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Forensic toxicology experience: Children poisoning cases in Riyadh, Saudi Arabia

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ABSTRACT
Background: This study aimed at analyzing the toxicological aspects of pediatric poisoning cases in Riyadh, Saudi Arabia. Child poisoning is a common cause of visits and admission to the emergency department, and it is essential in the identification of chemical causes of poisoning, particularly in children who are most vulnerable to poisonous substances such as drugs, chemicals, and pesticides, among other non-food substances.
Methodology: The study adopted a cross-sectional descriptive research style, and secondary data from the Ministry of Health (MoH) Saudi Arabia were extracted between 2019 and 2021. The collected data on the demography of the patients, place of exposure, and whether the poisoning occurred accidentally or deliberately were analyzed descriptively using Microsoft Excel.
Results and Discussion: This research established that male children are more prone to poisoning. Among them, children aged 1–5 were the most vulnerable group — 78,83 % of cases in 2019 and 81,26 % in 2020. Owing to chronic poisonings, more than 90% of the cases happened at home, and unintentional poisoning cases increased from 55.56% in 2019 to 84.49% in 2021, probably due to improved reporting. Non-accidental poisonings, in general, were not very frequent, but among the cases of juveniles, there were slightly more.
Conclusion: The implications discussed here in the overview require developing better campaigns on preventing pediatric poisoning, improving the services offered by poison control centers, and improving the detection and treatment services provided by forensic toxicology.

Keywords: Forensic toxicology, pediatric poisoning, child poisoning, unintentional poisoning; intentional poisoning

INTRODUCTION

Background

Forensic toxicology has considerable importance in cases involving poison to develop those cases, especially those involving minors. Child poisoning is a common occurrence in children worldwide, particularly in developing countries [1]. According to different studies, poisoning is a common cause of visits and admission to the emergency department [1,2,3]. Children are always curious; they take dangerous positions to analyze different environments and unintentionally take toxic substances. For children under the age of five, the WHO mainstreams that the results of unintentional poisoning are one of the most common diseases affecting the young [2]. Low and middle-income countries are hit most due to poor awareness, the rarity of accessing poison control centers, and the lack of preventive measures [4]. However, more recently, poisonings have emerged as a well-known issue, especially in the Middle East and in Saudi Arabia.

Riyadh, the capital city of Saudi Arabia, hosts millions of people, and more people are migrating to urban areas. With this newfound urbanization, the population has been exposed to hazardous substances such as household chemicals, pesticides, medications, and so on [4]. These substances are reported to be found in houses in Saudi Arabia, both rural and urban. Hence, there is a need for better awareness, preventive measures, and better medical treatment [5,6]. Therefore, the toxicity data of these poisonings differ, including paracetamol, cleaning agents, and pesticides. Forensic toxicology assumes increased importance in examining poisoning, determining toxic compounds, and delivering critical information to health departments and the justice system. Overall, poisoning cases are known in forensic medicine of Saudi Arabia, but more specific to the subject of this paper, which is pediatric poising literature in the kingdom of Saudi Arabia, is scarce.

Statement of the Problem

In Saudi Arabia, there has been an increase in research and development of healthcare, but pediatric poisoning research is limited, especially within cities like Riyadh. Up-to-date information on the kinds of toxic substances involved in pediatric poisoning, the profile of the affected children, and the fate of such children remains scanty [1]. This area requires better research because it is difficult to make precise policy changes and public health interventions to address and minimize such a situation. In addition, there are no local forensic toxicology published investigations in Riyadh that could help in pinpointing the trends, antecedents, and reasons for pediatric poisoning and the proper management of it [5]. As a result, the healthcare givers and forensic professionals do not have the much-needed crucial information that would enable them to have differential diagnoses of such children, thus worsening the prognosis of such children.

Research Objective

This study aims to assess pediatric poisoning in Riyadh, Saudi Arabia, with an emphasis on understanding the toxic agents most often encountered and assess the children's demographic profile.

Justification of the Research

This research focused on answering a significant health crisis that is detrimental to the lives of children in Riyadh. Although previous studies have investigated poisoning in Saudi Arabia in a broad manner, only some have investigated poisoning, particularly among children. Therefore, more data is needed to guide policymakers and healthcare practitioners on how to tackle the problem. This research will offer empirical information on how pediatric poisonings in Riyadh affect medical treatments and conceptualize sound public health strategies.

Second, it will significantly contribute to advancing forensic toxicology in Saudi Arabia. The cases involving child poisoning are peculiar, which means that there arises a necessity for qualified expertise in identifying the toxic substances that affect a child. This study could have implications for improving detection methods currently employed in forensic toxicology to enhance diagnostic precision, contributing to the efficacy of treatments. The most crucial function of forensic toxicologists is in analyzing and profiling cases concerning suspicious poisonings as well as in civil or criminal cases involving negligence or deliberate actions. This study will aid in the design of protocols and practices that supplement the work of forensic practitioners.

LITERATURE REVIEW

Poisoning in children is a significant problem worldwide and reviewing the literature on pediatric poisoning reveals that this condition remains an important cause of morbidity and mortality among children below the age of five years [1]. Cross-sectional surveys conducted in the past have indicated that children are at risk of accidental poisoning, usually within the homestead, because chemicals, medication, and poisonous plants are easily found, accessible, and sometimes available in large quantities. Given the nature of poisoning in the developing world and a comparison with developed countries, there is a need to have effective poison control centers, as well as poisoning prevention crusades, as a means of lowering the incidence of poisoning [5]. However, they still record a high incidence of pediatric poisoning, which is a result of ignorance, improper storage, and inadequate treatment facilities.

Forensic toxicology is a scientific discipline that offers valuable information about the nature of toxic substances in a body, their detection, and the mechanisms of their effects on the diagnosis, management, and prosecution of cases of poisoning [6]. This is quite crucial in pediatric poisoning because, in addition to identifying the type of poisons ingested, forensic toxicologists take responsibility for establishing negligence or intentional poison administration with the possibility of prosecution. In countries that have developed effective forensic analytical systems, new toxicological tests such as gas chromatography-mass spectrometry (GC-MS) have produced rapid results in identifying toxic substances [7,8]. studied how the use of forensic toxicology is increasing among children and stressed that forensic toxicology should be practiced under the cooperation of clinicians and toxicologists. Nevertheless, literature shows that it is still in its nascent stage in the Kingdom of Saudi Arabia about pediatric poisoning along with forensic toxicology [9]. As stated by [10], several studies have discussed areas such as drug-associated crime and adult cases of poisoning; however, literature on pediatric toxicology in Saudi Arabia has yet to be discovered. This can be attributed to the scene in Middle Eastern countries and most other developing world, where funding is rare and adequate forensic toxicology is lacking.

Studies by [11,12,13] identified various common agents of child poisoning across the world. The identified agents include cleansing products used within households, followed by prescription drugs, over-the-counter medications like paracetamol, and pesticides. The findings by [14] and [15] corroborate the above assertions by asserting that in low settlement areas where there is little control over the use of risky chemicals in homes, cases of child poisoning are on the rise. In the Saudi Arabian context, the present study showed that cases of paracetamol overdose are more common in pediatric patients [16,17.18,19,20]. These scholars established that paracetamol was the most frequently used substance causing poisoning in children admitted to Riyadh hospitals. Related investigations have also reported high rates of pesticide intoxication among rural children of Saudi

Arabia who are involved in agricultural activities [21,22,23]. However, the present studies are deficient in localized data, especially in Riyadh, one of the most urbanized cities in Saudi Arabia. Much of the literature available in this case only offers an approximated analysis of the poisoning cases in Saudi Arabia with little distinction based on regions or population categories [23]. This is a gap in the literature that requires to be closed for better honing of policy and interventions towards prevention of pediatric poisoning in Riyadh.

The management of pediatric poisoning has attracted a lot of discussion in the literature, involving both the clinical and forensic points of view. More generally, it has been pointed out in many of these works that early treatment is associated with better outcomes for poisoned children. There is published evidence of the effectiveness of antidotes, activated charcoal, and supportive care [24]. According to [25], poison centers offer rapid consultation services, hence reducing severe outcomes that may lead to hospitalization. Nevertheless, in Saudi Arabia, there are few options for poison control services, and according to [23], they often come late to medical assistance because parents and caregivers are not aware of poisoning signs.

METHODOLOGY

A cross-sectional descriptive design was adopted in this research to understand the forensic toxicology experience regarding the children poisoning cases in Riyadh, Saudi Arabia, for three years ranging from 2019 to 2021. In an epidemiological surveillance system initiated in 2000 for chemical poisoning, hospitals informed the General Directorate of Environmental Health at the MOH, Riyadh, of the incidents of child poisoning [1]. The collected dataset comprised the demographics (age, gender, and nationality), exposure location, and whether poisoning was accidental or intentional. These secondary data were collected with the help of desktop research, where data were extracted from the Ministry of Health, Saudi Arabia, for the abovementioned period. The extracted data were saved in an Excel Sheet, where the researcher relied on Microsoft Excel for analysis. The data were descriptively analyzed, and the results were presented as tables and graphs to enhance interpretation.

RESULTS

The information provided in Table 1 below gives a summary of child poisoning incidences in Riyadh, Saudi Arabia, in the years 2019, 2020, and 2021. These characteristics include sex, age, nationality, incident location, incident location, and exposure circumstances. The frequency and percentage of each variable are presented, showing the pattern of child poisoning cases for the three years and possible changes in the characteristics.

Table 1: Characteristics of child poisoning cases in Riyadh, Saudi Arabia

Characteristics of child poisoning cases in Riyadh, Saudi Arabia between 2019 and 2021							
		2019		2020		2021	
Variables							
Gender		Frequency (N=954	Percent (%)	Frequency (N=1062)	Percent (%	Frequency (N=993)	Percent (%)
	Male	550	57.65%	591	55.65%	560	56.39%
	Female	404	42.35%	471	44.35%	433	43.61%
Age		Frequency (N=954	Percent (%)	Frequency (N=1062)	Percent (%	Frequency (N=993)	Percent (%)
	Less than 1 year	49	5.14%	48	4.52%	140	14.10%
	1-5 years	752	78.83%	863	81.26%	686	69.08%
	6-12 years	72	7.55%	59	5.56%	83	8.36%
	13-19 years	81	8.49%	92	8.66%	84	8.46%
Nationality		Frequency (N=954	Percent (%)	Frequency (N=1062)	Percent (%	Frequency (N=993)	Percent (%)
	Saudi	864	90.57%	976	91.90%	922	92.85%
	Non-Saudi	90	9.43%	86	8.10%	71	7.15%
Place of Incidence		Frequency (N=954	Percent (%)	Frequency (N=1062)	Percent (%	Frequency (N=993)	Percent (%)
	Home	845	88.57%	956	90.02%	901	90.74%
	Others	109	11.43%	106	9.98%	92	9.26%
Circumstances of Exposure		Frequency (N=954	Percent (%)	Frequency (N=1062)	Percent (%	Frequency (N=993)	Percent (%)
	Intentional	35	3.67%	60	5.65%	39	3.93%
	Unintentional	530	55.56%	751	70.72%	839	84.49%
	Unknown	389	40.77%	251	23.63%	115	11.58%

Gender

The analysis of the male/female distribution of child poisoning cases in the three years showed that males dominated at 57.65%, 55.5%, and 56.39% in 2019, 2020, and 2021 respectively (Figure 1 below). This means that the number of boys affected by poisoning compared to girls was slightly higher in the course of the period. At the same time, females were 42,35% in 2019, 44,35% in 2020, and 43,61% in 2021. Such small changes in percentage depict a somewhat unpredictable gender value in none of the classes, showing a general shift in gender distribution over the three years. Therefore, it can be deduced that male children are more likely to be victims of accidental injuries and poisoning because of their behaviors, such as the propensity to take risks.

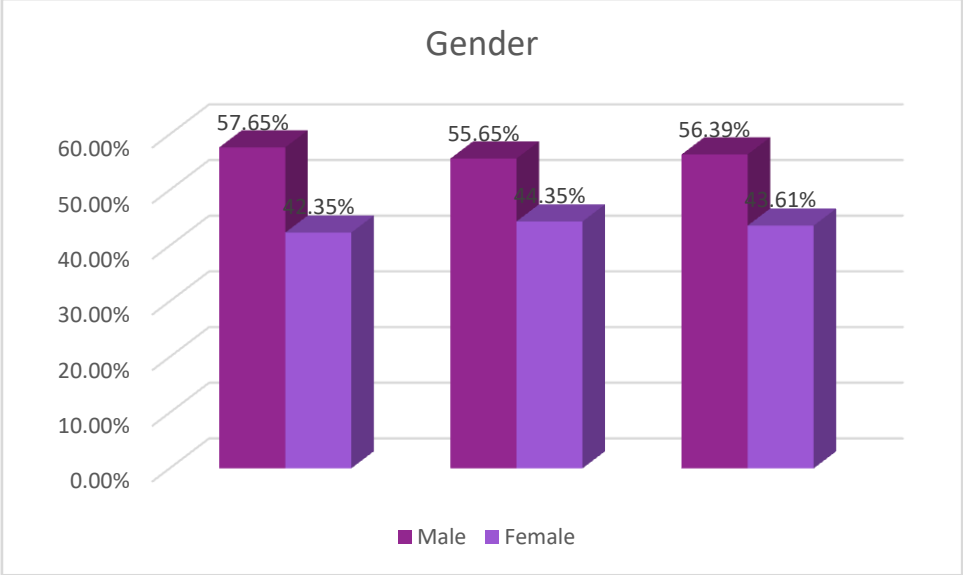

Figure 1: Gender

Age

Figure 2 below shows the age distribution of persons affected by child poisoning. From the figure, the age also depicts higher incidences of drug poisoning among children between the age one and five years. In 2020, 81.2% of the children were victims of drug poisoning, as opposed to 78.83% and 69.08% in 2021 and 2019, respectively. This consistent dominance of the 1-5 age group is regular as toddlers or preschool children are at an age where curiosity is at its peak, and they are physically active and mouth innovative but not very mouth-wise. Infants under one year were rated lower at 5.14% in 2019 and 4.52% in 2020, then shot to 14.10% in 2021. This rising rate observed in 2021 might indicate a change in exposure risk for this age group's behavior at home, supervision by parents or guardians, or the use of preventive measures.

The 6–12-year age group had a comparatively low poisoning incidence of 5.56% in 2020 and 8.36% in 2021. Likewise, the rate for the age group 13-19 years has varied slightly between 8-9% and shows that children of more advanced age are less likely to be poisoned. However, the risk for this age group should not be dismissed because teenagers may be more vulnerable to intentional poisoning or substance use, such as suicidal attempts.

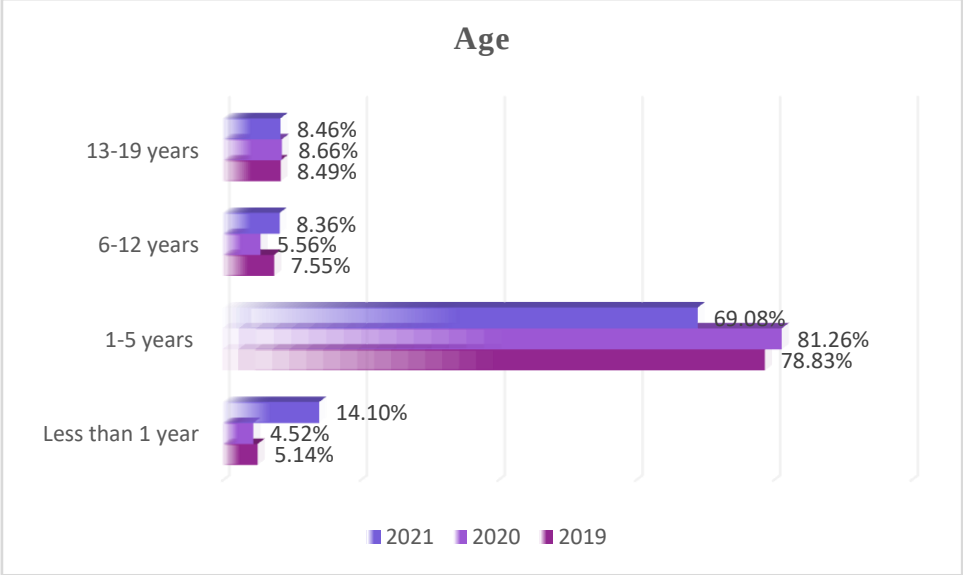

Figure 2: Age distribution

Nationality

As shown in figure 3 more than 90% of poisoning in the Kingdom were Saudi children for the whole year: 90.57% in 2019, 91.90% in 2020, and 92.85% in 2021. The total enrollment of non-Saudi children was 9.43% in 2019, 8.10% in 2020, and 7.15% in 2021. The year-wise slightly declining trend in the percentage of non-Saudi

cases may also be governed by other demographic conditions or changes in contact with healthcare services and reporting style among the non-Saudi population.

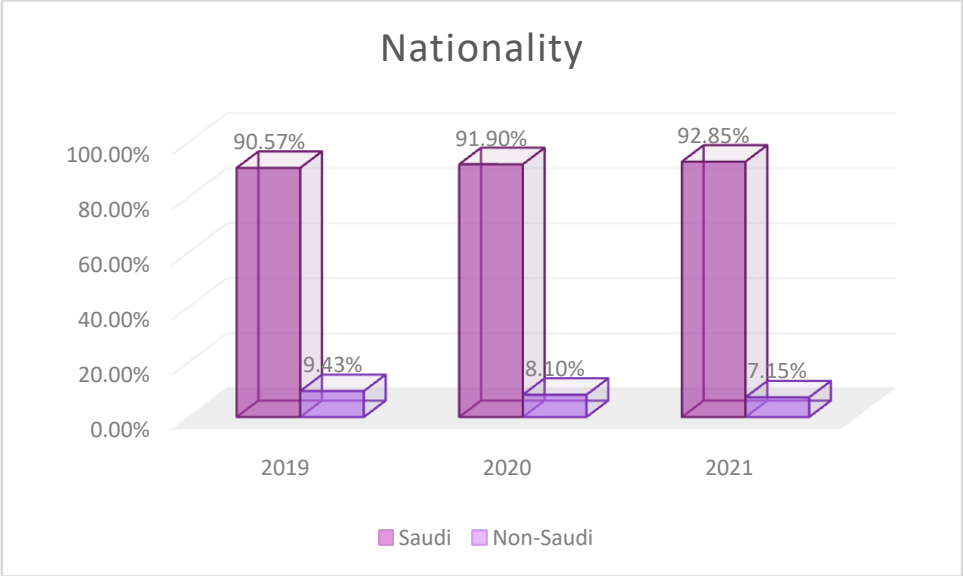

Figure 3: Nationality

Place of Incidence

Figure 4 displays most of the poisoning cases took place at home. In 2019, it was 88.57%; in 2020, it was 90.02%; and in 2021, it was 90.74%. This shows that the home environment is dominant in child poisoning, as is the case in other countries in the world. Most homes accommodate the above and many other potentially harmful products that are not well stored and efficiently within the child's reach. The proportion of cases in different venues, including schools, parks, and other public areas did not significantly decrease, hovering between 9% and 11%. Thus, the regularity of the results suggests that although poisoning can occur in public areas, it is often less likely than in a home setting.

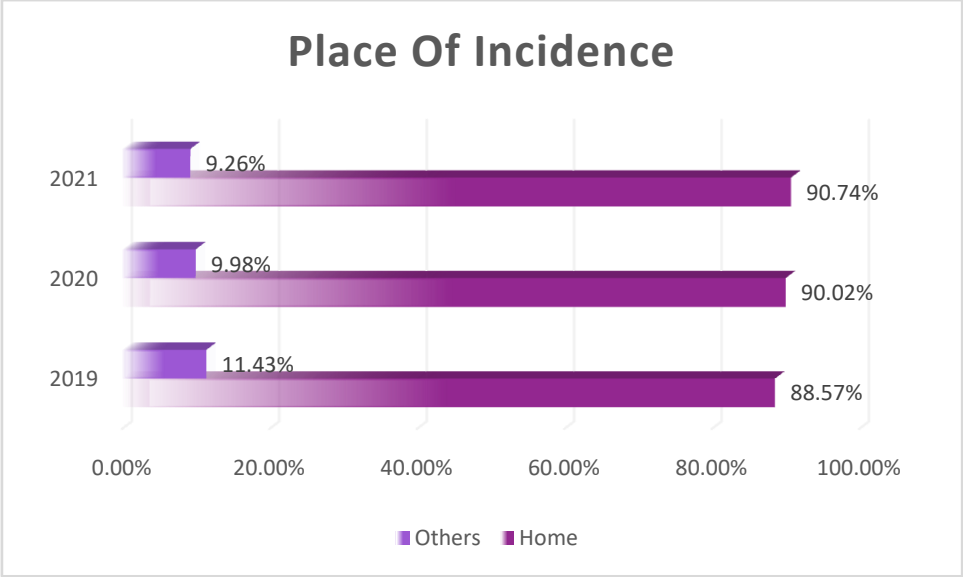

Figure 4: Place of incidence

Circumstances of Exposure

Figure 5 shown below unintentional poisoning was the most frequent of all poisoning events, reporting 55.56% in 2019, 70.72% in 2020, and 84.49% in 2021. Thus, the observed gradual increase in the trend indicates better registration and identification of unintentional poisonings and increasing awareness of accidental poison hazards at home. On the other hand, intentional poisonings comprised 3.67% of cases for 2019, 5.65% for 2020, and 3.93% for 2021. The above group could contain instances of attempted suicide, especially where the child is of comparatively older age, the adolescent. A significant number of cases in 2019 and 2020 involved an unknown nature of the poisoning, which means that the circumstances of the poisoning remain uncertain. However, the

proportion of such cases reduced considerably to 11.58 percent in 2021. This improvement may show improved methods in investigating poisoning occurrences and acquiring evidence, which leads to an improved concept of the circumstances around poisoning occurrences.

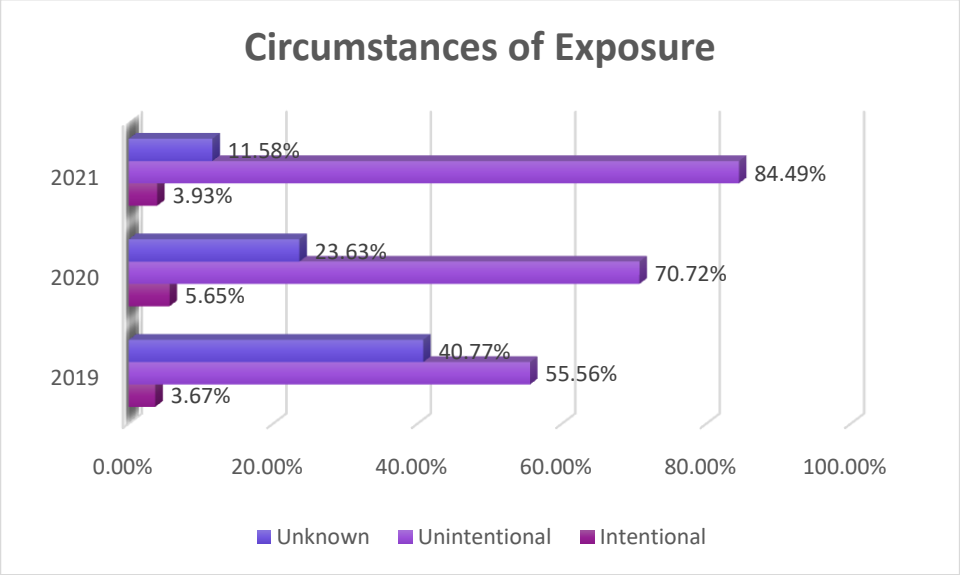

Figure 5: Circumstance of exposure

DISCUSSION

The specific results of the analysis of the gender distribution in cases of child poisoning within the period of 2019-2021 indicate a higher number of male children as opposed to females. This tendency can be explained by existing research, which claims that male children are at higher risk of accidental injuries, fallings, and poisoning because of their nature. The findings of [7,11] demonstrate that male children are more exploratory and less cautious compared to girls – factors that make them more at risk of developing accidental poisoning. However, it is imperative to note that for both the male and female children, the male children consistently record a higher rate of poisoning, though the difference is not very large; this means that the girls are also very vulnerable to poisoning. The increase in the proportion of female cases during this period, to some extent, does not show a change in gender distribution. This finding indicates that there is little deviation from the same across the globe, including the near parity of boy-to-girl child poisoning in some countries. The outcomes of this study support the idea that child poisoning is a widely spread problem that occurs in girls and boys, so any epidemiological protection work should not focus only on girls.

The age distribution of cases of poisoning underlines that compared to older children, those of 1-5 years are the most vulnerable. This conforms to findings from studies indicating that toddlers and preschool children are at higher risk due to curiosity, mobility, and a tendency to put everything in their mouths. The literature review by [9,13] agrees with this by noting that preschool-age children are most vulnerable to accidental poisoning through ingestion of non-food substances, which include cleaning agents, medications, and chemicals. A slightly increasing trend has been observed in 2021. It might be due to changes in exposure risks, family composition, parental control, or preventive measures, as evidenced by global studies.

Children aged 6-12 years showed a poisoning incidence inferior to that of younger kids, whereas teenagers had a poisoning incidence of about 8-9%. This trend has been supported by the literature in pediatric toxicology, revealing that children in older groups are less likely to suffer from accidental poisoning but are actually at higher risk of poisoning by poison, for instance, in cases of suicide or substance abuse. Although the primary type of exposure is accidental (84.49% in 2021), intentional poisoning should not be neglected, especially for adolescents who may develop mental health problems [10,16]. Overall, the place of poisoning and the predomination of cases that happened at home correspond to the worldwide data. Homes are recognized as some of the leading settings for child poisoning because these products remain readily available, more so in countries with little or no poison control legislation. Households within the low-income and rural areas where Regulations of dangerous chemicals are not well monitored, as pointed out by [14] and [15], pose a significant risk. In Riyadh, however, proportions of the poisoning literature remain generic without emphasizing urban/rural distinction, implying insufficient investigation [23]

Based on the above discussion, it is possible to conclude that this study focused on child poisoning cases in Riyadh, Saudi Arabia. The present paper focuses on the timely management of pediatric poisoning and relevant interventions, including antidote administration and activated charcoal, among others. According to [24] and [25] poisoning outcomes are less severe when there is early action and contact with poison control centers. In

Saudi Arabia, however, there are no organized poison control centers or enough awareness, meaning that patients end up seeking help much later than is required. This indicates the need for more public health promotion, enhanced support to poison centers, and better forensic toxicology to reduce poisoning hazards and optimize treatment in children.

CONCLUSION

Various patterns concerning gender distribution, age distribution, location, and exposure circumstances concerning child poisoning in the years 2019, 2020, and 2021 have been depicted by this study. Child poisoning has a slight inclination toward male children as opposed to female children, and this correlates with findings from previous cross-sectional research on children's risky behavior in boys. The vulnerable age group is 1-5 years; the children in this age group are curious and often fall prefab. Caregivers should carefully scrutinize possible changes in dynamics in household safety or supervision based on the observed trend of a higher poisoning incidence among infants under one year in 2021. A quarter of poisoning cases that happened at home stress the importance of improved home safety. The findings of this study are in tandem with those of global studies, which identify the presence of dangerous household products, inadequate containment, and restricted legislation at home as contributory factors. The number of unintentional poisoning cases has steadily risen over the three years, and awareness, as well as better reporting through intentional poisoning, specifically among adolescents, remains alarming and necessitates mental health attention. According to the existing literature, a significant focus should be made on early medical intervention, the functions of poison control centers, and the incorporation of forensic toxicology into pediatric poisoning response. However, there are no specialized poison control services offices, particularly in Riyadh, and only a limited number of forensic toxicological experts. This can only be closed by implementing enhanced poisoning prevention programs as well as improved public health campaigns and strengthened forensic toxicology skills to address pediatric poisoning cases in urban environments such as Riyadh.

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