A Narrative Review of Acute Adult Poisoning in Iran

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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.

Keywords • Epidemiology • Iran • Medicine • Pesticides • Poisoning • Stings • Toxicity

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.8 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).9 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.\textsuperscript{11,12}

Iran is a developing country with almost 80 million residents.\textsuperscript{1} Poisoning accounts for 15\% to 20\% of emergency department visits in Iran.\textsuperscript{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.\textsuperscript{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.

Table 1: Summary table for the patients of the studies

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

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

Poisoning rates account for 15\% to 20\% of emergency department visits in Iran.\textsuperscript{13-15} Understanding the pattern of intoxication in a certain region would possibly contribute to the early diagnosis and treatment of poisoning.\textsuperscript{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.\textsuperscript{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.\textsuperscript{10,20-22}

In studies conducted in Shiraz, Kerman, Tehran, and Razavi Khorasan (Neishabour), pharmaceutical compounds were the most common causes of poisoning (table 1).\textsuperscript{23-28} Additionally, in studies conducted in Bandar Abbas, Gorgan, Kishan, Tabriz, and Tehran, pharmaceutical drug toxicity was the most common method of self-poisoning (table 2).\textsuperscript{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.\textsuperscript{35} Psychological problems and addiction are factors associated with TCA poisoning.\textsuperscript{36,37} Antidepressants, especially TCAs, were the leading cause of poisoning in Tehran\textsuperscript{7,36,38,39} and Urmia,\textsuperscript{40} and the 2nd most important cause of poisoning in Tabriz and Mazandaran.\textsuperscript{16,41} In addition, TCA poisoning was the most prevalent cause of death among non-narcotic drugs in deaths referred to the Tehran Forensic Medicine Organization.\textsuperscript{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\%).\textsuperscript{43} Although benzodiazepines, TCAs, other antidepressants, and antihypertensives were
### Table 2: Review of demographic findings in general epidemiological studies

| Author et al., | 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., 2014 | Guilan (Rasht) | 1215 | Pharmaceuticals (benzodiazepines) | 15-64 years | Women | Not mentioned | Housewife | Intentional | 1.04% mostly by opiates |
| Islambulchilar et al., 2009 | East Azerbaijan (Tabriz) | 1342 | Pharmaceutical (psychological) | 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 | All were intentional | 2% |
| Dehghani 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 |
| Kasseri et al., 2012 | Khuzestan | 840 | Scorpion sting | 21-25 years | Male | Married | Not mentioned | Intentional | One case |
| Taghaddosinejad 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 (analgescics, NSAIDS, BZN) | >18 years | Female | Not mentioned | Not mentioned | Intentional | Not mentioned |
| Akhlagli 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 | Kohkiliouye-Boyer ahmad (Ysuj) | 470 | Pharmaceuticals | 21-30 years | Female | Single | Unemployed | Intentional | 11.1% |

(Contd...)
| 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 (anitiepileptic, sedative-hypnotic and antiparkinsonism drugs) | 18 years          | Male            | Not mentioned          | Not mentioned        | Intentional               | 1% mainly due to narcotics |
| Zare Fazloollahi et al., 2010 | West Azerbaijan         | 1208       | Pharmaceuticals                                                    | 16-25 years       | Female          | Married                | Housewife            | Intentional               | 4.6%       |
| Mortazaddamnia et al., 2002 | Mazandaran              | 1751       | Pharmaceuticals                                                    | 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                                                    | 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                                                    | >12 years          | Male            | 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. |
| Meh dizad et al., 2015   | Mazandaran (Babol)      | 635        | Pharmaceuticals                                                    | 16-25 years       | Female          | Married                | Housewife            | Intentional               | 1.3%       |
| Farzaneh et al., 2015   | Ardabil                 | 282        | Pharmaceuticals                                                    | 20-30 years       | Male            | Married                | Unemployed            | Intentional               | None       |
| Farzaneh et al., 2010   | Ardabil                 | 2852       | Pharmaceuticals                                                    | 21-30 years       | Male            | Single                 | Not mentioned        | Intentional               | 3.7%       |
| Tabizadeh et al., 2013  | Bandar Abbas            | 493        | Pharmaceuticals                                                    | 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 (Shahrekord) | 395       | Pharmaceuticals                                                    | Mean age of 27.6 years | Female   | Single                 | Unemployed            | 9.4%       |

(Contd...)
Pattern of poisoning in Iran easily available in this country, 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. In several studies, sedative-hypnotic drugs were responsible for most of the poisonings. Benzodiazepines were responsible for toxicities in several studies conducted in Tehran, Tabriz, Mashhad, Rafsanjan, Mazandaran, and Gorgan (table 2). Also, in another study in Razavi Khorasan Province, benzodiazepines were introduced as the most common causes of intoxication.

In another study conducted in the city of Karaj, acetaminophen was found as the commonest cause of poisoning. Multidrug toxicity was the most frequent cause of poisoning in studies conducted in Shahrekord, Khorramabad, Tehran, and Isfahan.

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. 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. 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 Corynanthis) and may induce hepatotoxicity.

**Illicit Drug Poisoning**

Substance abuse is a serious and complicated health problem worldwide. The pattern of drug abuse varies across the globe. 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. In a study, drug poisoning was found to be responsible for more

| 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 dominancy| Single                 | Unemployed          | Intentional              | 5.1%      |
| Vatandoost et al., 2002 | Tehran           | 19511      | Pharmaceuticals (Benzodiazepines) | 20-30 years       | Female          | Male                   | Housewife           | Intentional              | 0.96      |
| Shokrzadeh et al., 2016 | Golestan (Gorgan) | 800        | Pharmaceuticals (Benzodiazepines) | 20-29 years       | Male            | Not mentioned          | Not mentioned       | Not mentioned            | 1.6%      |
than one-third of poisoning deaths referred to medical centers in Kermanshah.\textsuperscript{63}

\textbf{Opioids}

Globally, narcotic use has extended and changed to an important health problem, especially in developing countries such as Iran.\textsuperscript{64,65} The highest rate of addiction to opioid worldwide belongs to Iran.\textsuperscript{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.\textsuperscript{55}

According to a study in 1975, the oral intake of crude opium stood for over 95\% of poisoning-based suicide attempts in Iran.\textsuperscript{68} Al\textsuperscript{a} et al., \textsuperscript{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.\textsuperscript{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.\textsuperscript{70} Opium and its derivatives were the most common cause of death in a study conducted in Hamadan.\textsuperscript{71}

\textbf{Methadone}

Methadone is a synthetic opioid generally used for opioid dependence in methadone maintenance treatment (MMT) protocols.\textsuperscript{72} Methadone has become popular in MMT programs because of its special pharmacokinetic and pharmacodynamics.\textsuperscript{85}

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

\textbf{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.\textsuperscript{76-78} The Iranian Drug Selecting Committee approved it as an analgesic in 2002.\textsuperscript{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.\textsuperscript{80-85} Tramadol poisoning is deemed the most common cause of drug-induced seizures.\textsuperscript{86,87}

In another study from Ardabil, tramadol, followed by benzodiazepines, was the leading cause of poisoning.\textsuperscript{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.\textsuperscript{89} In Kermanshah, tramadol was mostly used to attempt suicide and 40\% of the cases had an episode of seizure on presentation.\textsuperscript{89} These results chime in with those reported by other studies from Shiraz and Urmia.\textsuperscript{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.\textsuperscript{92} Tramadol-related fatalities are growing in Iran, not least among substance abusers.\textsuperscript{93}

\textbf{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.\textsuperscript{93} Methanol poisoning should be suspected in patients who abuse homemade alcohol.\textsuperscript{94} Adulterated alcoholic drinks may result in poisoning with impurities including methanol, plus complications that result from ethanol.\textsuperscript{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.\textsuperscript{96} In Tabriz, the total mortality rate due to alcohol was 3.7\%, mainly due to methanol poisoning.\textsuperscript{97} Methanol poisoning is becoming a serious and growing healthcare problem generally involving young males in our country.\textsuperscript{98}

\textbf{Stimulants}

\textbf{Methamphetamine}

Methamphetamine, a potent neurotoxin, may result in dopaminergic degeneration. In Iran, it has recently become a serious health problem.\textsuperscript{99} In Isfahan, a study on 3,235 admitted patients confirmed that 542 (23.3\%) used amphetamines and the remainder reported co-ingestion of opioids and amphetamines.\textsuperscript{100} In a study on drug-induced seizures, 143 patients were examined.
Methamphetamine was alleged to be the most common cause of new-onset seizures as well as the main cause of complications and death. Nikkhah et al. 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, Majoon Birjandi can cause panic attack with palpitations, hallucinations, and illusions. Major effects may continue for about 6 hours.

**Pesticides**

Increase in populations necessitates more agricultural products and more pesticide use. Pesticide compounds include organophosphates, organochlorines, carbamates, pyrethroid derivatives, and phosphides. Since 2000, pesticide use has been dramatically increased in Iran. As stated by the Statistical Centre of Iran, the total amount of pesticides distributed in the country was 2,291 tons in 2011 while they were the most common cause of poisoning. In Lorestan, the prevalence of pesticide poisoning was reported to be high. 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. 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.

**Metal Phosphides**

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

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. A study conducted in Tehran confirmed easy access to rice tablets even in this non-agricultural region. Although aluminum phosphide is banned, the incidence rates of its poisoning and its mortality rates have risen since 2007. Similar increased numbers of poisonings have been reported with zinc phosphide.

**Other Pesticides**

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

**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. Iran is a natural reservoir of a huge diversity of venomous animals, among them a large number of scorpion species.

**Scorpion Sting**

Study of the scorpion fauna in Iran began in 1807, when Androctonus Crassicauda was identified from Kashan. Reports of scorpion sting have been recorded in all Iranian provinces, particularly those in the southern and southwestern regions of Iran (table 1). 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. Stings generally occur in Khuzestan, Hormozgan, Sistan and Baluchestan, Bushehr, Ilam, and Fars provinces. In a study conducted in Khuzestan, it was shown that scorpion sting was the main cause of poisoning among nonmedical toxins. In another study on 3,258 patients, the most common cause of poisoning was animal bites or stings in Khuzestan. Scorpion envenomation was introduced as a public health problem in Khuzestan.

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. Envenomation by H. lepturus has been considered a serious medical emergency. In a study from Chaharmahal and Bakhtiari Province, H. lepturus was very common. However, A. Crassicauda was the most frequent scorpion causing poisoning in Khuzestan. In Bandar-Mahshahr county (Khuzestan), education and health promotion was found to prevent these envenomations.

**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. 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. 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.

**Spider Bite**
Spiders are the most abundant predators in ecosystems. Commonly identified as black widow spider, Latrodectus tredecimguttatus is notorious for its venomous bite. 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.

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

## Natural Elements

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

### Fluoride
The effect of fluoride on human health has been studied for over 100 years. A small amount of fluoride is often added to drinking water to improve dental health. However, at higher concentrations, it is a health hazard. 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).

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

**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.

### 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. *A. Phalloides* contains amatoxin, which can cause acute liver failure and death.
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. 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. 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.

**Carbon Monoxide**

Exposure to carbon monoxide (CO) can be especially hazardous given that the early effects of poisoning may often go unnoticed. 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. 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. A study conducted in the northwest of Iran confirmed that CO poisoning had a high prevalence in this geographic region. It was also shown that CO poisoning was a public health problem in Tehran and Kermanshah. A study conducted in Mashhad concluded that nearly all cases of accidental CO poisoning could be potentially prevented through education.

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

**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. The mortality rate of arsenic-based agents was once reported to be 5.8%. In a study, a higher mortality rate due to these agents was found between 1994 and 1999. Although this poisoning constituted only 1% of poisonings in the Loghman Hospital, it had a high mortality rate. 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. The availability of this agent was also strictly limited in the prisons.

**Pattern of poisoning in Iran**

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. Pharmaceutical drug poisoning is the 3rd leading cause of death due to suicides in Iran. 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.

**Discussion and Review of General Results**

In different studies, the most common intentional poisonings were due to sedative-hypnotics, pesticides, and opioids. 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.

Snake bite is a serious public health problem, especially in rural areas. 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.

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. 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. 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. in Khuzestan. Similar results were reported by Kassiri et al. in the same region. In a study from Guilan, organophosphates were responsible for most of the poisonings. 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. 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. 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. 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. reported a death rate of 13.3%. One explanation for such a high rate is the type of drug used by the patients. Another one is the small size of the population studied. In a study by Taghaddosinejad et al., the mortality rate was 17.7%, probably because it was conducted on ICU patients. The mortality rate in a study by Karbakhsh et al. 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. 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. Currently, there are 29 active DPICs countrywide, which work in a network.

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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