

A Narrative Review of Acute Adult Poisoning in Iran

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What's Known

• In Iran, poisoning is one of the most common causes of hospitalization and the 2nd leading cause of mortality. The pattern of poisoning is dissimilar in different regions of Iran. Understanding the common pattern of poisoning in different regions can contribute to early diagnosis and treatment of poisoning. Pharmaceutical compounds, pesticides, stings, and bites are the most common causes of poisoning in Iran.

What's New

• Medications were the most common cause of poisoning in most parts of Iran. Pesticides were more common in northern regions, whereas bites and stings were more commonly reported in southern Iran. Majoon Birjandi (containing cannabis) is a unique substance used in eastern Iran. Poisoning by opioids, tramadol, and pesticides (organophosphate and aluminum phosphide) remains common in Iran. Moreover, lead poisoning due to opium use is another recently recognized hazard in Iran. In addition, medicinal plants, often considered safe, could also be toxic.

Abstract

Poisoning is a frequent cause of referral to medical emergencies and a major health problem around the world, especially in developing countries. We aimed to review the epidemiology and pattern of adult poisoning in Iran in order to facilitate the early diagnosis and management of poisoning. The pattern of poisoning is different in various parts of Iran. Pharmaceutical compounds were the most common cause of poisoning in most parts of Iran. Pesticide-related toxicities were more common in northern agricultural regions, whereas bites and stings were seen more commonly in southern Iran. Carbon monoxide poisoning was common in cities with many motor vehicles such as Tehran and in colder climates such as in northern and western regions due to inadequately vented gas appliances such as stoves and heaters. Majoon Birjandi (containing cannabis) is a unique substance used in eastern Iran. Poisoning by opioids, tramadol, and pesticides (organophosphate and aluminum phosphide) has remained a common hazard in Iran. Poisoning-associated morbidity and mortality rates vary by region and have changed over time due to the introduction of new drugs and chemicals. Early diagnosis and proper treatment may be lifesaving; thus, understanding the general pattern of poisoning in different regions is important.

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Introduction

Intentional or accidental exposure to poisons and drugs is a typical problem in medical emergencies and a major health problem in developed or developing countries.¹⁻⁶ It is estimated that poisoning accounts for over 1 million morbidities worldwide annually.⁷ Fatality rates are estimated to be as high as 20% in some regions, and over 200,000 individuals are predicted by the World Health Organization to die as a result of pesticide poisoning alone each year.⁷ Poisoning is the most common type of lethal self-harm in Asian countries in that it accounts for more than 60% of all deaths.⁸

In developing countries with insufficient drug and chemical regulations, lack of surveillance systems and easy access to more toxic drugs or chemicals have been blamed for higher poisoning rates.⁹ The higher toxicity of available poisons in the developing countries and the shortage of medical services in these countries contribute to higher mortality rates due to poisoning (10%–20% in comparison with 0.5%–1% in developed countries).¹⁰ Analyses

recently made on the data from a few Asian countries estimate that there may be 300,000 intentional ingestions of pesticides in this region annually with suicidal purpose.^{11,12}

Iran is a developing country with almost 80 million residents.¹ Poisoning accounts for 15% to 20% of emergency department visits in Iran.¹³⁻¹⁵ In 1991, Iran had the 91st rank of self-poisoning in the world (111 suicides per year), which changed to 58th in 2003 (mean of 3,967 cases annually).

Poison-associated morbidity and mortality rates vary by region and may change over a certain period of time as new drugs and chemicals are introduced. Understanding the pattern of intoxication in a certain region would possibly contribute to the early diagnosis and treatment of poisoning.^{16,17} The pattern and prevalence of various common toxic agents in different parts of Iran were reviewed in order to determine the common poisoning patterns in various parts of Iran.

Pharmaceutical Compounds

Due to the general increase in the availability of medications, especially over-the-counter (OTC) products, pharmaceuticals were the most common cause of poisoning in Iran.^{2,18,19} Medications acting on the central nervous system (CNS) are the most common ones used for self-harm throughout the developing world. Of the analgesics, acetaminophen is the most commonly used poison in some regions of developing countries.^{10,20-22}

In studies conducted in Shiraz, Kermanshah, Isfahan, Tehran, and Razavi Khorasan (Neishabour), pharmaceutical compounds were the most common causes of poisoning (table 1).²³⁻²⁸ Additionally, in studies conducted in Bandar Abbas, Gorgan, Kashan, Tabriz, and Tehran, pharmaceutical drug toxicity was the most common method of self-poisoning (table 2).²⁹⁻³⁴ The most important pharmaceutical drugs ingested were antidepressants, sedative-hypnotics, antipsychotics, antiepileptics, acetaminophen, and opioids.

Intoxication with antidepressants, particularly tricyclic antidepressants (TCAs), is one of the most common causes of admission to Iranian poisoning emergency departments.³⁵ Psychological problems and addiction are factors associated with TCA poisoning.^{36,37} Antidepressants, especially TCAs, were the leading cause of poisoning in Tehran^{7,36,38,39} and Urmia,⁴⁰ and the 2nd most important cause of poisoning in Tabriz and Mazandaran.^{16,41} In addition, TCA poisoning was the most prevalent

Table 1: Summary table for the patients of the studies

Region/Poison	No. of studies	No. of patients	% of all poisonings
North of Iran ¹	49	60542	100
Medicines		45605	75
Substances		6141	10
Pesticides		6742	11
Bites		111	<1
Others		1943	3
South of Iran ²	16	49390	100
Medicines		1695	3
Substances		556	1
Pesticides		162	1
Bites		46965	95
Others		12	<1
East of Iran ³	7	9961	100
Medicines		5191	47
Substances		1048	9
Pesticides		1882	19
Bites		1198	11
Others		1252	14
West of Iran ⁴	7	1847	100
Medicines		568	30
Substances		226	12
Pesticides		275	14
Bites		635	34
Others		143	7
Center of Iran ⁵	7	2049	100
Medicines		960	46
Substances		686	33
Pesticides		46	2
Bites		287	14
Others		70	3

¹East Azerbaijani (Tabriz), West Azerbaijan (Urmia), Ardabil, Zanjan, Qazvin, Gilan (Rasht), Mazandaran (Sari), and Tehran; ²Khuzestan (Ahvaz, Ramhormoz, Izeh, and Ramshir), Sistan-Baluchistan, Fars (Shiraz), Kerman (Rafsanjan), and Hormozgan (Bandar Abbas); ³South Khorasan (Birjand) and Khorasan Razavi (Mashhad); ⁴Ilam, Chaharmahal and Bakhtiari (Shahrekord), Kurdistan (Sanandaj), Kermanshah, Lorestan (Khorramabad), and Hamadan; ⁵Esfahan (Kashan) and Yazd

cause of death among non-narcotic drugs in deaths referred to the Tehran Forensic Medicine Organization.⁴²

A very commonly prescribed group of medications consists of antiepileptic drugs (AEDs). The epidemiology of AED poisoning has not yet been well evaluated in developing countries such as Iran. In a study conducted in Tehran on patients poisoned with AEDs other than benzodiazepines, phenobarbital, carbamazepine, and sodium valproate accounted for most cases of poisoning (89%).⁴³

Although benzodiazepines, TCAs, other antidepressants, and antihypertensives were

Table 2: Review of demographic findings in general epidemiological studies

Author	Region	Study size	Most common cause of poisoning	Most affected age	Dominant gender	Dominant marital status	Dominant employment	Intentional/ Unintentional	Mortality
Afshari et al., 2004	Khorasan Razavi (Mashhad)	71589	Pharmaceuticals (CNS drugs)	Mean age of 22.3	Female	Not mentioned	Not mentioned	Intentional	0.6%
Eslami et al., 2014	East Azerbaijan (Tabriz)	988	Pharmaceuticals (benzodiazepines)	21-30 years	Male (65.1%)	Married (55.36%)	Unemployed	Intentional	Most of the cases were discharged with recovery (97.2%).
Hashemnezhad and Fatehi 2014	Karaj	172	Pharmaceuticals (benzodiazepines)	20-25 years	Male and females were equal	Married (55.8%)	Not mentioned	All were intentional	5.8%
Sobhani et al., 2000	Guilan (Rasht)	1215	Organophosphates phosphorous compounds	15-64 years	women	Not mentioned	Housewife	Intentional	1.04% mostly by opiates
Islambulchilar et al., 2009	East Azerbaijan (Tabriz)	1342	Pharmaceuticals (benzodiazepines)	11-20 years	Female	Married	Housewife	Intentional (90.2%)	2.3% mostly due to pesticides
Masoumi et al., 2012	Isfahan	402	Pharmaceuticals (psychological)	Mean age of 26.5	Male	Not mentioned	Not mentioned	Intentional	2%
Deighani et al., 2015	Kashan	163	Pharmaceutical (sedatives)	0-10 years	Male	Single	Not mentioned	Intentional	2.4%
Farzaneh et al., 2010	Tehran	248	Pharmaceutical	15-16 years	Female	Single	All were students	All were intentional	4.8%
Ahmadi et al., 2010	Mazandaran	2057	Pharmaceutical (sedative-hypnotics)	18-29 years	Female	Not mentioned	Not mentioned	Intentional	1.3% mostly due to pesticides
Ala et al., 2011	West Azerbaijan	200	Drugs (opioids)	33.42	Male	Married	Housewife	All were intentional	Not mentioned
Karbakhsh et al., 2008	Tehran	299	Pharmaceutical (benzodiazepines)	All were >60 years	Male	Married	Not mentioned	Unintentional	11.7% mostly due to opioids
Kassiri et al., 2012	Khuzestan	840	Scorpion sting	21-25 years	Male	Married	Not mentioned	Intentional	One case
Taghaddosimejad et al., 2012	Tehran	175	Pharmaceuticals (benzodiazepines)	20-29 y	Male	Not mentioned	Not mentioned	Intentional	17.7% mostly due to pesticides
Mortazavi et al., 2000	Khorasan Jonou bi (Birjand)	602	Pharmaceuticals (analgesics, NSAIDS, BZN)	>18 years	Female	Not mentioned	Not mentioned	Intentional	Not mentioned
Akhlaghi et al., 2009	Charmahal- Bakhtiari	638	Multidrug	20-45 years	Male	Not mentioned	Not mentioned	Intentional	1.2% mainly due to organophosphates
Mahmoudi et al., 2008	Lorestan (Khorram Abad)	250	Multidrug	Mean age of 25.25	Male	Not mentioned	Not mentioned	Intentional	1%
Sabzeghabaee et al., 2013	Isfahan	400	Pharmaceuticals	Mean age of 25.75	female	Married	Household	All were intentional	0.75
Mohammad hosseini et al., 2012	Kohkiluyeh-Boyer ahmad (Ysuj)	470	Pharmaceuticals	21-30 years	Female	Single	Unemployed	Intentional	11.1%

(Contd...)

Table 2: (Continued)

Author	Region	Study size	Most common cause of poisoning	Most affected age	Dominant gender	Dominant marital status	Dominant employment	Intentional/Unintentional	Mortality
Jalali et al., 2012	Khuzestan	3258	Envenoming by venomous animals	18-30 years	Males	Not mentioned	Not mentioned	Intentional	None
Mortazavi et al., 2012	Tehran	200	Pharmaceuticals (Antidepressants)	Adolescents	Male	Single	Not mentioned	Intentional	None
Sarjami et al., 2008	Tehran	11465	Pharmaceuticals (antiepileptic, sedative-hypnotic and antiparkinsonism drugs)	18 years	Male	Not mentioned	Not mentioned	Intentional	1% mainly due to narcotics
Zare Faziollahi et al., 2010	West Azerbaijan	1208	Pharmaceuticals	16-25 years	Female	Married	Housewife	Intentional	4.6%
Moghaddamnia et al., 2002	Mazandaran	1751	Pharmaceuticals (diazepam)	16-25 years	Female	Not mentioned	Not mentioned	Intentional	9%
Torkashvand et al., 2015	Rafsanjan	260	Pharmaceuticals	11-30 years	Male	Single	Not mentioned	Intentional	1.9%
Shadnia et al., 2007	Tehran	11465	Pharmaceuticals (sedative-hypnotics)	21-30 years	Male	Not mentioned	Not mentioned	Intentional	1.3% mainly due to opioids
Khodabandeh et al., 2013	Tehran	280	Multiple drugs	25-40 years	Male	Not mentioned	Not mentioned	Intentional	The study was conducted on deceased cases.
Hosseinian Moghaddam et al., 2014	Tehran	108265	Pharmaceuticals (antiepileptic and sedative hypnotic)	>12 years	Male	Not mentioned	Not mentioned	Not mentioned	1.9% mostly due to pesticides
Afzali et al., 2012	Hamadan	47	Organophosphates phosphorous compounds	10-20 years and >50 years	Male	Not mentioned	Not mentioned	Intentional	The study was conducted on deceased cases.
Mehdizadeh et al., 2015	Mazandaran (Babol)	635	Pharmaceuticals (benzodiazepines)	16-25 years	Female	Married	Housewife	Intentional	1.3%
Farzaneh et al., 2015	Ardabil	282	Pharmaceuticals (tramadol)	20-30 years	Male	Married	Unemployed	Intentional	None
Farzaneh et al., 2010	Ardabil	2852	Pharmaceuticals (tramadol)	21-30 years	Male	Single	Not mentioned	Intentional	3.7%
Tabibzadeh et al., 2013	Bandar Abbas	493	Pharmaceuticals (benzodiazepines)	14-29 years	Male	Single	Unemployed	Intentional	2.2%
Eizadi-Mood et al.	Isfahan	384	Pharmaceuticals	15-40 years	Female	Single	Unemployed	All were intentional	Not mentioned
Najjari et al., 2016	Chaharmahal and Bakhtiari (Shahrekor)	395	Pharmaceuticals	Mean age of 27.6 years	Female	Single	Unemployed		9.4%

(Contd...)

Table 2: (Continued)

Author	Region	Study size	Most common cause of poisoning	Most affected age	Dominant gender	Dominant marital status	Dominant employment	Intentional/ Unintentional	Mortality
Azizpour et al., 2016	Ilam	6794	Pharmaceuticals	15-24 years	Female dominance in attempted suicide Male dominance in complete suicide	Single	Unemployed	All were intentional	5.1%
Vatandoost et al., 2002	Tehran	19511	Pharmaceuticals (Benzodiazepines)	20-30 years	Female	Single	Housewife	Intentional	0.96
Shokrzadeh et al., 2016	Golestan (Gorgan)	800	Pharmaceuticals (Benzodiazepines)	20-29 years	Male	Not mentioned	Not mentioned	Intentional	1.6%

easily available in this country,² the main cause of poisoning varied in different parts of Iran. For instance, diazepam was found in Tehran, Mashhad, and Babol to be the most typical source of pharmaceutical drug-associated poisonings.^{18,41,44} In several studies, sedative-hypnotic drugs were responsible for most of the poisonings.^{1,7,45} Benzodiazepines were responsible for toxicities in several studies conducted in Tehran, Tabriz, Mashhad, Rafsanjan, Mazandaran, and Gorgan (table 2).^{3,16,41,44,46-53} Also, in another study in Razavi Khorasan Province, benzodiazepines were introduced as the most common causes of intoxication.⁵⁴

In another study conducted in the city of Karaj, acetaminophen was found as the commonest cause of poisoning.⁵⁵ Multidrug toxicity was the most frequent cause of poisoning in studies conducted in Shahrekord, Khorramabad, Tehran, and Isfahan.^{9,56-58}

In summary, antidepressants, especially TCAs, are the 1st and in some cases the 2nd cause of drug poisoning in the north and northwest of Iran. Poisoning with sedative-hypnotic drugs and acetaminophen is common in the north and east of Iran and multidrug toxicity is the 1st cause of drug poisoning in the center and west of Iran.

Medicinal Plants

Herbal medicines are extracted from different parts of various plants.⁵⁹ They may cause side effects or be ineffective, although they are usually considered safe and effective. Annually, many people turn to herbal medicine since they believe them to be free of side effects.^{60,61} Some herbs such as Arnica, Atropa belladonna, Aconitum, and Digitalis spp contain poisonous ingredients and should not be administered by unqualified people. Finally, there are groups of herbs that may cause specific patterns of toxicity such as pyrrolizidine-alkaloid-containing plants (Comfrey, Dryopteris, Viscum, and Corynanthe) and may induce hepatotoxicity.⁶¹

Illicit Drug Poisoning

Substance abuse is a serious and complicated health problem worldwide. The pattern of drug abuse varies across the globe.⁶² In recent reports from Iran, opium and opium-related extracts were still the most common drugs of abuse. There was no general population-based survey to determine the prevalence of illicit drug addiction in Iran, and it seems that the patterns of abuse vary in this country.⁶² In a study, drug poisoning was found to be responsible for more

than one-third of poisoning deaths referred to medical centers in Kermanshah.⁶³

Opioids

Globally, narcotic use has extended and changed to an important health problem, especially in developing countries such as Iran.^{64,65} The highest rate of addiction to opioid worldwide belongs to Iran.^{66,67} In Iran, opium remains the most typically abused drug, with opium overdose and poisoning constituting the major cause of drug-associated admissions in hospitals.⁶⁵

According to a study in 1975, the oral intake of crude opium stood for over 95% of poisoning-based suicide attempts in Iran.⁶⁸ Ala et al.,² in a study in Tabriz, showed that among toxic agents, opioids were the most frequent drugs that caused poisoning. In another study by Farzaneh et al.⁶⁹ in Ardabil (northwest of Iran), the most common toxic agents were opiates. In another study conducted in Shiraz, the majority of the participants were multidrug abusers and opium was the most commonly abused agent solely or in combination with other drugs.⁷⁰ Opium and its derivatives were the most common cause of death in a study conducted in Hamadan.⁷¹

Methadone

Methadone is a synthetic opioid generally used for opioid dependence in methadone maintenance treatment (MMT) protocols.⁷² Methadone has become popular in MMT programs because of its special pharmacokinetic and pharmacodynamics.⁶⁵

Increased use of methadone has added to the prevalence of its toxicity.^{73,74} It has been suggested that MMT clinics need to be strictly managed under the national guidelines to avoid methadone poisoning.⁷⁵ In Yazd, methadone was the most commonly used narcotic.⁶⁴ Indeed, among the drugs of abuse, opium was more prevalent in the early years of its introduction but was replaced by methadone later.⁴⁵

Tramadol

A centrally acting analgesic, tramadol is applied to cure moderate to severe pain. Its use has been confirmed in some countries dating back to 1980 and now it is the most prescribed opioid worldwide.⁷⁶⁻⁷⁸ The Iranian Drug Selecting Committee approved it as an analgesic in 2002.⁷⁹

In recent years, tramadol poisoning has turned into a major cause of admission to Iranian emergency departments, especially among young males who have a history of mental disorders and substance abuse. Important complications of tramadol poisoning include

seizure, depression of the CNS and respiratory systems, and renal dysfunction.⁸⁰⁻⁸⁵ Tramadol poisoning is deemed the most common cause of drug-induced seizures.^{86,87}

In another study from Ardabil, tramadol, followed by benzodiazepines, was the leading cause of poisoning.⁸⁸ In a study on 114 intentional tramadol intoxications, tramadol was used in some cases along with other illicit drugs, among which benzodiazepines were the most frequent.⁸² In Kermanshah, tramadol was mostly used to attempt suicide and 40% of the cases had an episode of seizure on presentation.⁸⁹ These results chime in with those reported by other studies from Shiraz and Urmia.^{90,91} In a study on 400 college students, it was shown that almost one-quarter of the participants had used tramadol in their lifetime.⁹² Tramadol-related fatalities are growing in Iran, not least among substance abusers.⁹³

Alcohol

Although alcohol dependency is not common in Iran (<1% of the users), it should be borne in mind that most cases of alcohol use and its complications are not reported because of social stigmas. This leads to the consumption of homemade alcohol, which in turn increases the probability of toxic alcohol poisoning. Recently, it has been suggested that the number of alcohol poisoning cases is growing in Iran.⁹³ Methanol poisoning should be suspected in patients who abuse homemade alcohol.⁹⁴ Adulterated alcoholic drinks may result in poisoning with impurities including methanol, plus complications that result from ethanol.⁹⁵ The occurrence of methanol poisoning most generally arises from consuming adulterated counterfeit or offhandedly made alcoholic drinks, particularly in countries in which alcohol consumption is not legally allowed such as Iran.⁹⁶ In Tabriz, the total mortality rate due to alcohol was 3.7%, mainly due to methanol poisoning.⁹⁷ Methanol poisoning is becoming a serious and growing healthcare problem generally involving young males in our country.⁹⁸

Stimulants

Methamphetamine

Methamphetamine, a potent neurotoxin, may result in dopaminergic degeneration. In Iran, it has recently become a serious health problem.⁹⁹ In Isfahan, a study on 2,325 admitted patients confirmed that 542 (23.3%) used amphetamines and the remainder reported co-ingestion of opioids and amphetamines.¹⁰⁰ In a study on drug-induced seizures, 143 patients were examined.

Methamphetamine was alleged to be the most common cause of new-onset seizures⁸⁶ as well as the main cause of complications and death.⁸⁶ Nikkhah et al.¹⁰¹ examined 4 methamphetamine-intoxicated patients admitted to their emergency department, which resulted in 3 deaths.

Processed Cannabis (Majoon Birjandi)

Majoon Birjandi is a kind of processed cannabis in eastern Iran (especially Birjand and Khorasan). It is frequently abused by youngsters to induce euphoria. Given its solid nature, Majoon Birjandi is easily smuggled and stored for long periods of time. Because of its localized use, toxicologists from other parts of the country are not very familiar with it. Although cannabis tends to be regarded a safe drug,¹⁰² Majoon Birjandi can cause panic attack with palpitations, hallucinations, and illusions. Major effects may continue for about 6 hours.¹⁰³

Pesticides

Increase in populations necessitates more agricultural products and more pesticide use.¹⁰⁴ Pesticide compounds include organophosphates, organochlorines, carbamates, pyrethroid derivatives, and phosphides.¹⁰⁵ Since 2000, pesticide use has been dramatically increased in Iran.¹⁰⁶ As stated by the Statistical Centre of Iran, the total amount of pesticides distributed in the country was 2,291 tons in 2011¹⁰⁷ while they were the most common cause of poisoning.^{108,109} In Lorestan, the prevalence of pesticide poisoning was reported to be high.¹¹⁰ Estimations hint that, in actuality, less than 0.1% of the pesticides used for crops reaches the intended pest and the remaining enters the environment contaminating soil, water, and air.¹⁰⁷ Pesticide use in agriculture may lead to the contamination of groundwater resources, while in Iran, more than 87% and 56% of rural and urban areas utilize groundwater resources, respectively.^{107,111,112}

Organophosphates

Acute poisoning with organophosphates is a significant cause of morbidity and mortality the world over.¹¹³ The use of organophosphates in agricultural and urban areas has resulted in the pollution of natural water resources.¹¹⁴

The majority of poisonings in northern Iran are due to organophosphates. In Guilan, organophosphates were reported to be the most common agents that led to poisoning.¹⁸ In 2 studies conducted in Mazandaran, organophosphates were present in the rivers of this region more than the permitted limits.^{114,115} Pesticide use in Mazandaran accounted for half

of its total usage in Iran, possibly raising the risks of accidental poisoning in this region.¹

Studies on pesticides and organophosphates have been conducted in parts of Iran other than Mazandaran and Guilan provinces, as well. In the 2 studies carried out in Chaharmahal and Bakhtiari and Razavi Khorasan provinces, organophosphates were the most common cause of acute chemical poisoning, with the highest morbidity and mortality.^{44,56}

Metal Phosphides

Aluminum phosphide (rice tablet) and zinc phosphide are solid compounds that repel stored rice pests.¹¹⁶⁻¹¹⁹ They have an estimated mortality rate of 18.6% to 24% in Iran. Patients usually ingest these compounds intentionally to commit suicide.¹¹⁹⁻¹²² It has been shown that aluminum phosphide poisoning and its mortality is increasing in Iran.¹²³⁻¹²⁶

Mazandaran and Guilan provinces are located by the Caspian Sea and are ideal for the production of rice. People in the urban areas can easily purchase cheap aluminum phosphide tablets from the black market. Suicidal ingestion of aluminum phosphide is, therefore, a common toxicity in northern Iran.¹²⁷ A study conducted in Tehran confirmed easy access to rice tablets even in this non-agricultural region.¹⁰⁴ Although aluminum phosphide is banned, the incidence rates of its poisoning and its mortality rates have risen since 2007.¹⁰⁴ Similar increased numbers of poisonings have been reported with zinc phosphide.¹²⁸

Other Pesticides

Two other pesticides less frequent in Iran are 2, 4-dichlorophenoxyacetic acid (2, 4-D) and amitraz.¹²⁹⁻¹³¹ Imidacloprid is another insecticide whose poisoning is on the rise.¹³²

Animal Bites and Stings

Animal bites and stings are among the most common injuries worldwide. In Asia, the highest rates of mortality and morbidity due to animal bites are observed in developing countries, including Iran.¹³³ Iran is a natural reservoir of a huge diversity of venomous animals, among them a large number of scorpion species.¹³⁴

Scorpion Sting

Study of the scorpion faunae in Iran began in 1807, when *Androctonus Crassicauda* was identified from Kashan.¹³⁴ Reports of scorpion sting have been recorded in all Iranian provinces, particularly those in the southern and southwestern regions of Iran (table 1).¹³⁵ In other studies in the endemic regions of the southeast

of Iran, scorpion sting was responsible for an average of 19 deaths every year, particularly in the farming lands and during the hot seasons.¹³⁶⁻¹³⁹ Stings generally occur in Khuzestan, Hormozgan, Sistan and Baluchestan, Bushehr, Ilam, and Fars provinces.^{140,141} In a study conducted in Khuzestan, it was shown that scorpion sting was the main cause of poisoning among nonmedical toxins.⁴ In another study on 3,258 patients, the most common cause of poisoning was animal bites or stings in Khuzestan.¹⁴² Scorpion envenomation was introduced as a public health problem in Khuzestan.¹⁴³

Iranian scorpion faunae consist of more than 44 named species from 23 genera in the 2 families of Buthidae and Scorpionidae. Nonetheless, *Hemiscorpius lepturus* of the Hemiscorpiidae family is the most medically significant scorpion in Iran.^{144,145} Envenomation by *H. lepturus* has been considered a serious medical emergency.^{146,147} In a study from Chaharmahal and Bakhtiari Province, *H. lepturus* was very common.¹⁴⁸ However, *A. Crassicauda* was the most frequent scorpion causing poisoning in Khuzestan.¹⁴⁹ In Bandar-Mahshahr county (Khuzestan), education and health promotion was found to prevent these envenomations.¹⁵⁰

Snake Bite

Snake bite is a significant health problem in tropical and subtropical regions. In Iran, 83 species have been identified, 45 of which are nonvenomous, 27 are venomous, and 11 are semivenomous.^{151,152} Based on the distribution of venomous snakes, *Echis carinatus*, *Vipera lebetina*, *Pseudocerastes persicus*, and *Walterinnesia aegyptia* are the most common venomous snakes in Iran. The recorded number of snake bites was approximately 5,000 to 7,000 annually from 2001 to 2008 with an annual death rate of 7.¹⁵¹ Dehghani et al.¹⁵¹ declared that the highest and the lowest rates of snake bites were detected in Semnan/Kerman (Rafsanjan) and Razavi Khorasan (Sabzevar), respectively. Another study in Kashan showed that most of the envenomations took place in summer.¹⁵³

Spider Bite

Spiders are the most abundant predators in ecosystems.¹⁵⁴⁻¹⁵⁶ Commonly identified as black widow spider, *Latrodectus tenebrosus* is notorious for its venomous bite.¹⁵⁷ Bites by this spider are relatively frequent in the northeast of Iran; they result in morbidity and at times mortality. It was shown that this spider's bite was rather common in Mashhad, where reports point to different findings, including cardiac toxicity.¹⁵⁸

Review of literature indicates that the spider fauna of Iran is not yet completely studied and will benefit from further detailed studies.¹⁵⁵

Natural Elements

Lead

Lead is a heavy metal that is commonly found in the environment, especially in developing countries.¹⁵⁹⁻¹⁶¹ People engaged in coal mining, paint factories, copying centers, and tile production factories, as well as bus drivers are at risk of lead toxicity.¹⁶² Although occupational lead toxicity has decreased in recent years, new forms of nonoccupational poisoning have recently been introduced,¹⁶³ including lead toxicity due to opium impurities.¹⁶⁴

Fluoride

The effect of fluoride on human health has been studied for over 100 years.¹⁶⁵ A small amount of fluoride is often added to drinking water to improve dental health. However, at higher concentrations, it is a health hazard.¹⁶⁵ Many parts of Iran are exposed to high fluoride in drinking water, causing a high rate of fluorosis in Borazjan, Khormoj (Boushehr), Maku (West Azerbaijan), and Lar (Fars).¹⁶⁶

Plants

In some regions of the world, plant poisoning is an important clinical problem causing morbidity and mortality.¹⁶⁷ Over 100,000 toxic plant exposures are annually reported to poison centers throughout the United States.¹⁶⁸

Datura Stramonium

Datura Stramonium or Tatoore is a weed from the *Solanaceae* family and may be present at roadsides, in cornfields, and in pastures. Most victims of this poisoning are teenagers who voluntarily ingest it for hallucinogenic and euphoric effects. Due to the content of anticholinergic alkaloids, anticholinergic signs and symptoms may develop. Toxicity with this plant as well as *Citrullus colocynthis* Schrad (Cucurbitaceae), also known as bitter apple, has been reported in the south, center, and east of Iran.^{169,170}

Mushrooms

There are approximately 10,000 mushroom species, and 50 to 100 of them are poisonous. The most dangerous poisonous mushrooms are the *Amanita species* (*A. phalloides*, *A. verna*, and *A. virosa*), *Gyromitraesculenta*, and the *Galerina species*.¹⁷¹ *A. Phalloides* contains amatoxin, which can cause acute liver failure and death.¹⁷²

Poisonous mushrooms are scattered in Iran, especially in Guilan, where mushroom poisoning has a relatively high prevalence due to the specific climate appropriate for fungal growth and local markets and villagers who collect and sell wild mushrooms.¹⁷² The prevalence of mushroom poisoning was very low (0.1%) among patients who referred to the Mashhad Toxicology Center, but the mortality rate was high (22%) in those with an impaired coagulation profile.¹⁷³ According to studies conducted in Tehran, Rasht, Hamadan, and Tabriz, the clinical symptoms of mushroom poisoning varied from mild gastrointestinal symptoms to organ failure and death.^{171,172,174-179}

Carbon Monoxide

Exposure to carbon monoxide (CO) can be especially hazardous given that the early effects of poisoning may often go unnoticed.¹⁸⁰ In Iran, according to the reports of the Forensic and Legal Medicine Organization, 769 deaths were recognized to be due to this poisoning in 2009.¹⁸¹ In fact, the weather is generally cold in the north and northwest of Iran and CO poisoning may happen when gas appliances such as stoves and heaters are poorly kept or inappropriately ventilated.¹⁸⁰ A study conducted in the northwest of Iran confirmed that CO poisoning had a high prevalence in this geographic region.¹⁸⁰ It was also shown that CO poisoning was a public health problem in Tehran and Kermanshah.^{182,183} A study conducted in Mashhad concluded that nearly all cases of accidental CO poisoning could be potentially prevented through education.¹⁸⁴

Air pollution can be another cause of CO poisoning.¹³ Tehran has the highest air pollution for the heavy automobile traffic it holds every day where CO poisonings with this source are frequently reported.^{185,186}

Corrosives

An arsenic-based depilatory agent named "vajebi" has been traditionally used in Iran for many years for hair removal. Its low cost and high availability make it an ideal method of suicide. Vajebi consists of approximately 65% calcium bicarbonate, 25% arsenic sulfide, and 10% clay and moisture.¹⁸⁷ The mortality rate of arsenic-based agents was once reported to be 5.8%.¹⁸⁸ In a study, a higher mortality rate due to these agents was found between 1994 and 1999.¹⁸⁹ Although this poisoning constituted only 1% of poisonings in the Loghman Hospital, it had a high mortality rate.¹⁹⁰ In another study in the same hospital, vajebi was shown to be the most frequently used corrosive that led to death with a 4.9% mortality rate. After 1999, there

was a significant decrease in the mortality rate of this poisoning because of the introduction of new arsenic-free depilatory products.^{191,192} The availability of this agent was also strictly limited in the prisons.

Discussion and Review of General Results

Approximately 30,000 poisonings occur in Tehran each year, leading to almost 12,000 admissions to toxicology wards, 1,200 admissions to toxicology ICUs, and a minimum of 120 deaths.^{46,55} Pharmaceutical drug poisoning is the 3rd leading cause of death due to suicides in Iran.^{45,193} Poisons such as pharmaceutical drugs, illicit drugs, and chemicals (especially pesticides) are in easy reach in almost any part of the country. Hence, acute or chronic exposures to chemicals are common. There are also natural toxins such as poisonous plants and venomous animals in various parts of the country.^{23,44,194}

In different studies, the most common intentional poisonings were due to sedative-hypnotics, pesticides, and opiates.^{7,18} The mortality rate of alcohol poisoning is reported to range between 3.7% and 8%, although the outcome of most of the alcohol-poisoned patients is not reported because of the social stigma associated with alcohol use. Alcohol use and abuse are, therefore, probably much more frequent than what is reported.^{94,97}

Scorpion sting and some poisonings due to spiders are common important health problems in the south and southwest regions of Iran.¹⁴⁸ Snake bite is a serious public health problem, especially in rural areas.¹⁵³ CO poisoning is common in cities with numerous motor vehicles such as Tehran. It is also a threat due to incompetently ventilated gas appliances like heaters and stoves. People who live in areas with cold climates such as the north and west of Iran are, thus, at risk of CO poisoning.^{180,181,185}

The clinical patterns of severe poisoning vary strikingly among study centers. The accessibility of prescribed and nonprescribed drugs in the developed countries has been linked with a significantly increased number of patients needing hospital admissions for drug overdose. Instances of pesticide poisoning have occurred during the past decades, resulting in a considerable number of fatal outcomes, although ICU facilities have been increasingly available. Recently published data on Iran reveal a dramatic rise in aluminum phosphide poisoning, whereas opioid and tramadol poisoning are still a major challenge for poisoning centers and hospitals.⁴⁹ In this paper, general and epidemiological studies were reviewed to discover more demographic

data. It is understood that the most common causes of poisoning in most of these studies were pharmaceutical compounds, especially CNS drugs. The availability of pharmaceutical compounds, increase in the sale of OTC drugs, and increase in prescribing CNS drugs by physicians, especially benzodiazepines, have contributed to the increase. Also, individuals using CNS drugs are those who often suffer from psychosocial problems and depression and this can increase the tendency for suicide.¹⁹⁵ On the other hand, in some studies, the most common cause of poisoning is non-pharmaceutical factors. For example, envenomation was the major cause of poisoning in a study conducted by Jalali et al.¹⁴² in Khuzestan. Similar results were reported by Kassiri et al.⁴ in the same region. In a study from Guilan, organophosphates were responsible for most of the poisonings.^{18,114,115} Another notable point is that poisoning often occurs among younger adults. This group of people, perhaps as a result of more socioeconomic stress and depression, are susceptible to attempt suicide. Men are the dominant group in most studies. One explanation is that men use illegal drugs more frequently and commit suicide more than women.¹⁹⁶ However, women were more involved in 13 studies, which could be due to the increase in psychosocial problems as well as the increase in "acting out" suicide among them.¹⁹⁵ From the aspect of marital status, there was no significant difference between single and married groups. However, in general, bachelorhood and loneliness can increase stressful factors.¹⁹⁵ Unemployment and job problems were determined as major risk factors for drug abuse and suicide in most of the studies. The mortality rate was dissimilar in different studies. Vahdati et al.⁹⁵ reported a death rate of 13.3%. One explanation for such a high rate is the type of drug used by the patients.⁹⁵ Another one is the small size of the population studied. In a study by Taghaddosinejad et al.,⁴⁹ the mortality rate was 17.7%, probably because it was conducted on ICU patients. The mortality rate in a study by Karbakhsh et al.³ was 11.7%. All the patients in that study were older than 60 years, and it goes without saying that this group of people is more susceptible to the side effects of drugs.³ Action should be taken with a view to giving proper public education and preventing the use of nonprescribed drugs.

Poison Centers in Iran

The treatment of poisoned patients has been growing more sophisticated in recent decades in Iran. In many cities, poisoned patients are managed under the supervision of trained clinical

toxicologists. Drug and poison information centers (DPICs) work across the country under the supervision of medical universities and the Food and Drug Department of the Ministry of Health.¹⁹⁷⁻²⁰⁰ Currently, there are 29 active DPICs countrywide, which work in a network.¹⁹⁹

Limitations: One of the limitations of the current study is the changing pattern of the poisoning in our country over time. As this is a review article, the studies were evaluated during a relatively long period of time (16 years). Performing studies to evaluate the poisoning trend in different periods is, therefore, recommended.

Conclusion

Morbidity and mortality due to poisoning vary from place to place and over time. Pharmaceutical compounds are responsible for most cases of poisoning in most parts of the country. Thus, steps should be taken in order to reduce the availability of OTC drugs and decrease the prescription of unnecessary pharmaceutical compounds, especially CNS drugs. Consequently, awareness of the general patterns of poisoning in different regions would contribute to the early diagnosis and management of poisoning. This can subsequently result in reduced rates of morbidity and mortality.

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