Ain Shams Journal of Forensic Medicine and Clinical Toxicology
July 2023, 41: 64-79

Patterns of Toxicities Before, During and After the COVID-19 Pandemic: A Retrospective Study at Poison Control Center - Ain Shams University Hospitals

Soha Ashry[1], Gihan Boshra Azab[1-2], Aya M. Abdellatif [3], Aya S. Khater[1]

[1] Department of Forensic Medicine and Clinical Toxicology, Faculty of Medicine, Ain Shams University, Cairo, Egypt.
[2] Director of Poison Control Center, Ain Shams University Hospitals, Cairo, Egypt.
[3] Department of Community, Environmental and Occupational Medicine, Faculty of Medicine, Ain Shams University, Cairo, Egypt.

Abstract

Background: The COVID-19 pandemic has significantly affected global health systems and has influenced patterns of disease worldwide.

Aim: The current study aims to analyze the patterns of toxicities before, during, and after the pandemic at Poison Control Center (PCC) Ain Shams University Hospitals, identifying any changes and their persistence after the pandemic.

Methods: A retrospective observational study using PCC's database of patients admitted from January 1st 2019 to December 31st 2022.

Results: Over four years, the center managed to service large number of patients peaking to 21,107 patients were hospitalized, in 2022. Most admissions were adults comprising 57.24% in 2019 to 62.14% in 2022. Females represented 54.77% of admissions in 2019 declining to 52.69% in 2020 and rising to 55.61% in 2022. Pharmaceutical poisoning accounted for 26.85% in 2019 and 27.13% in 2020 declining to 20.53% in 2022. Substance abuse, the second most common diagnosis in 2019 with 13.79% prevailed in 2022 with 21.38%. Improvement was the prevalent outcome with increase in demand leave and referral toward 2022. Gender and age significantly affected diagnoses and outcomes.

Conclusion and Recommendations: This study concluded that the pandemic-related lockdowns and subsequent easing of restrictions resulted in behavioral, substance exposure and use changes. Some changes faded with the pandemic's end, while others persisted and new behaviors became the norm. Urgent responses from healthcare providers and policymakers are needed, emphasizing mental health support and substance misuse initiatives, especially for vulnerable age groups.

Received in original form: 14 July 2023 Accepted in a final form: 30 July 2023

Key words COVID-19; pandemic; poisoning; toxicity

Introduction

The Corona virus (COVID-19) pandemic, caused by the novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), has been an unprecedented global health crisis, resulting in significant morbidity and mortality worldwide (Zhu et al., 2020). The pandemic not only disrupted healthcare systems but has also caused significant alterations to daily life, including changes in behavior patterns and environments, leading to changes in individual and societal norms (Holmes et al., 2020). The pandemic has affected many aspects of healthcare, which includes those affecting changes in poison exposures and toxicities (Brooks et al., 2020). These changes have resulted in a number of unintended consequences, including an increase in the number of cases related to poisoning and toxic exposures (Chang et al., 2020).

Poison control centers (PCCs) are crucial resources for managing poison exposures and preventing toxicities helping to reduce associated morbidity and mortality. They play a critical role in the management of poisoning cases and the provision of timely advice to healthcare providers and the public (Mowry et al., 2013; Gummin et al., 2021). Though poison control centers (PCCs) have tracked poison exposures for several years, there remains a gap in understanding these changes in the context of the COVID-19 pandemic, with the impact of the pandemic on the pattern of toxic exposures not fully understood (Adams & Walls, 2020).

Prior research has shown that changes in societal conditions, such as economic downturns and natural disasters, can influence the patterns of poisoning cases seen in PCCs (Greene et al., 2005; Mowry et al., 2013). Previous studies have also highlighted the impact of pandemic-related stressors, such as isolation, financial distress, and increased substance use, on the incidence of intentional and unintentional poisoning (Mars et al., 2019; Olfson et al., 2018). During the pandemic, PCCs worldwide have reported increased calls related to exposure to

disinfectants, hand sanitizers, and other cleaning products, driven by the public's heightened focus on hygiene and infection prevention (Gharpure et al., 2020; Raffee et al., 2021).

Although there have been isolated reports and studies on the impact of the COVID-19 pandemic on specific aspects of poisoning cases, a comprehensive examination of the patterns of toxicity in PCC before, during, and after the pandemic is lacking (Li et al., 2022). With the declaration of the World Health Organization (WHO) in May 2023 that *"COVID-19 is now an established and ongoing health issue which no longer constitutes a public health emergency of international concern (PHEIC)"*, it became crucial to have a look back on the effect of the pandemic on the patterns of poison exposures and toxicities (WHO, 2023).

The current study aims to address this gap in the literature by analyzing the patterns of toxicities before, during, and after the COVID-19 pandemic at the Poison Control Center- Ain Shams University Hospitals identifying any documented changes and determining whether such changes persisted after the pandemic. To our knowledge, this is one of the first studies to examine changes in poison exposures and toxicities across these distinct time periods. The study aims to contribute to the understanding of the pandemic's effects on poisoning cases and provide valuable insights for the improvement of public health interventions and clinical management strategies.

Patients and Methods

Study Design: A Retrospective observational study using data from the Poison Control Center's database.

Study population: Patients admitted to the Poison Control Center- Ain Shams University Hospitals (PCC-ASUH) from January 1st 2019 till December 31st 2022.

Sample Size:

To achieve the study objective, all patients admitted to the PCC-ASUH (at least 10,000 patients) recruited from January 1st 2019 till December 31st 2022 were included.

Data Collection tools:

Data extraction sheet was used to import the required data from medical records. Data was retrieved from the Poison Control Center's electronic database and records.

The variables of interest were identified. These included patient demographics (age, sex), type of toxin or poisoning and outcomes including discharge (improvement, discharge for follow up, referral or demand leave) and death.

Data management and Statistical analysis:

Data was tabulated and statistically analyzed using SPSS, version 20 (SPSS Inc., Chicago, IL). Descriptive statistics were used to summarize the study variables and compare the pattern of toxicities across study periods. Mean and standard deviation were used to describe quantitative data. Qualitative data were expressed by frequency (n) and percentage (%). The analysis was stratified by study period, comparisons were made using Chi square test where P-value ≤ 0.05 was considered significant and P-value ≤ 0.01 was considered highly significant.-

Ethics Considerations:

Approval was obtained from the Research Ethics Committee at the Faculty of Medicine, Ain Shams University (FMASU R162/2023) and from the Director of PCC-ASUH. Informed consent was not obtained from the patients as this is a retrospective study. Patients' confidentiality was maintained by de-identifying the data and using secure electronic storage and transmission.

Results

The current study analyzed the patients' data records of the PCC-ASUH from January 1st 2019 till December 31st 2022 regarding the patterns of toxicities before, during and after the COVID-19 pandemic.

The provided data in table 1 and figures 1&2, illustrates the number of patients who were admitted over four years, from 2019 to 2022. The number of admitted patients exhibited variability over the course of the years, with a recorded count of 21,492 patients in 2019, and a lowest number in 2020 with a figure of 16,021. The mean age of the admitted patients was close, ranging from 20.19 years in 2019 to 22.00 years in 2022. The corresponding standard deviations have ranged from 14.55 to 15.25.

Looking at the age categories, adults aged 18 to 64 years constituted the majority of admitted patients, with their representation ranging from 57.24% in 2019 to 62.14% in 2022. It is evident that preschool children (0-5 years) constituted a significant proportion of admitted patients, with percentages of 24.93% in 2019 and 22.86% in 2022 to. Conversely, individuals aged 65 years or older consistently exhibited the lowest level of representation, with percentages of 1.25% in 2019 and 2020 and 0.93% in 2022 to.

The data shows that throughout all years, there were more female patients than male patients. The proportions of female patients varied from 52.69% in 2020 to 55.61% in 2022.

Table 2 & figure 3 provide insight into the pattern of various diagnoses among the patients during the four years of study. It points out the alterations in the distribution of diagnoses on an annual basis, in relation to the total number of cases for each respective year.

In the year 2019, the prevailing diagnosis was pharmaceuticals, accounting for 26.85% of cases, while substance abuse constituted 13.79% of diagnoses. Household substances were the third most common diagnosis, representing 13.58% of cases, followed by Over The Counter (OTC) medications, which accounted for 10.75% of diagnoses. The remaining categories encompass various aspects such as pesticides, food and nutrient-related substances, natural and environmental exposures, metals, and other diagnoses that exhibit lower percentages.

In the year 2020, pharmaceuticals accounted for the highest proportion of diagnoses (27.13%). This was followed by substance abuse, which constituted 14.75% of the prevalent issues, and household-related concerns, which accounted for 13.79% of the total.

Nevertheless, the OTC medications rate experienced a decline, reaching a value of 8.99% in the year 2020. The distribution of the remaining categories remained consistent with that observed in 2019.

In the year 2021, there was a notable decline in diagnoses related to pharmaceuticals (24.47%), while substance abuse (13.68%) and household substances (13.43%) continued to be prominent categories. There was a marked rise in the "Others" which includes the 'toxic effects of unspecified substance' in addition to minor unclassifiable complaints where it reached 16.24% of cases.

In the year 2022, there was a notable decline observed in the pharmaceutical sector, with a decrease to 20.53%. Diagnoses for substance abuse considerably increased to 21.38%, making it the most prevalent group. Additional notable categories comprised pesticides (14.39%), household substances (13.56%), and food and nutrient-related substances, which constituted 11.34% of the overall categories.

Table 3 shows the outcome of inpatients over the four years, where the majority of cases showed improvement each year, however the proportion of this outcome showed a decline from 92.12% in 2019 to 73.66% in 2022. While, there was a considerable increase in the percentage of demand leave and referral in 2022 compared to the previous years. A statistically significant difference with p-value <0.001 between the outcome of inpatient's admission over the four years was noted.

Table 4 analyzes the diagnosis with age categories over the four years. In preschool age, household substances related toxicity was the top diagnosis in all years except in 2022 where it came in second place following substance abuse which appeared in the first place. Nevertheless, it showed a decline from 33.7% in 2019 to 24.2% in 2022.

In school age children food/nutrient-related substances was the first diagnosis in 2019 and 2022 accounting for 21.9% of cases and 20.6% of cases respectively; while it was the second diagnosis in year 2020 representing 17.2% of cases and the third diagnosis in the year 2021 with 15.7% of cases.

Pharmaceuticals ranked the first diagnosis for both adolescents and adult patients in the years 2019, 2020, 2021 accounting for 32.9%, 33.7%, 30.6% in adolescents and 29.6%, 29.1%, 26.9% in adults respectively. While the percent decreased for both age groups in the year 2022 with 22.1% in adolescents and 23% of cases in the adult group respectively. Substance of abuse showed a significant increase among adolescents and adults with the percent escalating from 7.5% in 2019 to 13.7% in adolescents and 16.8% in 2019 to 21.6% among adults in the year 2022 respectively. Pesticides caused toxicity in a substantial percentage of adolescents, with percentages running from 19.1% in 2019 to 22.1% in 2022.

For seniors above 65 years there was an increase in the diagnosis of substance abuse among them representing 14.7% of cases in the year 2022 after an initial decrease in 2020 and 2021 with 12.5% and 10% of cases respectively. Pharmaceuticals remained to be the top diagnosis for this group over the years. Household substances rose from 11.2% in 2019 to 19.8% of diagnoses in 2020 among this age group with relative decline to 17% in 2021.

It is important to acknowledge that the chi-square test yielded statistically significant results for all comparisons, indicating the presence of significant differences within the diagnosis groups and age categories for each respective year.

Table 5 shows that improvement was the most reported outcome across all age groups, and it was statistically significantly higher by chi square test with p-value<0.001 in each year. It is notable that demand leave was the second outcome across all age groups as well over the four years with noteworthy increase from 2019 to 2022 especially among adults and adolescent.

Looking at the data comparing the highest diagnoses and gender over 2019 and 2020 in males the first two diagnoses were pharmaceuticals followed by substance abuse. However, in 2021 and 2022, substance abuse was the first diagnosis with marked increase in 2022 reaching 26.64% of diagnoses among males as shown in table 6 and figure 4.

Among female patients, pharmaceuticals were the most common cause for toxicity over the four years as shown in table 6 and figure 5.

The difference between diagnoses among males and females was found to be statistically significant in each year by chi square test with p-value <0.001.

Table 7 shows that improvement was the most reported outcome among both males and females throughout 4 years, and it was statistically significantly higher by chi square test with p-value<0.001 in each year. It was also noticed that demand leave was the second outcome over the four years with constant increase from 2019 to 2022 among both males and females.

Table 1: Distribution of demographic data among the admitted patients during the period from January 1st 2019 till December 31st 2022

		Year	2019	2020	2021	2022
	Admitted patients	Number	21492	16021	16941	21107
	Age	Mean±SD	20.19±14.55	21.07±14.74	21.13±15.14	22.00±15.25
		Range	(1-95)	(1-97)	(1-91)	(1-93)
Age Categories	**Preschool children (0-5) years**	Number Percent	5358 (24.93%)	3762 (23.48%)	4100 (24.2%)	4825 (22.86%)
	School children (6-11) years	Number Percent	929 (4.32%)	705 (4.4%)	677 (4%)	969 (4.59%)
	Adolescents (12-17) years	Number Percent	2634 (12.26%)	1722 (10.75%)	1902 (11.23%)	2001 (9.48%)
	Adults (18-64) years	Number Percent	12302 (57.24%)	9632 (60.12%)	10033 (59.22%)	13116 (62.14%)
	Seniors 65 years or more	Number Percent	269 (1.25%)	200 (1.25%)	229 (1.35%)	196 (0.93%)
Gender	**Male**	Number Percent	9717 (45.23%)	7579 (47.31%)	7875 (46.48%)	9369 (44.39%)
	Female	Number Percent	11768 (54.77%)	8442 (52.69%)	9066 (53.52%)	11738 (55.61%)

SD: Standard deviation, %: Percentage.

Table 2: Chi square test comparing the diagnoses of the admitted patients during the period from January 1st 2019 till December 31st 2022

		Year								P-value
		2019		2020		2021		2022		
		N.	%	N.	%	N.	%	N.	%	
Diagnosis	**Pharmaceutical**	5771	26.85	4346	27.13	4145	24.47	4333	20.53	<0.001*
	OTC	2311	10.75	1440	8.99	1460	8.62	1553	7.36	
	Substance abuse	2963	13.79	2363	14.75	2318	13.68	4513	21.38	
	Pesticides	2647	12.32	2063	12.88	2124	12.54	3037	14.39	
	Food and nutrient	1985	9.24	1213	7.57	1189	7.02	2394	11.34	
	Household	2919	13.58	2210	13.79	2275	13.43	2862	13.56	
	Natural & environmental	990	4.61	788	4.92	677	4.00	627	2.97	
	Metals	11	0.05	1	0.01	2	0.01	17	0.08	
	Others	1895	8.82	1597	9.97	2751	16.24	1771	8.39	

N.: Number. %: Percentage, OTC: Over The Counter, *P-value ≤ 0.01: Highly Significant.

Table 3: Chi square test comparing the outcome of the admitted patients during the period from January 1st 2019 till December 31st 2022

		Year								P-value
		2019		2020		2021		2022		
		N.	%	N.	%	N.	%	N.	%	
Outcome	**Improvement**	19799	92.12%	13959	87.13%	14816	87.46%	15547	73.66%	<0.001*
	Follow up	43	0.20%	20	0.12%	19	0.11%	54	0.26%	
	Referral	95	0.44%	192	1.20%	123	0.73%	2243	10.63%	
	Demand Leave	1435	6.68%	1691	10.55%	1827	10.78%	3031	14.36%	
	Death	120	0.56%	159	0.99%	156	0.92%	232	1.10%	

N.: Number. %: Percentage, *P-value ≤ 0.01: Highly Significant.

Table 4: Chi square test comparing the distribution of poisoning among different age groups of the admitted patients during the period from January 1st 2019 till December 31st 2022

	2019						2020						2021						2022					
	Preschool children	School-age children	Adolescents	Adults	Seniors	p-value	Preschool children	School-age children	Adolescents	Adults	Seniors	p-value	Preschool children	School-age children	Adolescents	Adults	Seniors	p-value	Preschool children	School-age children	Adolescents	Adults	Seniors	p-value
	%	%	%	%	%		%	%	%	%	%		%	%	%	%	%		%	%	%	%	%	
Pharmaceutical	19.2	20.3	32.9	29.6	17.1		19.8	25.1	33.7	29.1	21.5		16.0	23.9	30.6	26.9	18.3		13.5	20.1	21.2	23.0	21.6	
OTC	10.5	5.8	13.2	10.8	7.8		8.3	5.7	9.9	9.4	5.5		8.0	4.4	11.4	8.7	5.7		6.6	6.3	9.0	7.5	2.6	
Substance abuse	11.4	4.3	7.5	16.8	16.0		15.5	4.5	7.3	16.6	12.5		16.8	4.1	6.5	14.5	10.0		26.3	11.3	13.7	21.6	14.7	
Pesticides	9.9	8.0	19.1	12.3	7.8	<0.001*	8.1	6.4	21.4	13.7	10.0		6.8	5.5	22.2	13.6	9.6		13.6	10.1	22.1	13.8	13.8	
Food and nutrient	6.2	21.9	9.2	9.5	14.1		5.1	17.2	8.4	7.7	7.0	<0.001*	5.8	15.7	6.3	7.0	9.2	<0.001*	6.7	20.6	11.1	12.3	14.7	<0.001*
Household	33.7	15.9	5.8	6.4	11.2		32.6	18.9	5.8	7.4	19.0		32.3	16.5	4.5	7.1	17.0		24.2	15.7	10.4	9.9	19.8	
Natural and environmental	1.4	13.0	4.1	5.4	6.7		1.4	12.8	5.6	5.6	5.0		1.2	12.7	4.6	4.4	6.1		3.2	3.5	3.2	2.8	2.6	
Metals	0.1	0.1	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.1	0.0	0.0	0.1	0.0	
Others	7.7	10.7	8.1	9.1	19.3		9.0	9.5	8.0	10.5	19.5		13.1	17.1	14.0	17.7	24.0		5.9	12.4	9.3	8.8	10.3	

OTC: Over The Counter, %: Percentage, *P-value ≤ 0.01: Highly Significant.

Table 5: Chi square test comparing the distribution of the outcome among different age groups of the admitted patients during the period from January 1st 2019 till December 31st 2022

	2019						2020						2021						2022					
	Preschool children	School-age children	Adolescents	Adults	Seniors	p-value	Preschool children	School-age children	Adolescents	Adults	Seniors	p-value	Preschool children	School-age children	Adolescents	Adults	Seniors	p-value	Preschool children	School-age children	Adolescents	Adults	Seniors	p-value
	%	%	%	%	%		%	%	%	%	%		%	%	%	%	%		%	%	%	%	%	
Improvement	94.9	95.7	91.4	90.8	92.9		91.9	94.0	86.6	84.8	87.5		91.8	92.3	85.2	85.8	88.2		83.5	81.3	75.2	69.4	64.7	
Follow up	0.2	0.3	0.1	0.2	0.0		0.1	0.0	0.1	0.2	0.0		0.2	0.1	0.0	0.1	0.0		0.4	0.3	0.5	0.2	0.0	
Referral	0.2	0.8	0.3	0.5	0.7		0.7	1.3	1.5	1.3	3.0		0.6	0.4	0.7	0.8	2.6		4.6	10.3	9.7	12.9	17.2	
Demand Leave	4.5	3.1	7.7	7.7	4.5	<0.001*	6.9	4.4	11.1	12.4	7.5	<0.001*	7.3	6.6	13.1	12.1	7.4	<0.001*	11.2	7.5	13.8	16.1	12.1	<0.001*
Death	0.1	0.1	0.4	0.8	1.9		0.3	0.3	0.6	1.3	2.0		0.1	0.4	0.9	1.3	1.7		0.3	0.5	0.8	1.4	6.0	

P-value ≤ 0.01: Highly Significant. %: Percentage

Table 6: Chi square test comparing the distribution of poisoning among both genders of the admitted patients during the period from January 1st 2019 till December 31st 2022

	2019			2020			2021			2022		
	Male	Female	p-value	Male	Female	p-value	Male	Female	p-value	Male	Female	p-value
	%	%		%	%		%	%		%	%	
Pharmaceutical	19.94	32.55		20.12	33.42		17.38	30.62		14.57	25.28	
OTC	6.60	14.19		5.52	12.11		5.49	11.34		4.31	9.79	
Substance abuse	19.64	8.95		19.92	10.10		18.44	9.55		26.93	16.95	
Pesticides	11.60	12.92		12.22	13.47		11.59	13.36		14.05	14.66	
Food and nutrient	9.68	8.86	<0.001*	7.97	7.21	<0.001*	6.90	7.13	<0.001*	12.45	10.45	<0.001*
Household	16.77	10.95		16.82	11.08		16.25	10.98		12.95	14.05	
Natural and environmental	5.37	3.98		5.79	4.13		5.08	3.06		4.06	2.10	
Metals	0.08	0.03		0.00	0.01		0.01	0.01		0.04	0.12	
Others	10.31	7.57		11.64	8.47		18.86	13.96		10.64	6.59	

P-value < 0.01: Highly Significant. %: Percentage

Table 7: Chi square test comparing the distribution of the outcome among both genders of the admitted patients during the period from January 1st 2019 till December 31st 2022

	2019			2020			2021			2022		
	Male	Female	p-value	Male	Female	p-value	Male	Female	p-value	Male	Female	p-value
	%	%		%	%		%	%		%	%	
Improvement	91.86	92.34		87.31	86.97		87.92	87.05		71.57	75.32	
Follow up	0.26	0.15		0.13	0.12		0.11	0.11		0.34	0.2	
Referral	0.63	0.29	<0.001*	1.40	1.02	<0.001*	1.04	0.45	<0.001*	12.73	8.94	<0.001*
Demand Leave	6.35	6.95		9.67	11.35		9.73	11.70		13.87	14.74	
Death	0.91	0.27		1.49	0.54		1.19	0.68		1.48	0.79	

P-value < 0.01: Highly Significant. %: Percentage

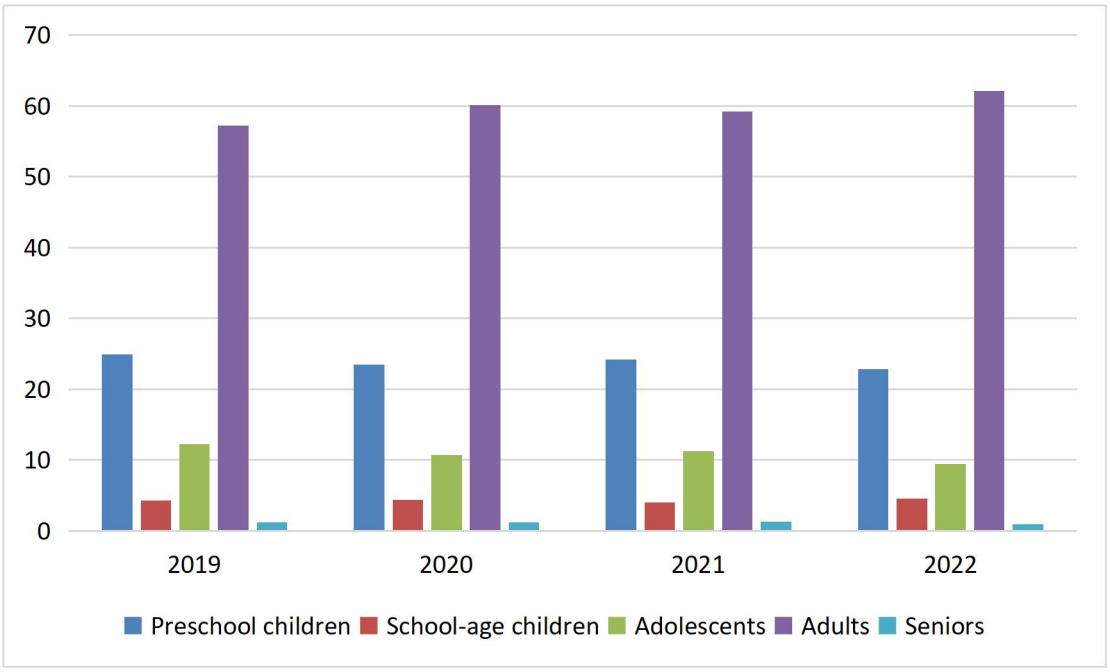

Figure 1: Distribution of age categories of the admitted patients during the period from January 1st 2019 till December 31st 2022

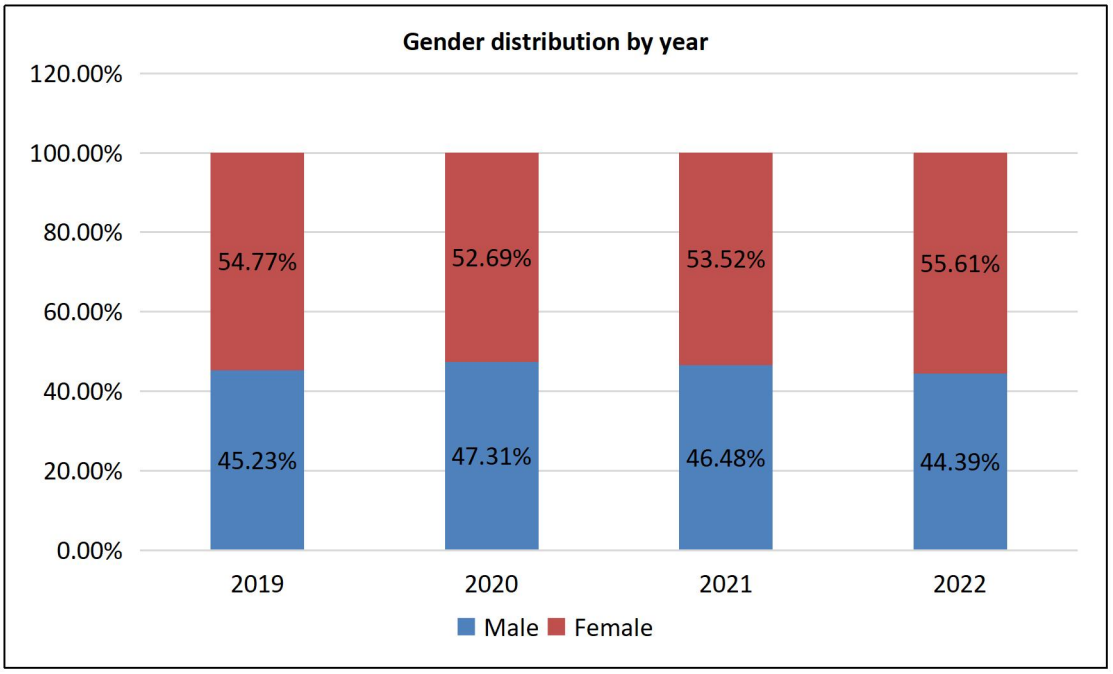

Figure 2: Distribution of gender of the admitted patients during the period from January 1st 2019 till December 31st 2022

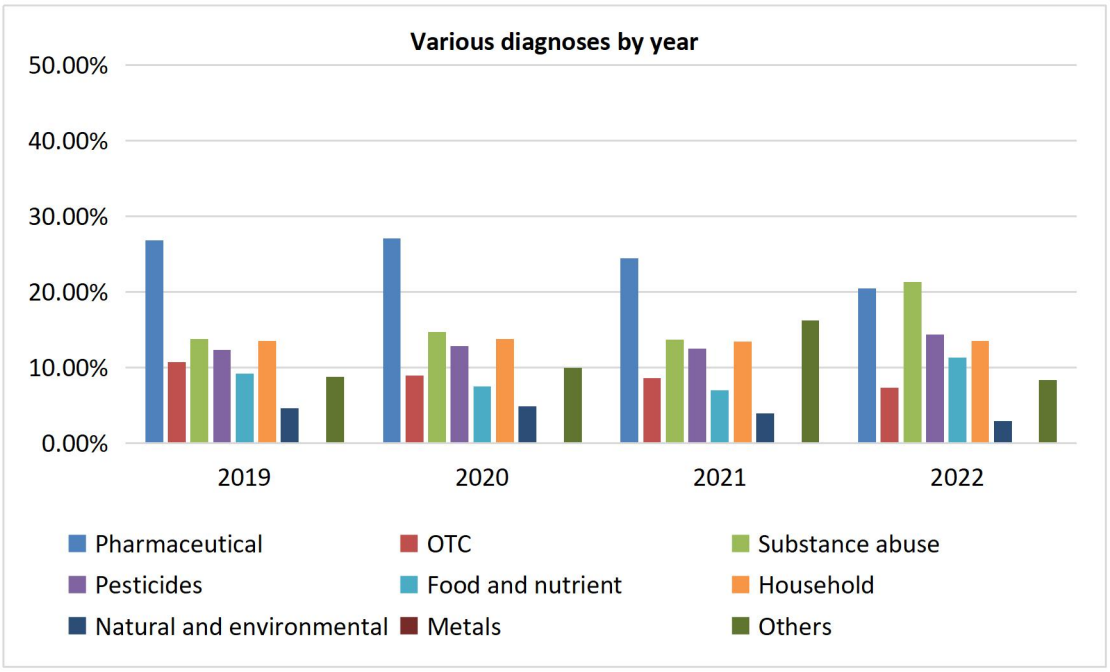

Figure 3: Distribution of the diagnoses of the admitted patients during the period from January 1st 2019 till December 31st 2022

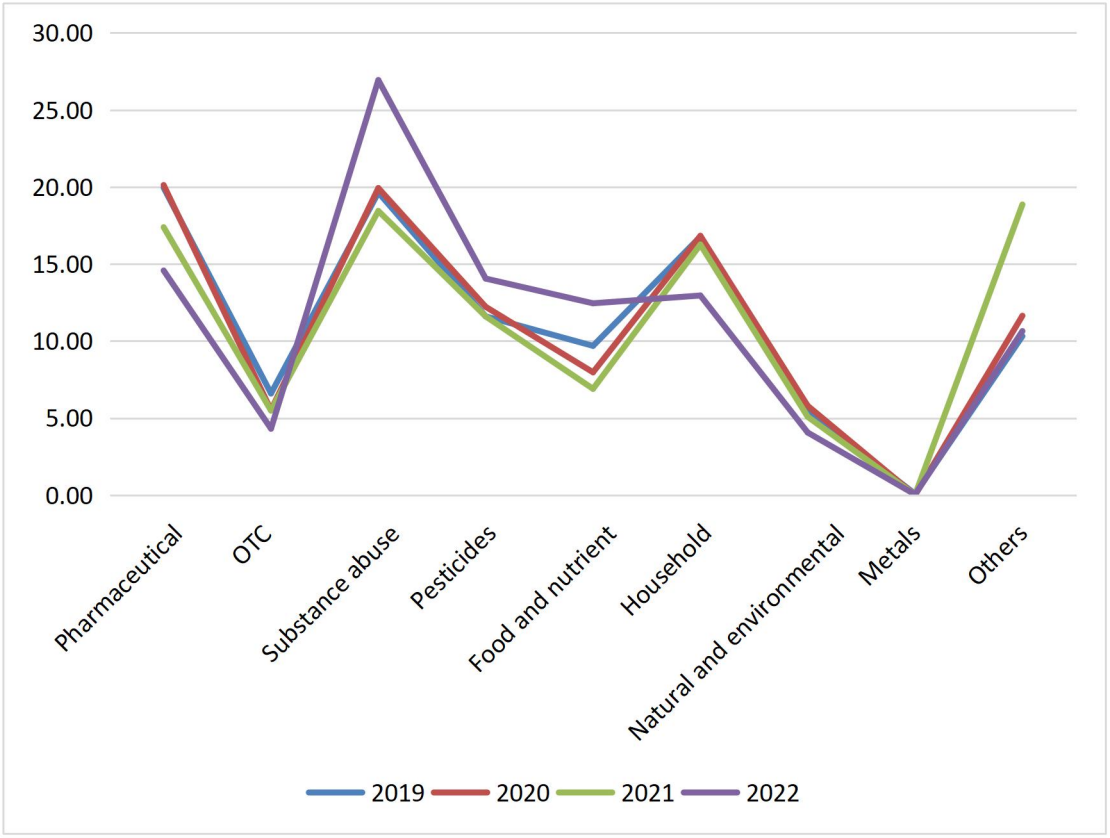

Figure 4: Diagnosis among the admitted male patients during the period from January 1st 2019 till December 31st 2022

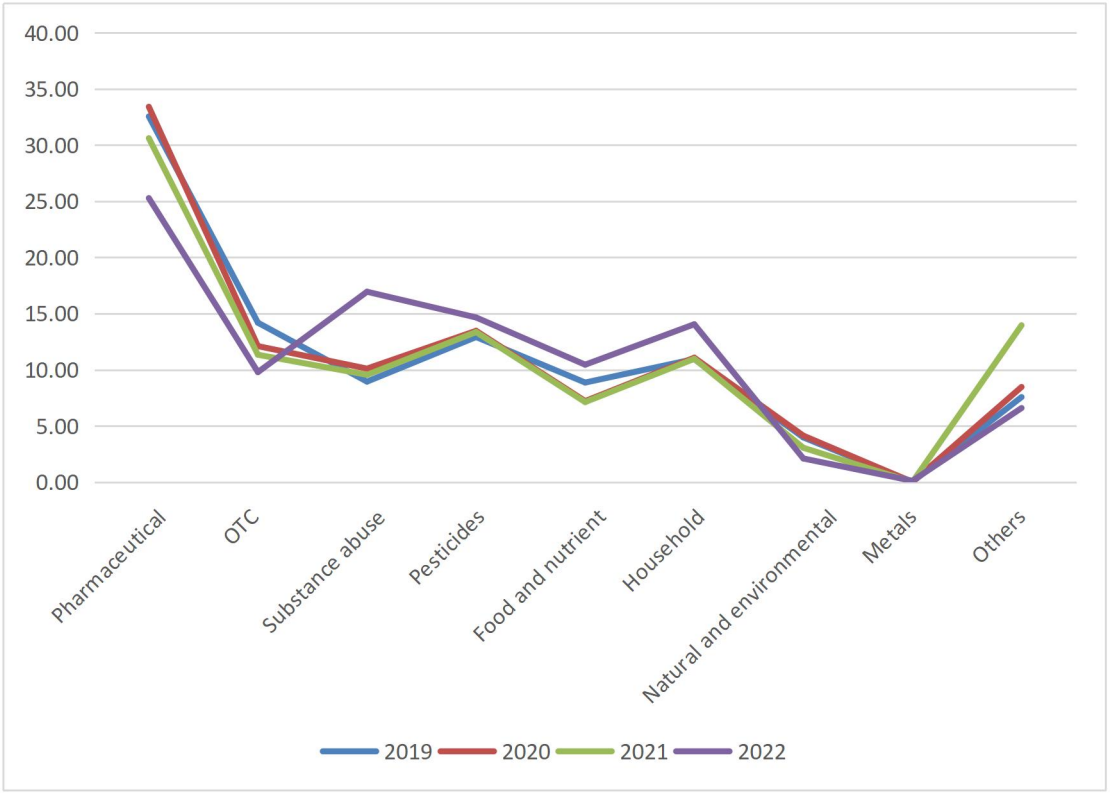

Figure 5: Diagnosis of admitted female patients during the period from January 1st 2019 till December 31st 2022

Discussion

The COVID-19 pandemic has had a significant impact on global health systems and has influenced patterns of disease and injury worldwide. Understanding the dynamics of poison exposures and toxicities in the context of such an unprecedented global health crisis is crucial to advise for more effective prevention and management strategies for poisonings and toxicities in case of future disruptions to everyday life (Neumann et al., 2020; Gummin et al., 2021).

The current study analyzed the patients' data records of the Poison Control- Center Ain Shams University Hospitals (PCC-ASUH) from 2019 to 2022 in search for possible changes in the pattern of toxicities before, during and after the pandemic. An interesting trend is the substantial decrease in the number of admitted patients from 2019 to 2020, dropping from 21,492 to 16,021. This decline coincides with the first year of the COVID-19 pandemic, when global lockdown measures were most forcible. The restricted mobility could have limited exposure to certain toxic substances, contributing to the decrease in poisoning cases. In addition, the decrease in the number of admitted cases could be related to fear of exposure to COVID-19 in healthcare settings (Holmes et al., 2020; Lai et al., 2020).

Despite a slight rebound in 2021, the patient number still remained lower than the pre-pandemic figure. However, by 2022, the patient number increased to 21,107, close to the 2019 numbers, potentially suggesting a return to pre-pandemic behaviors and exposure risks as lockdown measures ended. Other studies at the Tanta and Mansoura Poison Control Centers also reported fewer cases in 2020 compared to previous years (Fayed & Sharif, 2021; Motawei et al., 2022). In contrast, studies focusing on call volumes instead of admissions reported an increase in poisoning cases during the same period (Chang et al., 2020; Raffee et al., 2021), demonstrating varying impacts across different service types.

The mean age of admitted patients increased each year. This finding aligns with prior studies which have noted that stressors associated with the pandemic, such as social isolation and increased home stay, can exacerbate the risk of poisoning, particularly in older populations (Lai et al., 2020).

The data of age distribution suggests some shifts during the studied years, possibly influenced by the COVID-19 pandemic. The proportion of preschool children, recorded a small overall decrease from 24.93% in 2019 to 23.48% in 2020 reaching 22.86% in 2022. This could be attributed to increased parental supervision during the pandemic with many adults working from home and being more attentive to their young children's activities (Raffee et al., 2021). The current study suggests that more care for preschool children became the norm after the pandemic due to the sustained decrease in numbers of that age group. School-age children recorded a relatively stable percent of toxicity which suggests that school closures and remote learning due to the pandemic didn't dramatically influence the frequency of toxic exposures in this age group. Likewise, the senior age group

showed a stable percent through the studied years. Alhussein et al., 2023 recorded similar findings in their study covering the period of the pandemic.

For adolescents, there's a noticeable decrease from 12.26% in 2019 to 10.75% in 2020, 11.23% in 2021 and finally 9.48% in 2022. This drop could be linked to more adult supervision during the lockdown which contributed to the sustained decrease in the percent of toxicities in that age group after the pandemic (Li et al., 2022). On the other hand, adults' numbers showed an upward trend from 57.24% in 2019 to 60.12% in 2020, 59.22% in 2021 then, 62.14% in 2022. Similar findings were reported by Fayed & Sharif, 2021 where the number of toxicities were more encountered in adults during the pandemic. The increase could potentially be due to their greater likelihood of exposure to toxic substances, both in the workplace and general environment in addition to pandemic-induced stress (Gummin et al., 2021).

In terms of gender distribution, the proportion of admitted male patients decreased over the years, while the female proportion increased. Females are subjected to the increased stress of daily living making them prone to emotional stress. Poisoning, a prevalent cause of female mortality, has seen rising numbers (Vijayakumar, 2015; Kasemy et al., 2022). This increase could be attributed to factors like increased stress, changes in daily routines and increased time spent at home in the time of the pandemic (Gharpure et al., 2020).

Toxicity patterns may change in the context of a pandemic. As people resort to alternative treatments or misuse substances, there may be an increased prevalence of certain types of poisoning (Cusinato et al., 2021; Lee et al., 2023)

The data of the present study provides an insight into the effect of the pandemic on the patterns of various types of toxicities. The most evident change was observed in cases related to substance abuse, which rose from 13.79% in 2019 to a peak of 21.38% in 2022. This increase could be linked to the stress caused by the pandemic, leading to increased reliance on substances (Wei & Shah, 2020). Interestingly, the number of cases related to pharmaceuticals and over the counter (OTC) poisoning, which was the leading cause in 2019 and 2020, decreased consistently over these years, reaching its lowest in 2022 at 20.53%. This could be attributed to increased awareness about medication safety during the pandemic, improved medical practices, or even a shift towards substance abuse as a coping mechanism due to COVID-related stressors (Chacon et al., 2021; Wang et al., 2021).

Cases of pesticide poisonings recorded an increase in 2022, suggesting a potential rise in exposure. Similarly, food and nutrient-related cases increased, as the percent of food poisoning rose after the termination of the lockdown with the increase consumption of foods outside home (Motawei et al, 2022).

The 'Others' category which mainly includes ‘toxic effects of unspecified substance’ in addition to minor unclassifiable complaints, witnessed a significant increase of 16.24% in 2021 after an initial value of 8.82% in 2019 and 9.97% in 2020, before decreasing again to 8.39% in 2022. This trend may be attributable to a number of factors influenced by the unique circumstances of the COVID-19 pandemic. Firstly, the restrictions and lockdowns could have led to a rise in exposure to diverse substances of non-specific chemicals (Chang et al., 2020). Secondly, the psychological stress with an increase in substance use could involve a wide variety of substances, some of which might not fall under typical categories and hence would be grouped under "Others" (Wei & Shah, 2020). Finally, the surge in this category could also be related to challenges in data reporting and classification during the pandemic. The strain on healthcare systems might have resulted in incomplete or non-specific reporting of substances involved in toxicity cases (Gharpure et al., 2020).

Contrary to other researches, the total number of cases of household toxicities did not spike in the year of the complete lockdown. This could be explained by the nature of those studies focusing on the number of received calls rather than actual patient admission with marked signs of toxicity (Mahmoud et al., 2021).

In the current study, we also investigated toxicities across various age groups. Among preschool children, household substances represented the highest percentage, with recorded high levels through the years 2019-2021 followed by a significant decline in 2022. This aligns with existing literature highlighting the vulnerability of this age group to household poisonings (Peden et al., 2008). The pre-pandemic high levels could be attributed to lack of close supervision to that age group while the sustained high percent during the pandemic could be attributed to an increase in the availability and access of that age group to disinfectant products at homes. Post-pandemic, the decline in incidents is likely due to the sustained supervision to this age group (Dayasiri et al., 2017; Lee et al, 2023).

School-age children, recorded an alarming increase in the percent of substance abuse post-pandemic in 2022. The percent remained stable through the pandemic likely due to the increased supervision and reduced exposure to harmful substances during lockdowns, but it nearly doubled after the pandemic likely due to increased stress and easy accessibility of harmful substances (Ornell et al., 2020). Changes were also observed in food product-related toxicities, which declined in 2020 and 2021, then rebounded to pre-pandemic levels in 2022. This could be attributed to the shift in dietary habits towards home cooking during the pandemic, followed by a return to consuming meals outside of home pre- and post-pandemic (Peden et al., 2008; Alhussein et al., 2023).

Among adolescents, another alarming increase in substance abuse was recorded. The percent escalated significantly from 7.5% in 2019 to 13.7% in 2022, indicating a potentially worrying trend possibly exacerbated by the stress and isolation caused by the pandemic. A sharp decline in toxicities due to pharmaceuticals coincided with the increase in

substance abuse. This shift towards substance abuse could be attributed to accessibility issues, where during the lockdown, only the pharmaceuticals were available while post-pandemic substances of abuse became easily accessible. While the overall number of adolescent cases decreased post-pandemic, the change in toxicity patterns is alarming, potentially indicating a societal trend towards increased substance use, a finding consistent with other studies in this field. This trend necessitates careful monitoring and increased mental health support (Dumas et al., 2020).

Similarly, adults showed a pattern parallel to adolescents, with an increase in substance abuse-related toxicities from 16.8% in 2019 to 21.6% in 2022 and a decline in pharmaceutical incidents from 29.3% pre-pandemic to 23% post-pandemic. This trend underscores the potential impact of pandemic-related stress and mental health challenges (Holmes et al., 2020). Another noticeable change among adults was observed in food products, following a similar pattern of a decrease during the pandemic, followed by a rebound to pre-pandemic levels in 2022 (Motawei et al., 2022).

Seniors also showed an increase in substance abuse-related toxicities in 2022 after an initial decrease in 2020 and 2021. This trend exposes their vulnerability to pandemic-related stress and their chosen coping mechanisms (Farhoudian et al., 2020).

Regarding gender, the current study recorded a statistically significant difference between both genders in patterns of toxicities. Substance abuse-related poisonings increased significantly over the four years, with a more pronounced rise in females where the percent was doubled in 2022 (16.95%) compared to 2019 (8.95%) while still less than the percent in males (19.64% in 2019 and 26.93% in 2022). This trend aligns with the increased stress brought about by the pandemic and might reflect different coping mechanisms adopted during this period, correlating with the existing literature highlighting the exacerbating effects of the pandemic on substance use disorders (Volkow, 2020).

Poisoning from over-the-counter (OTC) drugs declined for both genders, perhaps indicating reduced reliance on these medications or improved safety practices. There's a consistent gender difference with females having a higher rate of OTC poisonings, which is consistent with previous studies suggesting medication overdoses are a leading cause of poisonings (Gummin et al., 2021). Pesticides-related poisonings increased, and females consistently had higher rates than males. This could be due to the increased use of these substances for suicide attempts by females, as reported by Kholeif, 2023.

The 'Others' category showed a substantial increase in male cases in 2021 before decreasing again in 2022. For females, the rate was lower. This could be attributed to the specific roles and the nature of each gender, where males had increased interaction with various uncommon substances due to home repairs, maintenance work, or other home-based activities. In addition, they are dauntless in trying unusual substances and with the pandemic-driven increase in substance use, atypical substances could be tried by them (Legato, 2016; Czeisler et al., 2020). Furthermore, during the pandemic, the information dissemination about the methods to prevent the spread of the virus, might have led to the consumption or application of harmful substances based on misinformation about their potential protective effects against the virus (Ornell et al., 2020). All this could lead to an increase in toxicities with unspecified substances.

The outcomes for patients in the current study recorded some shifts over the years which could be related to the impacts of the COVID-19 pandemic. The rate of patient improvement significantly decreased from 92.12% in 2019 to 73.66% in 2022. This downward trend might be attributed to the pandemic's strain on healthcare resources. Moreover, increased levels of stress and anxiety during the pandemic could potentially impact recovery rates (Kretchy et al., 2021).

Contrarily, there has been a sharp increase in referrals from 0.44% in 2019 to 10.63% in 2022. According to the PCC-ASUH referral policy, in case the center reached its full capacity, any further intoxicated patients referred to other tertiary health care facilities with toxin management capacities. Complicated intoxicated patients are referred to pertinent departments in ASUH under the combined supervision of the recipient department and PCC. Finally, patients who are misdiagnosed as toxicity are referred to other facilities/ departments after being reevaluated. All these factors explain the increase in the percent of referrals seen. In addition, this increase could indicate an increase in complicated cases, possibly due to increased exposure to toxic substances (Mintegi et al., 2019).

In addition, the number of patients choosing to leave the Poison Control Center, recorded an increase from 6.68% in 2019 to 14.36% in 2022. This could be due to a variety of factors like financial strains limiting the ability to afford treatment, fear of legal liability, especially for substance of abuse among youth and children whose families are afraid of legal responsibility. In addition, the increase in referrals and 'demand leave' over the years, might be indicative of pressure on the healthcare system and patients' preference to avoid hospitalization during the pandemic (Rosenbaum, 2020).

Despite the fact that the overall percentage of deaths remained relatively low during the four studied years, yet the number of deaths rose over these years echoing findings recorded in other studies (Ghose et al., 2022). This rise in mortality rates probably reflects more exposure to extensively dangerous types of toxins as pesticides; zinc or aluminum phosphides and certain narcotics that has become more reachable and a popular manner of suicide among different socioeconomic levels in Egypt.

Across different age groups, the improvement rates remained relatively high over the years, despite recording a decline in 2022. In the adolescent age group, a significant increase in the 'demand leave' category was observed, with the rate rising from 7.7%

in 2019 to 13.8% in 2022. This trend might indicate a growing tendency towards self-discharge against medical advice within this age group, which could be attributable to various factors such as non-compliance or mental health issues, particularly given the observed post-pandemic rise in substance abuse among this age group. For adults and seniors, the referral rates recorded a steep increase over the years, potentially indicating increased need for specialized care. Interestingly, the death rates increased significantly in the seniors group. This might possibly be due to older adults' vulnerability to poisoning incidents, as they are more likely to have comorbidities and take multiple medications (Gummin et al., 2021).

Regarding the gender-based outcome data, the improvement rate among both males and females declined substantially over these years, with a more pronounced drop in males from 91.86% in 2019 to 71.75% in 2022 and in females, from 92.34% in 2019 to 75.32% in 2022. These trends could reflect the pandemic's burden on healthcare resources and the potential impact of stress on recovery (Kretchy et al., 2021).

Remarkably, the referral rate and demand leave increased for both genders, with a larger increase in males, which may suggest an increasing need for specialized care beyond the capacities of the Poison Control Center or the strain on healthcare services. This could potentially reflect the influence of various biological and sociological factors that influence health outcomes (Legato, 2016).

The findings of the current study underline the need for further exploration into the factors contributing to the observed trends, as well as for the formulation of targeted strategies to address the increasing incidence of substance abuse and poisoning events across various demographics. It also underscores the importance of strengthening the capacities of healthcare services, including poison control centers, to cope with the challenges posed by pandemics and similar large-scale public health crises.

Limitations

However, our study have certain limitations. We focused only on data from the PCC-ASUH, which may not accurately represent the situation in different geographic locations or settings. Hence, other multicenter studies are recommended to further explore this important public health issue.

Conclusion

In conclusion, the current research provides valuable insights into the impact of the COVID-19 pandemic on poisoning. It is evident that the pandemic has impacted the patterns of toxicities, resulting in significant shifts in the types of poisonings during pandemic-related lockdowns and subsequent easing of restrictions, reflecting changes in behavior, exposure, and usage of various substances. Some changes faded with the end of the pandemic like the decrease in number of admitted cases, decrease in food poisoning cases, and increase in toxicities with unspecified substances, while others became the norm like the increase in substance abuse seen in most age groups even the school-age children and the decrease in pharmaceutical toxicities. In addition, new behaviors became the norm with the end of the pandemic like increase in the demand to leave the PCC before the end of treatment and the decrease in the number of cases of children in all age groups due to increased vigilance and care. The study highlights the importance of mental health support, and substance misuse initiatives, with special attention to vulnerable age groups. The study underscores that preventing and managing poisoning in the wake of such global crises requires an interdisciplinary, integrated approach, including not just healthcare but societal and policy-level efforts as well.

Recommendations

In order to improve the resilience of healthcare systems in the face of future public health crises, the current study recommends that facilitated accessibility to healthcare, including emergency services and poison control centers, should be maintained during pandemics. Telemedicine and other remote consultation services can be used to provide expert advice and guidance. The study calls for the development and implementation of comprehensive mental health services and campaigns to address the psychological distress caused by the pandemic. More research on the long-term impacts of the pandemic is needed. In addition, increased supervision and maintaining vigilance by parents and caregivers for children should be sustained. These recommendations, if implemented appropriately, could help save lives and reduce the negative impacts of future crises.

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أنماط التسمم قبل وأثناء وبعد جائحة كوفيد-١٩: دراسة بأثر رجعي في مركز علاج التسمم بمستشفيات جامعة عين شمس

سهى عشري[١] و جيهان بشرى عزب[1,2] وآية مصطفى عبد اللطيف[3] و آية شوقي خاطر[١]

الملخص العربي

الخلفية: لقد أثرت جائحة كوفيد-١٩ بشكل كبير على النظم الصحية العالمية وعلى أنماط المرض في جميع أنحاء العالم . **الهدف:** تهدف الدراسة الحالية إلى تحليل أنماط التسمم قبل الجائحة وأثناءها وبعدها في مركز علاج التسمم بمستشفيات جامعة عين شمس، وتحديد أي تغيرات ومدى استمرارها بعد الجائحة .**طريقة البحث:** الدراسة قائمة على الملاحظة بأثر رجعي باستخدام قاعدة بيانات مركز علاج التسمم للمرضى الذين تم قبولهم من الأول من يناير ٢٠١٩ إلى نهاية ديسمبر ٢٠٢٢. **النتائج:** على مدى الأربع سنوات، قام المركز بخدمة عدد كبير من المرضى الذين بلغ عددهم ٢١،١٠٧ ألف مريضا تم استقبالهم بالمركز، في عام ٢٠٢٢ بلغت نسبة حجز البالغين إلى ٥٧،٢٤٪ في عام ٢٠١٩، وقد ارتفعت هذه النسبة لتصل إلى ٦٢،١٤٪ في عام ٢٠٢٢. وقد بلغت نسبة الإناث ٥٤،٧٧٪ من المحجوزين في عام ٢٠١٩ وانخفضت إلى ٥٢،٦٩٪ في عام ٢٠٢٠ ثم ارتفعت إلى ٥٥،٦١٪ في عام ٢٠٢٢. بلغت نسبة التسمم الدوائي ٢٦،٨٥٪ في عام ٢٠١٩، و٢٧،١٣٪ في عام ٢٠٢٠، وانخفضت إلى ٢٠،٥٣ في عام ٢٠٢٢. بينما أصبح تعاطي المخدرات، الذي كان ثاني أكثر التشخيصات شيوعًا في عام ٢٠١٩ بنسبة ١٣،٧٩٪ هو السائد في عام ٢٠٢٢ بنسبة ٢١،٣٨٪. وقد كانت النتيجة الأكثر شيوعاً هى التحسن، رغم الزيادة في الطلب على الخروج بناءً على الطلب والإحالات حتى عام ٢٠٢٢. أما الجنس والعمر، فقد كان لهما تأثير كبير على التشخيص والنتائج.**الاستنتاج والتوصيات:** خلصت هذه الدراسة الى ان عمليات الإغلاق المرتبطة بالجائحة والتخفيف اللاحق للقيود أدت إلى تغيرات في السلوك والتعرض للتسمم وتعاطى المخدرات. كما تلاشت بعض التغييرات مع نهاية الجائحة، بينما استمرت التغييرات الأخرى وأصبحت السلوكيات الجديدة هي القاعدة. ولذلك أصبح هناك حاجة إلى استجابات عاجلة من مقدمي الرعاية الصحية وواضعي السياسات الطبية، مع التركيز على مبادرات دعم الصحة النفسية ومنع إساءة استخدام المواد، خاصة للفئات العمرية الاكثر عرضة.

1. قسم الطب الشرعي والسموم الاكلينيكية كلية الطب جامعة عين شمس
2. مدير مركز علاج التسمم مستشفيات جامعة عين شمس
3. قسم المجتمع والبيئة والطب المهني كلية الطب جامعة عين شمس