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Research Paper

The Trend of Poisoning During the COVID-19 and Post-COVID-19 Era in Tehran, Iran Between 2019 and 2023

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ABSTRACT

Background: Each year, a significant number of fatalities caused by drug poisoning are documented globally. Analyzing the pattern of poisonings is crucial for prevention, particularly in decreasing the incidence of suicides. This research aimed to investigate the trend of poisonings from 2019 to 2023 at Loghman Hakim Hospital, Tehran, Iran.

Methods: The present study collected data on gender, age, reasons for poisoning and patient outcomes from the archived records of Loghman Hakim Hospital Poison Center, Tehran, Iran, using the ICD- 10 coding system. Patients were categorized into medication groups following the guidelines in Goldfrank's book and with input from clinical toxicology specialists. All records underwent a thorough review. The data were analyzed using SPSS software, version 24, incorporating statistical analyses, such as Fisher's exact and chi-square tests.

Result: A comprehensive analysis was performed on 81,689 patients who had experienced poisoning, with 41336(50.6%) being male and 40353(49.4%) being female. The mortality rate over five years stood at 2.01%. The highest number of fatalities occurred in 2023 and 2022, with 359 cases (21.82%) and 358 cases (21.76%), respectively. Opioid and narcotic poisoning was identified as the primary cause of death, representing 30.33% of the cases.

Conclusion: It is crucial to restrict access to methadone and alcohol. Additionally, the increasing instances of poisonings underscore the societal requirement for government support to alleviate the psychological and economic burdens induced by the coronavirus pandemic.

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Introduction

Poisoning presents a significant health hazard, contributing to elevated rates of illness and mortality on a global scale. This issue poses a considerable financial burden on healthcare systems and hospitals due to the costs associated with emergency department visits and hospital admissions [1-3]. The incidence of acute poisoning varies depending on diverse religious, cultural and geographical contexts. Factors, such as the continuous evolution and varying accessibility of different toxic substances also play a role. For instance, in developed countries, the misuse of commercially available drugs stands as the primary cause of acute poisoning, whereas in developing countries, insecticides are more commonly involved. Additionally, the availability of drugs varies across regions [4-6].

Variations in the occurrence and origins of acute poisoning can be observed across different geographical regions, and this disparity can even be found within a single country. Understanding the typical poisoning trends within a specific area is crucial for identifying potential risk factors. This understanding plays a pivotal role in enabling the early detection and treatment of poisoning cases, ultimately leading to reduced rates of morbidity and mortality [7]. From 2011 to 2018, methadone poisoning, whether intentional or recreational, has surfaced as the primary reason for individuals being referred to poisoning departments in Iran [8].

Studying poisoning patterns is crucial for shaping public health policies, strategies, and actions to decrease poisoning cases and minimize their impact. This includes efforts to enhance awareness about poisoning, improve prevention and control measures and strengthen the treatment and management of poisoning cases. Furthermore, understanding the sociodemographic characteristics of individuals affected by poisoning can help identify at-risk groups and guide tailored interventions. This knowledge also sheds light on ongoing protocols, such as OMT programs. These insights emphasize the importance of conducting epidemiological studies in this area. The objective of the present research was to assess the patterns and fatality rates of drug and chemical poisonings over a five-year period from 2019 to 2023.

Materials and Methods

This descriptive retrospective study assessed the medical records of poisoning patients from February 2019 to November 2023. The diagnosis of poisoning included collecting data from conscious patients or their accompanying relatives, conducting a physical examination, observing clinical toxidrome and/or conducting confirmatory laboratory tests on unconscious patients. Data on gender, age, cause of poisoning, and patient outcomes were obtained from the archived files of Loghman Hakim Hospital Poison Center, Tehran, Iran, using the ICD-10 coding system. Patients were classified into medication groups following the guidelines outlined in Goldfrank's book and with input from clinical toxicology experts. Pharmaceuticals included pharmaceutical additives, antidiabetics, hypoglycemics/antiglycemics, antiepileptics, antihistamines and decongestants, chemotherapeutics such as methotrexate, 5-fluorouracil, and capecitabine, antimigraine medications, as well as thyroid and antithyroid medications. Disaster preparedness included chemical weapons, biological weapons, radiation, and gases.

The obtained data were analyzed using SPSS software, version 24 by Fisher's exact and chi-square tests. The Bonferroni's post hoc test was used to compare multiple years. A $P<0.05$ was considered statistically significant.

This study was based on retrospective data, which included instances of missing or unreliable data (such as inconsistent, incomplete, unusual, meaningless and incorrect data), potentially impacting the results. To address this concern, the research engaged the expertise of two clinical toxicologists to establish the standard range for each variable. Any values outside of this range were identified and reviewed by referencing patient records or consulting the attending physician.

The data did not encompass information on socioeconomic status, lifestyle behaviors and genomic or proteomic data. Therefore, it is advisable to conduct further research with more precise validations to enhance the findings and reduce any potential bias.

Results

Over a five-year period, 81689 patients with poisoning were referred to Loghman Hakim Hospital, Tehran, Iran, of whom 41336(50.6%) were men and 40353(49.4%) were women. Regarding gender, in 2019 and 2021, the majority of poisonings occurred in men (7752, 7678, and 8504 men, respectively). However, the gender distribution shifted thereafter, with women constituting the majority of cases (9996 and 8508 women in 2022 and 2023, respectively). Tables 1 and 2 display the incidence of poisoning in various demographics, including gender distribution, mean age, fatalities, and different years. Table

Table 1. Frequencies of the diagnoses based on coding system in males and females from 2019 to 2023

Code	Description	Male	Female	Mean Age (y)	Total No. of Cases	Total Mortality Rate	Case Fatality Ratio (n=100)
P1	Analgesics and anti-inflammatory medications (without opioids)	2487	6067	23.5	8554	40	0.47
P2	Opioids & narcotics	14731	5423	22.4375	20154	499	2.48
P3	Food, diet and nutrition	275	517	22.9063	792	4	0.51
P4	Pharmaceuticals	4689	8330	29.0938	13019	232	1.78
P5	Antimicrobials	327	877	28.625	1204	9	0.75
P6	Cardiopulmonary medications	1184	3297	34.5	4481	42	0.94
P7	Anesthetics & related medications	33	26	24.2188	59	1	1.69
P8	Psychotropic medications	2517	4818	25.5313	7335	80	1.09
P9	Other drugs that affect the CNS (without ethanol & nicotine)	5952	6089	26.75	12041	136	1.13
P10	Alcohol	4597	1429	25.8125	6026	165	2.74
P11	Nicotine	9	3	21.3333	12	0	0.00
P12	Metals	226	335	35.3125	561	8	1.43
P13	Household products (without alcohol)	479	437	18.4688	916	25	2.73
P14	Pesticides	1460	1585	29.125	3045	309	10.15
P15	Disaster preparedness	15	90	29.1729	105	0	0.00
P16	Occupational & environmental toxins	674	296	18.3438	970	16	1.65
P17	Unknown substance	1681	734	29.1875	2415	79	3.27
	Total	41336	40353		81689	1645	2.01

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3 show the trend of acute poisonings due to opioids and narcotic drugs.

Generally, the 10-20 age group had a higher number of female cases (10884), while males were more prevalent in the age groups under 10 years and over 20 years. Regarding age trends, young individuals aged 20-30 years comprised the majority of patients in all years. Until the end of 2021, individuals aged 30-40 years had the second-highest poisoning rate, but this pattern changed later, with teenagers aged 10-20 years having the second-highest rate (Table 4). Figures 1, 2, 3 and 4 illustrate the patterns of overall poisonings, metal poisonings, alcohol poisonings, carbon monoxide poisonings, poisonous mushrooms, and animal bites.

From 2019 to 2021, most people aged 20-30 and 30-40 were men; however, the trend later shifted to a predominance of women in these age groups. In the 10-20 age group, women consistently surpassed men throughout the examined period (Table 4).

The average age of the patients was 30.36±14.84 years. As depicted in Table 1, the classification of poisoning groups, gender distribution, average age, and the number of deaths are outlined. The 5 year mortality rate stood at 2.01%. The highest number of deaths occurred in 2023 and 2022, with 359 cases (21.82%) and 358 cases (21.76%), respectively. The majority of patient fatalities were male, with 1,169 male deaths compared to 476 female deaths. In 2019, there were 246 deaths, with 162 being male. The number rose to 339 deaths in 2020, with 256 being male. In 2021, there were 343 deaths, with 265 being male. The most common cause of death was poisoning with opioids and narcotics (30.33%). Opioids

Table 2. Frequencies of the diagnoses by year

Code	Description	2019	2020	2021	2022	2023	P
P1	Analgesics and anti-inflammatory medications (without opioids)	1588	1327	1680	2173	1786	<0.0001
P2	Opioids & narcotics	3963	3697	4150	4470	3874	<0.0001
P3	Food, diet and nutrition	99	98	128	268	199	<0.0001
P4	Pharmaceuticals	3029	2351	2360	2915	2364	<0.0001
P5	Antimicrobials	227	155	201	286	235	<0.0001
P6	Cardiopulmonary medications	927	688	838	1078	950	<0.0001
P7	Anesthetics & related medications	8	4	17	12	18	0.018
P8	Psychotropic medications	1353	1055	1380	1946	1601	<0.0001
P9	Other drugs that affect the CNS (without ethanol & nicotine)	2095	2140	2478	2962	2366	<0.0001
P10	Alcohol	722	1434	1193	1359	1318	<0.0001
P11	Nicotine	1	3	1	5	2	0.323
P12	Metals	114	97	109	165	76	<0.0001
P13	Household products (without alcohol)	203	154	163	214	182	0.007
P14	Pesticides	486	522	721	731	585	<0.0001
P15	Disaster preparedness	7	4	6	12	76	<0.0001
P16	Occupational & environmental toxins	236	154	186	197	197	0.001
P17	Unknown substance	398	392	441	559	625	<0.0001

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and narcotics were the leading cause of poisoning across all age groups, followed by pharmaceuticals as the most common cause in individuals under 30 years old, and other central nervous system (CNS)-affecting drugs (excluding ethanol & nicotine) as the primary cause in individuals over 30 years old (Figure 5).

Out of 51695 patients with a history of psychiatric diseases, 12635 cases (24.44%) were reported in 2022. Among all patients, 2.63% had a smoking history, and 0.7% had a history of alcohol consumption. Table 2 displays the occurrences of poisonings per year, indicating a significant increase in the majority of poisonings in 2022. Among men, the most common poisonings were opioids and narcotics (35.6%), other drugs affecting the CNS (14.4%), pharmaceuticals (11.3%) and alcohol (11.1%), respectively. Among women, the primary causes of poisonings were pharmaceuticals (20.6%), other drugs affecting the CNS (15.1%), analgesics and anti-inflammatory medications (15%) and opioids and narcotics (13.4%) (Table 1).

Table 3 presents information regarding poisonings caused by drugs of abuse. Methadone poisoning was the most common in this category, followed by other synthetic drugs, opium, morphine and codeine. The highest incidence of drug poisoning within this category was observed in 2022. Figures 1, 2 and 3 show the trends of total poisonings, metal poisonings, and alcohol poisonings. Interestingly, the peak of metal poisoning was in 2022, while the peak of alcohol poisoning in 2020 coincided with the COVID-19 pandemic.

A total of 1023 cases of poisoning with aluminum phosphide (rice tablets) were reported, with the highest number being 313(30.6%) cases in 2022. Figure 4 shows the trend of carbon monoxide poisoning, poisoning with poisonous mushrooms, and poisoning due to the bites from poisonous animals. There were a total of 232 in-

Table 3. Trend of acute poisonings due to opioids and narcotic drugs during the study period

Drugs	2019	2020	2021	2022	2023	Total
Methadone	1694	1726	1858	1857	1738	8873
Codeine and morphine	144	106	161	334	319	1064
Opium	633	569	723	767	556	3248
Other synthetic narcotics	1404	1182	1266	1375	1209	6436
Heroin	178	146	143	350	86	903
Cannabis	129	85	159	214	175	762
Cocaine	6	6	8	24	25	69
Naltrexone	5	9	16	20	15	65
Deta[#]	3	9	13	8	3	36
Lysergic acid diethylamide (LSD)	2	6	7	3	3	21
Crack	0	2	2	2	0	6

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[#]Deta is an herbal product for treating drug addiction. It was initially imported from India and Pakistan, but later analysis revealed that it contains pharmaceuticals, such as tramadol, methadone, gabapentin and tricyclic antidepressants.

cidents of carbon monoxide poisoning, 77 cases of poisonous mushroom poisoning and 427 cases of poisoning from bites by poisonous animals documented. Remarkably, the highest number of incidents involving poisonous mushrooms and animal bites occurred in 2023, while the highest number of cases related to carbon monoxide exposure was in 2019. Unfortunately, intentional or accidental poisonings were not investigated in this study.

Discussion

The research findings revealed that men were most commonly poisoned by opioids and narcotics, other substances affecting the CNS, pharmaceuticals and alcohol. In contrast, women predominantly experienced poisoning from pharmaceuticals, other CNS-affecting substances, analgesics and anti-inflammatory drugs, and opioids and narcotics. Pesticides, cases of unknown origin, alcohol, household products, and opioids were associated with the highest case-fatality ratios. From 2019 to 2021, the majority of cases in the 20-30 and 30-40 age groups were men, while in older age groups, women were more prevalent. Additionally, a higher number of women were observed in the 10-20 age group during the studies. During the COVID-19 pandemic, there was a significant increase in the use of antimicrobials due to inadequate treatment strategies [9]. Patients who received antibiotics had a mortality rate 4.23 times higher [10]. The results obtained indicated 227 cases of antibiotic poisoning in 2019, the onset of the pandemic, which decreased in the subsequent two years. This outcome is understandable considering the extensive use of antibiotics during that year, potentially leading to an increase in poisoning cases.

The COVID-19 pandemic has led to an increase in depression and suicide in Iran, with emotional issues, marital incompatibility, and economic issues being the most essential factors for suicide. Healthcare workers have been more susceptible to burnout, chronic fatigue, and post-traumatic stress disorder (PTSD) during the pandemic, while resident physicians have reported an increase in depressive symptoms [11-13]. The struggle to find meaning in life within the chaotic realm of the Coronavirus and its aftermath may lead to prolonged depression, feelings of helplessness, and numerous suicides. A significant part of society has turned to the unusual use of drugs and alcohol to relieve anxiety and cope with this mental pain [14, 15]. All these studies highlight the significant impact of the Coronavirus on human societies, resulting in substantial economic and psychological harm, increased suicide rates, and poisonings. Moreover, the current study revealed that post-pandemic, the pattern of poisonings has shifted and is on the rise. Regrettably, this research did not delve into economic and psychiatric-social factors.

Table 4. Age distribution and type of poisoning by gender and year of study

Variables		No.									
		2019		2020		2021		2022		2023	
		Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Age (y)	<10	545	447	370	301	466	368	438	289	291	219
	10-20	1335	1918	1326	1725	1565	1995	1887	2847	1594	2399
	20-30	2448	2375	2405	2056	2373	2158	2611	2807	2154	2328
	30-40	1821	1753	1801	1555	2057	1801	2220	2341	1884	1904
	40-50	656	676	804	556	960	696	1115	1016	976	945
	50-60	448	320	524	246	565	295	656	415	548	408
	60-70	323	138	300	86	335	142	356	198	331	183
	>70	176	77	148	72	183	93	173	83	168	122
Analgesics and anti-inflammatory medications (without opioids)		474	1114	407	920	533	1147	612	1561	461	1325
Opioids & narcotics		2896	1067	2746	951	3127	1023	3189	1281	2773	1101
Food, diet and nutrition		36	63	31	67	45	83	91	177	72	127
Pharmaceuticals		1180	1849	904	1447	869	1491	965	1950	771	1593
Antimicrobials		64	163	40	115	66	135	92	294	65	170
Cardiopulmonary medications		245	682	183	505	226	612	283	795	247	703
Anesthetics & related medications		5	3	2	2	5	12	8	4	13	5
Psychotropic medications		465	1015	370	684	504	876	633	1313	545	1056
Other drugs that affect the CNS (without ethanol & nicotine)		1015	1080	1081	1059	1290	1188	1461	1501	1105	1261
Alcohol		566	156	1121	313	917	276	1035	324	958	360
Nicotine		1	0	3	0	0	1	5	0	0	2
Metals		49	65	40	57	41	68	65	100	31	45
Household products (without alcohol)		105	98	87	67	84	79	118	96	85	97
Pesticides		212	274	251	271	341	380	378	353	278	307
Disaster preparedness		1	6	3	1	3	3	5	7	3	73
Occupational & environmental toxins		151	85	111	43	135	51	153	44	124	73
Unknown substance		287	111	298	94	318	123	363	196	415	210

Figure 1. The trend of total poisoning in the study period

Iran has experienced a significant prevalence of both unauthorized and medically prescribed opioid consumption, leading to elevated levels of opioid use disorder (OUD) and its related impact [16]. Currently, Iran hosts one of the most extensive methadone maintenance treatment (MMT) programs globally [17]. The MMT program has shown significant positive outcomes in Iran [17]. However, concerns are growing regarding the unauthorized use of methadone and the increasing number of fatal and non-fatal poisoning incidents linked to it. Hadeiy et al.'s study on the pattern of drug use revealed that between 2012 and 2018, methadone poisoning ranked highest among opioids and narcotics [8]. Our study also indicated that methadone continues to top the list in poisoning cases among opioids, potentially due to its easy accessibility.

Since the onset of the COVID-19 pandemic, misinformation regarding alcohol's ability to combat the virus has led to a significant increase in methanol-related

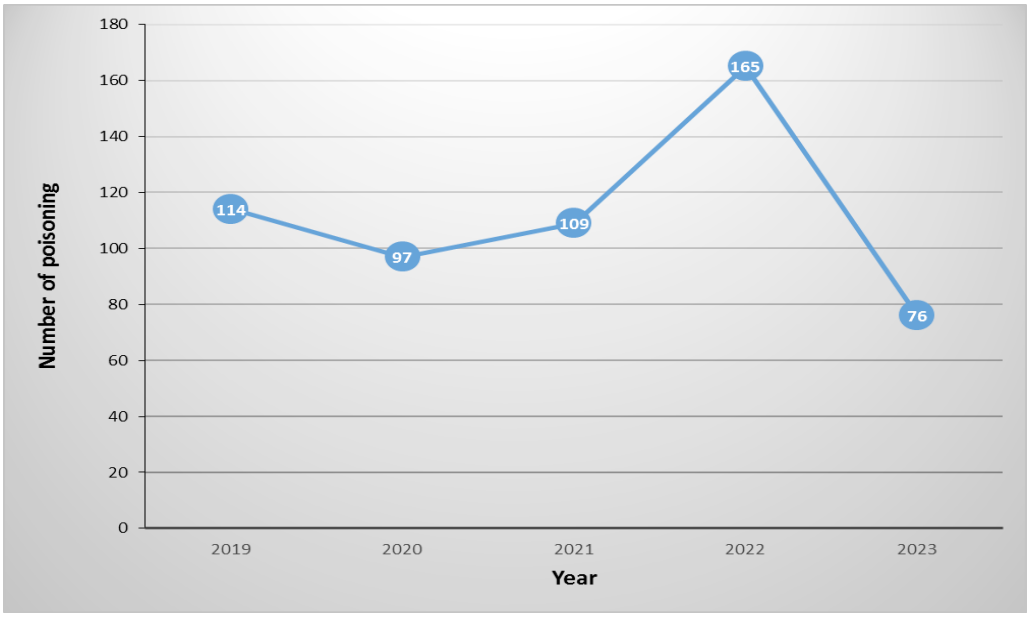

Figure 2. The trend of metal poisoning in the study period

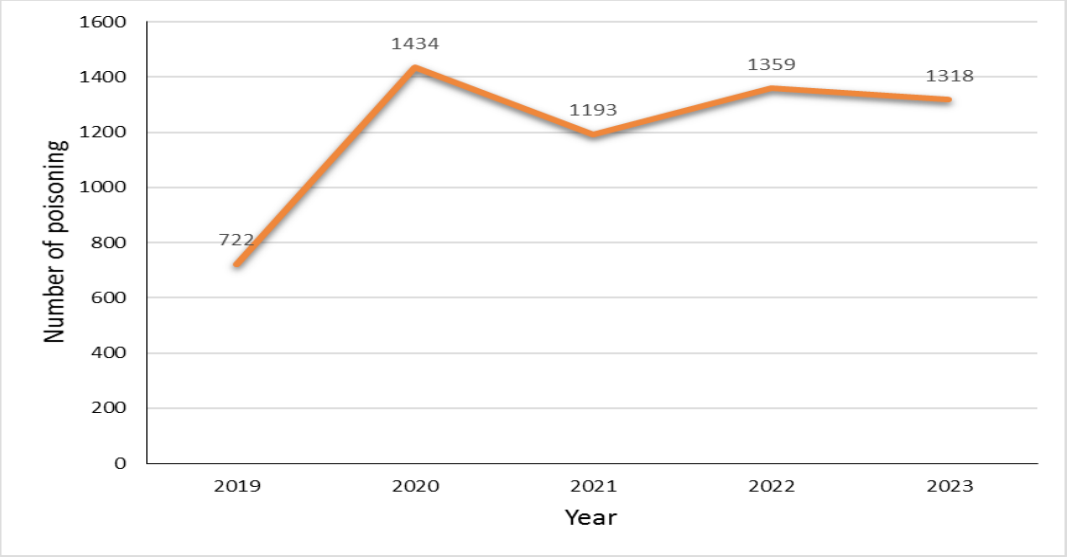

Figure 3. The trend of alcohol poisoning in the study period

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deaths. According to the Ministry of Health and Medical Education of Iran, as of April 27, 2020, 5011 cases of methanol poisoning resulted in 505 confirmed deaths. The total number of deaths from February to April 2020 was nearly eight times higher than the number of confirmed deaths during the same period in 2019. However, reports from before 2019 indicated lower mortality rates due to methanol poisoning [18-20]. Our results also indicated that the highest number of alcohol poisoning cases (23.8%) occurred in the year 2020.

Following infectious disease pandemics, such as COVID-19, PTSD emerges as a significant public health issue. Policymakers globally must prioritize attention to PTSD due to its substantial impact on the population, regardless of factors such as sex, gender, geographical location and income levels. A public health approach that addresses mental health is crucial, particularly in the post-pandemic period and during long-term recovery [21]. The present study indicated an increase in poisonings involving sedative-hypnotic drugs and substances

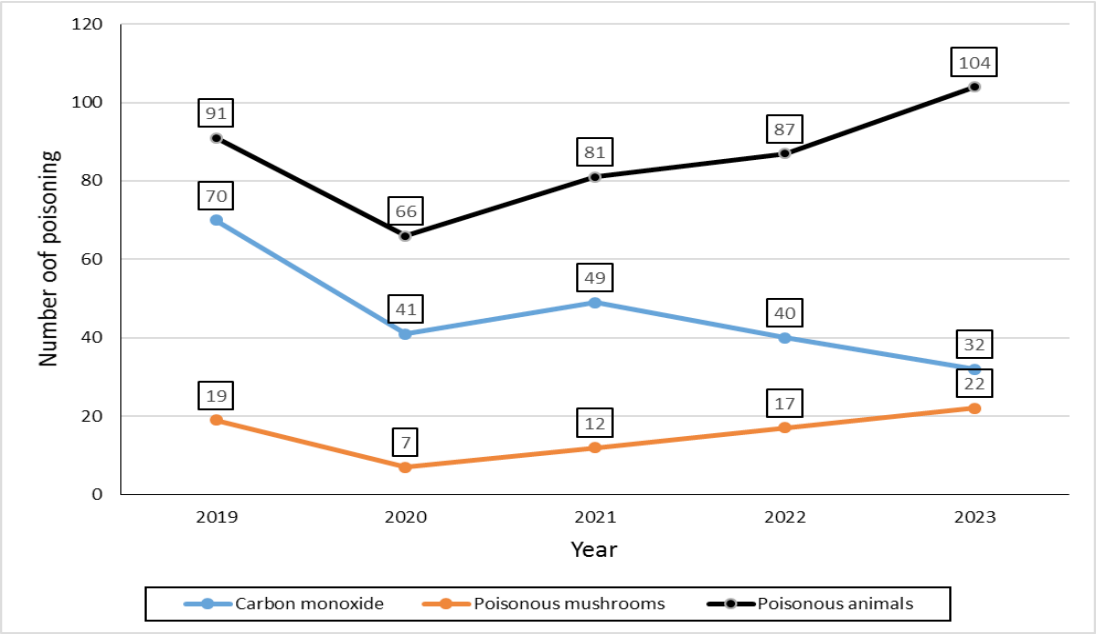

Figure 4. The trend of poisonings with carbon monoxide, poisonous mushrooms and animal bites

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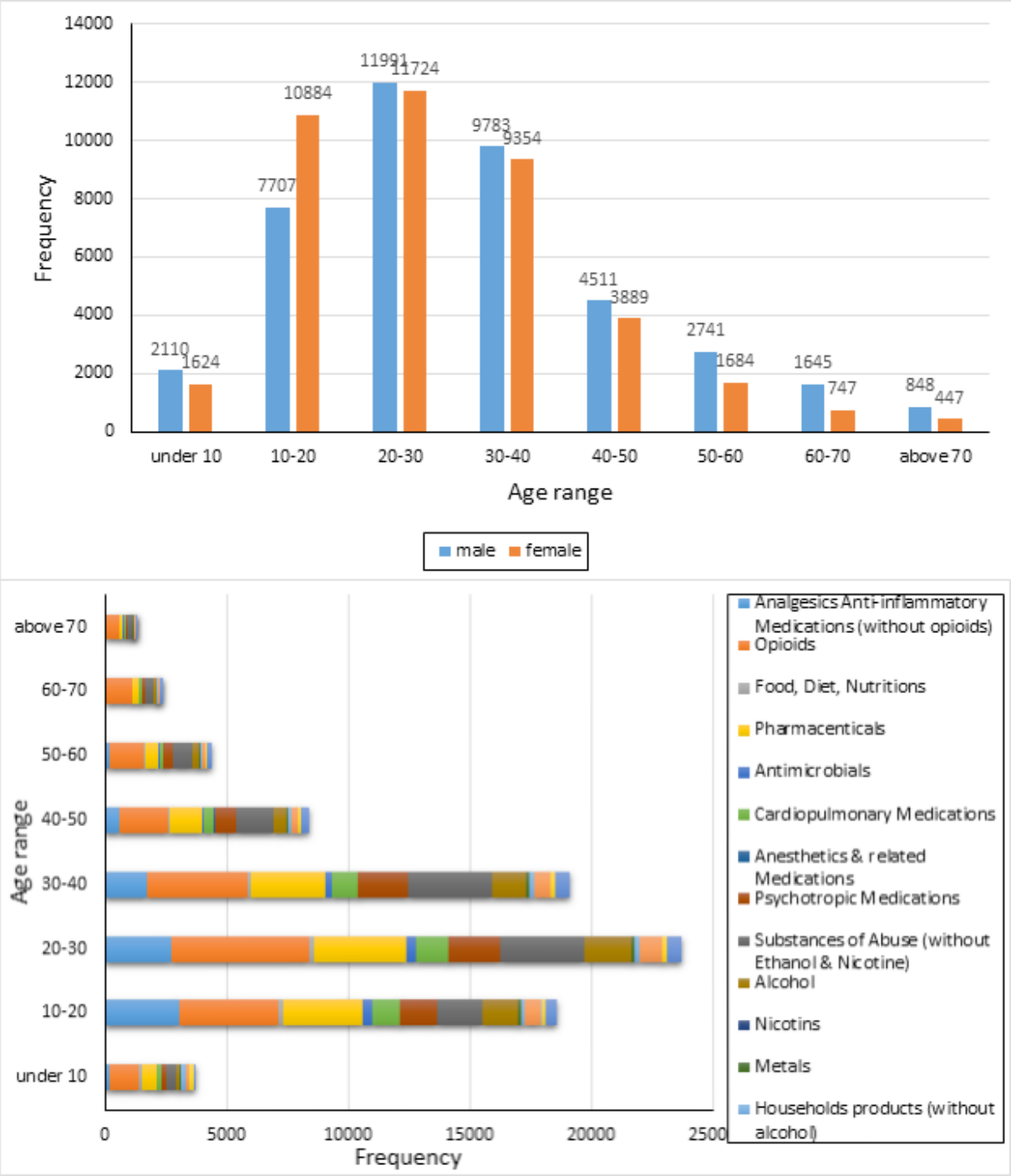

Figure 5. A) The number of poisoned people according to gender and age range, B) The number of poisoned people according to age range and type of poisoning

that weaken the nervous system after the pandemic, potentially linked to post-coronavirus PTSD issues. Policies and screenings are essential for the timely treatment of this complication.

Numerous studies have indicated a decline in suicide rates during the initial phase of the COVID-19 pandemic, followed by a subsequent rise in suicide rates, particularly among women [22-25]. This study did not differentiate between accidental and suicidal poisonings but indicates a rise in poisoning incidents among wom-

en following the COVID-19 outbreak, which could be linked to an increase in suicide attempts. The increased suicide rate ratio among women in the months after the pandemic crisis may be attributed to the higher incidence of job loss among women and the rise in domestic violence cases during the COVID-19 pandemic.

This study was conducted at a single center, which restricts the ability to generalize its findings. Furthermore, its retrospective design prevented the analysis of certain variables. Importantly, this research did not delve into the economic, social, and psychiatric factors of the patients, representing a significant limitation of the study.

Conclusion

The shift in the poisoning patterns after the COVID-19 pandemic has occurred due to various reasons, such as economic downturns and social issues. To prepare for this shift, essential education and policies are necessary to restrict access to methadone, alcohol, and other hazardous substances. Mental health education plays a crucial role in reducing suicides and consequently lowering poisoning incidents. Reports indicate a worrying trend of poisonings among women and individuals aged 10-20 years. It is critical to implement tailored education and counseling programs for teenagers, especially girls, to address this issue. Strategies for preventing drug abuse and managing withdrawal are vital. Economic challenges and family conflicts are likely significant contributors to poisoning cases, highlighting the need for targeted interventions. Conducting multicenter studies and analyzing social, psychiatric, and clinical outcomes collectively can provide a deeper insight into the underlying factors.

Ethical Considerations

Compliance with ethical guidelines

The study protocol was approved by the Ethics Committee of Shahid Beheshti University of Medical Sciences (Code: IR.SBMU.RETECH.REC.1401.246). Written consent was obtained from the participants.

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Authors' contributions

All authors equally contributed to preparing this article.

Conflict of interest

The authors declared no conflict of interest.

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