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Research Paper

Fatal Cases of Poisoning Diagnosed in Medicolegal Directorate of Baghdad

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ABSTRACT:

BACKGROUND:

Poisoning is a significant contributor to morbidity and mortality throughout the world. Providing accurate statistical data is essential to understand the different aspects of poisoning cases for seeking the diagnosis particularly at the medicolegal side, and also calling for better management.

OBJECTIVE:

To investigate the epidemiological characteristics, and the postmortem findings of fatal poisoning cases referred to the medicolegal directorate of Baghdad. To identify the most common toxic agents, and the manner of death, in addition to demonstrate the demographic factors for the purpose of prevention and management.

MATERIALS AND METHODS:

Retrospective study analyzing autopsy records from January 1st, 2021, to December 31st, 2022 in Medicolegal Directorate of Baghdad; focusing on cases where poisoning was the primary cause of death.

RESULTS:

The total number of cases was 328. There was a 35% increase in poisoning cases in 2022 compared to 2021. Males constituted 61.6% (202) of the total number of fatalities while females constituted 38.4% (126). Gaseous poisons were the most frequent cause of death accounting for 48.8% (160) of the total number of confirmed poisoning cases, in addition to other results of the study.

CONCLUSION:

CO Poisoning was the most common cause of death. The vast majority of victims were exposed to poisoning by accident, and less than one-third resulted from suicide by pesticide ingestion. Drugs and volatile substances were other common causes of death, respectively.

KEY WORDS: Fatal cases, Medicolegal directorate of Baghdad, Poisoning.

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INTRODUCTION:

Poisoning, both accidental and intentional, is a significant contributor to mortality and morbidity worldwide [(1)]. Forensic medicine plays a crucial role in investigating poisoning deaths, providing evidence in legal proceedings, determining the cause and manner of death, and detecting homicidal poisoning, which can often be misdiagnosed as a natural disease [(2,3)]. Children are particularly vulnerable to poisoning due to their curiosity and lack of control over their environment[(4)].

Poisons can result from exposure to various substances, such as pharmaceuticals, household products, pesticides, heavy metals, and illicit drugs, via various routes [(4)]. Poisoning can impair health, cause injury, or lead to death, and some people may choose poisoning as a means of suicide [(5)]. Poisons can have different effects depending on the dose, route of exposure, and type of chemical used, and can affect different organs or systems in the body [(6)].

In Iraq, poisoning is a chronic health challenge caused by various agents such as hydrocarbons, medications, household products, organophosphates, and heavy metals [(7)]. The World Health Organization (WHO) reports that poisoning causes over 1.5 million deaths and 24.4 million disability-adjusted life years (DALYs) annually, with most cases occurring in low-income and middle-income countries [(4)].

Poisons are classified generally into seven groups:

Group I - Gases – carbon monoxide, Hydrogen sulfide, cyanide, etc.

Group II - Pesticides - Organophosphorus (Parathion, Malathion), Carbamates, aluminum phosphide, etc.

Group III - Volatile substances – Ethanol, methanol, hydrocarbons, etc.

Group IV – Drugs – Barbiturates, opioids, stimulants, etc.

Group V - Metals – mercury, Arsenic, lead, etc.

Group VI – Corrosive materials, Anions – Sulphones, nitrites, etc.
Group VII - Miscellaneous – Plant poison (Oleander, cerebra, etc.)
Animal poisons – Snake, Scorpion, Fish [8].

Many facts are related to above mentioned poisons among which are those commercially used gases; they pose an asphyxiation hazard, potentially causing unconsciousness or death by depriving the body of oxygen. These hazards can be classified into simple asphyxiants, such as CO2, which impair oxygen availability in the air, and chemical asphyxiants, such as irritant gases like H2S, which interfere with oxygen transportation and absorption in the body, leading to cell starvation [9].

Pesticides are chemical substances used to kill or control pests like insects, weeds, or fungi [10]. Common types include organophosphates, chlorinated hydrocarbons, aluminum phosphide, zinc phosphide, carbamates, and pyrethroids [9]. Their pharmacological action varies greatly

A study by Silberman et al. found 14,000 reported exposures to carbamates and a 10-20% case fatality rate in the US between 2002 and 2006 [11].

The World Health Organization reports that alcohol consumption causes 3 million deaths annually [12].

AIMS OF THE STUDY:

1. To investigate the epidemiological characteristics, and postmortem findings of fatal poisoning cases referred to the medicolegal directorate in Baghdad
2. To identify the most common toxic agents involved and the manner of death.
3. To understand the demographic factors associated with fatal outcomes and to propose strategies for prevention and management

MATERIALS AND METHODS:

This study was conducted in the Medico-Legal Directorate in Baghdad, a forensic entity that receives cases for medico-legal investigation from fifteen Iraqi governorates. The study examined 16,889 autopsy documents between January 1st, 2021, and December 31st, 2022, analyzing toxicology test reports and case information. After excluding natural and violent causes of death (cases where death is due to natural, endogenous disease, or cases where death is primarily caused by external traumatic events such as blunt force trauma, sharp injuries, burns, or other forms of violence, with poisoning not being the central mechanism of death). 328 cases with intoxication as the primary cause of death were identified. The data was collected from the Medico-Legal Directorate in Baghdad after ethical approval, all autopsy records obtained from the Medicolegal Directorate were de-identified at the time of data collection. Each case was assigned a unique numeric identifier upon receipt of the autopsy request, and all personal or identifying information was removed. This approach ensured that the data analysis was conducted solely on anonymized records. Toxicological analysis was performed on 328 cases, including blood, urine, and tissue organs. Tissue samples were collected for toxicological analysis.

Statistical analysis was performed using Microsoft Excel 2019, with percentage ratios, Chi-square, and p values calculated to determine relative differences in the results. Tables and graphs were created to illustrate the findings.

RESULTS:

A retrospective study review of records of deceased people referred to the medico-legal directorate in Bagdad during 2 years period from January 1st, 2021 to December 31st, 2022 was carried out on 16,889 showed that the cases with poisoning as the main cause of death were 328 with a percentage of 1.94%. There was statistically significant increase in the number of poisoning cases in 2021 as compared with 2020.

Males in the total study cases constituted 61.6% with a total number of cases 202 cases while females constituted 38.4% with a total number of cases 126 cases.

Gaseous poisons are responsible for the majority of deaths in the seven groups, totaling (160) fatalities, which represent (48.8%) of all poisoning-related deaths. Pesticides follow with (70) deaths, accounting for (21.3%) of the total deaths as shown in table (1).

Table 1: Annual Distribution of Fatal Poisoning Cases (2021–2022).

Year	Gases	pesticides	drugs	Volatile substances	Corrosives + anions	Metals	Total
2021	79	37	10	12	1	-	139
2022	81	33	44	29	1	1	189
total	160	70	54	41	2	1	328
percentage	48.8%	21.3%	16.5%	12.5%	0.6	0.3%	
***p* value**	**0.1772**	**0.0675**	**0.0371 S**	**0.0729**	**0.0969**	**0.0947**	

***S= statistically significant**

The age group (≤ 14) came in first as the most affected age group in poisoning fatalities, and the least affected age group was 45 years and older, accounting for (13.4%). Please see table (2)

Table 2: Distribution of fatal poisoning according to age.

Age group (in years)	Number of fatalities	Percentage
≤ 14	85	25.9%
15-24	71	21.7%
25-34	71	21.7%
35-44	57	17.3%
≥ 45	44	13.4%
Total	**328**	**100%**

In the year 2021, The most affected age group by gaseous and volatile substances poisons was (≤14), while the age group (25-34) was the most affected by pesticides, followed by drugs and corrosives and, anions poisons as mentioned in table (3).

Table 3: Age Categories Versus Poison Class (2021).

Age	Gases	Pesticides	Drugs	Volatile substances	Corrosives and anions	Metals	Total
≤14	40	4	-	6	-	-	50
15-24	10	8	4	-	-	-	22
25-34	9	13	5	-	1	-	28
35-44	14	3	1	3	-	-	21
≥45	6	9	-	3	-	-	18
total	79	37	10	12	1	-	139
Chi-square	**50.896**						
***p* value**	**0.0000 S**						

***S= statistically significant**

In the year 2022 the age group (≤14) was the most affected by gaseous poisons, while pesticides affected (15-24) the most, and the age group (25-34) was the most affected by drugs and volatile substances poisons as shown in table (4).

Table 4: Age Categories Versus Poison Class (2022).

Age	Gases	pesticides	Drugs	Volatile substances	Corrosives and anions	Metals	Total
≤14	28	3	4	-	-	-	35
15-24	21	16	11	1	-	-	49
25-34	14	4	15	10	-	-	43
35-44	7	8	11	10	-	-	36
≥45	11	2	3	8	1	1	26
Total	81	33	44	29	1	1	189
Chi-square	**68.472**						
***p* value**	**0.0000 S**						

***S= statistically significant**

Most of the cases (254) were accidental death and (73) cases were suicidal with pesticides being the most frequently used poison in suicides and only one homicide. Please review table 5.

Table 5: Fatal Poisoning Cases by Manner of Death.

Type of poison	Accident	Percent	Suicide	Percent	Homicide	Percent
Gases	160	48.8%	0	-	-	-
Pesticides	3	0.9%	66	20.2%	1	0.3%
Drugs	49	14.9%	5	1.5%	-	-
Volatile substances	41	12.5%	-	-	-	-
Corrosives and anions	1	0.3%	1	0.3%	-	-
Metals	1	0.3%	-	-	-	-
Miscellaneous	-	-	-	-	-	-
	255	77.7%	72	22%	1	0.3%
Chi-square	**282.387**					
***p* value**	**0.0000 S**					

*S= statistically significant

Results show total fatalities due to gaseous poisons were 160 deaths, accounting for 48.8%. Males were the most affected gender, and females were second, then followed by the pesticides group with total fatalities of 70, accounting for 21.4%; female fatalities were higher than male fatalities and the least fatalities were for the metals group, with only one fatality, which was a male, accounting for 0.3%. Please see figure (1).

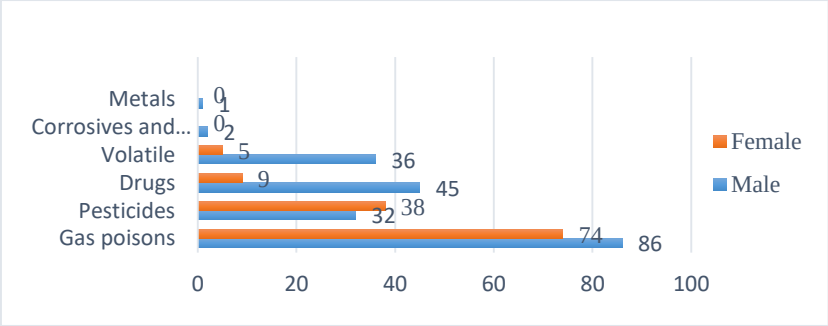

Figure 1: Fatal Poisoning Cases by Sex.

The fatality distribution based on the type of poison, revealed that gaseous poisons accounted for a total of 79 deaths, with carbon monoxide poisoning responsible for 64 deaths. The pesticides category subsequently accounted for a total of 37 fatalities, with 34 attributed to zinc phosphide poisoning. Drugs caused 10 deaths and stimulants responsible for 5 fatalities as illustrated in table (6).

Table 6: Fatal Poisoning Cases by Poisonous Agent (2021).

Type	Subtype		Number	Total
Gaseous	CO		64	79
	H_2S		15	
	CO_2		-	
pesticides	Zinc phosphide		34	37
	Carbamate		3	
Drugs	Stimulants	amphetamine	5	10
	Opiates	codeine	1	
		tramadol	1	
	anesthetic	lidocaine	2	
	Antipsychotic	perphenazine	1	
volatile	kerosene		6	12
	Ethanol		1	
	methanol		5	
Corrosives and anions	polyethylene glycol		1	1
Metals	-		-	-
Total				**139**

Based on the poisonous group distribution of poisoning fatalities, gaseous poisons accounted for a total of 81 deaths, of which 79 were attributable to carbon monoxide poisoning and 2 to hydrogen sulphide. The following category, pesticides, were responsible for a total of 33 fatalities. Among these, carbamate toxicity caused three fatalities, zinc phosphide 28; organophosphate and aluminum phosphide each caused one. 44 fatalities were attributed to drugs poisoning with amphetamine being the most frequent agent accounting for 23 deaths as illustrated in table (7).

Table 7: Fatal Poisoning Cases by Poisonous Agent (2022).

Type	Subtype		Number	Total
Gaseous	CO		79	81
	H_2S		2	
	CO_2		-	
pesticides	Zinc phosphide		28	33
	Carbamate		3	
	Aluminum phosphide		1	
	organophosphate		1	
drugs	stimulants	amphetamine	23	44
		Meth. Amphetamine	2	
	Opiates	codeine	1	
		tramadol	2	
		Methadone	2	
	anesthetics	lidocaine	2	
	Barbiturates	Phenobarbital	3	
	anticonvulsant	Gabapentin	2	
	Sedatives hypnotics	Amitriptyline	1	
		Benzodiazepine	1	
	Antipsychotic	perphenazine	1	
	Medications	Paracetamol	2	
		Propranolol	2	
volatile	kerosene		8	29
	Ethanol		20	
	Toluene		1	
Corrosives and anions	Sulfuric Acid		1	1
Metals	Mercury		1	1
Total				**189**

Monthly Poisoning Fatality Trends showed that March was the month with the highest number of fatalities with a total of 39 cases accounting for 11.89% followed by February with a total of 34 accounting for 10.36% and the month with the least fatalities was May with 16 fatalities accounting for 4.87%. please see (Figure 2).

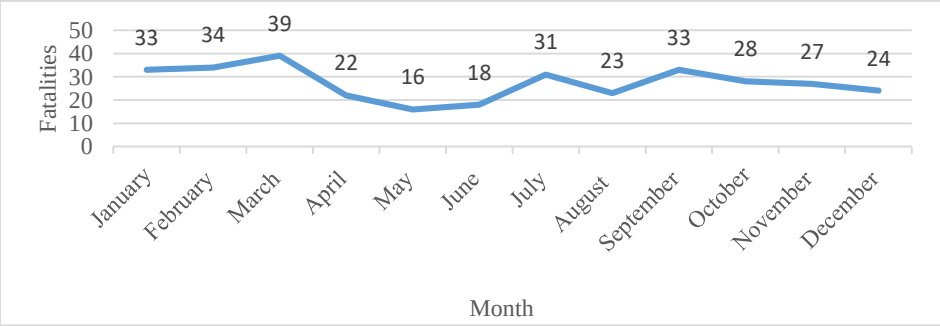

Figure 2: Monthly Poisoning Fatality Trends.

Baghdad was the most affected governorate accounting for 198 poisoning cases and gaseous poisons were the most common class of poison, followed by Basra, Karbala, and Dhi Qar accounting for 35, 25, and 20 poisoning cases respectively. Gaseous poisons were the most common poison group, Diwaniya was the least

affected governorate with only one case of poisoning due to volatile substances.

DISCUSSION:

This retrospective study of the fatal poisoning cases in the medicolegal directorate in Baghdad for the two-year period (2021–2022) revealed that 16889 autopsies were performed during that time, and 328 autopsies determined that poisoning was the cause of death (1.94%). This finding contrasts with the findings of the previous study, which found that 198 deaths overall 0.61% of all deaths during the study's ten years—were caused by poisoning. [13]

The distribution of fatal poisoning cases shows a 35% increase in the year 2022 over 2021, which is mostly attributable to the sharp rise in drug abuse-related mortality.

This study found that out of all the confirmed poisoning fatalities, males constituted the majority of the cases accounting for almost two-thirds of the cases, while females constituted almost one-third of the cases. This result is consistent with the research conducted by Chandran A, Karekar CL, Suares S, Fernandes AV. [14]

Gaseous toxins were the primary cause of mortality during the study period. The most frequent cause of gas poisoning was carbon monoxide, followed by hydrogen sulphide. This is primarily attributed to the use of defective kerosene heat appliances or improper electrical wiring in residential settings, resulting in severe disasters. or any source of indoor fires that ignites furniture or ceiling lining, resulting in the emission of carbon monoxide when burned. The findings agree with the results obtained by Pipaliya KN, Aghera VJ, Patel M, Vaghela RD, Masharu RK during the duration of their investigation. [15]

Pesticides constituted the second most prevalent toxic group. The most frequent agents in this group are zinc phosphide, followed by carbamate, and aluminum phosphide, organophosphorus respectively. This is primarily due to the agricultural nature of Iraq, which facilitates their accessibility, affordability, and ease of purchase from street vendors. However, inadequate education regarding safe handling and usage practices and preventative measures further contributes to their prevalence. This result is consistent with what Alhaddad H. during his investigation. [16]

The third most common poisonous group is drugs, with stimulants are the leading poisonous agents, especially amphetamine, this is quite an alarming finding as it shows an increase in illegal drug trafficking making these drugs quite easy to obtain and increasing the numbers of users and addicts thus increase the risk of mortality due drug abuse, and how it is plaguing our society and the result only for deaths induced by these drugs when looking at the accident caused by the drug users the numbers are quite larger than the death by the toxicity of these drugs. This finding corresponds to what Alharbi F, Alsubaie EG, Al-Surimi K. in their research. [17]

The fourth most common lethal group was volatile chemicals. ethel alcohol is the most common agent in this group followed by kerosene and then methyl alcohol, and lastly toluene and this is because of the broad availability of alcohol and the increasing ratio of alcohol intake in our culture. not only the toxicity of alcohol that leads to mortality but the linked effect of being under the influence and how it raises the chance of accidents such as road traffic accidents is significantly more in numbers than the deaths as a result of toxicity. Kerosene is usually seen in accidental consumption or suicidal attempts. This finding is in line with the finding of Xiao L, Ye Y, Wang Y, Dai X, Fang S, Wei Y, et al.in their study. [18]

The fifth group was corrosive material and anions, and it’s quite rare with only two cases documented in the study period, with one case of sulfuric acid ingestion and the other one being poly ethylene glycol also known as (anti-freeze) ingestion. these groups are generally observed in suicidal attempts or accidental intake by youngsters. This finding is in line with Bd G, Vaghela P.in their finding. [19]

The metals group had the least number of fatalities during the study period with only one death; Mercury was the causative agent of that one causality. This finding accords with the finding of Parekh U, Gupta S. in their study. [20]

The age group (≤ 14) was the most affected age group by fatal poisoning. this is resulted from unintentional poisoning in youngsters by kerosene consumption or pesticide ingestion or medications as well as carbon monoxide and hydrogen sulfide poisoning. Followed by the age group (15-24 years) and (25-34), while the least affected age group was (≥ 45). This finding agrees with Goswami O, Mahanta P, Kalita D, Konwar R, Yadav DK. [21], the findings and disagrees with Mohammed J. Ali who found that the age group 15-24 was the most affected age group with poisoning, and the age group of 14 and below was the least affected age group. [13]

When dispersing the positive instances of poisoning according to the month of the year the study showed that the winter season months had

the highest mortality due to poisoning (march, February, January, and December). This is owing to the use of heating appliances that generate carbon monoxide as a byproduct of kerosene burning. And May was the month with the least number of fatal poisoning cases. This finding agrees with Mohammed J. Ali's finding [13] and disagrees with Patel JB, Chandegara P, Patel UP, Parkhe S, Govekar G. where they found that August was the month with the highest number of confirmed poisoning cases and February was the least confirmed poisoning cases in a month. [22]

Baghdad governorate was the most affected by fatal poisoning cases, Basra governorate was the second most affected and the holy city of Karbala was third most affected, while the least affected governorate was Diwaniya. No comparison in the finding can be done due to a lack of similar statistics.

Among most important limitations of this study are the existing records, which may not have complete information on all relevant factors. For instance, marital status, and occupation, might not be fully or accurately recorded or not recorded at all.

The accuracy of the data is dependent on the precision of the initial record-keeping. Any inaccuracies in the original records could affect the study's findings.

Limitations:

The study relies on existing records, which may not have complete information on all relevant factors. For instance, marital status, and occupation, might not be fully or accurately recorded or not recorded at all.

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CONCLUSION:

The study at the Medicolegal Directorate (MLD) found that poisoning accounted for 1.94% of all autopsies in 2022, with a 35% increase in cases compared to 2021. Males were more affected than females, accounting for almost two-thirds of confirmed cases. Gaseous poison was the most common cause of death, followed by pesticides and metals. The age group of ≤ 14 was most affected, followed by 15-24 years, 25-34, and 45+. Most poisoning cases were accidental, with gaseous poisons being the most common cause. Suicide was the second manner of death, and pesticides were the most frequent poisons. The study highlights serious issues like increasing drug abuse, carbon monoxide poisoning deaths, and pesticide-ingestion-related suicides.

It is recommended to conduct further studies for longer period of time considering marital status, occupation and educational status for poisoning victims. Enhancing collaboration between investigative agencies and hospitals, specifically with the medicolegal directorate, by ensuring the provision of comprehensive reports regarding the cause of death and the investigation of the crime scene.

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