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A Retrospective Study of Acute Poisoning in Children under 5 Years Old Admitted to Alexandria Poison Center in Egypt

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Abstract Childhood poisoning represents a major public health preventable problem worldwide. It has been identified that unintentional poisoning is the most common circumstances of poisoning in young children. Various drugs and chemical compounds have been implicated such as kerosene being the most common household agent. **Aim:** The current study aimed to retrospectively study acute poisoning in children less than 5 years old admitted to Alexandria Poison Center (APC) at Alexandria Main University hospital as regards; pattern of childhood poisoning (incidence and prevalence), risk factors related to poisoning accidents and the outcome. **Subjects and Methods:** All patients aged less than 5 years with acute poisoning admitted to Alexandria Poison Center at Alexandria Main University Hospital, Alexandria, Egypt, during the period of 8 months started from 1st January to 31st August 2012 were included in the study. **Results:** This retrospective study involved 620 intoxicated children which represented 20.7% of total poisoning cases admitted to APC at that period of time. The incidence of poisoning was found to be highest in children aged between 3 to 5 years old and constituted 49.1% and 39.6% of males and females respectively. The mode of poisoning was found to be accidental with no reported cases of neither homicidal nor suicidal poisonings. The most common agent of toxicity in children was found to be kerosene, followed by chlorine and cholinesterase inhibitor insecticide. The outcome of most of cases (84.5%) was recovery and discharge, with 10.5% being admitted to (Intensive Care Unit) ICU and 5% mortality rate. **Conclusion:** Risk factors for unintentional poisoning in children involve accessibility to hazardous chemicals and medicines caused by unsafe storage, aggressive child's behavior, unsafe storage of kerosene oil and petrol, low socioeconomic status as well as low educational level of the mother.

Keywords: *acute poisoning, children, kerosene, chlorine, acetyl cholinesterase inhibitor insecticides, carbon monoxide, prevention*

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1. Introduction

A poison is any substance that impairs health or destroys life when ingested, inhaled, or absorbed by the body in relatively small amounts. Some toxicologists suggest that, depending on the dose, all substances can be considered as poisons. Many experts state that it is impossible to categorize any chemical as either safe or toxic and that the real concern is the risk or hazard associated with the use of such substance. [1]

Constructive uses for poisons have increased considerably in the modern world. Poisons are now used as pesticides, disinfectants, cleaning solutions, and preservatives. [2]

Childhood poisoning represents a major public health problem worldwide that can be prevented through educational efforts. Poisoning might occur accidental or intentional whether suicidal or homicidal.

Various drugs and chemical compounds have been implicated in children poisoning such as kerosene, chlorine, acetyl cholinesterase inhibitor insecticides as well as carbon monoxide. Kerosene was reported to be the most common household agent responsible for accidental domestic poisoning cases in children.

Among the risk factors for unintentional poisoning in children under 5 years are: (1) Accessibility to hazardous chemicals and medicines due to unsafe storage. (2) Aggressive child's behavior. (3) Low socioeconomic status. (4) Low level of mother's education.

The aim of the current work was to retrospectively study acute poisoning in children under 5 years old admitted in the Alexandria Poison Center (APC) at Alexandria Main University hospital, Alexandria, Egypt, as regards: 1) Study of pattern of childhood poisoning (incidence and prevalence). 2) Risk factors related to poisoning accidents. 3) Outcome (discharge, complications or death).

2. Subjects and Methods

All patients with the age less than 5 years with acute poisoning admitted to Alexandria Poison Center at Alexandria Main University Hospital during the period of 8 months started from 1st January to 31st August 2012 were included in the study with no exclusions.

Study design: A hospital-based retrospective observational descriptive approach was conducted from 1st January to 31th August 2012. Data were collected from medical records of the patients.

Data collection: By using a specially designated sheet (Appendix 1) which included:

1. History and descriptive data

This included data related to the patient's age, gender, time of admission, time elapsed since poison intake, route of poisoning and way of referral.

2. Patient's medical records

This included data related to diagnosis of individual patients in all domains of clinical care.

3. Patient's outcome

Data related to patient's outcome after care (recovery, death, complications, discharge against medical advice, escaped) were reported.

Statistical Analysis: Data were fed to the computer and analyzed using IBM SPSS software package version 20.0. [6,7]

Arithmetic mean was calculated as follows

Arithmetic mean=sum of observations/number of observations.

Chi-square (X^2)

For comparison between distributions of patients according to different items of study and use this formula for calculation:

$$X^2 = \sum \frac{(\text{Observed frequency} - \text{Expected frequency})^2}{\text{Expected frequency}}.$$

The probability "p" value

It was obtained from special table for probability (p) value, where the degree of freedom (control group + patient group – 2) was used. A "p" value less than 0.05 was considered statistically significant.

3. Results

3.1. Socio-demographic Data

This retrospective study involved 620 intoxicated children which represented 20.7% of total poisoning cases (n= 2995) admitted to Alexandria Poison Centre at that period of time. All cases involved in the present study were accidental poisoning cases with a sex ratio of 1.2 and the highest frequency reported in age group of 3-5 in both sexes (Table 1). Nearly two thirds of the studied patients (66.5%) lived in urban areas while (33.5%) lived in rural areas (Figure 1).

Table 1. Distribution of the studied patients by age and sex (n=620).

Age (years)	Male		Female		Total	
	No.	%	No.	%	No.	%
<1	32	9.4	65	23.4	97	15.6
<3	142	41.5	103	37.0	245	39.6
3-5	168	49.1	110	39.6	278	44.8
Total	342	100	278	100	620	100
Ratio	1.2		1			

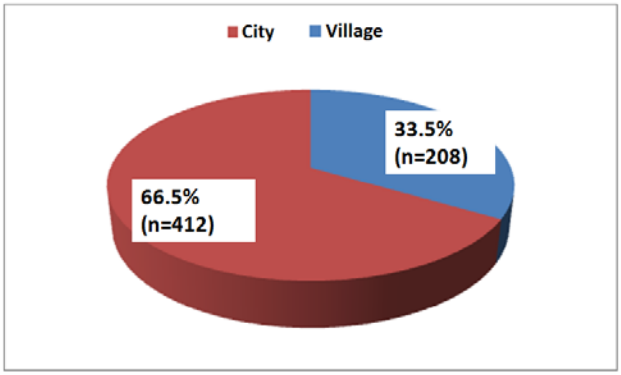

Figure 1. Residence of the studied poisoning cases.

3.2. History of Previous Psychiatric Troubles

Most of the studied cases did not have any psychiatric troubles while few of them had previous history of psychiatric medications (4%) (Figure 2).

3.3. Types of Poison

Fifteen different types of poisons were reported in children with seven of them showing the highest frequencies (Table 2).

Table 2. Distribution of the studied patients by type of poison (n=620).

Poison type	No.	%
Hydrocarbons (Kerosene)	146	23.5
Chlorine	122	19.7
Acetyl-cholinestrase inhibitor insecticides	104	16.8
Carbon monoxide	54	8.7
Food poisoning	20	3.3
Potassium hydroxide (caustic potash)	10	1.6
Paracetamol	10	1.6
Others:	154	24.8
Oral contraceptives	9	
Psychiatric medication	9	
Cardiac Therapy (Digitalis)	8	
Antihypertensive therapy	8	
Anxiolytic (Benzodiazepines)	6	
Narcotic (Tramadol)	6	
Furosemide (Lasix)	2	
Unknown	104	
Total	620	100.0

3.4. Route of Poisoning

The majority of patients (n=564; 91%) ingested the poison orally while 9% (n= 56) were exposed by inhalation.

3.5. Outcome:

The majority of cases (n= 524; 84.5%) were discharged from hospital after receiving treatment and recovery in the poison center while 65 cases (10.5%) were admitted to the ICU and 31 cases (5%) have died.

3.6. Treatment before Admission

As regards patients discharged from APC, 519 (99%) did not receive any pre-hospital management, while five patients (1%) did receive. In relation to ICU admission, 51

patients (78.5%) did not receive any pre-hospital treatment, whereas fourteen (21.5%) received some form of treatment prior to entering ICU. As regards to deceased cases, 12 patients (38.7%) did not receive any form of management prior to admission, while nineteen patients (61.3%) did receive a form of management. There was no significant statistical difference found as regards outcome and pre-hospital management (p=0.014, X^2 = 3.68) (Figure 2).

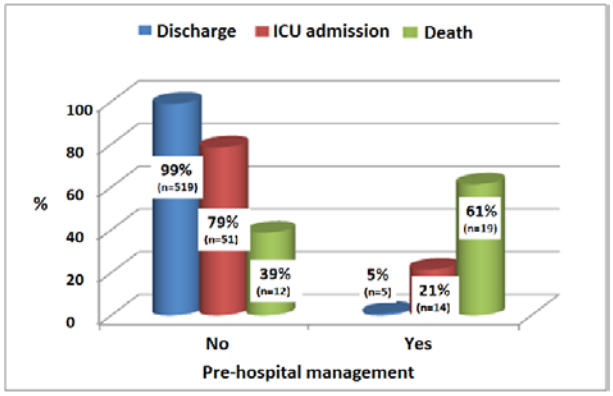

Figure 2. Pre-hospital treatment and outcome

3.7. Clinical Manifestations

3.7.1. Level of Consciousness

For discharged patients, 410 cases (78.2%) were fully conscious on admission and 114 (21.8%) had disturbed consciousness. As for patients admitted in the ICU, only 10 cases (15.4%) were fully conscious while the majority (n=55; 84.6%) had disturbed consciousness. Regarding fatal cases, five patients (16.1%) were fully conscious on admission in contrast to patients that had disturbed consciousness, who constituted 83.9% (n=26). There was a significant statistical difference (X^2=8.25, p=0.001) as regards level of consciousness and outcome**.**

Concerning Glasgow Coma Score (GCS), slightly more than two thirds of patients (n= 422; 68.1%) had a score more than or equal 13, while 142 cases (22.9%) had a score between 9-12 and 56 cases (9%) had it at 8 or below. In discharged patients, GCS was ≥13 in 80.5% (n=422), while 18.4% (n=96) had a GCS at 9-12. In relation to cases admitted to ICU, no patients had a GCS more than 13, but 55.4% (n=36) had a GCS from 9-12 and 44.6% (n=29) had a score less than 8. As for the deceased patients, 32.3% (n=10) had a score between 9-12 and 67.7% (n=21) had a GCS less than 8. There was a significant statistical difference (X^2 = 8.25, p=0.001) regarding outcome and GCS.

3.7.2. Pupil Size

Concerning pupil size, 63.7% (n=395) had normal pupil size, while 19.7% (n=122) had constricted pupils. Pin point pupils were present in 7.3% (n=45) whereas dilated pupils was present in 9.3% (n=58). Three quarters of discharged patients (75.4%) had normal pupil size, while 19.2% (n=101) had constricted pupils. In relation to patients admitted to ICU, about half of them (49.2%) had dilated pupils, while 27.7% had pin point pupils. In patients who died, 35.5% of cases had pin point pupil, while dilated pupils was observed in 45.1 % of cases.

3.7.3. Vital Signs

A statistical significant difference was noted between three different outcome groups as regards all vital signs (pulse, systolic blood pressure, diastolic blood pressure and respiratory rate) except temperature where X^2=11.84, 13.2, 10.83 and 10.83 while p= 0.002, 0.0032, 0.001, and 0.001 respectively.

3.7.4. Neurological Manifestations on Admission

As regard discharged cases, the most frequent neurological manifestation on admission was headache (27.7%) followed by slurred speech (12.4%). Convulsions occurred in 3.6% of cases while coma occurred in only 1% on admission. Contrarily, for patients admitted in the ICU, slurred speech and coma were the most common findings among them (27.7% and 24.6% respectively), while 18.5% of cases had convulsions on admission. As regards patients that had fatal outcome, more than half (71%) complained of headache, and 48.4% complained of dizziness on admission As regards the total number of patients more than a quarter of patients 27.4% (n=170) reported headache, 14.5% (n=90) had slurred speech, 7.7% (n=48) complained of either delirium or confusion, anxiety was reported in 7.6% (n=47), convulsions occurred in 6.6 (n=41), and coma occurred in 5.3% (n=33).

3.7.5. Cardiovascular Manifestations on Admission

As regards discharged patients, 3.6% had chest pain on admission, 3.2% experienced syncope, 2.1% complained of palpitations, and no cases had cardiac arrest on admission. In relation to ICU admitted cases, 15.4% reported chest pain on admission, syncope occurred in 12.3% of patients, 11% had cardiac arrest and 10.8% complained of palpitations. As for patients with the fatal outcome, 38.7% had syncope on admission, 32.3% reported either chest pain or had cardiac arrest, while 25.8% complained of palpitations. As regards the total number of patients, 6.3% had chest pain, 6% had syncope, and 4.2% had experienced palpitations. There was a statistical significant difference between the three groups of patients as regards chest pain and cardiac arrest (X^2 =4.15, 0.047and p=0.042, 0.047 respectively).

3.7.6. Respiratory Manifestations on Admission

Regarding patients discharged from APC, 4.8% complained of cough, 2.3% had dyspnea on admission, 2.1% were found to have rhonchi on auscultation, 1.3% was found to have crepitation, and 1.5% had stridor on admission. In patients admitted to ICU, about a quarter (24.6%) had a cough, followed by 10.8% complained of dyspnea on admission, 12.4% were found to have rhonchi on auscultation. Crepitation was found in 10.8% of cases, while 3.1% had stridor on admission. In relation to patients with fatal outcome, the majority (71%) reported dyspnea on admission, 35.5% had crepitation, 29% had stridor, 19.4% complained of cough and 12.9% had rhonchi on auscultation. On overall, 7.6% of studied patients had cough, while dyspnea was present in 6.6%, and crepitation was found in 4%, rhonchi was heard in 3.7% and stridor was detected in 3.1%. Globally, there was no significant difference between the three groups as regards respiratory signs and symptoms.

3.7.7. -Gastro-intestinal Manifestations on Admission

In light of discharged cases, less than one quarter 23.9% reported abdominal colics, while 6.3% had vomiting, 5.3% had diarrhea, while 4.8% experienced anorexia upon admission to the APC. Nausea was reported in 3.6% and 1.3% had constipation. As for patients admitted to ICU, 18.5% had anorexia, 26.2% complained of nausea, 23.1% had vomiting, while 24.6% experienced abdominal colics. Diarrhea was reported in 15.4% whereas one patient had constipation. In patients where death was the outcome, half of the patients (51.6%) had abdominal colics, 32.3% had diarrhea, 25.8% had anorexia, 19.4% had nausea, and 16.1% experienced vomiting, while 6.5% had constipation. Overall, there was a statistical significant difference between the three groups as regards the presence of vomiting and diarrhea on admission.

3.8. Laboratory Findings and Outcome

3.8.1. Arterial Blood Gases (ABG) and Acid-base Status: (Table 3)

There was a significant statistical difference between the three groups as regards ABGs and acid-base status (X^2 = 2.07, 4.22, 5.41, 16.2 and p= 0.15, 0.04, 0.02, 0.03 respectively).

Table 3. Mean and S.D of arterial blood gases and acid_base status of the studied patients (n=620) with outcome.

	Discharge "n=524"	ICU admission "n=65"	Death "n=31"	P value	X^2
pH	7.36±0.265	7.30±0.015	7.26±0.331	0.15*	2.07
$PCO_{2\ (mmHg)}$	38.9±4.32	39.8±3.65	42.6±4.98	0.04*	4.22
$PO_{2\ (mmHg)}$	98.6±1.32	97.5±1.68	96.2±1.42	0.02*	5.41
$HCO_{3(mEq/L)}$	17.98±1.58	18.65±3.65	19.25±4.36	0.03*	16.2

*significant.

3.8.2. Complete Blood Count (CBC)

The current study showed that there was no significant statistical difference between the three groups as regards hemoglobin, hematocrit value, RBCs, platelets count, WBCs, and eosinophils. (X^2 = 1.03, 1.01, 1.03, 0.01, 0.96, 0.36 and p= 0.322, 0.33, 0.32, 0.95, 0.35, 0.57 respectively).

3.8.3. Liver Enzymes Level, Kidney Function Tests and Random Blood Sugar (RBS): (Table 4)

There was a significant statistical difference between the three outcome groups of patients as regards ALT and creatinine (P= 0.042 and 0.46 respectively). On the other hand, there was no statistical significant difference between the three groups regarding AST, blood urea and RBS. (X^2 = 4.11, 5.04, 3.06, 4.03, 2.71 and p=0.042, 0.24, 0.08, 0.46, 0.109 respectively).

Table 4. Mean and S.D of liver enzymes, kidney function tests and random blood sugar of the studied patients (n=620) with outcome.

	Discharge "n=524"	ICU admission "n=65"	Death "n=31"	P value	X^2
Liver enzymes					
ALT (U/L)	36.5±4.65	35.6±7.25	42.6±8.25	0.042*	4.11
AST (U/L)	28.6±7.25	32.3±6.25	40.2±6.2	0.24	5.04
Kidney function					
Urea (mg/dl)	22.5±4.32	25.6±4.58	29.5±6.25	0.08	3.06
Creatinine (mg/dl)	0.98±0.133	1.01±0.456	1.09±0.771	0.46*	4.03
RBS (mg/dl)	89.9±11.36	82.6±14.65	72.9±15.65	0.109	2.71

ALT= Alanine transaminase
AST= Aspartate transaminase
RBS= Random blood sugar
*significant.

3.9. Management and Outcome

The present study showed that gastric lavage was done for the majority of patients (94.4%), especially in patients who recovered after treatment and discharged. Emesis was performed in 26.1% of all cases mainly in patients where recovery and discharge was the ultimate outcome.

A comparison of different clinical manifestations in patients suffering from different poisoning conditions (chlorine, kerosene, carbon monoxide and cholinesterase inhibitor insecticides (ChIIs)) was performed and results are summarized in Figures 3a - f.

4. Discussion

As regards ***socio-demographic data,*** the highest percentage of children admitted to the poison center (44.8%) was in the age group of 3-5 years. At this age, children usually gain motor independence and they go around actively exploring their environment. Therefore, children become highly mobile and able to get into dangerous situations quickly. Additionally, children at that age have well developed skills to locate and ingest liquids and solids, but are unable to discriminate rapidly between edible liquids and solids from toxic ones. [8,9] Similarly, Kohli et al (2009) [10] reported that the peak of accidental poisoning was seen in children between 2-5 years, with this problem spreading in the developing countries as these agents become more available. These findings are contradictory with the WHO report on child injury prevention in 2008 where it was found that the rate of fatal poisoning was highest among children below one year, with another slight peak around the age of 15 years. [11] Similarly, U.S. Poison Statistics National Data Report in 2014 has shown that peak poisoning frequency occurred in one and two year olds. [12]

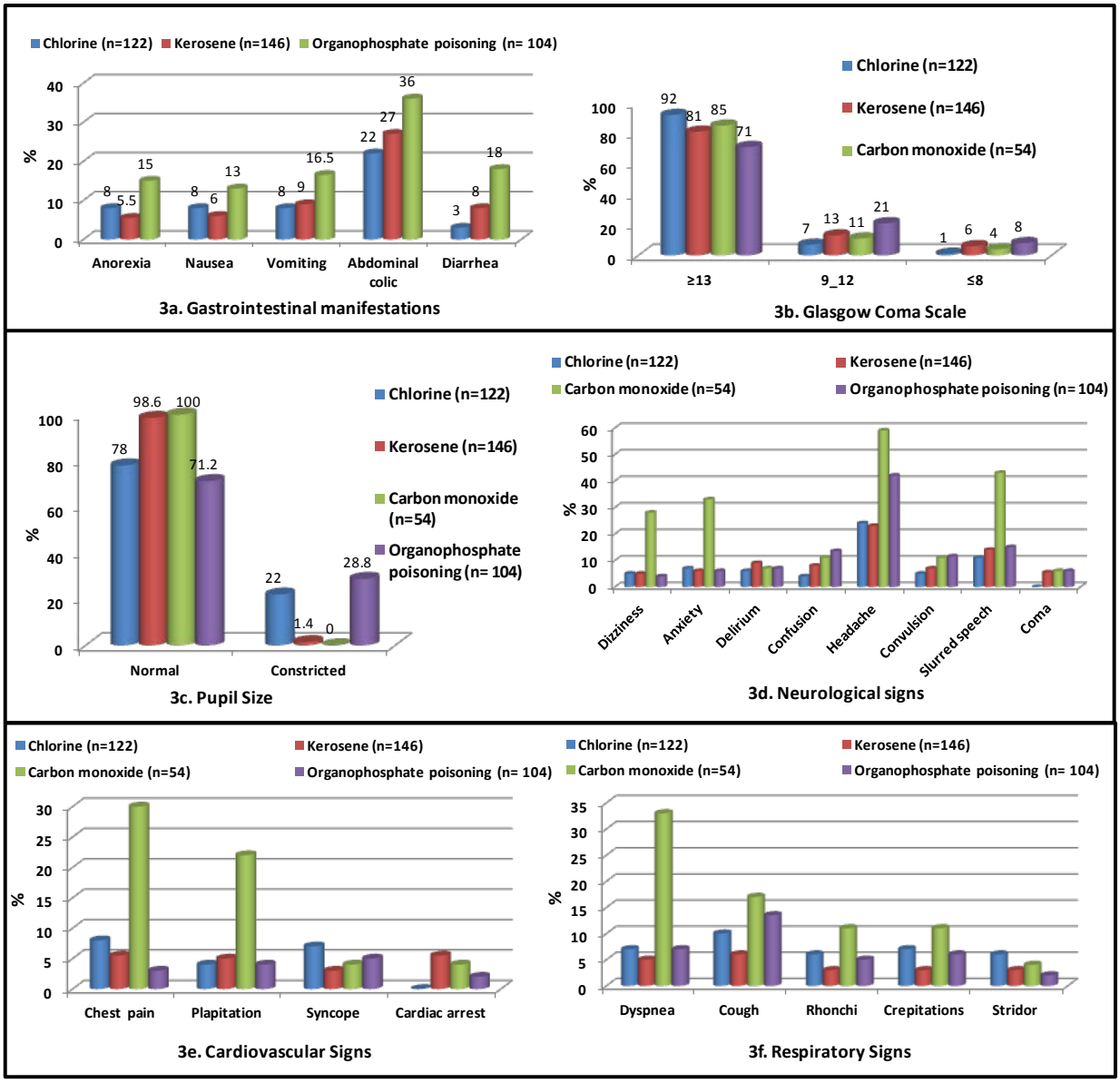

Figure 3. Distribution of patients suffering from chlorine, kerosene, carbon monoxide and cholinesterase inhibitor insecticides poisoning by; a: gastrointestinal manifestations, b: Glasgow coma scale, c: pupil size, d: neurological signs, e: cardiovascular signs, and f: respiratory signs

As regards sex distribution among cases, in the present study, the ratio between boys and girls was 1.2:1. This might be due to the more boisterous pattern of behavior in boys, hence the increased likelihood of exposure to poisons. This coincides with Hegazy et al., (1995) [13], who reported boys to girls ratio as 1.5:1, whereas the ratio was almost 1:1 in the study conducted by Abd El Kader et al., (2011) [14].

Concerning residence, in the present study, most of patients came from Alexandria (66.5%) and only 33.5% came from the rural areas. This could be explained by the presence of APC in Alexandria and most of its patients come from adjacent urban areas, while patients living in other governorates could receive medical help from poison centers close to their residence. This is in accordance with data reported by Abd El Kader (2011) [14] in Ain Shams where the majority of the patients (75%) came from Cairo.

Regarding ***circumstances of poisoning*** in the current study, all poisoning cases (100%) occurred accidentally, which is in agreement with Abd El Kader et al., (2011) [14] who reported accidental poisoning in 100% of the studied group. Additionally, Cheng and Rifaat (2009) [15] have reported accidental poisoning in 98% of cases. Furthermore, the U.S. Poison Statistics National Data 2014 report has shown unintentional exposures in 99% in children younger than 6 years. [12] This shows that poisoning in children is a preventable cause of morbidity and mortality as children mostly ingest the poison with the belief that it is edible. A common fault is parental negligence through careless labeling or unsafe storage of poisonous substances. [15]

For ***type of poison***, *household agents* were the most common causes of poisoning in the present study, where kerosene and chlorine were reported in 43.2% of cases collectively. This result agrees with the study of Hegazy et al., (1995) [13] that found household agents to represent 54.4%. This is also in agreement with Contini et al., (2009) [16] who found 80% of cases of poisoning were due to caustics and also agree with Cheng and Rifaat (2009) [15] who reported caustic poisoning in 74% of the studied group. These findings are attributed to the spread of

uncontrolled and cheap domestic cleaners which have been introduced through common informal or open markets in different developing countries, and associated with increased ingestion of household agents in children, particularly amongst low socioeconomic families, as reported by Gun et al., (2007). [17] On the other hand, Rifdah et al (2006) [18] have found that household materials constituted 34%, while drug poisoning constituted 65% in their study in Dublin. In the U.S. National Data 2014 statistics, cosmetics and personal care products as well as cleaning substances appeared at the top list of the most common substances implicated in poison exposures in children younger 6 years. [12]This difference is probably due to the difference in culture between Ireland and Egypt, as the availability of drugs is more at homes of the developed countries. This incident is decreasing in most developed countries as a result of introduction of child resistant containers where the Poison Prevention Packaging Act of 1970 empowered special packaging of drugs or any household substance that is considered as a poison. [13]

Acetylcholinestrase inhibitor insecticides constituted 16.8% of the studied cases in the current study. This was in close agreement with Hegazy et al (1995) [13] who showed poisoning by rodenticides and insecticides making up 5.7% and 4.9% respectively. The difference could be accounted for by decreased public awareness on safe storage of rodenticides and insecticides. [13] In the present study, acetylcholinestrase inhibitor insecticides was found in a chemical product called ‘‘Licid’’ which is used for treatment of hair lice infestation. In western countries, such compounds are available in child resistant packaging. [19]

In the current study, c*arbon monoxide* poisoning represented 8.7% of studied cases. This was in agreement with Sahin et al., (2011) [20] that showed 12% of 218 cases admitted to Pediatric Emergency Department of Eskisehir Osmangazi University Hospital, Iran during the year 2009 had carbon monoxide poisoning.

As regards food poisoning, in the present study, it constituted 3.3% of cases, while in the study conducted by Hegazy et al (1995) [13] food poisoning constituted 14.1% of the studied group. This difference may be attributed to improved sanitation and public awareness of hygiene during food preparation. [9]

Regarding the outcome of the poisoning cases, most of patients (84.5%) in the current study were discharged immediately from hospital after improvement, while 10.5% of patients were admitted to the ICU and the mortality rate was 5%. This was in accordance with the study conducted by Abd El Kader et al (2011) [14] , at which most of the cases (96.7%) were discharged from Ain Shams poison center after improvement of cases, while 3.1% were admitted to the ICU and the mortality rate was 0.2%. [14] This goes along with the U.S. statistics that reported non-fatal outcome in 85% of poison exposures in general. [12] Tohda et al (2008) [21] have also reported that all patients who ingested kerosene or chlorine responded well to the conservative therapy and did not need ICU admission. These results go in line with Cheng and Riffat (2009) [15] and Contini et al., (2009) [16] who reported that the mortality rate among cases of corrosive poisoning in low and middle income countries was ranged from 0% to 11.9%.

5. Conclusion

The incidence of poisoning was found to be highest in children aged between 3 to 5 years old. Boys had higher rate of poisoning than girls. Fatal and non-fatal poisonings were strongly associated with lower socioeconomic status. The most common agent of toxicity in children was kerosene, followed by chlorine, followed by cholinesterase inhibitor insecticide. Poisoning in children can be reduced through the use of effective prevention strategies and by implying legislation and enforcement measures targeting child-resistant packaging of medications and necessary poisonous agents as well as increasing parental awareness of the circumstances under which pediatric poisoning occurs.

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Appendix 1

Date :……..……

Personal history:

- Name: …… • Age: □ < 1 □ 1-3 □ 3-5 • Sex: □ male □ female
- Socioeconomic status: □ poor □ middle □ high
- Residence: □ urban □ rural
- Psychiatric troubles: □ no □ yes

Poisoning condition:

- Mode of poisoning: □ accidental □ homicidal
- Route of poisoning: □ ingestion □ inhalation
- Pre-hospital management: □ no □ yes

Examination:

General Examination Signs :

- Conscious level: □ fully conscious level □ disturbed conscious level
- Glasgow Coma Score: □ ≥13 □ 12-9 □ < 9
- Vital signs: • Pulse: ……... beat/min • Blood Pressure:…..…/…….. mmHg
  • Temperature: ……c • Respiratory Rate:……..cycle/min
- Pupil: □ normal □ constricted □ pinpoint □ dilated

Systemic Examination Signs :

Signs	No	Yes	Signs	No	Yes
•Neurological signs: □dizziness □anxiety □delirium □confusion □headache □convulsion □slurred speech □coma			•Gastrointestinal signs: □anorexia □nausea □vomiting □abdominal colic □diarrhea □constipation		
•Cardiovascular signs: □precordial pain □palpitation □syncope □cardiac arrest			•Respiratory signs: □dyspnea □cough □rhonchi □crepitations □stridor		

Investigation:

•Arterial blood gases: □PH: □$PCO_{2:}$ □$PO_{2:}$ □$HCO_{3:}$ □BE: □O_2%:		•Complete blood picture: □Hg: □Ht: □RBC: □Platelets: □WBC: □Neutrophils: □Lymphocytes: □Eosinophils :	
•Renal functions tests: □Urea: □Creatinine:		•Liver functions tests: □ALT: □AST:	
•Random blood glucose:			

Treatment:

• Decontamination: □ emesis □ gastric lavage □ activated charcoal

Treatment	No	Yes
•Supportive and emergency treatment: □IV fluids □oxygenation □mechanical ventilator □vasopressors □antiarrhythmic therapy □anticonvulsive therapy □IV hydrocortisone		

• Duration of hospitalization: ……

Prognosis:

□ complete recovery & discharge □ put patient under observation
□ ICU admission □death