases/vapors, 676 (13.5%) patients consumed two or more toxic agents. However, with regard to specific substances, alcohol, paraquat, CO and sedatives/hypnotics were the four main toxic agents.

For peer review only

Table 4 The distribution of toxic agent over the five years.

Toxic agent category	2012		2013		2014		2015		2016		Total		
	N	%	N	%	N	%	N	%	N	%	N	%	Total %
Therapeutic drugs	**303**	**100**	**394**	**100**	**326**	**100**	**310**	**100**	**304**	**100**	**1637**	**100**	**32.62**
Sedatives & hypnotics	101	33.33	141	35.79	79	24.23	68	21.94	82	26.97	471	28.77	9.39
Analgesics	50	16.50	67	17.01	62	19.02	53	17.1	39	12.83	*271*[*]	16.55	5.40
Mixed drugs	42	13.86	63	15.99	53	16.26	52	16.77	59	19.41	269	16.43	5.36
Cold and cough preparations	31	10.23	26	6.6	37	11.35	42	13.55	27	8.88	163	9.96	3.25
Psychotropics	16	5.28	23	5.84	23	7.06	27	8.71	36	11.84	125	7.64	2.49
Cardiovascular drugs	15	4.95	27	6.85	22	6.75	26	8.39	22	7.24	112	6.84	2.23
Other drugs	16	5.28	21	5.33	24	7.36	20	6.45	15	4.93	96	5.86	1.91
Antimicrobials	19	6.27	12	3.05	15	4.60	8	2.58	11	3.62	65	3.97	1.30
Traditional Chinese medicine	13	4.29	14	3.55	11	3.37	14	4.52	13	4.28	65	3.97	1.30
Pesticides	**241**	**100.00**	**280**	**100.00**	**308**	**100.00**	**272**	**100.00**	**248**	**100.00**	**1349**	**100.00**	**26.88**
Paraquat	97	40.25	134	47.86	149	48.38	141	51.84	123	49.60	644	47.74	12.83
Rodenticide	50	20.75	55	19.64	60	19.48	49	18.01	45	18.15	259	19.20	5.16
Organophosphate	56	23.24	44	15.71	48	15.58	46	16.91	38	15.32	232	17.20	4.62
Other	24	9.95	33	11.79	42	13.64	28	10.29	33	13.31	160	11.86	3.19
Unknown	14	5.81	14	5.00	9	2.92	8	2.94	9	3.63	54	4.00	1.08
Alcohol	**203**		**227**		**226**		**182**		**201**		**1039**		**20.71**
Fumes/gases/vapors	**70**		**144**		**103**		**119**		**136**		**572**		**11.40**
Chemicals	**25**		**47**		**46**		**32**		**31**		**181**		3.61
Food	**20**		**9**		**15**		**35**		**9**		**88**		1.75
Other substance	**8**		**11**		**7**		**10**		**14**		**50**		1.00
Unknown	**22**		**24**		**17**		**19**		**20**		**102**		2.03
Subtotal	**892**		**1136**		**1048**		**979**		**963**		***5018***[*]		**100.00**

For peer review only

271*：Including 13 cases of opioids poisoning.

5018*: 9 cases were calculated tautologically, of which 7 cases had a combination of alcohol poisoning and other drugs poisoning, and 2 cases had a combination of CO poisoning and other drugs poisoning.

3.4.1Therapeutic drug categories

Therapeutic drug poisoning showed a slight decrease during the five-year study despite a high number in 2013. A total of 1637 cases had therapeutic drug poisoning. Of these cases, 28.8% involved sedatives/hypnotics poisoning, which were the most commonly used drugs, followed by analgesics (16.6%) (including 13 cases of opioids poisoning) and cold and cough preparations (10.0%). Mixed drug poisoning was found in approximately 16.4% of patients. The rate of psychotropics poisoning increased over the five year period. Cardiovascular drugs, antimicrobials, traditional medicine and other drugs showed a relatively stable trend. Drug poisoning was more common in both males and females aged 20-29 years attempting suicide (Figure 3). However, drug poisoning was significantly more frequent in females than males (71.9% vs. 28.1%).

3. 4.2 Pesticide categories

Pesticide poisoning showed an increasing trend from 2012 to 2015 but decreased in 2016. A total of 1349 cases were observed to have pesticide poisoning. Of these cases, the predominant pesticide poison taken was paraquat (47.7% of cases), followed by rodenticide (19.2%), organophosphate (17.2%) and other pesticides (11.9%). A slightly higher number of males (683 cases) than females (666 cases) had pesticide poisoning. With regard to the distribution of age and gender in pesticide poisoning, there were two peaks, one in the 20-29 year old group and the other in the 40-49 year old group for both males and females (Figure 4). Eighty-eight percent of pesticide poisoning occurred with suicide attempt, and males were involved in 5% more accidental pesticide poisonings than females. Pesticide poisoning was most frequent during the month of July.

3.4.3 Alcohol and Fumes/gases/vapors

There was a stable trend in alcohol poisoning. Alcohol poisoning was

For peer review only

predominant in males and was ~2.5 times higher in males than in females. Alcohol poisoning was more prevalent in the 20-29 year old group than in any other age group. (Figure 5) In addition, <1% of alcohol poisoning cases were found to be affected by other poisonings. Fumes/gases/vapors poisoning displayed an increasing trend, even though there was a decrease from 2013 to 2014. Of these cases, carbon monoxide poisoning was the dominant toxic agent. Carbon monoxide poisoning was more common in the 20-39 year old group and in females. The majority of CO poisoning events occurred in winter.

3.5 Treatment and Outcome

It was noted that gastric lavage and activated charcoal were administrated in 72.5% (n=3634) cases and 64.8% (n=3244) cases, respectively, to prevent absorption of toxic agents. Some 7.7% of cases (n=385) received hemodialysis treatment. All patients with organophosphorous poisoning (n=232) were treated with atropine and pralidoxime. In addition, hyperbaric oxygen therapy for CO poisoning was performed in all cases (n=556).

A total of 4945 patients were discharged from the hospital, including 1416 cases with complete recovery, 3255 cases with relative recovery, 347 cases were referred to another institution, and 253 cases left hospital during treatment. The hospital mortality rate was 1.3% with 64 deaths including 36 females and 28 males. The fatality ratio was 1.3% for female patients and 1.2% for male patients. More than half of the fatality cases (n=33) occurred in 40-59 age group. Sixty-eight percent of the patients who died lived in urban areas. Death was due to suicide attempt in 51cases, accidental poisoning in 11 cases, and in two cases, the type of poisoning was unknown. The associated agents involved in death were paraquat (33 cases), therapeutic drugs (16 cases), organophosphate (6 cases), food poisoning (4 cases), CO poisoning (2 cases), alcohol (1case) and two cases with unidentified poisons.

3.6 Comparison with Previous Findings

The female-to-male ratio was 1.5:1 in a previous study and 1.18:1 in the present study. Similar to the previous report; the most vulnerable patients were aged 20-29 years, but the percentages in the previous study was 37.1% which was higher than that

For peer review only

in our study. The major route of exposure was ingestion in both studies (86.2% in our study and 81.8% in the previous study). With regard to the type of exposure, suicide attempt accounted for 69.6% and accidental exposure accounted for 29.7% in the previous study, higher than our findings. The most common toxic agents were the same in both studies, therapeutic drugs, followed by pesticides, alcohol and CO (41.40%, 15.2%, 14.1% 12.5% in the previous study and 32.6%, 26.9%, 20.7%, 11.4% in this study). The major medicine was sedatives/hypnotics (27.5%) and the major pesticide was organophosphates (8.0%) in the previous study. The major toxic agents were sedatives/hypnotics (9.4%) and the major pesticide was paraquat(12.8%) in this study. The average mortality rate was 1.0% and 1.3%, respectively.

4. Discussion

Acute poisoning is one of the most frequent causes of visits to the ED and is a threat to public health. The annual rate of ED visits associated with poisoning varies widely across the world, and ranges from 0.07% to 0.7%.[18,19] Studies in western countries have reported annual rates of ED visits associated with poisoning of approximately 0.26%.[19,20] In the present study, this rate was 0.60%, and a similar percentage (0.64%) was seen in the research carried out by Bulent.[21] As it is not common practice for many poisoned patients to seek medical help in health care institutions, the annual rate of ED visits associated with poisoning recorded by hospitals may be misleading. Therefore, the actual number of poisoning cases may be more than that recorded, and accurate statistical data for poisonings are difficult to estimate. Developed countries also have similar problems in obtaining meaningful poisoning statistics even though they are equipped with advanced systems to collect population health data .[22]

This study concluded that the incidence of poisoning in females was slightly higher than that in males, especially among young adults aged 20-29 years, with a female-to-male ratio of 1.18:1. Similar findings have also been reported in Beijing, China [23] (1.23:1) and Sari, Iran [17] (1.16:1). In contrast, male preponderance has been found in some other countries. [24, 25] The most likely explanation for the high number

For peer review only

of poisonings in females is that they may be more susceptible to stress, which can lead to overreactions.[26-28]

The findings of this study showed a difference in poisoning based on age and indicated that the most affected age group was the 20-29 year age group (30.8%) with a secondary peak in the 30-39 year old group (21.9%). Both intentional and accidental poisoning were common in males and females aged 20-29 years, which is consistent with previous findings in China[16,23] and in other countries[29-31]. The fact that poisoning is more common among young adults reflects their vulnerability to stress, possibly due to failure or frustration in love or exams, maladjustment and inability to cope with the high expectation of parents.[32,33] Overall, this group of people is not emotionally stable or mature enough to tolerate extreme mental or physical pressure.[34,35]

Intentional poisoning (suicide+abuse) was the predominant cause of poisoning(78.8%) in the current study, an observation that is consistent with that in other studies.[30,36] Our study indicated that of all poisoning cases, a large proportion were suicidal in nature, but the incidence was lowered compared with the previous study. This change may be related to the benefits of socioeconomic achievement and prosperity, such as higher employment and more educational opportunities, which may have contributed to the reduction in suicide rates in China.[37] Despite this decline in suicide rate, suicide attempt is still the primary reason for poisoning due to the general belief that poisons terminate life with minimal suffering.[38,39].

Our study demonstrated that therapeutic drugs were the most frequently used toxic agents. A similar pattern that therapeutic drugs being the most common cause of acute poisoning has been observed in developed and some developing countries.[40-45] With regard to the subgroup of therapeutic drugs in poisoning cases, sedatives/hypnotics were common in Taiwan, Hong Kong, Iran and Finland, while analgesics were the most frequently ingested drugs in Turkey and USA. Pharmaceutical poisoning comprised 32.6% of the various drug poisonings observed in the present study, of which sedatives/hypnotics (28.8%) were the most frequently ingested agents. A similar pattern was also seen in the previous study, although an

For peer review only

apparent decline in sedatives/hypnotics poisoning was seen in our study [16]. This decline may be connected with the implementation of drug classification control where patients can only access these drugs with a doctor's prescription.[46] However, a rise was observed in the use of analgesics, cold and cough medicines, mixed drugs, as well as cardiovascular drugs, resulting in a different pattern to that seen previously. This may be explained by the easy availability of pharmaceuticals due to the numerous drugstores in China, inadequate supervision of government, insufficient knowledge about rational use of analgesics[47], increase of incidence of cardiovascular disease[48], poor psychological well-being and mental fragility among populations.[49] In addition, we found the frequency of psychotropic drugs poisonings had increased, which indicated that mental disorder played a part in poisoning events and should receive attention. It is noteworthy that the number of opioid poisonings is surprisingly small in our study, and this is associated with government's strict regulation with opiods, physicians' and patients'insufficient cognition to opiods (such as excessive worry about addiction and adverse events), making the use of opiods not ubiquitous.[50,51]

Pesticide poisoning has occurred relatively frequently for some time, as shown by previously published papers from different countries. [36, 39] The incidence of this type of poisoning varies geographically and historically [52]. Several studies conducted in India, Sri Lanka and Bangladesh showed a pesticide-dominant poisoning pattern, with organophosphates being the most common pesticide.[53-55] Pesticide was the second leading cause of acute poisoning in this study, accounting for 26.6% of all poisoning cases and showed an increased frequency.[16] There are two reasons: first, suicide by pesticide poisoning is still high in China, although suicides related to pesticide poisoning in China have continuously declined from 2006 to 2013.[56] Previous studies have shown that highly lethal pesticides are commonly used in suicide in rural China.[57,58] Our study showed that up to 88% of pesticide poisonings were suicide attempts. Second, pesticides are used extensively and unsafely in agriculture, industry, and home storage causing toxicity due to intentional and accidental exposure.[58] The quantity of pesticide use is large and ever-increasing, and

For peer review only

has grown from 1.28 million ton in 2001 to 1.81 million ton in 2014[59]. In the present study, paraquat was the most frequently used pesticide, and a similar pattern was found in a study carried out in northeast China which showed an increasing trend [60], whereas a decreasing trend was found in Korea [61].

Not surprisingly, our study found that alcohol poisoning was common and accounted for 20.7% of all poisoning cases. The incidence of alcohol poisoning increased compared to previous figures. This change can be explained by rapid social and economic development, urbanization, increased alcohol production, and alcoholic beverage commercials in the mass media, which have all led to an increase in alcohol consumption.[62] According to recent data, the annual per-capita alcohol consumption in Chinese adults in 2012 was 3 L.[63] Findings reported elsewhere in China showed a higher number of alcohol poisonings.[64] Alcohol poisoning in other countries has been shown to be lower [41,65-67]. This kind discrepancy is partially related to the disparity in alcohol consumption habits between different countries and districts. In Chinese culture, people often urge companions to drink as much as possible so that they can construct social connections and establish a happy and congenial atmosphere. [68] This can also explain the gender difference in poisonings, as males are more engaged in social intercourse than females. In addition to wildly practiced social drinking, solitary drinking is also common for stress reduction and coping among Chinese. [69]

The current data showed that the fourth leading cause of acute poisoning was fumes/gases/vapors (mainly CO), which decreased from 12.5% to less than 11.4% despite remaining in fourth place. This reduction is related to the improvement in dwelling conditions and preventive education on CO poisoning. With improvements in heating measures and advances in the fuel switching project from coal to natural gas in rural areas, a further decline in CO poisoning is expected in rural areas in China. There was a significant association between residency and month and reason for exposure to CO. Rural residents are more susceptible to CO poisoning than urban citizens, as local residents in remote villages in northern China use stoves to keep warm in winter, which can result in gas leaks due to a chimney jam and lack of

For peer review only

ventilation, and are common causes of CO poisoning in these areas. In contrast, CO poisoning in urban citizens may be explained by eating barbecued food and hotpot, a well-known traditional Chinese cuisine; both require charcoal as fuel.[70] In addition, almost all CO poisoning cases in our study were accidental with the exception of one case which was a suicide.

In our study, the rate of patients staying in hospital for less than 48h is small compared with other studies. This was due to patients with poisoning usually being asked to remain in the observing room (available in our ED) for 48h to 72h in consideration of complex doctor-patient environment in China.

Our study was primarily limited by its retrospective nature, which resulted in missing patient data. Another limitation was that the statistics of a single centre teaching hospital-based study, even with three branches, may not reflect precise situation in this region. Hence, a more extensive data collection and analysis from other general hospitals in the region can depict the regional poisoning pattern more accurately. In addition, the comparison between two studies was rough because of the absence of data standardization.

5. Conclusion and Suggestions

The present data provide additional insight into the epidemiology of acute poisoning in Shenyang. The findings demonstrated that more females than males had acute poisoning and the most vulnerable age group was the young-adult group aged 20-29. We also observed that the majority of poisoning cases were intentional, particularly suicidal in nature, and accidental poisonings were non-negligible. Our study indicated that therapeutic drugs were the most commonly used toxic agent group, followed by pesticides, alcohol and noxious gas. In addition, the pattern of acute poisoning was slightly altered when compared with 10 years ago. Poisoning due to analgesics and cold and cough preparations was more frequent than poisoning due to psychotropics in the therapeutic drugs poisoning group. In addition, poisoning due to paraquat and rodenticide exceeded poisoning due to organophosphate in the pesticide poisoning group.

For peer review only

Some suggestions are proposed based on the present study and include the following:

- Vulnerable groups such as females and young adults deserve special consideration due to their weak coping capacity.[37]
- Further investment is required to promote public health education on the rational use and safe storage of toxic agents as well as self-protection to reduce accidental poisoning.[7]
- The upward trend in the prevalence and alcohol and drug use should receive increasing attention.
- Patients who attempt suicide must undergo psychiatric consultation as soon as possible. Early psychiatric consultation and identification may minimize the risk of further self-harm in suicidal cases.[71]
- Lastly, relevant policies and regulations should be formulated and initiated immediately to restrict access to toxic agents, especially pesticides due to their high toxicity.[72]

For peer review only

Acknowledgment

Contributors: TG Li developed and directed the study. NN Wang conceived and designed the survey questions on poisoning. BX Yu coordinated data collection and carried out data cleaning. YJ Zhang performed the statistical analysis and drafted the manuscript. All authors drafted, edited and approved the final manuscript.

Ethical approval: Research ethical approval was obtained from Shengjing hospital institutional ethics committee before the study commences.

Funding: This work was supported by the National nature science foundation of China (No. 81301627 and No.81500628) .We would like to appreciate the staff of library for their contribution in providing language help.

Competing interests: The Authors declare that there is no conflict of interest.

Data sharing statement: No additional data sharing available.

References

1. Kalseen CD, Andur MO, Doull J. Casarett and Doull's Toxicology. Newyork: Macmillan, 1986:10-17.
2. Senarathna L, Buckley AN, Jayamann a SF, et al. Validity of referral hospitals for the toxicovigilance of acute poisoning in Sri Lanka.[J] Bull World Health Organization, 2012, 90(6):401–76.http://dx.doi.org/10.2471/BLT.11.092114
3. Güloğlu C, Kara IH. Acute poisoning cases admitted to a university hospital emergency department in Diyarbakir, Turkey. Human and Experimental Toxicology, 2005, 24(2):49-54.http://dx.doi.org/10.1191/0960327105ht499oa
4. Eddleston M. Patterns and problems of deliberate self-poisoning in the developing world[J]. Qjm Monthly Journal of the Association of Physicians, 2000, 93(11):715-731. https://doi.org/10.1093/qjmed/93.11.715
5. Gunnell D, Eddleston M, Phillips M R, et al. The global distribution of fatal pesticide self-poisoning: Systematic review[J]. BMC Public Health, 2007, 7(1):357. https://doi.org/10.1186/1471-2458-7-357
6. SM Shah, PD Asari, J Amin. CLINICO-EPIDEMIOLOGICAL PROFILE OF PATIENTS PRESENTING WITH ACUTE POISONING.[J] IJCRR. 2016; 8(13): 35-41
7. Konradsen F, Van d H W, Cole D C, et al. Reducing acute poisoning in developing countries--options for restricting the availability of pesticides.[J]. Toxicology, 2003, 192(2-3):249.http://dx.doi.org/10.1016/S0300-483X(03)00339-1
8. Yumeng Tang, MS, Lan Zhang, et al. Unintentional Poisoning in China, 1990 to 2015: The Global Burden of Disease Study 2015.[J] AmJ Public Health. 2017; 107:1311–1315. http://dx.doi.org/10.2105/AJPH.2017.303841
9. Liu QH, Jiang DF. Research Status of Acute Poisoning in China.[J] Journal of Occupational Health and Damage, 2011; 26:238–9. (inChinese). https://dx.doi.org/10.3969/j.issn.1006-172X.2011.04.016
10. Zhang J, Xiang P, Zhuo X, et al. Acute poisoning types and prevalence in Shanghai, China, from January 2010 to August 2011.[J]. Journal of Forensic Sciences, 2014, 59(2):441-6. http://dx.doi.org/10.1111/1556-4029.12334
11. Zhang M, Fang X, Zhou L, et al. Pesticide poisoning in Zhejiang, China: a

For peer review only

retrospective analysis of adult cases registration by occupational disease surveillance and reporting systems from 2006 to 2010[J]. BMJ Open, 2013, 3(11):e003510. http://dx.doi.org/10.1136/bmjopen-2013-003510

12. Wang B S, Chen L, Li X T, et al. Acute Pesticide Poisoning in Jiangsu Province, China, from 2006 to 2015[J]. Biomed Environ Sci, 2017, 30(9):695-700. https://dx.doi.org/10.3967/bes2017.094
13. Ge XM, Jiang DF, Liu QH. Epidemiological study on 6011 cases of the acute poisoning during 2005～2009 year in Guangxi[J]. Chinese Journal of New Clinical Medicine, 2011,4(8):699-701. (in Chinese) https://dx.doi.org/10.3969/j.issn.1674-3806.2011.08.02
14. The 2010 population census of the People's Republic of China. Available at: http://www.stats.gov.cn/tjsj/pcsj/rkpc/6rp/indexch.htm
15. Chataut J, Adhikari R K, Sinha N P, et al. Pattern of organophosphorous poisoning: a retrospective community based study.[J]. Kathmandu University Medical Journal, 2011, 9(34):31.
16. Zhao M, Ji XP, Wang NN, Liu SY, Wang YZ. Study of poisoning pattern at China Medical University from 1997 to 2007.[J] Public Health,2009,123:454–5. https://doi.org/10.1016/j.puhe.2009.04.010
17. Ahmadi A, Pakravan N, Ghazizadeh Z. Pattern of acute food, drug, and chemical poisoning in Sari City, Northern Iran.[J]. Human and Experimental Toxicology, 2010, 29(9):731-738.http://dx.doi.org/10.1177/0960327110361501
18. Hanssens Y, Deleu D, Taqi A. Etiologic and demographic characteristics of poisoning: a prospective hospital-based study in Oman. Journal of Toxicology Clinical Toxicology, 2001, 39: 371? / 80.http://dx.doi.org/10.1081/CLT-100105158
19. Thomas SH, Bevan L, Bhattacharyya S, et al. Presentation of poisoned patients to accident and emergency departments in the north of England.[J] Human and Experimental Toxicology, 1996, 15[6]:466–470.http://dx.doi.org/10.1177/096032719 60500602
20. McCaig L F, Burt C W. Poisoning-related visits to emergency departments in the

For peer review only

United States 1993–1996.[J]. Journal of Toxicology Clinical Toxicology, 1999, 37(7): 817–826.http://dx.doi.org/10.1081/CLT-100102460

21. Ergun B, Cevik A A, Ilgin S, et al. Acute drug poisonings in Eskisehir, Turkey: A retrospective study [J]. Turkish Journal of Pharmaceutical Sciences, 2013, 10(2):303-312.
22. Meredith T J. Epidemiology of poisoning [J]. Pharmacology and Therapeutics, 1993, 59(3):251-6.http://dx.doi.org/10.1016/0163-7258(93)90069-P
23. Zhigang Z, Peiyi Z, Jianming G. Epidemiological analysis of 560 cases of acute poisoning. Beijing Med 2007;29:708–19.(in Chinese) https://dx.doi.org/10.3969/j.issn.0253-9713.2007.12.017
24. Thalappilli MC, Jimmy A. A profile of acute poisonings: A retrospective study[J]. Journal of the Scientific Society, 2015, 42(3):156-160.http://dx.doi.org/10.4103/0974-5009.165547
25. Malangu N. Acute poisoning at two hospitals in Kampala-Uganda. Journal of Forensic Legal Medicine, 2008,15(8):489-92.http://dx.doi.org/10.1016/j.jflm.2008.04.003
26. Canetto SS. Women and suicidal behavior: a cultural analysis.[J] Am J Orthopsychiatry, 2008, 78(2):259–266. http://dx.doi.org/10.1037/a0013973
27. Weiyuan C. Women and suicide in rural China.[J] Bull World Health Org, 2009, 87(12):888–889. http://dx.doi.org/10.2471/BLT.09.011209
28. Qin P, Mortensen PB. Specific characteristics of suicide in China.[J] Acta Psychiatr Scand,2001, 103(2):117–121. http://dx.doi.org/10.1034/j.1600-0447.2001.00008.x
29. Nair PK, Revi NG. One-Year Study on Pattern of Acute Pharmaceutical and Chemical Poisoning Cases Admitted to a Tertiary Care Hospital in Thrissur, India. Asia Pac J Med Toxicol,2015,4:79-82.
30. Ramesha KN, Rao KB, Kumar GS. Pattern and outcome of acute poisoning cases in a tertiary care hospital in Karnataka, India. Indian Journal of Critical Care Medicine, 2009, 13:152-5.http://dx.doi.org/10.4103/0972-5229.58541.
31. Bari MS, Chakraborty SR, Alam MMJ, et al. Four-Year Study on Acute Poisoning

For peer review only

Cases Admitted to a Tertiary Hospital in Bangladesh: Emerging Trend of Poisoning in Commuters. Asia Pac J Med Toxicol 2014;3:152-6

32. Fergusson D M, Woodward L J, Horwood L J. Risk factors and life processes associated with the onset of suicidal behaviour during adolescence and early adulthood.[J]. Psychological Medicine, 2000, 30(1):23. http://dx.doi.org/10.1017/S003329179900135X
33. Zhao CJ, Dang XB, Su XL, et al. Epidemiology of Suicide and Associated Socio-Demographic Factors in Emergency Department Patients in 7 General Hospitals in Northwestern China[J]. Medical Science Monitor International Medical Journal of Experimental & Clinical Research, 2015, 21:2743-2749. http://dx.doi.org/10.12659/MSM.894819
34. Zhang J, Jia CX. Suicidal intent among young suicides in rural China.[J] Arch Suicide Res,2011,15(2):127–139.http://dx.doi.org/10.1080/13811118.2011.565269
35. Cash SJ, Bridge JA. Epidemiology of youth suicide and suicidal behavior. Curr Opin Pediatr,2009, 21(5):613–619. http://dx.doi.org/10.1097/MOP.0b013e32833063e1
36. Bundotich JK, Gichuhi MM. Acute poisoning in the Rift Valley Provincial General Hospital, Nakuru, Kenya: January to June 2012[J]. Official Journal of the South African Academy of Family Practice/primary Care, 2015, 57(3):1-5. http://dx.doi.org/10.1080/20786190.2014.97544
37. Wang C W, Chan C L W, Yip P S F. Suicide rates in China from 2002 to 2011: an update[J]. Social Psychiatry & Psychiatric Epidemiology, 2014, 49(6):929-941. http://dx.doi.org/10.1007/s00127-013-0789-5
38. Thomas M, Anandan S, Kuruvilla PJ, et al. Profile of hospital admissions following acute poisoning--experiences from a major teaching hospital in south India.[J]. Adverse Drug Reactions and Toxicological Reviews, 2000, 19(4):313-7.: http://dx.doi.org/10.1258/td.2011.110398
39. Tufekci IB, Curgunlu A, Sirin F. Characteristics of acute adult poisoning cases admitted to a university hospital in Istanbul [J]. Human and Experimental Toxicology, 2004, 23(7): 347-51.http://dx.doi.org/10.1191/0960327104ht460oa

For peer review only

40. JB Mowry, DA. Spyker, DE Brooks, et al. 2014 Annual Report of the American Association of Poison Control Centers' National Poison Data System (NPDS): 32nd Annual Report.[J] Clinical Toxicology, 2015, 53:10, 962-1147. http://dx.doi.org/10.3109/15563650.2015.1102927

41. Lapatto-Reiniluoto O, Kivistö K T, Pohjola-Sintonen S, et al. A prospective study of acute poisonings in Finnish hospital patients [J]. Human and Experimental Toxicology, 1998, 17(6):307-11.http://dx.doi.org/10.1177/096032719801700604

42. Moradi M, Ghaemi K, Mehrpour O. A hospital base epidemiology and pattern of acute adult poisoning across Iran: a systematic review[J]. Electronic Physician, 2016, 8(9):2860-2870. http://dx.doi.org/10.19082/2860

43. Kavalci C, Demir A, Arslan E D, et al. Adult Poisoning Cases in Ankara: Capital City of Turkey[J]. International Journal of Clinical Medicine, 2012, 03(7):736-739. http://dx.doi.org/10.4236/ijcm.2012.37A129

44. Lee H L, Lin H J, Yeh S Y, et al. Etiology and outcome of patients presenting for poisoning to the emergency department in Taiwan: a prospective study.[J]. Human & Experimental Toxicology, 2008, 27(5):373-379. http://dx.doi.org/10.1177/0960327108094609

45. Lam S M, Lau A C, Yan W W. Over 8 years experience on severe acute poisoning requiring intensive care in Hong Kong, China [J]. Human & Experimental Toxicology, 2010, 29(9):757-65. http://dx.doi.org/10.1177/0960327110361753

46. Liu CG, Jin F, Yuan GH. The History and Expectation of Classification Management of Drugs in China.[J] Chinese Journal of Pharmacovigilance,2013, 10(6):348-351. http://dx.doi.org/10.3969/j.issn.1672-8629.2013.06.009

47. Yu SY, Shang FF, Huang K.Status Quo and Countermeasures Research on Categorization Management of Medicine.[J] Chinese Pharmaceutical Affairs,2016, 30(1):32-34.http://dx.doi.org/10.16153/j.1002-7777.2016.01.005

48. Chen WW, Gao YL, Liu LS, et al. Summary of China cardiovascular disease report 2016. Chinese Circulation Journal, 2017, 32(6):521-530. http://dx.doi.org/10.3969/j.issn.1000-3614.2017.06.001

49. Wu P, Li L P, Jin J, et al. Need for mental health services and service use among

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

high school students in China [J]. Psychiatric Services, 2012, 63(10):1026. http://dx.doi.org/10.1176/appi.ps.201200090

50. Fang W, Liu T, Gu Z, et al Consumption trend and prescription pattern of opioid analgesics in China from 2006 to 2015. Eur J Hosp Pharm Published Online First: 27 January 2018. http://dx.doi.org/10.1136/ejhpharm-2017-001460
51. Wang JS, Pan SF. Analysis of current clinical survey of chronic non-cancer pain-relief and opioid：the Chinese subgroup report of ACHEON study. J Journal of Chinese Physician,2016,18(4):492-496.(in Chinese) http://dx.doi.org/10.3760/cma.j.issn.1008-1372.2016.04.003
52. Jeyaratnam J. Acute pesticide poisoning: a major global health problem.[J]. World health statistics quarterly. Rapport trimestriel de statistiques sanitaires mondiales, 1990, 43(3):139-144.
53. Jaiprakash H, Sarala N, Venkatarathnamma P N, et al. Analysis of different types of poisoning in a tertiary care hospital in rural South India[J]. Food & Chemical Toxicology An International Journal Published for the British Industrial Biological Research Association, 2011, 49(1):248-250. http://dx.doi.org/10.1016/j.fct.2010.10.026
54. Van Der Hoek W, Konradsen F: Analysis of 8000 hospital admissions for acute poisoning in a rural area of Sri Lanka. Clin Toxicol 2006, 44(3):225–231. http://dx.doi.org/10.1080/15563650600584246
55. Howlader M, Hossain M, Morshed M, et al. Changing Trends of Poisoning in Bangladesh[J]. Journal of Dhaka Medical College, 2011, 20(1):51-56
56. Page A, Liu S, Gunnell D, et al. Suicide by pesticide poisoning remains a priority for suicide prevention in China: analysis of national mortality trends 2006–2013[J]. Journal of Affective Disorders, 2016, 208:418.https://doi.org/10.1016/j.jad. 2016.10.047.
57. Zhang J, Xu HL. The effects of religion, superstition, and perceived gender inequality on the degree of suicide intent: a study of serious attempters in China. Omega: Journal of Death and Dying. 2007, 55(3):185–197. http://dx.doi.org/10.2190/OM.55.3.b

For peer review only

58. Zhang X, Li HS, Zhu QH, Zhou J, Zhang S, Zhang L, Sun CY. Trends in suicide by poisoning in China 2000–2006: age, gender, method, and geography. Biomedical and Environmental Sciences.2008; 21:253–256.http://dx.doi.org/10.1016/S0895-3988(08) 60038-0

59. Wang J, Li Y, Wang X, et al. Status Quo of Pesticide Use in China and Its Outlook [J]. Agricultural Outlook, 2017, 13(2):56-60. https://dx.doi.org/10.3969/j.issn.1673-3908.2017.02.012

60. Zhang S, Zheng Q, Zhang PS, et al. Epidemiological study of 357 acute paraquate poisoning cases [J]. Chinese Journal of Health Statistics, 2013, 30(2):251-252.(in Chinese)

61. Lee JW, Hwang IW, Kim JW, et al. Common Pesticides Used in Suicide Attempts Following the 2012 Paraquat Ban in Korea [J]. Journal of Korean Medical Science, 2015, 30(10):1517-21.http://dx.doi.org/10.3346/jkms.201 5.30.10.1517.

62. Guan-Sheng MA, Zhu DH, Xiao-Qi HU, et al. The drinking practice of people in China. Ying Yang Xue Bao. 2005;27(5):362–365.(in Chinese) https://dx.doi.org/10.13325 /j.cnki.acta.nutr.sin.2005.05.003

63. National Health and Family Planning Commission of the People's Republic of China. China national nutrition and chronic disease status report [in Chinese]. 2015. Available at: http://www.nhfpc.gov.cn/jkj/s5879/201506/4505528e65f3460fb88685081ff158a2.shtml. Accessed December 15, 2016.

64. Yuan T, Fan Q, Tang X Z, et al. Analysis of acute poisoning in 640 cases[J]. Practical Clinical Medicine, 2009, 10(11):27-27. http://dx.doi.org/10.3969/j.issn.1009-8194.2009.11.010

65. Thapa SR, Lama P, Karki N, et al. Pattern of poisoning cases in Emergency Department of Kathmandu Medical College Teaching Hospital.[J]. Kathmandu University Medical Journal, 2008, 6(2):209-213.

66. M. Balai-Mood. Pattern of acute poisonings in Mashhad, Iran 1993-2000.[J]. Journal of Toxicology Clinical Toxicology, 2004, 42(7):965. http://dx.doi.org /10.1081 /CLT-200042550

For peer review only

67. Jayasinghe NRM, Foster JH. Deliberate self-harm/poisoning, suicide trends. The link to increased alcohol consumption in Sri Lanka. Arch Suicide Research 2011, 15(3):223–237. http://dx.doi.org/10.1080/13811118.2011.589705

68. Li YC, Jiang Y, Zhang M, et al. Drinking behavior among men and women in China: the 2007 China Chronic Disease and Risk Factor Surveillance. Addiction. 2011; 106(11):1946–1956. http://dx.doi.org/10.1111/j.1360-0443.2011.03514.x

69. Hussong, A. Further refining the stress-coping model of alcohol involvement. Addict. Behav.2003,28, 1515–1522 https://doi.org/10.1016/S0306-4603 (03)00072-8

70. Xue J, Sun Q, Wang Y, et al. Features of Carbon Monoxide Poisoning in China[J]. Iranian Journal of Public Health, 2013, 42(10):1192-1193.

71. Linehan MM, Korslund KE, Harned MS et al. Dialectical behavior therapy for high suicide risk in individuals with borderline personality disorder: a randomized clinical trial and component analysis. JAMA Psychiatry, 2015; 72: 475–82 http://dx.doi.org/10.1001/jamapsychiatry.2014.3039

72. Gunnell D, Eddleston M, Phillips M R, et al. The global distribution of fatal pesticide self-poisoning: Systematic review[J]. Bmc Public Health, 2007, 7(1):357. http://dx.doi.org/10.1186/1471-2458-7-357

Fig. 1 Distribution of all poisoning cases by age and gender
Fig. 2 Intention for 20-29 age-group cases from 2012to 2016
Fig. 3 Distribution of therapeutic drugs poisoning by age and gender
Fig. 4 Distribution of pesticide poisoning by age and gender
Fig. 5 Distribution of alcohol and fumes poisoning by age and gender (A-Male means Alcohol poisoning for Male; F-Male means Fumes/gas/fog poisoning for Male.)

For peer review only

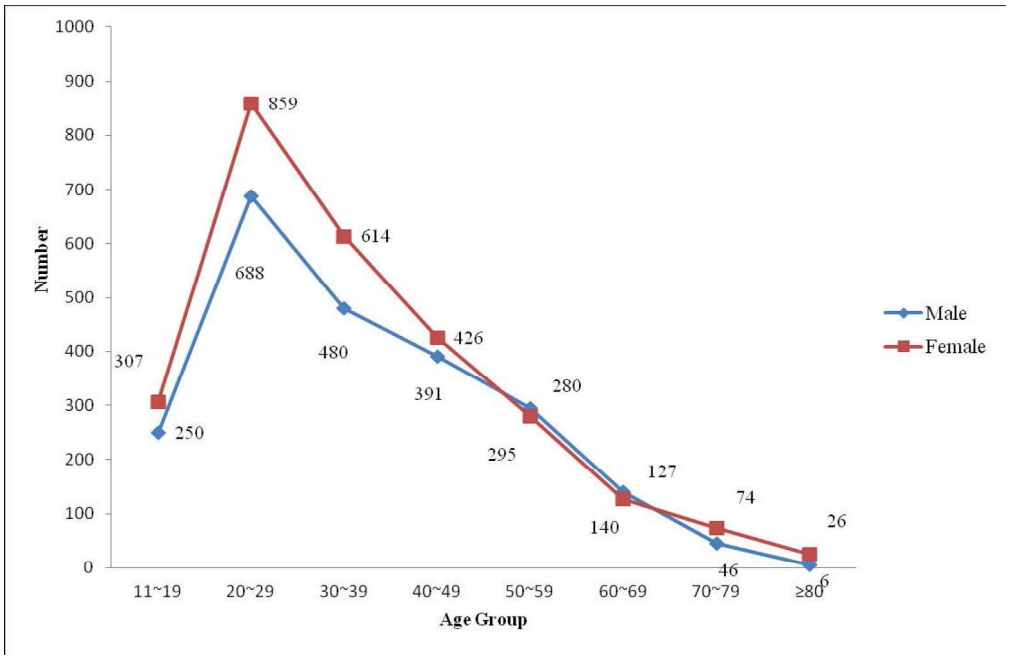


Fig. 1 Distribution of all poisoning cases by age and gender

188x122mm (300 x 300 DPI)

view only

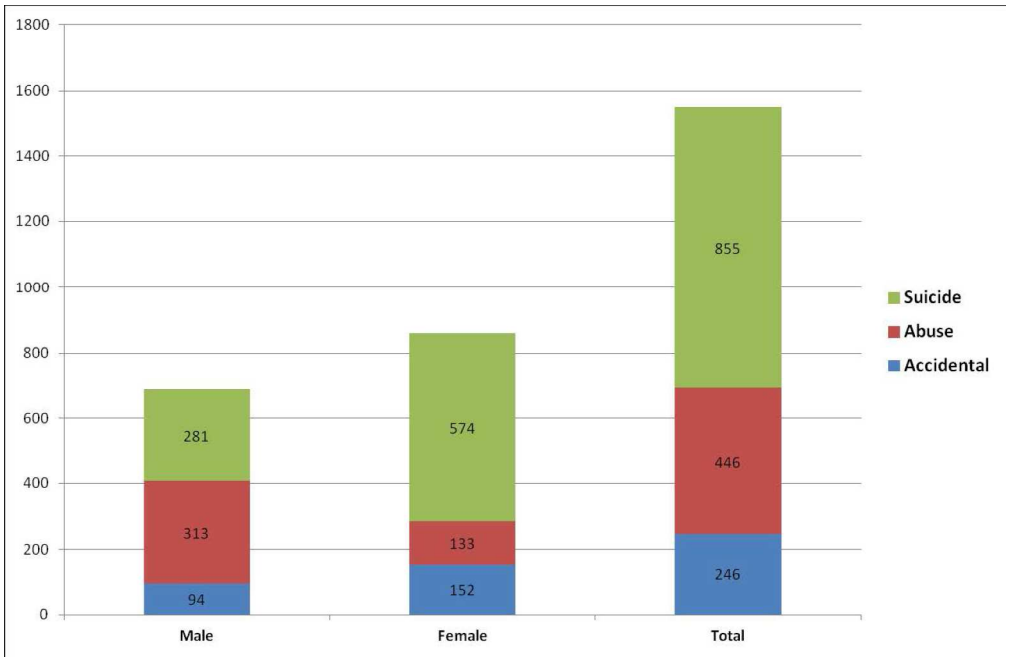


Fig. 2 Intention for 20-29 age-group cases from 2012to 2016

216x140mm (300 x 300 DPI)

view only

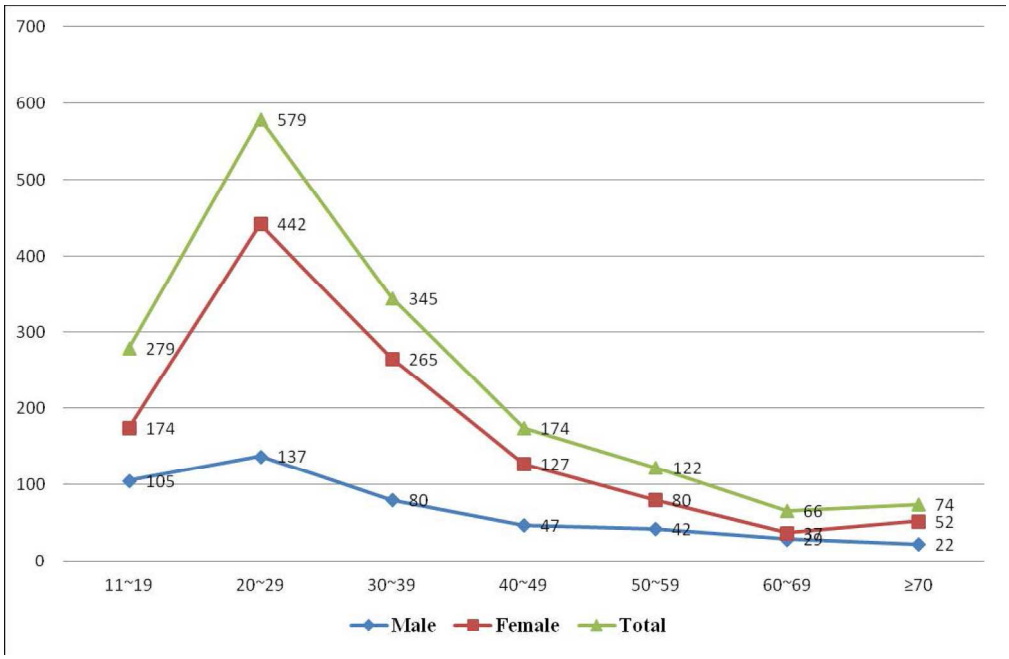


Fig. 3 Distribution of therapeutic drugs poisoning by age and gender

188x122mm (300 x 300 DPI)

view only

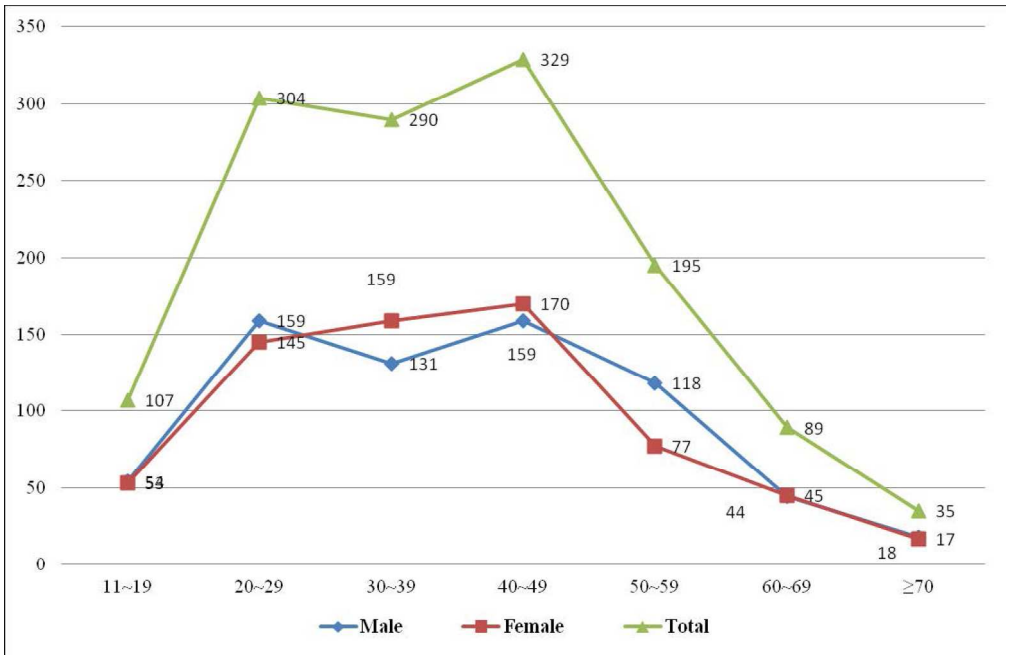
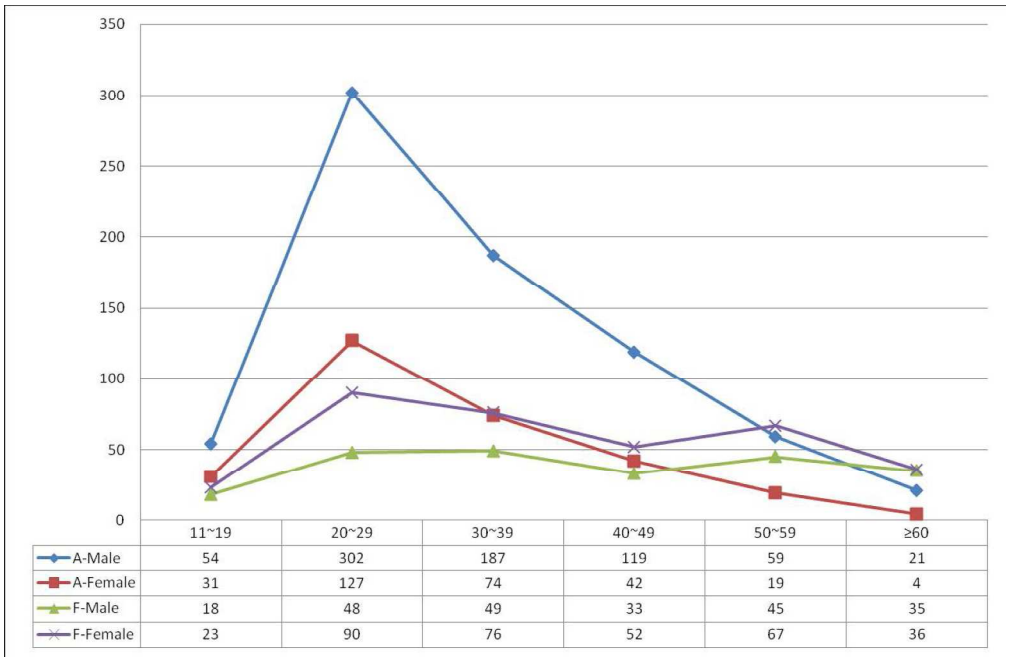


Fig. 4 Distribution of pesticide poisoning by age and gender

188x122mm (300 x 300 DPI)

view only



	11~19	20~29	30~39	40~49	50~59	≥60
A-Male	54	302	187	119	59	21
A-Female	31	127	74	42	19	4
F-Male	18	48	49	33	45	35
F-Female	23	90	76	52	67	36

Fig. 5 Distribution of alcohol and fumes poisoning by age and gender (A-Male means Alcohol poisoning for Male; F-Male means Fumes/gas/fog poisoning for Male.)

216x140mm (300 x 300 DPI)

For peer review only

BMJ Open

Acute poisoning in Shenyang, China: a retrospective and descriptive study from 2012 to 2016

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2018-021881.R3
Article Type:	Research
Date Submitted by the Author:	17-May-2018
Complete List of Authors:	Zhang, YaJie; Shengjing Hospital of China Medical University Yu, Boxin; Shengjing Hospital of China Medical University Wang, Nana; Shengjing Hospital of China Medical University Li, Tiegang; Shengjing Hospital of China Medical University,
Primary Subject Heading:	Emergency medicine
Secondary Subject Heading:	Emergency medicine, Epidemiology, Public health
Keywords:	Poisoning, Carbon Monoxide Poisoning, Pesticides, Paraquat, Suicide

SCHOLARONE™
Manuscripts

For peer review only

Acute poisoning in Shenyang, China: a retrospective and descriptive study from 2012 to 2016

Yajie Zhang,[1] Boxin Yu,[2] Nana Wang,[3] Tiegang Li[4,*]

1. Emergency Department, Shengjing Hospital of China Medical University, Shenyang 110004, China

2. Gerontology Department, Shengjing Hospital of China Medical University, Shenyang 110004, China

3. Endocrinology Department, Shengjing Hospital of China Medical University, Shenyang 110004, China

4. Emergency Department, Shengjing Hospital of China Medical University, Shenyang 110004, China

Corresponding author:

* Tiegang Li, M.D., Emergency Department, Shengjing Hospital of China Medical University, No. 36, Sanhao Street, Heping District, Shengyang, China, 110004

E-mail: litg@sj-hospital.org

For peer review only

Abstract

Objective: It is crucial to have up-to-date information on the patterns of acute poisoning in a tertiary medical center in northeast China to properly manage poisoning events. The objective of this study was to analyze the characteristics of acute poisoning patients admitted to the emergency department (ED) and to compare these characteristics with those in a previous study.

Design: Retrospective and descriptive study.

Setting: Cases diagnosed with poisoning admitted to the ED. Data were collected from the hospital information system in Shengjing Hospital, China from January 2012 to December 2016.

Participants: All cases aged ≥ 11 years old with a diagnosis of acute poisoning.

Results: In total, 5009 patients aged ≥11 years presented to the ED with acute poisoning during the study period. The average age of the patients was 36.0 ± 15.1 years and over half of the patients (52.7%) were in the age group 20-39 years. The ratio of females to males was 1.18:1. Patients with acute poisoning mainly lived in rural areas rather than urban areas. The majority of patients consumed poison as suicide attempts (56.7%). Males were more commonly poisoned by drug abuse than females, but females outnumbered males in suicidal poisoning. The most common form of poison intake was ingestion (86.2%) (oral intake).The five most common toxic agent groups in descending order were therapeutic drugs (32.6%), pesticides (26.9%), alcohol (20.7%), fumes/gases/vapors (11.4%), and chemicals (3.6%). Sedatives/hypnotics in the therapeutic drugs group and paraquat in the pesticides group were the most common toxic agents, respectively. The hospital mortality rate was 1.3% with 64 deaths.

Conclusions: The results of this study indicate the need to strengthen education regarding management of the rational and safe use of drugs in Shenyang.

Keywords:

Poisoning; Carbon Monoxide Poisoning; Pesticides; Paraquat; Suicide

For peer review only

Strengths and limitations of this study:

The cross-sectional and retrospective study design included over 5,000 poisoning cases in 5 consecutive years.

Although the sample size in this study is large, its retrospective nature makes it difficult to obtain complete information in all poisoning cases, which introduced bias.

Data from a single centre teaching hospital-based study, even with three branches, may not reflect the precise situation in this region.

1 Introduction

Acute poisoning is defined as acute exposure (less than 24 h) to the toxic substance.[1] Acute poisoning is a major public and preventable health issue contributing to morbidity and mortality in many parts of the world. It is estimated that poisoning events are responsible for more than one million illnesses annually.[2,3] Low mortality contrasts with high morbidity in acute poisoning; however, patients who attempt suicide usually have higher mortality.[4-6] As the most common form of fatal self-harm in rural Asia, poisoning accounts for more than 60% of deaths.[7]

China is a developing country transitioning from an agricultural to an industrialized economy. In recent years, the number of acute poisoning cases in China has continued to increase,[8] and both poisoning and injury are now two of the top five causes of death.[9] Of the various types of poisoning, pesticide poisoning is more common in most regions of China, while therapeutic drugs poisoning is the main type of poisoning in developed regions or cities, such as Shanghai.[9-13] Shenyang, is the provincial capital of Liaoning, the biggest city in Northeast China and the national regional central city, with an estimated population of more than 8.1 million.[14] Liaoning is an industrial province, but agriculture is still an important economic sector. The major crops in this region are corn and rice. The widespread use of pesticides such as organophosphorous compounds by farmers may increase the risk of poisoning events in this area.[15] A previous investigation in this region from 1997 to 2007 showed that (i) medicine was the most common agent (41.4%), followed by pesticides

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

(15.2%), alcohol (14.1%), carbon monoxide (12.5%) and food (9.7%); (ii) the major medicine was sedatives/hypnotics and the major pesticide was organophosphates; (iii) mortality decreased from 2.05% to 0.37% over the 10-year study period, with an average mortality rate of 1.0%.[16]

In the last few decades, China has witnessed significant advancements in the fields of agriculture, industrial technologies and medical pharmacology. These advancements have been paralleled by marked changes in the trends of acute poisoning,[17] and has led to the development and easy accessibility of a vast number of toxic agents including pesticides, therapeutic drugs and other chemicals. Thus, the toxic agents associated with morbidity and mortality and the pattern of acute poisoning, which vary from place to place and over time, are expected to change. Therefore, there is a constant need to obtain up-to-date information on acute poisoning for planning rational use of resources and for evaluating public health interventions. The aim of this retrospective and descriptive study was to describe the clinical and sociodemographic patterns of acute poisoning in the medicine emergency department (ED) of Shengjing Hospital of China Medical University, a tertiary care center, and to compare these patterns with previous findings.

2 Methods

This retrospective and descriptive study based on hospital records was carried out in the Shengjing Hospital of China Medical University in Shenyang, China. Shengjing Hospital is one of the regional tertiary care hospitals in northeast China with three hospital areas, and covers the entire Liaoning province and some areas of neighboring provinces. Moreover, Liaoning Poisoning Diagnosis and Treatment Center was established in the ED of Shengjing hospital on July 2011, and the ED has a specialized toxicology unit. Hence many patients with poisoning who seek treatment visit or are referred to this hospital. We reviewed all records of poisoning cases admitted to the ED (including cases referred to the ED from other wards) over 5 consecutive years from January 2012 to December 2016. Patients admitted to the ED with a diagnosis of drug poisoning and aged ≥ 11 years were enrolled in this study.

For peer review only

The diagnosis was established by patients' history, physical examination, routine and toxicological laboratory evaluation. Poisoned patients < 11 years admitted to the pediatric ward, and those with animal bites (snake, insect) due to infrequency and chronic poisoning were excluded from the study. Research ethical approval was obtained from Shengjing hospital institutional ethics committee before study commencement.

Relevant medical records were obtained from the electronic hospital information system (HIS). The HIS is an electronic system used in the clinic to record patient information. Poisoning cases were retrieved by searching the HIS using the following keywords: poisoning, alcohol, carbon monoxide (CO) and organophosphate. Demographic data including age, gender, place of residence, diagnosis, type of exposure (suicidal, abusive, accidental and unknown), type of toxic agent (the common name or trade name are indicated, where available), duration of hospital stay and the outcome of treatment (whether the patient survived or died) were collected and documented on a structured form. The circumstances of poisoning were deduced from the patients' history.

The toxic agent was classified as a therapeutic drug, pesticide, alcohol, poisonous fume/gas/vapor, chemical, food, other substance and unknown. The subgroup of toxic agents was categorized based on the indications for use. Mixed drugs were defined as the ingestion of two or more drugs. The toxic agent was categorized as unknown when no suspected toxic agent was reported in the patient history.

Type of exposure was classified as suicidal, abusive, accidental and unknown as follows: (1) Exposure due to the inappropriate use of drugs for self-destruction was categorized as suicidal. (2) Exposure due to the intentional improper or incorrect use of a drug in which the victim was likely attempting to achieve a euphoric or psycho-tropic effect was categorized as abusive. (3) Accidental was classified as environmental poisoning, misuse, food poisoning and an adverse reaction. ① If patients were poisoned due to being in an environment where a toxic substance (e.g.

For peer review only

CO) was present this was categorized as environmental poisoning. ②An overdose of medicine or being given the wrong drug, taking the wrong drug in error, or taking a drug inadvertently were categorized as misuse. ③Exposure due to the ingestion of edible items was categorized as food poisoning. ④The side effect of an herb or health product was categorized as an adverse reaction. (4) If information was unavailable the cause of poisoning was categorized as unknown.

Gastric lavage, activated charcoal, intubation, infusion and dieresis therapy, and hemoperfusion were standard treatment protocols for poisonings caused by ingestion. Hemodialysis was performed when indicated. Special antidotes, naloxone for alcohol poisoning, Vitamin K1 and acetamide for rodenticide poisoning, were given as indicated. For poisoning with no specific available antidotes, symptomatic treatment was administered.

Patients with normal symptoms, signs and laboratory findings on discharge were categorized as recovery. Patients with normal symptoms and signs but the laboratory findings were abnormal or unavailable on discharge were categorized as relative recovery.

Microsoft Excel 2007 was used to perform descriptive statistical analyses of the data. The average age was presented as the mean ± standard deviation (SD). To evaluate the differences, the chi-square test was performed using SPSS for Windows, version 21.0. A p value of less than 0.05 was considered significant.

Patient and Public Involvement: patients and/or the public were not involved.

3 Results

A total of 5,375 cases of poisoning (age ≥11 years of age) from 829,808 entries were obtained from the HIS from 1 January 2012 to 31 December 2016. Of these, 366 were identified as animal bites (10) and chronic poisoning events, leaving a total of 5009 unique cases that met our criteria. These cases comprised 0.6% of all emergency admissions. Descriptive information including age, gender, type and route of exposure, place of residence, length of hospital stay, and outcome of the poisoned patients are summarized in Table 1.

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Table 1 Demographic characteristic of poisoned patients admitted to ED from 2012 to 2016.

Variables categories	N	%
Age group		
11~19	557	11.1
20~29	1547	30.9
30~39	1094	21.8
40~49	817	16.3
50~59	575	11.5
60~69	267	5.3
⩾70	152	3.0
Gender		
Male	2296	45.8
Female	2713	54.2
Type for exposure		
Suicidal	2842	56.7
Abusive	1105	22.1
Accidental	1017	20.3
Unknown	45	0.9
Route of exposure		
Ingestion (oral)	4316	86.1
Inhalation (nasal)	590	11.8
Contact (dermal)	98	2.0
Other	5	0.1
Place of residence		
Urban	2415	48.2
Rural	2568	51.3
Unknown	26	0.5
Length of hospital stay		
<48h	367	7.3
<1week	3219	64.3
>1week	1423	28.4
Outcome		
Recovery	1416	28.3
Relative recovery	3255	65.0
Referral to other center	198	3.9
Left against medical advice	76	1.5
Death	64	1.3
Total	5009	100.0

3.1 Age and gender

For peer review only

Of the 5009 cases included, 2713 (54.2%) were recognized as female, and 2296 (45.8%) were determined as male, and the ratio of male to female was 1:1.18. In this study, the youngest patient was 11 years old, while the oldest patient was 92 years old. The mean age of all patients was 36.0 ± 15.1 years. The mean age of male and female patients was 36.4 ± 15.0 years and 35.7 ± 15.3 years, respectively. The most vulnerable patients were aged 20-29 years (30.9% of cases), followed by patients aged 30-39 years (21.8% of cases) and 40-49 years (16.3% of cases) (Figure 1). There was a statistically significant gender difference (male and female) between the different age groups of poisoned patients (χ^2=28.19, p<0.001).

The predominant group of toxic agents consumed by the 20-29 age group was therapeutic drugs (579 cases, 37.4% of poisonings in the 20-29 age group) (Table 2). Of these, sedatives/hypnotics (169 cases) plus analgesics (120 cases) accounted for over half. Alcohol and pesticides were ranked second and third, accounting for 27.7% and 19.6%, respectively. There was a statistically significant gender difference related to suicide and drug abuse in the 20-29 age group (χ^2=140.29, χ^2=167.69, p < 0.001). Most cases of intentional poisoning with 855 suicide attempts and 446 abuse cases were seen in young adults (20-29 years old). (Figure 2)

Table 2 Distribution of toxic agents consumed by 20-29 age-group people from 2012 to 2016

Toxic agents category	N	Group percentage	Total percentage	Direct percentage*
Therapeutic drugs	**579**	**100.0**	**37.4**	**35.4**
Sedatives & hypnotics	169	29.2	10.9	35.9
Analgesics	120	20.7	7.7	44.3
Mixed drugs	92	15.9	5.9	34.2
Cold and cough preparations	64	11.1	4.1	39.3
Antipsychotics	35	6.0	2.3	28.0
Cardiovascular drugs	22	3.8	1.4	19.6
Other drugs	29	5.0	1.9	30.2
Antimicrobials	27	4.7	1.7	41.5
Traditional Chinese medicine	21	3.6	1.4	32.8
Alcohol	**429**		**27.7**	**41.3**
Pesticides	**304**	**100.0**	**19.6**	**22.5**
Paraquat	133	43.8	8.6	20.7
Rodenticide	66	21.7	4.3	25.5
Organophosphate	45	14.8	2.9	19.4

For peer review only

Other	48	15.8	3.1	30.0
Unknown	12	3.9	0.8	22.2
Fumes/gases/vapors	**138**		**8.9**	**24.1**
Chemicals	**33**		**2.1**	**18.2**
Food	**16**		**1.0**	**18.2**
Other substance	**16**		**1.0**	**47.1**
Unknown	**35**		**2.3**	**34.3**
Total	***1550****		**100.0**	**30.9**

Direct percentage*: the ratio of the same toxic agent consumed by twenties people to all age-group people

1550*: Among 1550 cases, 3 cases were calculated tautologically for a combination of alcohol poisoning and other drugs poisoning.

3.2 Type of exposure

Table 3 lists the reasons for toxin exposure in these patients. It was noted that suicidal exposure occurred in the overwhelming majority of poisonings (2842, 56.7%), followed by abusive exposure (1105, 22.1%), accidental exposure (1017, 20.3%) and unknown reason (45, 0.9%). There was a significant gender difference in suicide and drug abuse: females were involved in more suicidal poisonings than males: 63.4% for females versus 36.6% for males (χ^2=226.09, p <0.001); poisoning due to drug abuse showed the opposite tendency: 70.8% for males versus 29.2% for females (χ^2=354.97, p<0.001). The main substances used were therapeutic drugs and pesticides for suicide attempts and alcohol for abuse. CO poisoning (~ 80% of cases) was the most common environmental poison, and pesticides poisoning (20%) was less common. Therapeutic drugs were taken mistakenly or in overdose by females.

For peer review only

1

Table 3 Type for exposure of all cases by gender

Type for exposure	Male		Female		Total		Chi-square test	
	N	%	N	%	N	%	$\chi 2$	*p*
Suicidal	1040	45.3	1802	66.4	2842	56.7	**226.086**	**0.000**
Abusive	782	34.1	323	11.9	1105	22.1	**354.968**	**0.000**
Accidental:	451	19.6	566	20.9	1017	20.3	1.143	0.285
Environmental	303	13.2	387	14.3	690	13.8	1.622	0.203
Misuse	97	4.2	106	3.9	203	4.1	0.323	0.570
Food poisoning	35	1.5	53	2.0	88	1.8	1.327	0.249
Adverse reaction	16	0.7	20	0.7	36	0.7	0.028	0.866
Unknown:	23	1.0	22	0.8	45	0.9	0.509	0.476
Subtotal	2296	100.0	2713	100.0	5009	100.0		

For peer review only

3.3 Route of exposure

Among the various routes of exposure, ingestion was the most common (86.2 %), followed by inhalation (11.8%) and contact (2.0%).

3.4 Common Substances in Human Exposures

The most prevalent substance categories are shown in Table 4 and are listed by frequency of exposure in these patients. This ranking shows the direction in which prevention efforts should be focused, as well as the types of poisonings our hospital regularly manages. The four most common toxic agent groups in decreasing order were therapeutic drugs, pesticides, alcohol, fumes/gases/vapors, 676 (13.5%) patients consumed two or more toxic agents. However, with regard to specific substances, alcohol, paraquat, CO and sedatives/hypnotics were the four main toxic agents.

For peer review only

Table 4 The distribution of toxic agent over the five years.

Toxic agent category	2012		2013		2014		2015		2016		Total		
	N	%	N	%	N	%	N	%	N	%	N	%	Total %
Therapeutic drugs	**303**	**100.0**	**394**	**100.0**	**326**	**100.0**	**310**	**100.0**	**304**	**100.0**	**1637**	**100.0**	**32.6**
Sedatives & hypnotics	101	33.3	141	35.8	79	24.2	68	21.9	82	27.0	471	28.8	9.4
Analgesics	50	16.5	67	17.0	62	19.0	53	17.1	39	12.8	***271****	16.6	5.4
Mixed drugs	42	13.9	63	16.0	53	16.3	52	16.8	59	19.4	269	16.4	5.4
Cold and cough preparations	31	10.2	26	6.6	37	11.4	42	13.6	27	8.9	163	10.0	3.2
Psychotropics	16	5.3	23	5.8	23	7.1	27	8.7	36	11.8	125	7.6	2.5
Cardiovascular drugs	15	5.0	27	6.9	22	6.8	26	8.4	22	7.2	112	6.8	2.2
Other drugs	16	5.3	21	5.3	24	7.4	20	6.5	15	4.9	96	5.9	1.9
Antimicrobials	19	6.3	12	3.1	15	4.6	8	2.6	11	3.6	65	4.0	1.3
Traditional Chinese medicine	13	4.3	14	3.6	11	3.4	14	4.5	13	4.3	65	4.0	1.3
Pesticides	**241**	**100.0**	**280**	**100.0**	**308**	**100.0**	**272**	**100.0**	**248**	**100.0**	**1349**	**100.0**	**26.9**
Paraquat	97	40.2	134	47.9	149	48.4	141	51.8	123	49.6	644	47.7	12.8
Rodenticide	50	20.7	55	19.6	60	19.5	49	18.0	45	18.2	259	19.2	5.2
Organophosphate	56	23.2	44	15.7	48	15.6	46	16.9	38	15.3	232	17.2	4.6
Other	24	10.0	33	11.8	42	13.6	28	10.3	33	13.3	160	11.9	3.2
Unknown	14	5.8	14	5.0	9	2.9	8	2.9	9	3.6	54	4.0	1.1
Alcohol	**203**		**227**		**226**		**182**		**201**		**1039**		**20.7**
Fumes/gases/vapors	**70**		**144**		**103**		**119**		**136**		**572**		**11.4**
Chemicals	**25**		**47**		**46**		**32**		**31**		**181**		**3.6**
Food	**20**		**9**		**15**		**35**		**9**		**88**		**1.8**
Other substance	**8**		**11**		**7**		**10**		**14**		**50**		**1.0**
Unknown	**22**		**24**		**17**		**19**		**20**		**102**		**2.0**
Subtotal	**892**		**1136**		**1048**		**979**		**963**		***5018****		**100.0**

For peer review only

271*：Including 13 cases of opioids poisoning.

5018*: 9 cases were calculated tautologically, of which 7 cases had a combination of alcohol poisoning and other drugs poisoning, and 2 cases had a combination of CO poisoning and other drugs poisoning.

3.4.1Therapeutic drug categories

Therapeutic drug poisoning showed a slight decrease during the five-year study despite a high number in 2013. A total of 1637 cases had therapeutic drug poisoning. Of these cases, 28.8% involved sedatives/hypnotics poisoning, which were the most commonly used drugs, followed by analgesics (16.6%) (including 13 cases of opioids poisoning) and cold and cough preparations (10.0%). Mixed drug poisoning was found in approximately 16.4% of patients. The rate of psychotropics poisoning increased over the five year period. Cardiovascular drugs, antimicrobials, traditional medicine and other drugs showed a relatively stable trend. Drug poisoning was more common in both males and females aged 20-29 years attempting suicide (Figure 3). However, drug poisoning was significantly more frequent in females than males (71.9% vs. 28.1%).

3. 4.2 Pesticide categories

Pesticide poisoning showed an increasing trend from 2012 to 2015 but decreased in 2016. A total of 1349 cases were observed to have pesticide poisoning. Of these cases, the predominant pesticide poison taken was paraquat (47.7% of cases), followed by rodenticide (19.2%), organophosphate (17.2%) and other pesticides (11.9%). A slightly higher number of males (683 cases) than females (666 cases) had pesticide poisoning. With regard to the distribution of age and gender in pesticide poisoning, there were two peaks, one in the 20-29 year old group and the other in the 40-49 year old group for both males and females (Figure 4). Eighty-eight percent of pesticide poisonings were with suicide attempts, and males were involved in 5% more accidental pesticide poisonings than females. Pesticide poisoning was most frequent during the month of July.

3.4.3 Alcohol and Fumes/gases/vapors

There was a stable trend in alcohol poisoning. Alcohol poisoning was

For peer review only

predominant in males and was ~2.5 times higher in males than in females. Alcohol poisoning was more prevalent in the 20-29 year old group than in any other age group. (Figure 5) In addition, <1% of alcohol poisoning cases were found to be affected by other poisonings. Fumes/gases/vapors poisoning displayed an increasing trend, even though there was a decrease from 2013 to 2014. Of these cases, carbon monoxide poisoning was the dominant toxic agent. Carbon monoxide poisoning was more common in the 20-39 year old group and in females. The majority of CO poisoning events occurred in winter.

3.5 Treatment and Outcome

It was noted that gastric lavage and activated charcoal were administered in 72.5% (n=3634) cases and 64.8% (n=3244) cases, respectively, to prevent absorption of toxic agents. Some 7.7% of cases (n=385) received hemodialysis treatment. All patients with organophosphorous poisoning (n=232) were treated with atropine and pralidoxime. In addition, hyperbaric oxygen therapy for CO poisoning was performed in all cases (n=556).

A total of 4945 patients were discharged from the hospital, including 1416 cases with complete recovery, 3255 cases with relative recovery, 347 cases were referred to another institution, and 253 cases left hospital during treatment. The hospital mortality rate was 1.3% with 64 deaths including 36 females and 28 males. The fatality ratio was 1.3% for female patients and 1.2% for male patients. More than half of the fatality cases (n=33) occurred in the 40-59 age group. Sixty-eight percent of the patients who died lived in urban areas. Death was due to suicide attempt in 51 cases, accidental poisoning in 11 cases, and in two cases, the type of poisoning was unknown. The associated agents involved in death were paraquat (33 cases), therapeutic drugs (16 cases), organophosphate (6 cases), food poisoning (4 cases), CO poisoning (2 cases), alcohol (1 case) and two cases with unidentified poisons.

3.6 Comparison with Previous Findings

The female-to-male ratio was 1.5:1 in a previous study and 1.18:1 in the present study. Similar to the previous report; the most vulnerable patients were aged 20-29 years, but the percentage in the previous study was 37.1% which was higher than that

For peer review only

in our study. The major route of exposure was ingestion in both studies (86.2% in our study and 81.8% in the previous study). With regard to the type of exposure, suicide attempt accounted for 69.6% and accidental exposure accounted for 29.7% in the previous study, higher than our findings. The most common toxic agents were the same in both studies, therapeutic drugs, followed by pesticides, alcohol and CO (41.40%, 15.2%, 14.1%, 12.5% in the previous study and 32.6%, 26.9%, 20.7%, 11.4% in this study). The major medicine was sedatives/hypnotics (27.5%) and the major pesticide was organophosphates (8.0%) in the previous study. The major toxic agents were sedatives/hypnotics (9.4%) and the major pesticide was paraquat (12.8%) in this study. The average mortality rate was 1.0% and 1.3%, respectively.

4. Discussion

Acute poisoning is one of the most frequent causes of visits to the ED and is a threat to public health. The annual rate of ED visits associated with poisoning varies widely across the world, and ranges from 0.07% to 0.7%.[18,19] Studies in western countries have reported annual rates of ED visits associated with poisoning of approximately 0.26%.[19,20] In the present study, this rate was 0.60%, and a similar percentage (0.64%) was seen in the research carried out by Bulent.[21] As it is not common practice for many poisoned patients to seek medical help in health care institutions, the annual rate of ED visits associated with poisoning recorded by hospitals may be misleading. Therefore, the actual number of poisoning cases may be more than that recorded, and accurate statistical data for poisonings are difficult to estimate. Developed countries also have similar problems in obtaining meaningful poisoning statistics even though they are equipped with advanced systems to collect population health data. [22]

This study concluded that the incidence of poisoning in females was slightly higher than that in males, especially among young adults aged 20-29 years, with a female-to-male ratio of 1.18:1. Similar findings have also been reported in Beijing, China [23] (1.23:1) and Sari, Iran [17] (1.16:1). In contrast, male preponderance has been found in some other countries.[24, 25] The possible explanation for the high number of

For peer review only

poisonings in females is that they may suffer a higher level of stress and depressive symptoms when compared to males, which can lead to overreactions.[26-28]

The results of this study showed a difference in poisoning based on age and indicated that the most affected age group was the 20-29 year age group (30.8%) with a secondary peak in the 30-39 year old group (21.9%). Both intentional and accidental poisoning were common in males and females aged 20-29 years, which is consistent with previous findings in China[16,23] and in other countries[29-31]. The fact that poisoning is more common among young adults reflects their vulnerability to stress, possibly due to failure or frustration in love or exams, maladjustment and inability to cope with the high expectation of parents.[32,33] Overall, this group of people is not emotionally stable or mature enough to tolerate extreme mental or physical pressure.[34,35]

Intentional poisoning (suicide+abuse) was the predominant cause of poisoning (78.8%) in the current study, an observation that is consistent with that in other studies.[30,36] Our study indicated that of all poisoning cases, a large proportion were suicidal in nature, but the incidence was lower compared with the previous study. This change may be related to the benefits of socioeconomic achievement and prosperity, such as higher employment and more educational opportunities, which may have contributed to the reduction in suicide rates in China.[37] Despite this decline in suicide rate, suicide attempt is still the primary reason for poisoning due to the general belief that poisons terminate life with minimal suffering.[38,39].

Our study demonstrated that therapeutic drugs were the most frequently used toxic agents. A similar pattern of therapeutic drugs as the most common cause of acute poisoning has been observed in developed and some developing countries.[40-45] With regard to the subgroup of therapeutic drugs in poisoning cases, sedatives/hypnotics were common in Taiwan, Hong Kong, Iran and Finland, while analgesics were the most frequently ingested drugs in Turkey and the USA. Pharmaceutical poisoning comprised 32.6% of the various drug poisonings observed in the present study, of which sedatives/hypnotics (28.8%) were the most frequently ingested agents. A similar pattern was also seen in the previous study, although an

For peer review only

apparent decline in sedatives/hypnotics poisoning was seen in our study.[16] This decline may be connected with the implementation of drug classification control where patients can only access these drugs with a doctor's prescription.[46] However, a rise was observed in the use of analgesics, cold and cough medicines, mixed drugs, as well as cardiovascular drugs, resulting in a different pattern to that seen previously. This may be explained by the easy availability of pharmaceuticals due to the numerous drugstores in China, inadequate supervision of government, insufficient knowledge about rational use of analgesics,[47] increase in the incidence of cardiovascular disease,[48] poor psychological well-being and mental fragility among populations.[49] In addition, we found that the frequency of psychotropic drugs poisonings had increased, which indicated that mental disorder played a part in poisoning events and should receive attention. It is noteworthy that the number of opioid poisonings is surprisingly small in our study, and this is associated with government's strict regulation on opiods, insufficient knowledge on opioids in physicians and patients (such as excessive worry about addiction and adverse events), making the use of opiods not-ubiquitous.[50, 51]

Pesticide poisoning has occurred relatively frequently for some time, as shown by previously published papers from different countries.[36, 39] The incidence of this type of poisoning varies geographically and historically.[52] Several studies conducted in India, Sri Lanka and Bangladesh showed a pesticide-dominant poisoning pattern, with organophosphates being the most common pesticide.[53-55] Pesticide was the second leading cause of acute poisoning in this study, accounting for 26.6% of all poisoning cases and showed an increased frequency.[16] There are two reasons for this increased frequency: first, suicide by pesticide poisoning is still high in China, although suicides related to pesticide poisoning in China have continuously declined from 2006 to 2013.[56] Previous studies have shown that highly lethal pesticides are commonly used in suicide in rural China.[57,58] Our study showed that up to 88% of pesticide poisonings were suicide attempts. Second, pesticides are used extensively and unsafely in agriculture, industry, and home storage causing toxicity due to intentional and accidental exposure.[58] The quantity of pesticide use is large and

For peer review only

ever-increasing, and has grown from 1.28 million ton in 2001 to 1.81 million ton in 2014.[59] In the present study, paraquat was the most frequently used pesticide, and a similar pattern was found in a study carried out in northeast China which showed an increasing trend, [60] whereas a decreasing trend was found in Korea. [61]

Not surprisingly, our study found that alcohol poisoning was common and accounted for 20.7% of all poisoning cases. The incidence of alcohol poisoning increased compared to previous figures. This change can be explained by rapid social and economic development, urbanization, increased alcohol production, and alcoholic beverage commercials in the mass media, which have all led to an increase in alcohol consumption.[62] According to recent data, the annual per-capita alcohol consumption in Chinese adults in 2012 was 3 L.[63] Findings reported elsewhere in China showed a higher number of alcohol poisonings.[64] Alcohol poisoning in other countries has been shown to be lower.[41,65-67] This discrepancy is partially related to the disparity in alcohol consumption habits between different countries and districts. In Chinese culture, people often urge companions to drink as much as possible so that they can construct social connections and establish a happy and congenial atmosphere.[68] This can also explain the gender difference in poisonings, as males are more engaged in social intercourse than females. In addition to widely practiced social drinking, solitary drinking is also common for stress reduction and coping among Chinese.[69]

The current data showed that the fourth leading cause of acute poisoning was fumes/gases/vapors (mainly CO), which decreased from 12.5% to less than 11.4% despite remaining in fourth place. This reduction is related to the improvement in dwelling conditions and preventive education on CO poisoning. With improvements in heating measures and advances in the fuel switching project from coal to natural gas in rural areas, a further decline in CO poisoning is expected in rural areas in China. There was a significant association between residency and month and reason for exposure to CO. Rural residents are more susceptible to CO poisoning than urban citizens, as local residents in remote villages in northern China use stoves to keep warm in winter, which can result in gas leaks due to a chimney jam and lack of ventilation, and are common causes of CO poisoning in these areas. In contrast, CO

For peer review only

poisoning in urban citizens may be explained by eating barbecued food and hotpot, a well-known traditional Chinese cuisine and both require charcoal as fuel.[70] In addition, almost all CO poisoning cases in our study were accidental with the exception of one case which was a suicide.

In our study, the rate of patients staying in hospital for less than 48 h is small compared with other studies. This was due to patients with poisoning usually being asked to remain in the observing room (available in our ED) for 48 h to 72 h in consideration of the complex doctor-patient environment in China.

Our study was primarily limited by its retrospective nature, which resulted in missing patient data. Another limitation was that the data from a single centre teaching hospital-based study, even with three branches, may not reflect the precise situation in this region. Hence, extensive data collection and analysis from other general hospitals in the region may depict the regional poisoning pattern more accurately. In addition, the comparison between two studies was rough du to the absence of data standardization.

5. Conclusion and Suggestions

The present data provide additional insight into the epidemiology of acute poisoning in Shenyang. The findings demonstrated that more females than males had acute poisoning and the most vulnerable age group was the young-adult group aged 20-29. We also observed that the majority of poisoning cases were intentional, particularly suicidal in nature, and accidental poisonings were non-negligible. Our study indicated that therapeutic drugs were the most commonly used toxic agent group, followed by pesticides, alcohol and noxious gas. In addition, the pattern of acute poisoning was slightly altered when compared with 10 years ago. Poisoning due to analgesics and cold and cough preparations was more frequent than poisoning due to psychotropics in the therapeutic drugs poisoning group. In addition, poisoning due to paraquat and rodenticide exceeded poisoning due to organophosphate in the pesticide poisoning group.

Some suggestions are proposed based on the present study and include the

For peer review only

following: First, vulnerable groups such as females and young adults deserve special consideration due to their weak coping capacity;[37] Further investment is required to promote public health education on the rational use and safe storage of toxic agents as well as self-protection to reduce accidental poisoning.[7] The upward trend in the prevalence of alcohol and drug use should receive increasing attention. Patients who attempt suicide must undergo psychiatric consultation as soon as possible. Early psychiatric consultation and identification may minimize the risk of further self-harm in suicidal cases.[71] Lastly, relevant policies and regulations should be formulated and initiated immediately to restrict access to toxic agents, especially pesticides due to their high toxicity.[72]

For peer review only

Acknowledgment

Contributors: TG Li developed and directed the study. NN Wang conceived and designed the survey questions on poisoning. BX Yu coordinated data collection and carried out data cleaning. YJ Zhang performed the statistical analysis and drafted the manuscript. All authors drafted, edited and approved the final manuscript.

Ethical approval: Research ethical approval was obtained from Shengjing hospital institutional ethics committee before the study commences.

Funding: This work was supported by the National nature science foundation of China (No. 81301627 and No.81500628) .We would like to appreciate the staff of library for their contribution in providing language help.

Competing interests: The Authors declare that there is no conflict of interest.

Data sharing statement: No additional data sharing available.

References

1. Kalseen CD, Andur MO, Doull J. Casarett and Doull's Toxicology. Newyork: Macmillan, 1986:10-17.
2. Senarathna L, Buckley AN, Jayamann a SF, et al. Validity of referral hospitals for the toxicovigilance of acute poisoning in Sri Lanka.[J] Bull World Health Organization, 2012, 90(6):401–76.http://dx.doi.org/10.2471/BLT.11.092114

3. Güloğlu C, Kara IH. Acute poisoning cases admitted to a university hospital emergency department in Diyarbakir, Turkey. Human and Experimental Toxicology, 2005, 24(2):49-54.http://dx.doi.org/10.1191/0960327105ht499oa
4. Eddleston M. Patterns and problems of deliberate self-poisoning in the developing world [J]. Qjm Monthly Journal of the Association of Physicians, 2000, 93(11):715-731. https://doi.org/10.1093/qjmed/93.11.715
5. Gunnell D, Eddleston M, Phillips M R, et al. The global distribution of fatal pesticide self-poisoning: Systematic review[J]. BMC Public Health, 2007, 7(1):357. https://doi.org/10.1186/1471-2458-7-357
6. SM Shah, PD Asari, J Amin. CLINICO-EPIDEMIOLOGICAL PROFILE OF PATIENTS PRESENTING WITH ACUTE POISONING.[J] IJCRR. 2016; 8(13): 35-41
7. Konradsen F, Van d H W, Cole D C, et al. Reducing acute poisoning in developing countries--options for restricting the availability of pesticides.[J]. Toxicology, 2003, 192(2-3):249.http://dx.doi.org/10.1016/S0300-483X(03)00339-1
8. Yumeng Tang, MS, Lan Zhang, et al. Unintentional Poisoning in China, 1990 to 2015: The Global Burden of Disease Study 2015.[J] AmJ Public Health. 2017; 107:1311–1315. http://dx.doi.org/10.2105/AJPH.2017.303841
9. Liu QH, Jiang DF. Research Status of Acute Poisoning in China.[J] Journal of Occupational Health and Damage, 2011; 26:238–9. (inChinese). https://dx.doi.org/10.3969/j.issn.1006-172X.2011.04.016
10. Zhang J, Xiang P, Zhuo X, et al. Acute poisoning types and prevalence in Shanghai, China, from January 2010 to August 2011.[J]. Journal of Forensic Sciences, 2014, 59(2):441-6. http://dx.doi.org/10.1111/1556-4029.12334
11. Zhang M, Fang X, Zhou L, et al. Pesticide poisoning in Zhejiang, China: a retrospective analysis of adult cases registration by occupational disease surveillance and reporting systems from 2006 to 2010[J]. BMJ Open, 2013, 3(11):e003510. http://dx.doi.org/10.1136/bmjopen-2013-003510
12. Wang B S, Chen L, Li X T, et al. Acute Pesticide Poisoning in Jiangsu Province, China, from 2006 to 2015[J]. Biomed Environ Sci, 2017, 30(9):695-700.

For peer review only

https://dx.doi.org/10.3967/bes2017.094

13. Ge XM, Jiang DF, Liu QH. Epidemiological study on 6011 cases of the acute poisoning during 2005～2009 year in Guangxi[J]. Chinese Journal of New Clinical Medicine, 2011,4(8):699-701. (in Chinese) https://dx.doi.org/10.3969/j.issn.1674-3806.2011.08.02
14. The 2010 population census of the People's Republic of China. Available at: http://www.stats.gov.cn/tjsj/pcsj/rkpc/6rp/indexch.htm
15. Chataut J, Adhikari R K, Sinha N P, et al. Pattern of organophosphorous poisoning: a retrospective community based study.[J]. Kathmandu University Medical Journal, 2011, 9(34):31.
16. Zhao M, Ji XP, Wang NN, Liu SY, Wang YZ. Study of poisoning pattern at China Medical University from 1997 to 2007.[J] Public Health,2009,123:454–5. https://doi.org/10.1016/j.puhe.2009.04.010
17. Ahmadi A, Pakravan N, Ghazizadeh Z. Pattern of acute food, drug, and chemical poisoning in Sari City, Northern Iran.[J]. Human and Experimental Toxicology, 2010, 29(9):731-738.http://dx.doi.org/10.1177/0960327110361501
18. Hanssens Y, Deleu D, Taqi A. Etiologic and demographic characteristics of poisoning: a prospective hospital-based study in Oman. Journal of Toxicology Clinical Toxicology, 2001, 39: 371? / 80.http://dx.doi.org/10.1081/CLT-100105158
19. Thomas SH, Bevan L, Bhattacharyya S, et al. Presentation of poisoned patients to accident and emergency departments in the north of England.[J] Human and Experimental Toxicology, 1996, 15[6]:466–470.http://dx.doi.org/10.1177/096032719 60500602
20. McCaig L F, Burt C W. Poisoning-related visits to emergency departments in the United States 1993–1996.[J]. Journal of Toxicology Clinical Toxicology, 1999, 37(7): 817–826.http://dx.doi.org/10.1081/CLT-100102460
21. Ergun B, Cevik A A, Ilgin S, et al. Acute drug poisonings in Eskisehir, Turkey: A retrospective study [J]. Turkish Journal of Pharmaceutical Sciences, 2013, 10(2):303-312.

For peer review only

22. Meredith T J. Epidemiology of poisoning [J]. Pharmacology and Therapeutics, 1993, 59(3):251-6.http://dx.doi.org/10.1016/0163-7258(93)90069-P

23. Zhigang Z, Peiyi Z, Jianming G. Epidemiological analysis of 560 cases of acute poisoning. Beijing Med 2007;29:708–19.(in Chinese) https://dx.doi.org/10.3969/j.issn.0253-9713.2007.12.017

24. Thalappilli MC, Jimmy A. A profile of acute poisonings: A retrospective study[J]. Journal of the Scientific Society, 2015, 42(3):156-160.http://dx.doi.org/10.4103/0974-5009.165547

25. Malangu N. Acute poisoning at two hospitals in Kampala-Uganda. Journal of Forensic Legal Medicine, 2008,15(8):489-92.http://dx.doi.org/10.1016/j.jflm.2008.04.003

26. Matud M P. Gender differences in stress and coping styles.[J]. Personality & Individual Differences, 2004, 37(7):1401-1415. http://dx.doi.org/10.1016/j.paid.2004.01.010

27. Sandanger I, Nygård J F, Sørensen T, et al. Is women's mental health more susceptible than men's to the influence of surrounding stress?[J]. Soc Psychiatry Psychiatr Epidemiol, 2004, 39(3):177-184. http://dx.doi.org/10.1007/s00127-004-0728-6

28. Peter R, March S, Du P J. Are status inconsistency, work stress and work-family conflict associated with depressive symptoms? Testing prospective evidence in the lidA study[J]. Social Science & Medicine, 2016, 151:100. https://doi.org/10.1016/j.socscimed.2016.01.009

29. Nair PK, Revi NG. One-Year Study on Pattern of Acute Pharmaceutical and Chemical Poisoning Cases Admitted to a Tertiary Care Hospital in Thrissur, India. Asia Pac J Med Toxicol,2015,4:79-82.

30. Ramesha KN, Rao KB, Kumar GS. Pattern and outcome of acute poisoning cases in a tertiary care hospital in Karnataka, India. Indian Journal of Critical Care Medicine, 2009, 13:152-5.http://dx.doi.org/10.4103/0972-5229.58541.

31. Bari MS, Chakraborty SR, Alam MMJ, et al. Four-Year Study on Acute Poisoning Cases Admitted to a Tertiary Hospital in Bangladesh: Emerging Trend of

For peer review only

Poisoning in Commuters. Asia Pac J Med Toxicol 2014;3:152-6

32. Fergusson D M, Woodward L J, Horwood L J. Risk factors and life processes associated with the onset of suicidal behaviour during adolescence and early adulthood.[J]. Psychological Medicine, 2000, 30(1):23. http://dx.doi.org/10.1017/S003329179900135X
33. Zhao CJ, Dang XB, Su XL, et al. Epidemiology of Suicide and Associated Socio-Demographic Factors in Emergency Department Patients in 7 General Hospitals in Northwestern China[J]. Medical Science Monitor International Medical Journal of Experimental & Clinical Research, 2015, 21:2743-2749. http://dx.doi.org/10.12659/MSM.894819
34. Zhang J, Jia CX. Suicidal intent among young suicides in rural China.[J] Arch Suicide Res,2011,15(2):127–139.http://dx.doi.org/10.1080/13811118.2011.565269
35. Cash SJ, Bridge JA. Epidemiology of youth suicide and suicidal behavior. Curr Opin Pediatr,2009, 21(5):613–619. http://dx.doi.org/10.1097/MOP.0b013e32833063e1
36. Bundotich JK, Gichuhi MM. Acute poisoning in the Rift Valley Provincial General Hospital, Nakuru, Kenya: January to June 2012[J]. Official Journal of the South African Academy of Family Practice/primary Care, 2015, 57(3):1-5. http://dx.doi.org/10.1080/20786190.2014.97544
37. Wang C W, Chan C L W, Yip P S F. Suicide rates in China from 2002 to 2011: an update[J]. Social Psychiatry & Psychiatric Epidemiology, 2014, 49(6):929-941. http://dx.doi.org/10.1007/s00127-013-0789-5
38. Thomas M, Anandan S, Kuruvilla PJ, et al. Profile of hospital admissions following acute poisoning--experiences from a major teaching hospital in south India.[J]. Adverse Drug Reactions and Toxicological Reviews, 2000, 19(4):313-7.: http://dx.doi.org/10.1258/td.2011.110398
39. Tufekci IB, Curgunlu A, Sirin F. Characteristics of acute adult poisoning cases admitted to a university hospital in Istanbul [J]. Human and Experimental Toxicology, 2004, 23(7): 347-51.http://dx.doi.org/10.1191/0960327104ht460oa
40. JB Mowry, DA. Spyker, DE Brooks, et al. 2014 Annual Report of the American

For peer review only

Association of Poison Control Centers' National Poison Data System (NPDS): 32nd Annual Report.[J] Clinical Toxicology, 2015, 53:10, 962-1147. http://dx.doi.org/10.3109/15563650.2015.1102927

41. Lapatto-Reiniluoto O, Kivistö K T, Pohjola-Sintonen S, et al. A prospective study of acute poisonings in Finnish hospital patients [J]. Human and Experimental Toxicology, 1998, 17(6):307-11.http://dx.doi.org/10.1177/096032719801700604
42. Moradi M, Ghaemi K, Mehrpour O. A hospital base epidemiology and pattern of acute adult poisoning across Iran: a systematic review[J]. Electronic Physician, 2016, 8(9):2860-2870. http://dx.doi.org/10.19082/2860
43. Kavalci C, Demir A, Arslan E D, et al. Adult Poisoning Cases in Ankara: Capital City of Turkey[J]. International Journal of Clinical Medicine, 2012, 03(7):736-739. http://dx.doi.org/10.4236/ijcm.2012.37A129
44. Lee H L, Lin H J, Yeh S Y, et al. Etiology and outcome of patients presenting for poisoning to the emergency department in Taiwan: a prospective study.[J]. Human & Experimental Toxicology, 2008, 27(5):373-379. http://dx.doi.org/10.1177/0960327108094609
45. Lam S M, Lau A C, Yan W W. Over 8 years experience on severe acute poisoning requiring intensive care in Hong Kong, China [J]. Human & Experimental Toxicology, 2010, 29(9):757-65. http://dx.doi.org/10.1177/0960327110361753
46. Liu CG, Jin F, Yuan GH. The History and Expectation of Classification Management of Drugs in China.[J] Chinese Journal of Pharmacovigilance,2013, 10(6):348-351. http://dx.doi.org/10.3969/j.issn.1672-8629.2013.06.009
47. Yu SY, Shang FF, Huang K.Status Quo and Countermeasures Research on Categorization Management of Medicine.[J] Chinese Pharmaceutical Affairs,2016, 30(1):32-34.http://dx.doi.org/10.16153/j.1002-7777.2016.01.005
48. Chen WW, Gao YL, Liu LS, et al. Summary of China cardiovascular disease report 2016. Chinese Circulation Journal, 2017, 32(6):521-530. http://dx.doi.org/10.3969/j.issn.1000-3614.2017.06.001
49. Wu P, Li L P, Jin J, et al. Need for mental health services and service use among high school students in China [J]. Psychiatric Services, 2012, 63(10):1026.

For peer review only

http://dx.doi.org/10.1176/appi.ps.201200090

50. Fang W, Liu T, Gu Z, et al Consumption trend and prescription pattern of opioid analgesics in China from 2006 to 2015. Eur J Hosp Pharm Published Online First: 27 January 2018. http://dx.doi.org/10.1136/ejhpharm-2017-001460
51. Wang JS, Pan SF. Analysis of current clinical survey of chronic non-cancer pain-relief and opioid：the Chinese subgroup report of ACHEON study. J Journal of Chinese Physician,2016,18(4):492-496.(in Chinese) http://dx.doi.org/10.3760/cma.j.issn.1008-1372.2016.04.003
52. Jeyaratnam J. Acute pesticide poisoning: a major global health problem.[J]. World health statistics quarterly. Rapport trimestriel de statistiques sanitaires mondiales, 1990, 43(3):139-144.
53. Jaiprakash H, Sarala N, Venkatarathnamma P N, et al. Analysis of different types of poisoning in a tertiary care hospital in rural South India[J]. Food & Chemical Toxicology An International Journal Published for the British Industrial Biological Research Association, 2011, 49(1):248-250. http://dx.doi.org/10.1016/j.fct.2010.10.026
54. Van Der Hoek W, Konradsen F: Analysis of 8000 hospital admissions for acute poisoning in a rural area of Sri Lanka. Clin Toxicol 2006, 44(3):225–231. http://dx.doi.org/10.1080/15563650600584246
55. Howlader M, Hossain M, Morshed M, et al. Changing Trends of Poisoning in Bangladesh[J]. Journal of Dhaka Medical College, 2011, 20(1):51-56
56. Page A, Liu S, Gunnell D, et al. Suicide by pesticide poisoning remains a priority for suicide prevention in China: analysis of national mortality trends 2006–2013[J]. Journal of Affective Disorders, 2016, 208:418.https://doi.org/10.1016/j.jad. 2016.10.047.
57. Zhang J, Xu HL. The effects of religion, superstition, and perceived gender inequality on the degree of suicide intent: a study of serious attempters in China. Omega: Journal of Death and Dying. 2007, 55(3):185–197. http://dx.doi.org/10.2190/OM.55.3.b
58. Zhang X, Li HS, Zhu QH, Zhou J, Zhang S, Zhang L, Sun CY. Trends in suicide

For peer review only

by poisoning in China 2000–2006: age, gender, method, and geography. Biomedical and Environmental Sciences.2008; 21:253–256.http://dx.doi.org/10.1016/S0895-3988(08) 60038-0

59. Wang J, Li Y, Wang X, et al. Status Quo of Pesticide Use in China and Its Outlook [J]. Agricultural Outlook, 2017, 13(2):56-60. https://dx.doi.org/10.3969/j.issn.1673-3908.2017.02.012
60. Zhang S, Zheng Q, Zhang PS, et al. Epidemiological study of 357 acute paraquate poisoning cases [J]. Chinese Journal of Health Statistics, 2013, 30(2):251-252.(in Chinese)
61. Lee JW, Hwang IW, Kim JW, et al. Common Pesticides Used in Suicide Attempts Following the 2012 Paraquat Ban in Korea [J]. Journal of Korean Medical Science, 2015, 30(10):1517-21.http://dx.doi.org/10.3346/jkms.201 5.30.10.1517.
62. Guan-Sheng MA, Zhu DH, Xiao-Qi HU, et al. The drinking practice of people in China. Ying Yang Xue Bao. 2005;27(5):362–365.(in Chinese) https://dx.doi.org/10.13325 /j.cnki.acta.nutr.sin.2005.05.003
63. National Health and Family Planning Commission of the People's Republic of China. China national nutrition and chronic disease status report [in Chinese]. 2015. Available at: http://www.nhfpc.gov.cn/jkj/s5879/201506/4505528e65f3460fb88685081ff158a2.shtml. Accessed December 15, 2016.
64. Yuan T, Fan Q, Tang X Z, et al. Analysis of acute poisoning in 640 cases[J]. Practical Clinical Medicine, 2009, 10(11):27-27. http://dx.doi.org/10.3969/j.issn.1009-8194.2009.11.010
65. Thapa SR, Lama P, Karki N, et al. Pattern of poisoning cases in Emergency Department of Kathmandu Medical College Teaching Hospital.[J]. Kathmandu University Medical Journal, 2008, 6(2):209-213.
66. M. Balai-Mood. Pattern of acute poisonings in Mashhad, Iran 1993-2000.[J]. Journal of Toxicology Clinical Toxicology, 2004, 42(7):965. http://dx.doi.org /10.1081 /CLT-200042550
67. Jayasinghe NRM, Foster JH. Deliberate self-harm/poisoning, suicide trends. The

link to increased alcohol consumption in Sri Lanka. Arch Suicide Research 2011, 15(3):223–237. http://dx.doi.org/10.1080/13811118.2011.589705

68. Li YC, Jiang Y, Zhang M, et al. Drinking behavior among men and women in China: the 2007 China Chronic Disease and Risk Factor Surveillance. Addiction. 2011; 106(11):1946–1956. http://dx.doi.org/10.1111/j.1360-0443.2011.03514.x
69. Hussong, A. Further refining the stress-coping model of alcohol involvement. Addict. Behav.2003,28, 1515–1522 https://doi.org/10.1016/S0306-4603 (03)00072-8
70. Xue J, Sun Q, Wang Y, et al. Features of Carbon Monoxide Poisoning in China[J]. Iranian Journal of Public Health, 2013, 42(10):1192-1193.
71. Linehan MM, Korslund KE, Harned MS et al. Dialectical behavior therapy for high suicide risk in individuals with borderline personality disorder: a randomized clinical trial and component analysis. JAMA Psychiatry, 2015; 72: 475–82 http://dx.doi.org/10.1001/jamapsychiatry.2014.3039
72. Gunnell D, Eddleston M, Phillips M R, et al. The global distribution of fatal pesticide self-poisoning: Systematic review[J]. Bmc Public Health, 2007, 7(1):357. http://dx.doi.org/10.1186/1471-2458-7-357

Fig. 1 Distribution of all poisoning cases by age and gender
Fig. 2 Intention for 20-29 age-group cases from 2012to 2016
Fig. 3 Distribution of therapeutic drugs poisoning by age and gender
Fig. 4 Distribution of pesticide poisoning by age and gender
Fig. 5 Distribution of alcohol and fumes poisoning by age and gender (A-Male means Alcohol poisoning for Male; F-Male means Fumes/gas/fog poisoning for Male.)

For peer review only

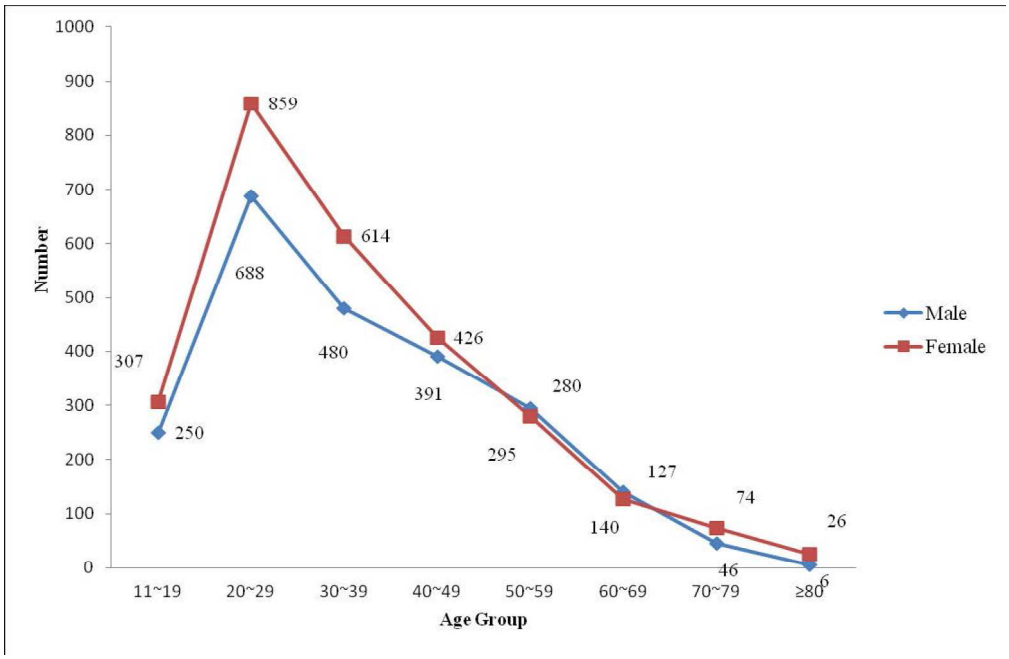


Fig. 1 Distribution of all poisoning cases by age and gender

188x122mm (300 x 300 DPI)

view only

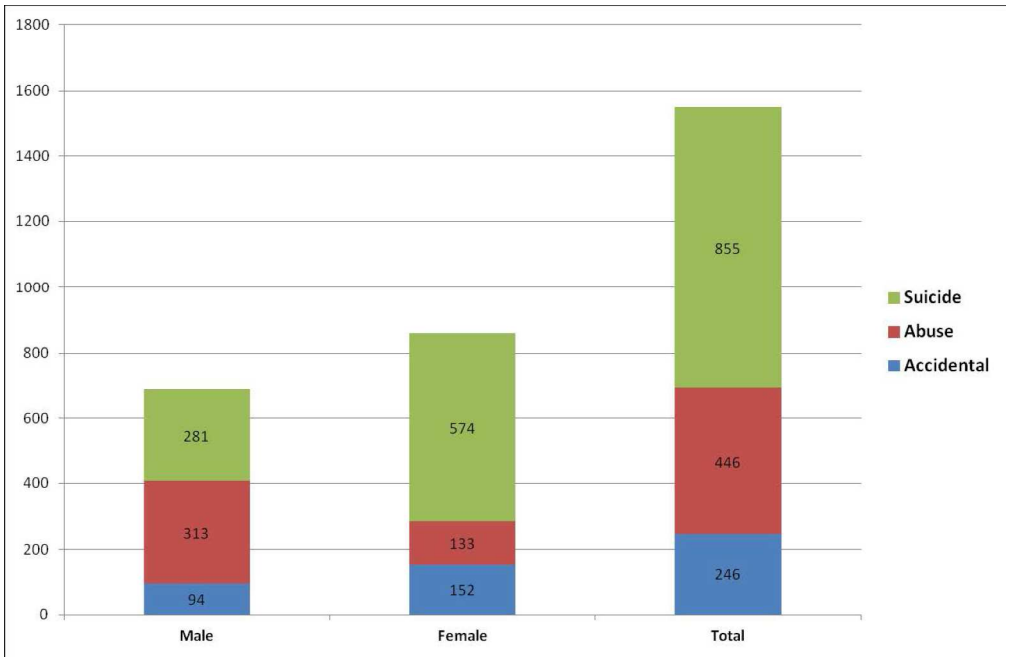


Fig. 2 Intention for 20-29 age-group cases from 2012to 2016

216x140mm (300 x 300 DPI)

view only

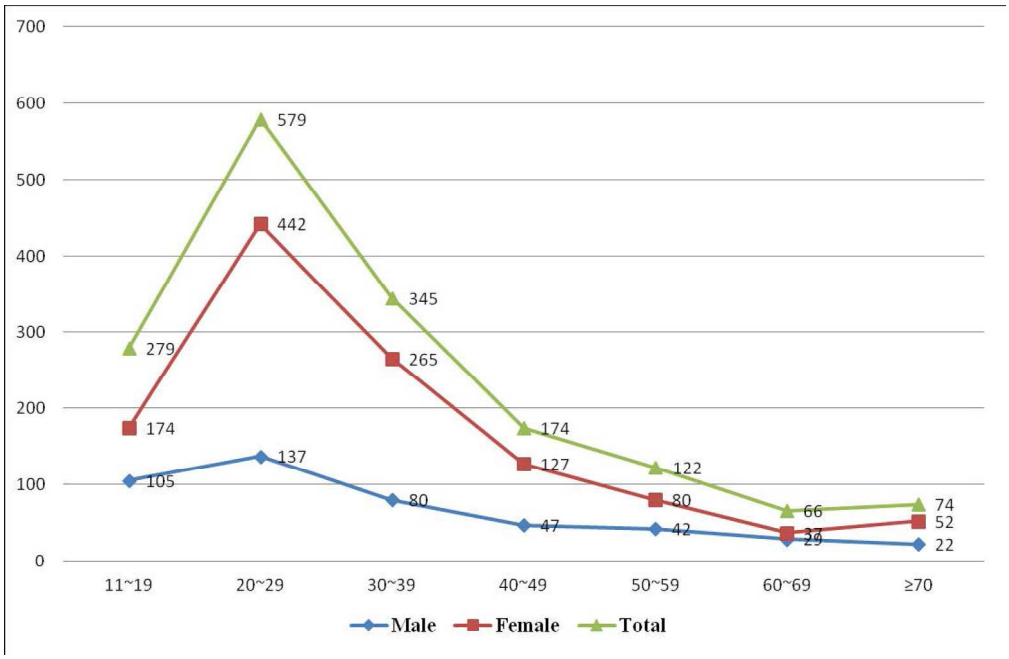


Fig. 3 Distribution of therapeutic drugs poisoning by age and gender

188x122mm (300 x 300 DPI)

view only

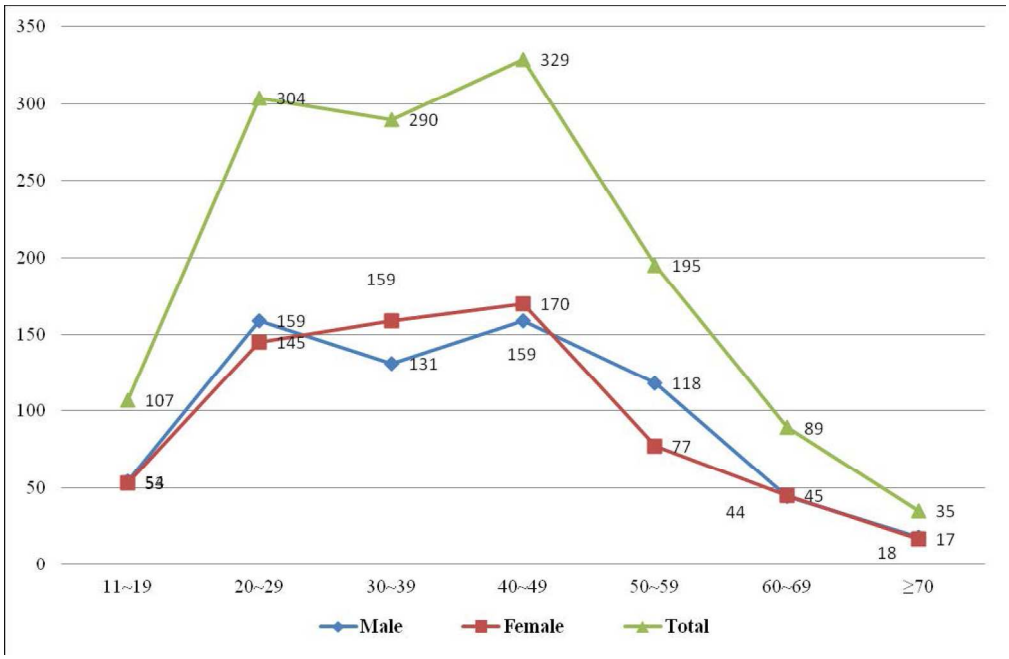
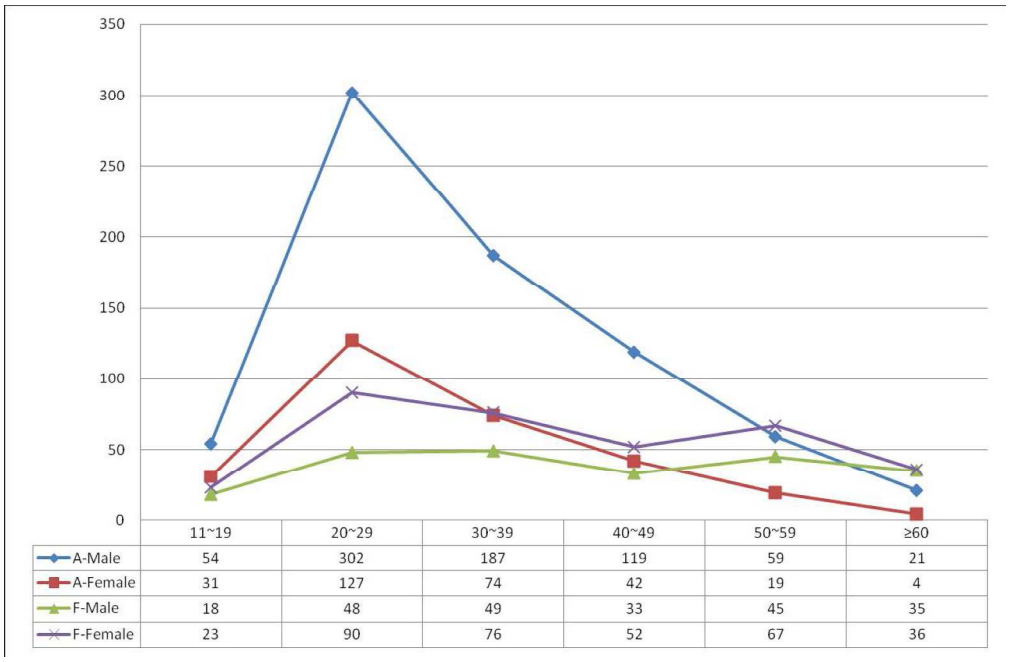


Fig. 4 Distribution of pesticide poisoning by age and gender

188x122mm (300 x 300 DPI)

view only



	11~19	20~29	30~39	40~49	50~59	≥60
A-Male	54	302	187	119	59	21
A-Female	31	127	74	42	19	4
F-Male	18	48	49	33	45	35
F-Female	23	90	76	52	67	36

Fig. 5 Distribution of alcohol and fumes poisoning by age and gender (A-Male means Alcohol poisoning for Male; F-Male means Fumes/gas/fog poisoning for Male.)

216x140mm (300 x 300 DPI)

For peer review only

BMJ Open

Acute poisoning in Shenyang, China: a retrospective and descriptive study from 2012 to 2016

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2018-021881.R4
Article Type:	Research
Date Submitted by the Author:	21-Jun-2018
Complete List of Authors:	Zhang, YaJie; Shengjing Hospital of China Medical University Yu, Boxin; Shengjing Hospital of China Medical University Wang, Nana; Shengjing Hospital of China Medical University Li, Tiegang; Shengjing Hospital of China Medical University,
Primary Subject Heading:	Emergency medicine
Secondary Subject Heading:	Emergency medicine, Epidemiology, Public health
Keywords:	Poisoning, Carbon Monoxide Poisoning, Pesticides, Paraquat, Suicide

SCHOLARONE™
Manuscripts

For peer review only

Acute poisoning in Shenyang, China: a retrospective and descriptive study from 2012 to 2016

Yajie Zhang,[1] Boxin Yu,[2] Nana Wang,[3] Tiegang Li[4,*]

1. Emergency Department, Shengjing Hospital of China Medical University, Shenyang 110004, China

2. Gerontology Department, Shengjing Hospital of China Medical University, Shenyang 110004, China

3. Endocrinology Department, Shengjing Hospital of China Medical University, Shenyang 110004, China

4. Emergency Department, Shengjing Hospital of China Medical University, Shenyang 110004, China

Corresponding author:

* Tiegang Li, M.D., Emergency Department, Shengjing Hospital of China Medical University, No. 36, Sanhao Street, Heping District, Shengyang, China, 110004

E-mail: litg@sj-hospital.org

For peer review only

Abstract

Objective: Up-to-date information on the patterns of acute poisoning is crucial for the proper management of poisoning events. The objective of this study was to analyze the characteristics of patients suffering acute poisoning admitted to the emergency department (ED) in a tertiary medical center in northeast China and to compare these characteristics with those of a previous comparable study.

Design: Retrospective and descriptive study.

Setting: Data were collected from the hospital information system in Shengjing Hospital, China from January 2012 to December 2016.

Participants: All cases aged ≥ 11 years old with a diagnosis of acute poisoning.

Results: In total, 5009 patients aged ≥11 years presented to the ED with acute poisoning during the study period. The average age of the patients was 36.0 ± 15.1 years and over half of the patients (52.7%) were in the age group 20–39 years. The ratio of females to males was 1.2:1. Patients with acute poisoning mainly lived in rural areas rather than urban areas. The majority of patients consumed poison as suicide attempts (56.7%). Males were more commonly poisoned by drug abuse than females, but females outnumbered males in suicidal poisoning. The most common form of poison intake was ingestion (oral intake; 86.2%).The five most common toxic agent groups in descending order were therapeutic drugs (32.6%), pesticides (26.9%), alcohol (20.7%), fumes/gases/vapors (11.4%), and chemicals (3.6%). Sedatives/hypnotics in the therapeutic drugs group and paraquat in the pesticides group were the most common toxic agents, respectively. The mortality rate of study participants was 1.3% with 64 deaths.

Conclusions: The results of this study indicate the need to strengthen education regarding management of the rational and safe use of drugs in Shenyang.

Keywords:

Poisoning; Carbon Monoxide Poisoning; Pesticides; Paraquat; Suicide

For peer review only

Strengths and limitations of this study:

The cross-sectional and retrospective study design included over 5,000 poisoning cases in 5 consecutive years.

Although the sample size in this study was large, its retrospective nature made it difficult to obtain complete information in all poisoning cases, which may have introduced bias.

Data from a single centre teaching hospital, even with three branches, may not reflect the precise situation in this region.

1 Introduction

Acute poisoning is defined as acute exposure (less than 24 h) to a toxic substance.[1] Acute poisoning is a major public and preventable health issue contributing to morbidity and mortality in many parts of the world. It is estimated that poisoning events are responsible for more than one million illnesses annually.[2,3] Low mortality contrasts with high morbidity in acute poisoning; however, patients who attempt suicide usually have higher mortality.[4-6] As the most common form of fatal self-harm in rural Asia, poisoning accounts for more than 60% of deaths.[7]

China is a developing country transitioning from an agricultural to an industrialized economy. In recent years, the number of acute poisoning cases in China has continued to increase,[8] and both poisoning and injury are now two of the top five causes of death.[9] Of the various types of poisoning, pesticide poisoning is the most common in most regions of China, while therapeutic drugs poisoning is the main type of poisoning in developed regions or cities, such as Shanghai.[9-13] Shenyang, is the provincial capital of Liaoning and the biggest city in Northeast China, with an estimated population of more than 8.1 million.[14] Liaoning is an industrial province, but agriculture is still an important economic sector. The widespread use of pesticides such as organophosphorous compounds by farmers may increase the risk of poisoning events in this area.[15] A previous investigation performed by Zhao et al. in this region from 1997 to 2007 showed that (i) medicine was the most common poisoning agent (41.4%), followed by pesticides (15.2%), alcohol (14.1%), carbon monoxide (12.5%)

For peer review only

and food (9.7%); (ii) the major medicines were sedatives/hypnotics and the major pesticides were organophosphates; (iii) mortality decreased from 2.1% to 0.4% over the 10-year study period, with an average mortality rate of 1.0%.[16]

In the last few decades, China has witnessed significant advancements in the fields of agriculture, industrial technologies and medical pharmacology. These advancements have been paralleled by marked changes in the trends of acute poisoning,[17] and has led to the development and easy accessibility of a vast number of toxic agents including pesticides, therapeutic drugs and other chemicals. Thus, the toxic agents associated with morbidity and mortality and the pattern of acute poisoning, which vary from place to place and over time, are expected to change. Therefore, there is a constant need to obtain up-to-date information on acute poisoning for planning rational use of resources and for evaluating public health interventions. The aim of this retrospective and descriptive study was to describe the clinical and sociodemographic patterns of acute poisoning in the emergency department (ED) of Shengjing Hospital of China Medical University, a tertiary care center, and to compare these patterns with previous findings obtained by Zhao et al.

2 Methods

This retrospective and descriptive study based on hospital records was carried out in Shengjing Hospital of the China Medical University in Shenyang, China. Shengjing Hospital is a regional tertiary care hospital in northeast China with three hospital areas and covers the entire Liaoning province and some areas of neighboring provinces. Moreover, the Liaoning Poisoning Diagnosis and Treatment Center was established in the ED of Shengjing hospital in July 2011, and the ED has a specialized toxicology unit. Hence many patients with poisoning who seek treatment visit or are referred to this hospital. We reviewed all records of cases of poisoning admitted to the ED (including cases referred to the ED from other wards) over 5 consecutive years from January 2012 to December 2016. Patients admitted to the ED with a diagnosis of drug poisoning and aged ≥ 11 years were enrolled in this study. Diagnoses were established by patients' history, physical examination, routine and toxicological

For peer review only

laboratory evaluation. Poisoned patients < 11 years admitted to the pediatric ward, and those with animal bites (snake, insect) due to infrequency and chronic poisoning were excluded from the study. Research ethical approval was obtained from the Shengjing hospital institutional ethics committee before study commencement.

Relevant medical records were obtained from the electronic hospital information system (HIS). The HIS is an electronic system used in the clinic to record patient information. Poisoning cases were retrieved by searching the HIS using the following keywords: poisoning, alcohol, carbon monoxide (CO) and organophosphate. Demographic data including age, gender, place of residence, diagnosis, type of exposure (suicidal, abusive, accidental and unknown), type of toxic agent (the common name or trade name were indicated, where available), duration of hospital stay and the outcome of treatment (whether the patient survived or died) were collected and documented on a structured form. The circumstances of poisoning were deduced from the patients' history.

Toxic agents were classified as therapeutic drugs, pesticides, alcohol, poisonous fumes/gases/vapors, chemicals, food, other substances and unknown. The subgroup of toxic agents was categorized based on the indications for use. Mixed drugs were defined as the ingestion of two or more drugs. The toxic agent was categorized as unknown when no suspected toxic agent was reported in the patient history.

Type of exposure was classified as suicidal, abusive, accidental and unknown as follows: (1) Exposure due to the inappropriate use of drugs for self-destruction was categorized as suicidal. (2) Exposure due to the intentional improper or incorrect use of a drug in which the victim was likely attempting to achieve a euphoric or psycho-tropic effect was categorized as abusive. (3) Accidental was classified as environmental poisoning, misuse, food poisoning and an adverse reaction; (a) If patients were poisoned due to being in an environment where a toxic substance (e.g. CO) was present this was categorized as environmental poisoning; (b) An overdose of medicine or being given the wrong drug, taking the wrong drug in error, or taking a drug inadvertently were categorized as misuse; (c) Exposure due to the ingestion of edible items was categorized as food poisoning; (d) Side effects from a herb or health

For peer review only

product was categorized as an adverse reaction. (4) If information was unavailable the cause of poisoning was categorized as unknown.

Gastric lavage, activated charcoal, intubation, infusion and dieresis therapy, and hemoperfusion were standard treatment protocols for poisoning caused by ingestion. Hemodialysis was performed when indicated. Special antidotes, naloxone for alcohol poisoning, and Vitamin K1 and acetamide for rodenticide poisoning, were given as indicated. For poisoning with no specific available antidotes, symptomatic treatment was administered.

Patients with normal symptoms, signs and laboratory findings on discharge were categorized as recovery. Patients with normal symptoms and signs but abnormal or unavailable laboratory findings on discharge were categorized as relative recovery.

Microsoft Excel 2007 was used to perform descriptive statistical analyses of the data. The average age was presented as the mean ± standard deviation (SD). To evaluate the differences, a chi-square test was performed using SPSS for Windows, version 21.0. A p value of less than 0.05 was considered significant.

Patient and Public Involvement: Patients and/or the public were not involved.

3 Results

A total of 5,375 cases of poisoning (age ≥11 years of age) from 829,808 entries were obtained from the HIS from 1 January 2012 to 31 December 2016. Of these, 366 were identified as animal bites (10 cases) and chronic poisoning events, leaving a total of 5009 unique cases that met our criteria. These cases comprised 0.6% of all emergency admissions. Descriptive information including age, gender, type and route of exposure, place of residence, length of hospital stay, and outcome of the poisoned patients are summarized in Table 1.

Table 1 Demographic characteristic of poisoned patients admitted to ED from 2012 to 2016.

Variables categories	N	%
Age group		
11~19	557	11.1

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

20~29	1547	30.9
30~39	1094	21.8
40~49	817	16.3
50~59	575	11.5
60~69	267	5.3
⩾70	152	3.0
Gender		
Male	2296	45.8
Female	2713	54.2
Type for exposure		
Suicidal	2842	56.7
Abusive	1105	22.1
Accidental	1017	20.3
Unknown	45	0.9
Route of exposure		
Ingestion (oral)	4316	86.1
Inhalation (nasal)	590	11.8
Contact (dermal)	98	2.0
Other	5	0.1
Place of residence		
Urban	2415	48.2
Rural	2568	51.3
Unknown	26	0.5
Length of hospital stay		
<48h	367	7.3
<1week	3219	64.3
>1week	1423	28.4
Outcome		
Recovery	1416	28.3
Relative recovery	3255	65.0
Referral to other center	198	3.9
Left against medical advice	76	1.5
Death	64	1.3
Total	5009	100.0

3.1 Age and gender

Of the 5009 cases included, 2713 (54.2%) were recognized as female, and 2296 (45.8%) were determined as male, and the ratio of male to female was 1:1.2. In this study, the youngest patient was 11 years old, while the oldest patient was 92 years old. The mean age of all patients was 36.0 ± 15.1 years. The mean age of male and female patients was 36.4 ± 15.0 years and 35.7 ± 15.3 years, respectively. The patients most

For peer review only

vulnerable to poisoning were aged 20–29 years (30.9% of cases), followed by patients aged 30–39 years (21.8% of cases) and 40–49 years (16.3% of cases) (Figure 1). There was a statistically significant gender difference (male and female) between the different age groups of poisoned patients (χ^2=28.19, p<0.001).

The predominant group of toxic agents consumed by the 20–29 age group was therapeutic drugs (37.4%, 579 cases) (Table 2). Of these, sedatives/hypnotics (169 cases) plus analgesics (120 cases) accounted for over half. Alcohol and pesticides were ranked second and third, accounting for 27.7% and 19.6%, respectively. There was a statistically significant gender difference related to suicide and drug abuse in the 20–29 age group (χ^2=140.29, χ^2=167.69, p < 0.001). Most cases of intentional poisoning were seen in young adults (20–29-year-olds) with 855 suicide attempts and 446 abuse cases. (Figure 2)

Table 2 Distribution of toxic agents consumed by 20–29 age-group people from 2012 to 2016

Toxic agents category	N	Group percentage	Total percentage	Direct percentage*
Therapeutic drugs	**579**	**100.0**	**37.4**	**35.4**
Sedatives & hypnotics	169	29.2	10.9	35.9
Analgesics	120	20.7	7.7	44.3
Mixed drugs	92	15.9	5.9	34.2
Cold and cough preparations	64	11.1	4.1	39.3
Antipsychotics	35	6.0	2.3	28.0
Cardiovascular drugs	22	3.8	1.4	19.6
Other drugs	29	5.0	1.9	30.2
Antimicrobials	27	4.7	1.7	41.5
Traditional Chinese medicine	21	3.6	1.4	32.8
Alcohol	**429**		**27.7**	**41.3**
Pesticides	**304**	**100.0**	**19.6**	**22.5**
Paraquat	133	43.8	8.6	20.7
Rodenticide	66	21.7	4.3	25.5
Organophosphate	45	14.8	2.9	19.4
Other	48	15.8	3.1	30.0
Unknown	12	3.9	0.8	22.2
Fumes/gases/vapors	**138**		**8.9**	**24.1**
Chemicals	**33**		**2.1**	**18.2**
Food	**16**		**1.0**	**18.2**
Other substance	**16**		**1.0**	**47.1**
Unknown	**35**		**2.3**	**34.3**
Total	***1550****		**100.0**	**30.9**

For peer review only

Direct percentage*: the ratio of the same toxic agent consumed by twenties people to all age-group people

1550*: Among 1550 cases, 3 cases were calculated tautologically for a combination of alcohol poisoning and other drugs poisoning.

3.2 Type of exposure

Table 3 lists the reasons for toxin exposure in these patients. It was noted that suicidal exposure occurred in the overwhelming majority of poisonings (2842, 56.7%), followed by abusive exposure (1105, 22.1%), accidental exposure (1017, 20.3%) and unknown reason (45, 0.9%). There was a significant gender difference in suicide and drug abuse: females were involved in more suicidal poisonings than males: 63.4% for females versus 36.6% for males (χ^2=226.09, p <0.001); poisoning due to drug abuse showed the opposite tendency: 70.8% for males versus 29.2% for females (χ^2=354.97, p<0.001). The main substances used were therapeutic drugs and pesticides for suicide attempts and alcohol for abuse. CO poisoning (~ 80% of cases) was the most common environmental poison, and pesticides poisoning (20%) was less common. Therapeutic drugs were taken mistakenly or in overdose by females.

For peer review only

1

Table 3 Type for exposure of all cases by gender

Type for exposure	Male		Female		Total		Chi-square test	
	N	%	N	%	N	%	$\chi 2$	*p*
Suicidal	1040	45.3	1802	66.4	2842	56.7	**226.086**	**0.000**
Abusive	782	34.1	323	11.9	1105	22.1	**354.968**	**0.000**
Accidental:	451	19.6	566	20.9	1017	20.3	1.143	0.285
Environmental	303	13.2	387	14.3	690	13.8	1.622	0.203
Misuse	97	4.2	106	3.9	203	4.1	0.323	0.570
Food poisoning	35	1.5	53	2.0	88	1.8	1.327	0.249
Adverse reaction	16	0.7	20	0.7	36	0.7	0.028	0.866
Unknown:	23	1.0	22	0.8	45	0.9	0.509	0.476
Subtotal	2296	100.0	2713	100.0	5009	100.0		

For peer review only

3.3 Routes of exposure

Among the various routes of exposure, ingestion was the most common (86.2 %), followed by inhalation (11.8%) and contact (2.0%).

3.4 Common Substances in Human Exposures

The most prevalent substance categories are shown in Table 4 and are listed by frequency of exposure in the study patients. This ranking shows the direction in which prevention efforts should be focused, as well as the types of poisonings our hospital regularly manages. The four most common toxic agent groups in decreasing order were therapeutic drugs, pesticides, alcohol, fumes/gases/vapors; 676 (13.5%) patients consumed two or more toxic agents. However, with regard to specific substances, alcohol, paraquat, CO and sedatives/hypnotics were the four main toxic agents.

For peer review only

Table 4 The distribution of toxic agent over the five years.

Toxic agent category	2012		2013		2014		2015		2016		Total		
	N	%	N	%	N	%	N	%	N	%	N	%	Total %
Therapeutic drugs	**303**	**100.0**	**394**	**100.0**	**326**	**100.0**	**310**	**100.0**	**304**	**100.0**	**1637**	**100.0**	**32.6**
Sedatives & hypnotics	101	33.3	141	35.8	79	24.2	68	21.9	82	27.0	471	28.8	9.4
Analgesics	50	16.5	67	17.0	62	19.0	53	17.1	39	12.8	***271****	16.6	5.4
Mixed drugs	42	13.9	63	16.0	53	16.3	52	16.8	59	19.4	269	16.4	5.4
Cold and cough medicines	31	10.2	26	6.6	37	11.4	42	13.6	27	8.9	163	10.0	3.2
Psychotropics	16	5.3	23	5.8	23	7.1	27	8.7	36	11.8	125	7.6	2.5
Cardiovascular drugs	15	5.0	27	6.9	22	6.8	26	8.4	22	7.2	112	6.8	2.2
Other drugs	16	5.3	21	5.3	24	7.4	20	6.5	15	4.9	96	5.9	1.9
Antimicrobials	19	6.3	12	3.1	15	4.6	8	2.6	11	3.6	65	4.0	1.3
Traditional Chinese medicine	13	4.3	14	3.6	11	3.4	14	4.5	13	4.3	65	4.0	1.3
Pesticides	**241**	**100.0**	**280**	**100.0**	**308**	**100.0**	**272**	**100.0**	**248**	**100.0**	**1349**	**100.0**	**26.9**
Paraquat	97	40.2	134	47.9	149	48.4	141	51.8	123	49.6	644	47.7	12.8
Rodenticide	50	20.7	55	19.6	60	19.5	49	18.0	45	18.2	259	19.2	5.2
Organophosphate	56	23.2	44	15.7	48	15.6	46	16.9	38	15.3	232	17.2	4.6
Other	24	10.0	33	11.8	42	13.6	28	10.3	33	13.3	160	11.9	3.2
Unknown	14	5.8	14	5.0	9	2.9	8	2.9	9	3.6	54	4.0	1.1
Alcohol	**203**		**227**		**226**		**182**		**201**		**1039**		**20.7**
Fumes/gases/vapors	**70**		**144**		**103**		**119**		**136**		**572**		**11.4**
Chemicals	**25**		**47**		**46**		**32**		**31**		**181**		**3.6**
Food	**20**		**9**		**15**		**35**		**9**		**88**		**1.8**
Other substance	**8**		**11**		**7**		**10**		**14**		**50**		**1.0**
Unknown	**22**		**24**		**17**		**19**		**20**		**102**		**2.0**
Subtotal	**892**		**1136**		**1048**		**979**		**963**		***5018****		**100.0**

For peer review only

271*：Including 13 cases of opioids poisoning.

5018*: 9 cases were calculated tautologically, of which 7 cases had a combination of alcohol poisoning and other drugs poisoning, and 2 cases had a combination of CO poisoning and other drugs poisoning.

3.4.1Therapeutic drug categories

Therapeutic drug poisoning showed a slight decrease during the 5-year study despite a high number in 2013. A total of 1637 cases involved therapeutic drug poisoning. Of these cases, 28.8% involved sedatives/hypnotics poisoning, which were the most commonly used drugs, followed by analgesics (16.6%) (including 13 cases of opioids poisoning) and cold and cough medicines (10.0%). Mixed drug poisoning was found in approximately 16.4% of patients. The rate of psychotropics poisoning increased over the 5-year period. Cardiovascular drugs, antimicrobials, traditional medicine and other drugs showed a relatively stable trend. Drug poisoning was more common in both males and females aged 20–29 years attempting suicide (Figure 3). However, drug poisoning was significantly more frequent in females than males (71.9% vs. 28.1%).

3. 4.2 Pesticide categories

Pesticide poisoning showed an increasing trend from 2012 to 2015 but decreased in 2016. A total of 1349 cases were observed to have pesticide poisoning. Of these cases, the predominant pesticide poison taken was paraquat (47.7% of cases), followed by rodenticide (19.2%), organophosphate (17.2%) and other pesticides (11.9%). A slightly higher number of males (683 cases) than females (666 cases) had pesticide poisoning. With regard to the distribution of age and gender in pesticide poisoning, there were two peaks, one in the 20–29-year-old group and the other in the 40–49-year-old group for both males and females (Figure 4). Eighty-eight percent of pesticide poisonings were suicide attempts, and males were involved in 5% more accidental pesticide poisonings than females. Pesticide poisoning was most frequent during the month of July.

3.4.3 Alcohol and fumes/gases/vapors

There was a stable trend in alcohol poisoning. Alcohol poisoning was

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

predominant in males and was ~2.5 times higher in males than in females. Alcohol poisoning was more prevalent in the 20–29-year-old group than in any other age group. (Figure 5) In addition, <1% of alcohol poisoning cases were found to be affected by other poisonings. Fumes/gases/vapors poisoning displayed an increasing trend, even though there was a decrease from 2013 to 2014. Of these cases, CO poisoning was the dominant toxic agent. Carbon monoxide poisoning was more common in the 20–39-year-old group and in females. The majority of CO poisoning events occurred in winter.

3.5 Treatment and Outcome

It was noted that gastric lavage and activated charcoal were administered in 72.5% (n=3634) of cases and 64.8% (n=3244) of cases, respectively, to prevent absorption of toxic agents. Some 7.7% of cases (n=385) received hemodialysis treatment. All patients with organophosphorous poisoning (n=232) were treated with atropine and pralidoxime. In addition, hyperbaric oxygen therapy for CO poisoning was performed in all cases (n=556).

A total of 4945 patients were discharged from the hospital, including 1416 cases with complete recovery, 3255 cases with relative recovery, 347 cases were referred to another institution, and 253 cases left the hospital during treatment. The hospital mortality rate was 1.3% with 64 deaths including 36 females and 28 males. The fatality ratio was 1.3% for female patients and 1.2% for male patients. More than half of the fatality cases (n=33) occurred in the 40–59 age group. Sixty-eight percent of the patients who died lived in urban areas. Death was due to suicide attempt in 51 cases, accidental poisoning in 11 cases, and in two cases, the type of poisoning was unknown. The associated agents involved in death were paraquat (33 cases), therapeutic drugs (16 cases), organophosphate (6 cases), food poisoning (4 cases), CO poisoning (2 cases), alcohol (1 case) and two cases with unidentified poisons.

3.6 Comparison with Previous Findings by Zhao et al.

The female-to-male ratio was 1.5:1 in Zhao's study and 1.2:1 in the present study. Similar to Zhao's report, the most vulnerable patients were aged 20–29 years, but the percentage in Zhao's study was 37.1% which was higher than that in our study. The

For peer review only

major route of exposure was ingestion in both studies (86.2% in our study and 81.8% in the previous study). With regard to the type of exposure, suicide attempt accounted for 69.6% and accidental exposure accounted for 29.7% in the previous study, higher than our findings. The most common toxic agents were the same in both studies, therapeutic drugs, followed by pesticides, alcohol and CO (41.4%, 15.2%, 14.1%, 12.5% in the previous study and 32.6%, 26.9%, 20.7%, 11.4% in this study). The major medicines were sedatives/hypnotics (27.5%) and the major pesticides were organophosphates (8.0%) in the previous study. While in this study, the major toxic agents were sedatives/hypnotics (9.4%) and the major pesticide was paraquat (12.8%). The average mortality rate was 1.0% and 1.3% in the previous study and this study, respectively.

4. Discussion

Acute poisoning is one of the most frequent causes of visits to the ED and is a threat to public health. The annual rate of ED visits associated with poisoning varies widely across the world, and ranges from 0.1% to 0.7%.[18,19] Studies in western countries have reported annual rates of ED visits associated with poisoning of approximately 0.3%.[19,20] In the present study, this rate was 0.6%, and a similar percentage (0.6%) was seen in the research carried out by Bulent.[21] As it is not common practice for many poisoned patients to seek medical help in health care institutions, the annual rate of ED visits associated with poisoning recorded by hospitals may be misleading. Therefore, the actual number of poisoning cases may be more than that recorded, and accurate statistical data for poisonings are difficult to estimate. Developed countries also have similar problems in obtaining meaningful poisoning statistics even though they are equipped with advanced systems to collect population health data. [22]

This study concluded that the incidence of poisoning in females was slightly higher than that in males, especially among young adults aged 20–29 years, with a female-to-male ratio of 1.2:1. Similar findings have also been reported in Beijing, China [23] (1.2:1) and Sari, Iran [17] (1.2:1). In contrast, male preponderance has been

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

found in some other countries.[24, 25]

The results of this study showed a difference in poisoning based on age and indicated that the most affected age group was the 20–29 year age group (30.8%) with a secondary peak in the 30–39-year-old group (21.9%). Both intentional and accidental poisoning were common in males and females aged 20–29 years, which is consistent with previous findings in China[16,23] and in other countries[26-28]. The fact that poisoning is more common among young adults reflects their vulnerability to stress, possibly due to failure or frustration in relationships or exams, maladjustment and inability to cope with the high expectation of parents.[29,30] Overall, this group of people is not emotionally stable or mature enough to tolerate extreme mental or physical pressure.[31,32]

Intentional poisoning (suicide+abuse) was the predominant cause of poisoning (78.8%) in the current study, an observation that is consistent with that in other studies.[27,33] Our study indicated that of all poisoning cases, a large proportion were suicidal in nature, but the incidence was lower compared with Zhao's study. This change may be related to the benefits of socioeconomic achievement and prosperity, such as higher employment and more educational opportunities, which may have contributed to the reduction in suicide rates in China.[34] Despite this decline in suicide rate, suicide attempt is still the primary reason for poisoning due to the general belief that poisons terminate life with minimal suffering.[35,36]

Our study demonstrates that therapeutic drugs are the most frequently used toxic agents. A similar pattern of therapeutic drugs as the most common cause of acute poisoning has been observed in developed and some developing countries.[37–42] With regard to the subgroup of therapeutic drugs in poisoning cases, sedatives/hypnotics were common in Taiwan, Hong Kong, Iran and Finland, while analgesics were the most frequently ingested drugs in Turkey and the USA. Pharmaceutical poisoning comprised 32.6% of the various drug poisonings observed in the present study, of which sedatives/hypnotics (28.8%) were the most frequently ingested agents. A similar pattern was also seen Zhao's study, although an apparent decline in sedatives/hypnotics poisoning was seen in our study.[16] This decline may be

For peer review only

connected with the implementation of drug classification control where patients can only access these drugs with a doctor's prescription.[43] However, a rise was observed in the use of analgesics, cold and cough medicines, mixed drugs, as well as cardiovascular drugs, resulting in a different pattern to that seen previously. This may be explained by the easy availability of pharmaceuticals due to the numerous drugstores in China, inadequate governmental supervision, insufficient knowledge about rational use of analgesics,[44] increase in the incidence of cardiovascular disease,[45] and poor psychological well-being and mental fragility among populations.[46] In addition, we found that the frequency of psychotropic drugs poisoning, has increased, which indicates that mental disorder plays a part in poisoning events and should receive attention. It is noteworthy that the number of opioid poisonings is surprisingly small in our study, and this is associated with the government's strict regulation on opioids, insufficient knowledge on opioids in physicians and patients (such as excessive worry about addiction and adverse events), making the use of opioids rare.[47, 48]

Pesticide poisoning has occurred relatively frequently for some time, as shown by previously published papers from different countries.[33, 36] The incidence of this type of poisoning varies geographically and historically.[49] Several studies conducted in India, Sri Lanka and Bangladesh showed a pesticide-dominant poisoning pattern, with organophosphates being the most common pesticide.[50–52] Pesticides were the second leading cause of acute poisoning in this study, accounting for 26.6% of all poisoning cases and showed an increased trend.[16] There are two reasons for this increased frequency: first, suicide by pesticide poisoning is still high in China, although suicides related to pesticide poisoning in China have continuously declined from 2006 to 2013.[53] Previous studies have shown that highly lethal pesticides are commonly used in suicide in rural China.[54,55] Our study showed that up to 88% of pesticide poisonings were suicide attempts. Second, pesticides are used extensively and unsafely in agriculture and industry, and can be stored in the home, causing toxicity due to intentional and accidental exposure.[55] The quantity of pesticide use is large and ever-increasing, and has grown from 1.3 million ton in 2001 to 1.8 million

For peer review only

ton in 2014.[56] In the present study, paraquat was the most frequently used pesticide, and a similar pattern was found in a study carried out in northeast China which showed an increasing trend, [57] whereas a decreasing trend was found in Korea. [58]

Not surprisingly, our study found that alcohol poisoning was common and accounted for 20.7% of all poisoning cases. The incidence of alcohol poisoning increased compared to previous figures in Zhao's study (14.1%). This change can be explained by rapid social and economic development, urbanization, increased alcohol production, and alcoholic beverage commercials in the mass media, which have all led to an increase in alcohol consumption.[59] According to recent data, the annual per-capita alcohol consumption in Chinese adults in 2012 was 3 L.[60] Findings reported elsewhere in China showed a higher number of alcohol poisonings.[61] Alcohol poisoning in other countries has been shown to be lower.[38,62-64] This discrepancy is partially related to the disparity in alcohol consumption habits between different countries and districts. In Chinese culture, people often urge companions to drink as much as possible so that they can construct social connections and establish a happy and congenial atmosphere.[65] This can also explain the gender difference in poisonings, as males are more engaged in social intercourse than females. In addition to widely practiced social drinking, solitary drinking is also common for stress reduction and coping among Chinese.[66]

The current data showed that the fourth leading cause of acute poisoning was fumes/gases/vapors (mainly CO), which decreased from 12.5% in Zhao's study to less than 11.4% in our study despite remaining in fourth place. This reduction is related to the improvement in dwelling conditions and preventive education on CO poisoning. With improvements in heating measures and advances in the fuel switching project from coal to natural gas in rural areas, a further decline in CO poisoning is expected in rural areas in China. There was a significant association between residency and month and reason for exposure to CO. Rural residents are more susceptible to CO poisoning than urban citizens, as local residents in remote villages in northern China use stoves to keep warm in winter, which can result in gas leaks due to a chimney jam and lack of ventilation, and are common causes of CO poisoning in these areas. In contrast, CO

For peer review only

poisoning in urban citizens may be explained by eating barbecued food and hotpots, well-known traditional Chinese cuisine that both require charcoal as fuel.[67] In addition, almost all CO poisoning cases in our study were accidental, with the exception of one case of suicide.

In our study, the rate of patients staying in hospital for less than 48 h is small compared with other studies. This was due to patients with poisoning usually being asked to remain in the observing room (available in our ED) for 48 h to 72 h in consideration of the complex doctor-patient relationship in China.

Our study was primarily limited by its retrospective nature, which resulted in missing patient data. Another limitation was that the data from a single centre teaching hospital, even with three branches, may not reflect the precise situation in this region. Hence, extensive data collection and analysis from other general hospitals in the region may depict the pattern of regional poisoning more accurately. In addition, the comparison between the two studies was rudimentary due to the absence of data standardization.

5. Conclusion and Suggestions

The present data provide additional insight into the epidemiology of acute poisoning in Shenyang. The findings demonstrated that more females than males presented with acute poisoning and the most vulnerable age group was the young adult group aged 20–29 years. We also observed that the majority of poisoning cases were intentional, particularly suicidal in nature, and accidental poisonings were non-negligible. Our study indicated that therapeutic drugs were the most commonly used toxic agent group, followed by pesticides, alcohol and noxious gas. In addition, the pattern of acute poisoning was slightly altered when compared with 10 years ago. Poisoning due to analgesics and cold and cough medicines was more frequent than poisoning due to psychotropics in the therapeutic drugs poisoning group. In addition, poisoning due to paraquat and rodenticide exceeded poisoning due to organophosphate in the pesticide poisoning group.

Some suggestions are proposed based on the present study and include the

For peer review only

following: First, vulnerable groups such as young adults deserve special consideration due to their weak coping capacity;[34] Further investment is required to promote public health education on the rational use and safe storage of toxic agents as well as self-protection to reduce accidental poisoning.[7] The upward trend in the prevalence of alcohol and drug use should receive more attention. Patients who attempt suicide must undergo psychiatric consultation as soon as possible. Early psychiatric consultation and identification may minimize the risk of further self-harm in suicidal cases.[68] Lastly, relevant policies and regulations should be formulated and initiated immediately to restrict access to toxic agents, especially pesticides due to their high toxicity.[69]

For peer review only

Acknowledgment

Contributors: TG Li developed and directed the study. NN Wang conceived and designed the survey questions on poisoning. BX Yu coordinated data collection and carried out data cleaning. YJ Zhang performed the statistical analysis and drafted the manuscript. All authors drafted, edited and approved the final manuscript.

Ethical approval: Research ethical approval was obtained from Shengjing hospital institutional ethics committee before the study commences.

Funding: This work was supported by the National nature science foundation of China (No. 81301627 and No.81500628) .We would like to appreciate the staff of library for their contribution in providing language help.

Competing interests: The Authors declare that there is no conflict of interest.

Data sharing statement: No additional data sharing available.

References

1. Kalseen CD, Andur MO, Doull J. Casarett and Doull's Toxicology. Newyork: Macmillan, 1986:10-17.
2. Senarathna L, Buckley AN, Jayamann a SF, et al. Validity of referral hospitals for the toxicovigilance of acute poisoning in Sri Lanka.[J] Bull World Health Organization, 2012, 90(6):401–76.http://dx.doi.org/10.2471/BLT.11.092114

3. Güloğlu C, Kara IH. Acute poisoning cases admitted to a university hospital emergency department in Diyarbakir, Turkey. Human and Experimental Toxicology, 2005, 24(2):49-54.http://dx.doi.org/10.1191/0960327105ht499oa
4. Eddleston M. Patterns and problems of deliberate self-poisoning in the developing world [J]. Qjm Monthly Journal of the Association of Physicians, 2000, 93(11):715-731. https://doi.org/10.1093/qjmed/93.11.715
5. Gunnell D, Eddleston M, Phillips M R, et al. The global distribution of fatal pesticide self-poisoning: Systematic review[J]. BMC Public Health, 2007, 7(1):357. https://doi.org/10.1186/1471-2458-7-357
6. SM Shah, PD Asari, J Amin. CLINICO-EPIDEMIOLOGICAL PROFILE OF PATIENTS PRESENTING WITH ACUTE POISONING.[J] IJCRR. 2016; 8(13): 35-41
7. Konradsen F, Van d H W, Cole D C, et al. Reducing acute poisoning in developing countries--options for restricting the availability of pesticides.[J]. Toxicology, 2003, 192(2-3):249.http://dx.doi.org/10.1016/S0300-483X(03)00339-1
8. Yumeng Tang, MS, Lan Zhang, et al. Unintentional Poisoning in China, 1990 to 2015: The Global Burden of Disease Study 2015.[J] AmJ Public Health. 2017; 107:1311–1315. http://dx.doi.org/10.2105/AJPH.2017.303841
9. Liu QH, Jiang DF. Research Status of Acute Poisoning in China.[J] Journal of Occupational Health and Damage, 2011; 26:238–9. (inChinese). https://dx.doi.org/10.3969/j.issn.1006-172X.2011.04.016
10. Zhang J, Xiang P, Zhuo X, et al. Acute poisoning types and prevalence in Shanghai, China, from January 2010 to August 2011.[J]. Journal of Forensic Sciences, 2014, 59(2):441-6. http://dx.doi.org/10.1111/1556-4029.12334
11. Zhang M, Fang X, Zhou L, et al. Pesticide poisoning in Zhejiang, China: a retrospective analysis of adult cases registration by occupational disease surveillance and reporting systems from 2006 to 2010[J]. BMJ Open, 2013, 3(11):e003510. http://dx.doi.org/10.1136/bmjopen-2013-003510
12. Wang B S, Chen L, Li X T, et al. Acute Pesticide Poisoning in Jiangsu Province, China, from 2006 to 2015[J]. Biomed Environ Sci, 2017, 30(9):695-700.

For peer review only

https://dx.doi.org/10.3967/bes2017.094

13. Ge XM, Jiang DF, Liu QH. Epidemiological study on 6011 cases of the acute poisoning during 2005～2009 year in Guangxi[J]. Chinese Journal of New Clinical Medicine, 2011,4(8):699-701. (in Chinese) https://dx.doi.org/10.3969/j.issn.1674-3806.2011.08.02
14. The 2010 population census of the People's Republic of China. Available at: http://www.stats.gov.cn/tjsj/pcsj/rkpc/6rp/indexch.htm
15. Chataut J, Adhikari R K, Sinha N P, et al. Pattern of organophosphorous poisoning: a retrospective community based study.[J]. Kathmandu University Medical Journal, 2011, 9(34):31.
16. Zhao M, Ji XP, Wang NN, Liu SY, Wang YZ. Study of poisoning pattern at China Medical University from 1997 to 2007.[J] Public Health,2009,123:454–5. https://doi.org/10.1016/j.puhe.2009.04.010
17. Ahmadi A, Pakravan N, Ghazizadeh Z. Pattern of acute food, drug, and chemical poisoning in Sari City, Northern Iran.[J]. Human and Experimental Toxicology, 2010, 29(9):731-738.http://dx.doi.org/10.1177/0960327110361501
18. Hanssens Y, Deleu D, Taqi A. Etiologic and demographic characteristics of poisoning: a prospective hospital-based study in Oman. Journal of Toxicology Clinical Toxicology, 2001, 39: 371? / 80.http://dx.doi.org/10.1081/CLT-100105158
19. Thomas SH, Bevan L, Bhattacharyya S, et al. Presentation of poisoned patients to accident and emergency departments in the north of England.[J] Human and Experimental Toxicology, 1996, 15[6]:466–470.http://dx.doi.org/10.1177/096032719 60500602
20. McCaig L F, Burt C W. Poisoning-related visits to emergency departments in the United States 1993–1996.[J]. Journal of Toxicology Clinical Toxicology, 1999, 37(7): 817–826.http://dx.doi.org/10.1081/CLT-100102460
21. Ergun B, Cevik A A, Ilgin S, et al. Acute drug poisonings in Eskisehir, Turkey: A retrospective study [J]. Turkish Journal of Pharmaceutical Sciences, 2013, 10(2):303-312.

For peer review only

22. Meredith T J. Epidemiology of poisoning [J]. Pharmacology and Therapeutics, 1993, 59(3):251-6.http://dx.doi.org/10.1016/0163-7258(93)90069-P

23. Zhigang Z, Peiyi Z, Jianming G. Epidemiological analysis of 560 cases of acute poisoning. Beijing Med 2007;29:708–19.(in Chinese) https://dx.doi.org/10.3969/j.issn.0253-9713.2007.12.017

24. Thalappilli MC, Jimmy A. A profile of acute poisonings: A retrospective study[J]. Journal of the Scientific Society, 2015, 42(3):156-160.http://dx.doi.org/10.4103/0974-5009.165547

25. Malangu N. Acute poisoning at two hospitals in Kampala-Uganda. Journal of Forensic Legal Medicine, 2008,15(8):489-92.http://dx.doi.org/10.1016/j.jflm.2008.04.003

26. Nair PK, Revi NG. One-Year Study on Pattern of Acute Pharmaceutical and Chemical Poisoning Cases Admitted to a Tertiary Care Hospital in Thrissur, India. Asia Pac J Med Toxicol,2015,4:79-82.

27. Ramesha KN, Rao KB, Kumar GS. Pattern and outcome of acute poisoning cases in a tertiary care hospital in Karnataka, India. Indian Journal of Critical Care Medicine, 2009, 13:152-5.http://dx.doi.org/10.4103/0972-5229.58541.

28. Bari MS, Chakraborty SR, Alam MMJ, et al. Four-Year Study on Acute Poisoning Cases Admitted to a Tertiary Hospital in Bangladesh: Emerging Trend of Poisoning in Commuters. Asia Pac J Med Toxicol 2014;3:152-6

29. Fergusson D M, Woodward L J, Horwood L J. Risk factors and life processes associated with the onset of suicidal behaviour during adolescence and early adulthood.[J]. Psychological Medicine, 2000, 30(1):23. http://dx.doi.org/10.1017/S003329179900135X

30. Zhao CJ, Dang XB, Su XL, et al. Epidemiology of Suicide and Associated Socio-Demographic Factors in Emergency Department Patients in 7 General Hospitals in Northwestern China[J]. Medical Science Monitor International Medical Journal of Experimental & Clinical Research, 2015, 21:2743-2749. http://dx.doi.org/10.12659/MSM.894819

31. Zhang J, Jia CX. Suicidal intent among young suicides in rural China.[J] Arch

For peer review only

Suicide Res,2011,15(2):127–139.http://dx.doi.org/10.1080/13811118.2011.565269

32. Cash SJ, Bridge JA. Epidemiology of youth suicide and suicidal behavior. Curr Opin Pediatr,2009, 21(5):613–619. http://dx.doi.org/10.1097/MOP.0b013e32833063e1
33. Bundotich JK, Gichuhi MM. Acute poisoning in the Rift Valley Provincial General Hospital, Nakuru, Kenya: January to June 2012[J]. Official Journal of the South African Academy of Family Practice/primary Care, 2015, 57(3):1-5. http://dx.doi.org/10.1080/20786190.2014.97544
34. Wang C W, Chan C L W, Yip P S F. Suicide rates in China from 2002 to 2011: an update[J]. Social Psychiatry & Psychiatric Epidemiology, 2014, 49(6):929-941. http://dx.doi.org/10.1007/s00127-013-0789-5
35. Thomas M, Anandan S, Kuruvilla PJ, et al. Profile of hospital admissions following acute poisoning--experiences from a major teaching hospital in south India.[J]. Adverse Drug Reactions and Toxicological Reviews, 2000, 19(4):313-7.: http://dx.doi.org/10.1258/td.2011.110398
36. Tufekci IB, Curgunlu A, Sirin F. Characteristics of acute adult poisoning cases admitted to a university hospital in Istanbul [J]. Human and Experimental Toxicology, 2004, 23(7): 347-51.http://dx.doi.org/10.1191/0960327104ht460oa
37. JB Mowry, DA. Spyker, DE Brooks, et al. 2014 Annual Report of the American Association of Poison Control Centers' National Poison Data System (NPDS): 32nd Annual Report.[J] Clinical Toxicology, 2015, 53:10, 962-1147. http://dx.doi.org/10.3109/15563650.2015.1102927
38. Lapatto-Reiniluoto O, Kivistö K T, Pohjola-Sintonen S, et al. A prospective study of acute poisonings in Finnish hospital patients [J]. Human and Experimental Toxicology, 1998, 17(6):307-11.http://dx.doi.org/10.1177/096032719801700604
39. Moradi M, Ghaemi K, Mehrpour O. A hospital base epidemiology and pattern of acute adult poisoning across Iran: a systematic review[J]. Electronic Physician, 2016, 8(9):2860-2870. http://dx.doi.org/10.19082/2860
40. Kavalci C, Demir A, Arslan E D, et al. Adult Poisoning Cases in Ankara: Capital City of Turkey[J]. International Journal of Clinical Medicine, 2012, 03(7):736-739.

For peer review only

http://dx.doi.org/10.4236/ijcm.2012.37A129

41. Lee H L, Lin H J, Yeh S Y, et al. Etiology and outcome of patients presenting for poisoning to the emergency department in Taiwan: a prospective study.[J]. Human & Experimental Toxicology, 2008, 27(5):373-379. http://dx.doi.org/10.1177/0960327108094609
42. Lam S M, Lau A C, Yan W W. Over 8 years experience on severe acute poisoning requiring intensive care in Hong Kong, China [J]. Human & Experimental Toxicology, 2010, 29(9):757-65. http://dx.doi.org/10.1177/0960327110361753
43. Liu CG, Jin F, Yuan GH. The History and Expectation of Classification Management of Drugs in China.[J] Chinese Journal of Pharmacovigilance,2013, 10(6):348-351. http://dx.doi.org/10.3969/j.issn.1672-8629.2013.06.009
44. Yu SY, Shang FF, Huang K.Status Quo and Countermeasures Research on Categorization Management of Medicine.[J] Chinese Pharmaceutical Affairs,2016, 30(1):32-34.http://dx.doi.org/10.16153/j.1002-7777.2016.01.005
45. Chen WW, Gao YL, Liu LS, et al. Summary of China cardiovascular disease report 2016. Chinese Circulation Journal, 2017, 32(6):521-530. http://dx.doi.org/10.3969/j.issn.1000-3614.2017.06.001
46. Wu P, Li L P, Jin J, et al. Need for mental health services and service use among high school students in China [J]. Psychiatric Services, 2012, 63(10):1026. http://dx.doi.org/10.1176/appi.ps.201200090
47. Fang W, Liu T, Gu Z, et al Consumption trend and prescription pattern of opioid analgesics in China from 2006 to 2015. Eur J Hosp Pharm Published Online First: 27 January 2018. http://dx.doi.org/10.1136/ejhpharm-2017-001460
48. Wang JS, Pan SF. Analysis of current clinical survey of chronic non-cancer pain-relief and opioid：the Chinese subgroup report of ACHEON study. J Journal of Chinese Physician,2016,18(4):492-496.(in Chinese) http://dx.doi.org/10.3760/cma.j.issn.1008-1372.2016.04.003
49. Jeyaratnam J. Acute pesticide poisoning: a major global health problem.[J]. World health statistics quarterly. Rapport trimestriel de statistiques sanitaires mondiales, 1990, 43(3):139-144.

For peer review only

50. Jaiprakash H, Sarala N, Venkatarathnamma P N, et al. Analysis of different types of poisoning in a tertiary care hospital in rural South India[J]. Food & Chemical Toxicology An International Journal Published for the British Industrial Biological Research Association, 2011, 49(1):248-250. http://dx.doi.org/10.1016/j.fct.2010.10.026

51. Van Der Hoek W, Konradsen F: Analysis of 8000 hospital admissions for acute poisoning in a rural area of Sri Lanka. Clin Toxicol 2006, 44(3):225–231. http://dx.doi.org/10.1080/15563650600584246

52. Howlader M, Hossain M, Morshed M, et al. Changing Trends of Poisoning in Bangladesh[J]. Journal of Dhaka Medical College, 2011, 20(1):51-56

53. Page A, Liu S, Gunnell D, et al. Suicide by pesticide poisoning remains a priority for suicide prevention in China: analysis of national mortality trends 2006–2013[J]. Journal of Affective Disorders, 2016, 208:418.https://doi.org /10.1016/j.jad. 2016.10.047.

54. Zhang J, Xu HL. The effects of religion, superstition, and perceived gender inequality on the degree of suicide intent: a study of serious attempters in China. Omega: Journal of Death and Dying. 2007, 55(3):185–197. http://dx.doi.org/10.2190/OM.55.3.b

55. Zhang X, Li HS, Zhu QH, Zhou J, Zhang S, Zhang L, Sun CY. Trends in suicide by poisoning in China 2000–2006: age, gender, method, and geography. Biomedical and Environmental Sciences.2008; 21:253–256.http://dx.doi.org/10. 1016/S0895-3988(08) 60038-0

56. Wang J, Li Y, Wang X, et al. Status Quo of Pesticide Use in China and Its Outlook [J]. Agricultural Outlook, 2017, 13(2):56-60. https://dx.doi.org/10.3969/j.issn.1673-3908.2017.02.012

57. Zhang S, Zheng Q, Zhang PS, et al. Epidemiological study of 357 acute paraquate poisoning cases [J]. Chinese Journal of Health Statistics, 2013, 30(2):251-252.(in Chinese)

58. Lee JW, Hwang IW, Kim JW, et al. Common Pesticides Used in Suicide Attempts Following the 2012 Paraquat Ban in Korea [J]. Journal of Korean Medical Science,

For peer review only

2015, 30(10):1517-21.http://dx.doi.org/10.3346/jkms.201 5.30.10.1517.

59. Guan-Sheng MA, Zhu DH, Xiao-Qi HU, et al. The drinking practice of people in China. Ying Yang Xue Bao. 2005;27(5):362–365.(in Chinese) https://dx.doi.org/10.13325 /j.cnki.acta.nutr.sin.2005.05.003
60. National Health and Family Planning Commission of the People's Republic of China. China national nutrition and chronic disease status report [in Chinese]. 2015. Available at: http://www.nhfpc.gov.cn/jkj/s5879/201506/4505528e65f3460fb88685081ff158a2.shtml. Accessed December 15, 2016.
61. Yuan T, Fan Q, Tang X Z, et al. Analysis of acute poisoning in 640 cases[J]. Practical Clinical Medicine, 2009, 10(11):27-27. http://dx.doi.org/10.3969/j.issn.1009-8194.2009.11.010
62. Thapa SR, Lama P, Karki N, et al. Pattern of poisoning cases in Emergency Department of Kathmandu Medical College Teaching Hospital.[J]. Kathmandu University Medical Journal, 2008, 6(2):209-213.
63. M. Balai-Mood. Pattern of acute poisonings in Mashhad, Iran 1993-2000.[J]. Journal of Toxicology Clinical Toxicology, 2004, 42(7):965. http://dx.doi.org /10.1081 /CLT-200042550
64. Jayasinghe NRM, Foster JH. Deliberate self-harm/poisoning, suicide trends. The link to increased alcohol consumption in Sri Lanka. Arch Suicide Research 2011, 15(3):223–237. http://dx.doi.org/10.1080/13811118.2011.589705
65. Li YC, Jiang Y, Zhang M, et al. Drinking behavior among men and women in China: the 2007 China Chronic Disease and Risk Factor Surveillance. Addiction. 2011; 106(11):1946–1956. http://dx.doi.org/10.1111/j.1360-0443.2011.03514.x
66. Hussong, A. Further refining the stress-coping model of alcohol involvement. Addict. Behav.2003,28, 1515–1522 https://doi.org/10.1016/S0306-4603 (03)00072-8
67. Xue J, Sun Q, Wang Y, et al. Features of Carbon Monoxide Poisoning in China[J]. Iranian Journal of Public Health, 2013, 42(10):1192-1193.
68. Linehan MM, Korslund KE, Harned MS et al. Dialectical behavior therapy for

For peer review only

high suicide risk in individuals with borderline personality disorder: a randomized clinical trial and component analysis. JAMA Psychiatry, 2015; 72: 475–82 http://dx.doi.org/10.1001/jamapsychiatry.2014.3039

69. Gunnell D, Eddleston M, Phillips M R, et al. The global distribution of fatal pesticide self-poisoning: Systematic review[J]. Bmc Public Health, 2007, 7(1):357. http://dx.doi.org/10.1186/1471-2458-7-357

Fig. 1 Distribution of all poisoning cases by age and gender
Fig. 2 Intention for 20-29 age-group cases from 2012to 2016
Fig. 3 Distribution of therapeutic drugs poisoning by age and gender
Fig. 4 Distribution of pesticide poisoning by age and gender
Fig. 5 Distribution of alcohol and fumes poisoning by age and gender (A-Male means Alcohol poisoning for Male; F-Male means Fumes/gas/fog poisoning for Male.)

For peer review only

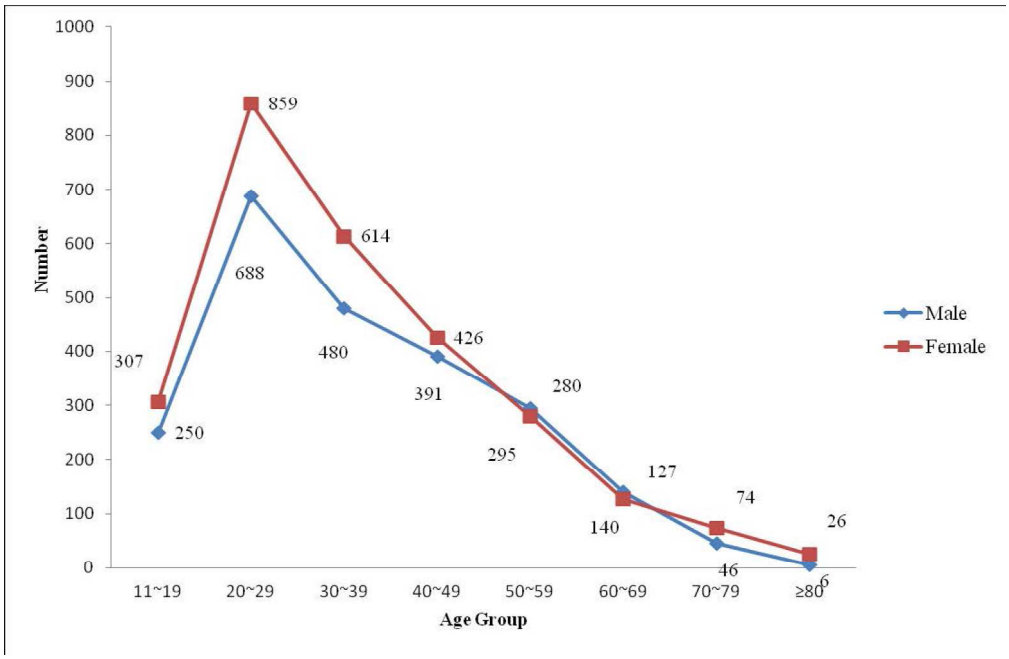


Fig. 1 Distribution of all poisoning cases by age and gender

188x122mm (300 x 300 DPI)

view only

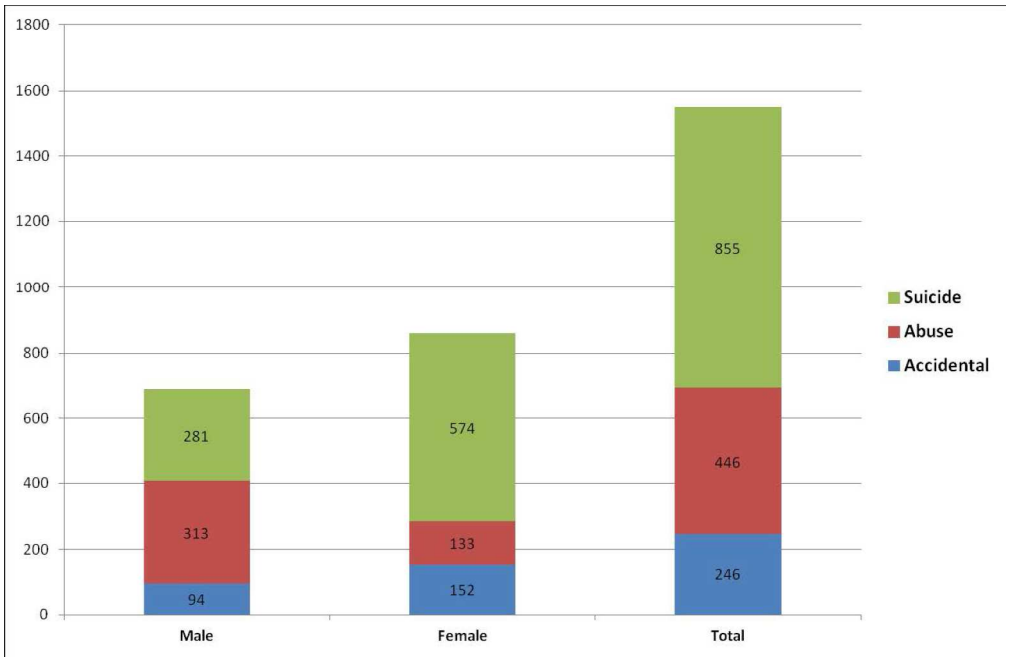


Fig. 2 Intention for 20-29 age-group cases from 2012to 2016

216x140mm (300 x 300 DPI)

view only

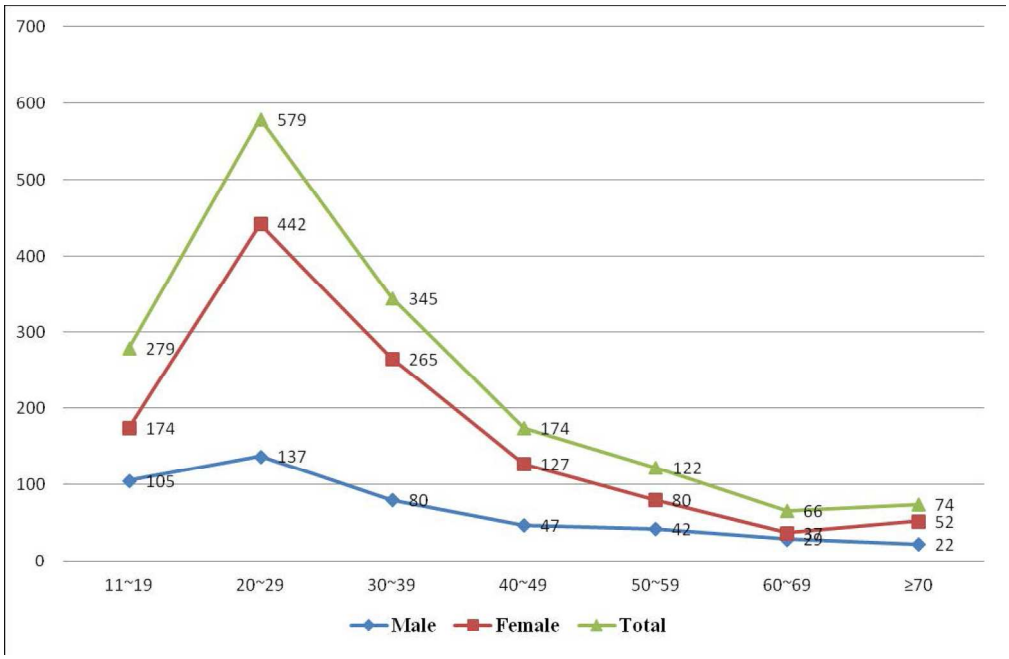


Fig. 3 Distribution of therapeutic drugs poisoning by age and gender

188x122mm (300 x 300 DPI)

view only

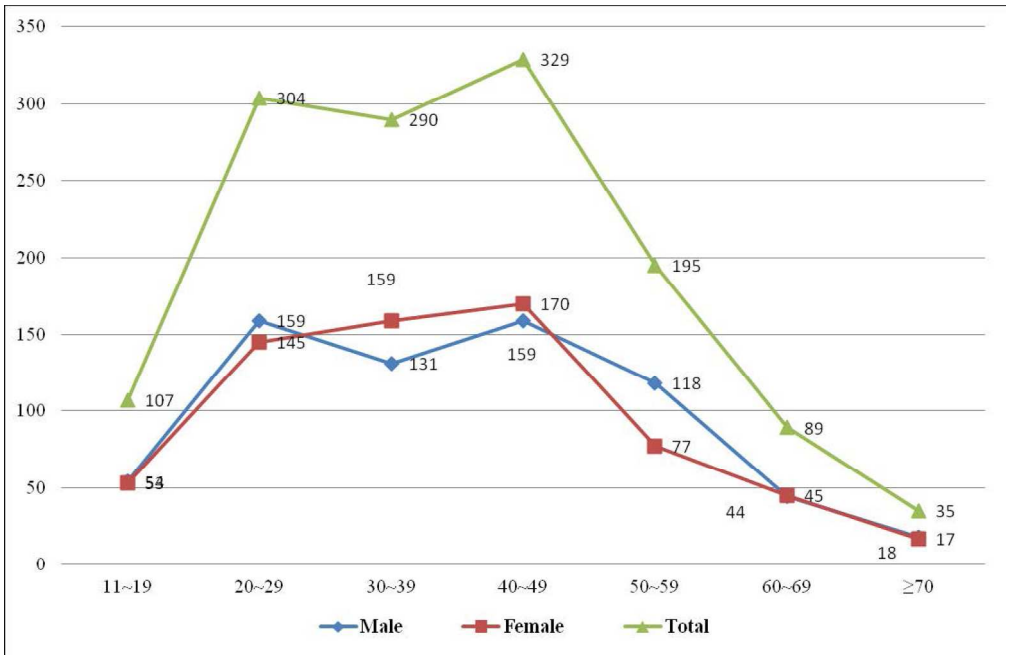
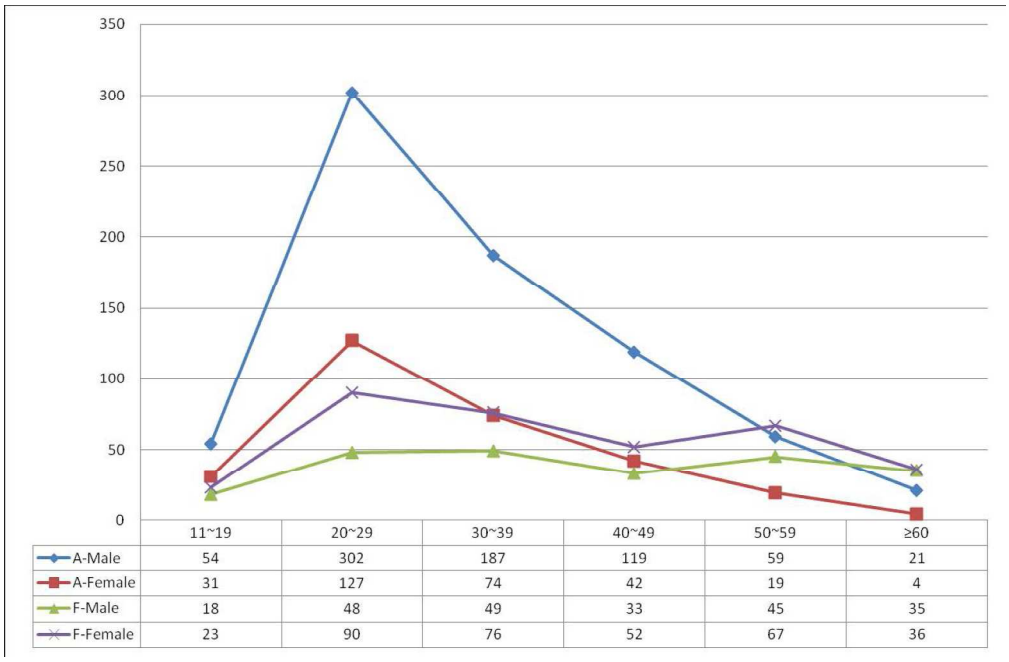


Fig. 4 Distribution of pesticide poisoning by age and gender

188x122mm (300 x 300 DPI)

view only



	11~19	20~29	30~39	40~49	50~59	≥60
A-Male	54	302	187	119	59	21
A-Female	31	127	74	42	19	4
F-Male	18	48	49	33	45	35
F-Female	23	90	76	52	67	36

Fig. 5 Distribution of alcohol and fumes poisoning by age and gender (A-Male means Alcohol poisoning for Male; F-Male means Fumes/gas/fog poisoning for Male.)

216x140mm (300 x 300 DPI)

For peer review only