

ORIGINAL RESEARCH



Trends in drug poisoning hospitalizations over ten years in South Korea: mortality and length of hospital stay

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Abstract

Drug poisoning has evolved in South Korea, with changes in substance availability and a rise in non-lethal abuse among youth, necessitating an updated understanding of this public health concern. This study aims to investigate the shifts in toxicity-causing substances and their impacts over the past decade, providing a comprehensive overview to inform future interventions. This study was conducted as a retrospective observational study utilizing the Korea National Hospital Discharge In-depth Injury Survey, including data from January 2011–December 2020. Hospitalization patterns, durations and corresponding mortality rates were examined. The study, analyzing 10,017 patients hospitalized for drug poisoning, observed a decrease in average hospital stay (average decrease from 7.1 days in 2011 to 5.8 days in 2020) and mortality rate (7.7% in 2011 to 2.6% in 2020), with older adults having the longest stays and highest mortality. The use of prescription and non-prescription drugs as intoxicants increased, while pesticide use decreased, with older adults showing the highest frequency of pesticide poisoning. Factors affecting length of stay and mortality rate included age, sex and intent, with statistical analyses showing significant correlations. An increase in poisonings was caused by prescription and non-prescription drugs, whereas there was a decrease in poisonings caused by pesticides. Despite decreases in drug poisoning-related deaths in South Korea, largely attributed to national control for high-toxic agents and improved medical systems, the rising number of incidents involving prescription and over-the-counter medications highlights the urgent need for ongoing surveillance and focused interventions.

Keywords

Hospitalization; Intoxication; Mortality; Poisoning; South Korea

1. Introduction

Drug poisoning has emerged as a significant public health concern in many countries, including South Korea, over the past few decades [1–3]. Various factors, ranging from accidental overdoses to intentional self-harm, cause drug poisoning. Hospitalizations caused by drug poisoning represent a substantial burden on healthcare systems, both in terms of resources and economic costs [4–6]. Furthermore, they frequently emphasize underlying social and psychological difficulties that require multifaceted solutions.

The face of drug poisoning in South Korea has been evolving, particularly with the constant medical advancement interaction, substance availability and societal challenges. Pesticides, which are notorious for their high toxicity, were a previously major concern [3, 7, 8]. Their abuse caused an alarmingly high mortality rate. However, recent patterns indicate a shift. Regulatory interventions have significantly mitigated the dangers presented by such highly toxic substances [9–11]. However, the modern era, highlighted by the difficulties of the

pandemic, has witnessed an increase in non-lethal substance abuse, especially among the younger demographic [12]. Such pattern modifications not only reflect the evolving character of drug accessibility but also indicate the evolution of social and psychological dynamics.

Therefore, acquiring an up-to-date understanding of the current state of drug poisoning in South Korea is necessary. This study aims to investigate the mortality rate and hospitalization duration for patients hospitalized in the past decade due to drug poisoning. We expect to reveal how the primary substances that causes toxicity have changed over time and how the outcomes have evolved through an extensive investigation. We aim to provide a comprehensive overview that will assist in making well-informed decisions regarding future interventions.

2. Materials and methods

2.1 Study design, setting and data source

This retrospective observational study used the nationwide, population-based Korea National Hospital Discharge In-depth Injury Survey managed by the Korea Disease Control and Prevention Agency (KDCA) to evaluate the characteristics and length of hospital stays of patients hospitalized for drug poisoning. Data were obtained from patients who were admitted to general hospitals with a bed capacity of over 100. Additionally, it consisted of information, such as medical institution, demographic, sociological, geographical, patient visits, diseases and treatments, and in-depth data related to injuries, including intent, place of occurrence, and addictive substances. This study involved the analysis of over a decade of data obtained from January 2011 to December 2020.

2.2 Study population and classification of toxic drugs

This study included patients hospitalized for drug toxicity and omitted age or any limitation for the exclusion.

Toxic drugs were categorized into five main classifications, each of which was further subdivided into particular subcategories based on previous research [3, 13]. Group 1 consisted of a variety of pharmaceuticals, including non-opioid analgesics, antipyretics, anti-epileptic agents, sedatives, hypnotics and drugs for Parkinson's disease psychotropics, narcotics, hallucinogens, autonomic nervous system medications, and other unspecified medical substances. Group 2 consisted of various gases and vapors. Group 3 included pesticides. Group 4 consisted of organic solvents, halogenated hydrocarbons, vapors and alcohols. Group 5 included a diverse range of unspecified chemicals and substances that possess harmful properties.

2.3 Variables and outcomes

Data on several variables were extracted, including sex, age, insurance type, poisoning occurrence at home, intent, poisoning agent classification, hospital size and outcomes.

The study outcomes included mortality and length of hospital stay. Additionally, we compared the outcomes for three age groups: children (<18 years), younger adults (≥ 18 and <65 years), and older adults (≥ 65 years). Moreover, we investigated changes in addictive drugs over the past decade and age groups distributed by poisonous drug category.

2.4 Statistical analysis

R software (version 4.3.1; R Foundation for Statistical Computing, Vienna, Austria) and Jamovi software (version 2.3.21.0; The Jamovi Project, 2020, Sydney, Australia) were used for all statistical analyses. Descriptive statistics were conducted to state the baseline characteristics. Logistic regression analysis was conducted to assess mortality, adjusted age, sex, insurance type, event occurrence at home, intent and poisoning agent. Additionally, linear regression analysis was performed to evaluate the length of hospital stay. Two-tailed p -values of < 0.05 were considered statistically significant.

3. Results

The analysis included 10,017 hospitalized for drug poisoning of 2,559,741 patients hospitalized due to injuries. Of these, 46.6% were male, with an average age of 49.6 years (standard deviation (SD): 21.8). Additionally, 7.2% were <18 years of age, 64.7% were younger adults, and 28.2% were older adults. Further, 60.7% of all patients experienced intentional intoxication. The most prominently used intoxicating substances include single-category drugs, such as antiepileptics, sedative-hypnotics, anti-Parkinsonism and psychotropic, followed by other and unspecified chemicals and noxious substances, and then pesticides (**Supplementary Table 1**).

The average length of hospital stay for the entire population was 6.4 days (SD: 11.8) (Fig. 1A and **Supplementary Table 2**). Over a decade, the length of hospital stay was the longest at 7.1 days (SD: 11.9) in 2011 and gradually decreased to 5.8 days (SD: 10.1) in 2020. The mortality rate was the highest in 2011 at 7.7% and gradually decreased to 2.6% in 2020. The older adults had the longest average stay of 8.4 days (9.6 days in 2011 and 7.7 days in 2020) when age groups were divided. The overall average stay for younger adults was 5.8 days (6.5 days in 2011 to 4.9 days in 2020) and that for children was 3.9 days, which remained relatively stable over the decade (Fig. 1B and **Supplementary Table 2**).

The mortality rate for the entire population was 3.7% (Fig. 1A and Table 1). Over the decade, the mortality rate among older adults dramatically decreased (overall mortality was 8.6%, 15.0% in 2011, and 7.3% in 2021, $p < 0.001$). The overall mortality rate for adults was 2.0% (5.7% in 2011 and approximately 2% after 2013, $p < 0.001$) (Fig. 1C and Table 1).

The proportion of Group 1 agents, consisting of prescription and non-prescription drugs, consistently increased when the yearly trends of intoxicating drug categories were examined. In contrast, pesticides (Group 3) steadily decreased ($p < 0.001$) (Fig. 2A). Older adults, compared to other groups, demonstrated the highest frequency of pesticide (Group 3) poisoning ($p < 0.001$) (Fig. 2B).

Linear regression analysis revealed factors affecting the length of stay, including age ($p < 0.001$), sex ($p = 0.006$), and intent ($p = 0.002$) (**Supplementary Table 2**). The correlation coefficient R was 0.154, and the adjusted R square was 0.0228. Logistic regression analysis revealed factors influencing the mortality rate, including sex (odds ratio (OR): 1.68, 95% confidence interval (CI): 1.33–2.13, $p < 0.001$), intent (OR: 2.27, 95% CI: 1.63–3.18, $p < 0.001$), and age (OR: 1.04, 95% CI: 1.03–1.05, $p < 0.001$) (**Supplementary Table 3**).

4. Discussion

This decade-long observational study revealed a notable shift in drug poisoning trends in South Korea. The most significant results include a decrease in the average length of hospital stay for drug poisoning cases, from 7.1 days in 2011 to 5.8 days in 2020, and a significant reduction in mortality rates, from 7.7% in 2011 to 2.6% in 2020. Notably, older adults were most affected, experiencing the longest hospital stays and highest mortality rates. Another critical trend was the increase in pre-

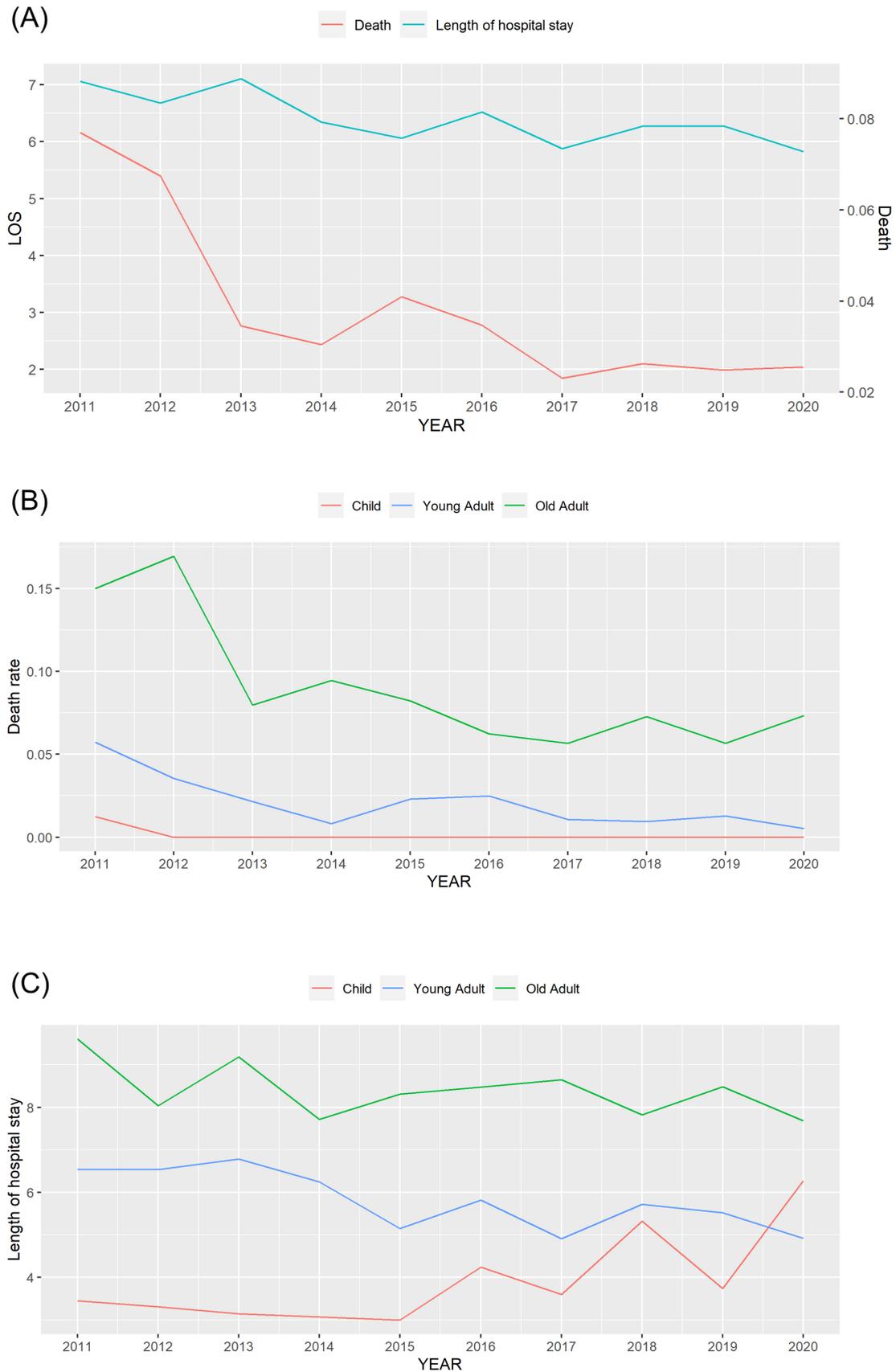


FIGURE 1. Trends of mortality and length of hospital stay for patients with drug poisoning hospitalization over ten years. (A) Total population. (B) Mortality according to age group. (C) Length of hospital stay according to age group. LOS: length of stay.

TABLE 1. Length of hospital stay and death rate according to age group (children, younger adults and older adults).

Year	Children		Younger adults		Older adults	
	LOS	Death rate	LOS	Death rate	LOS	Death rate
2011	3.5	1.3%	6.5	5.7%	9.6	15.0%
2012	3.3	0.0%	6.5	3.5%	8.0	16.9%
2013	3.1	0.0%	6.8	2.2%	9.2	8.0%
2014	3.1	0.0%	6.2	0.8%	7.7	9.4%
2015	3.0	0.0%	5.1	2.3%	8.3	8.2%
2016	4.2	0.0%	5.8	2.5%	8.5	6.2%
2017	3.6	0.0%	4.9	1.1%	8.7	5.7%
2018	5.3	0.0%	5.7	0.9%	7.8	7.3%
2019	3.7	0.0%	5.5	1.3%	8.5	5.7%
2020	6.3	0.0%	4.9	0.5%	7.7	7.3%
Total	3.9 ± 7.9	0.1%	5.8 ± 11.5	2.0%	8.4 ± 13.1	8.6%
<i>p</i> -value	0.228	0.536	0.013	<0.001	0.787	<0.001

LOS: length of stay.

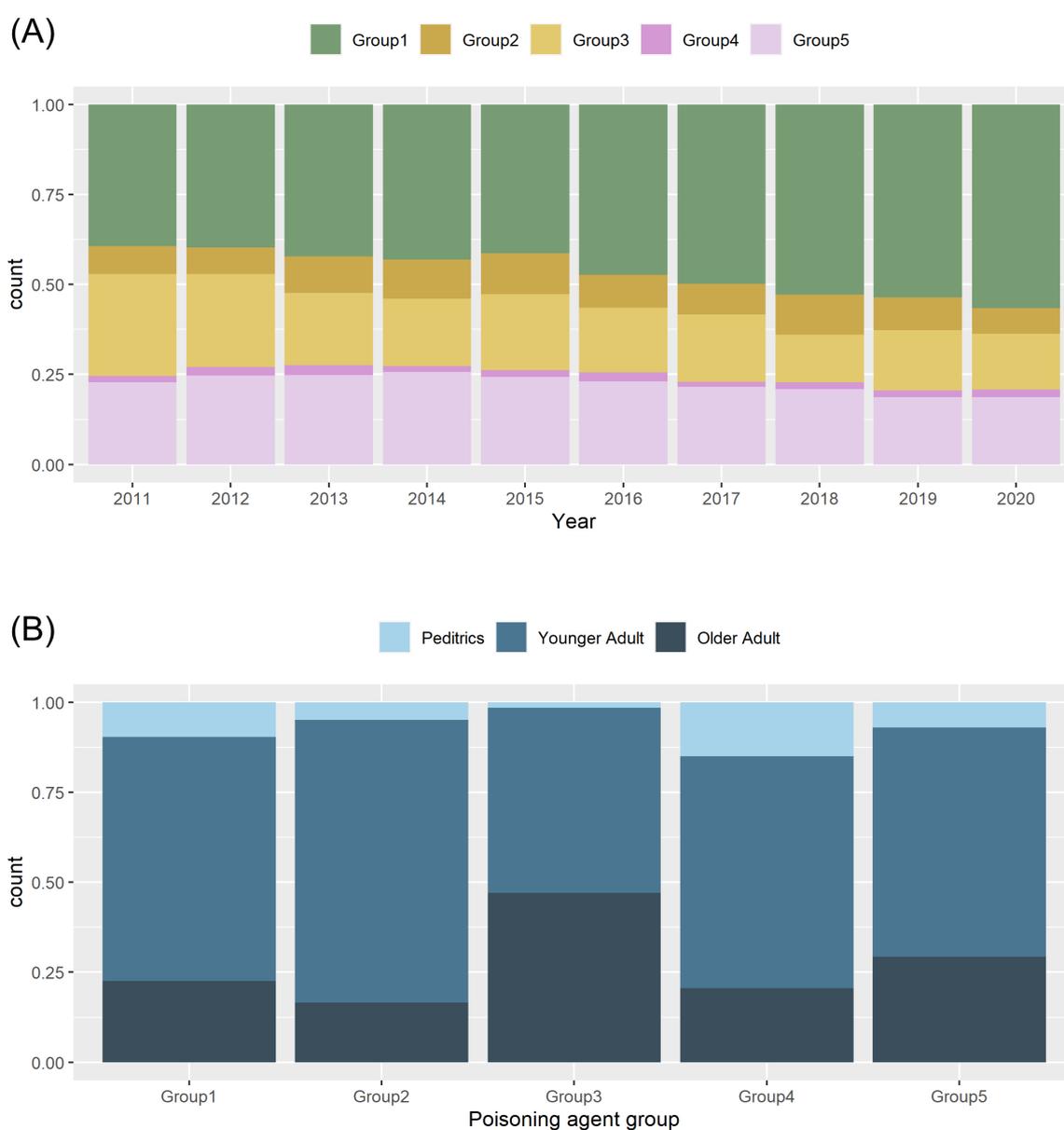


FIGURE 2. Analysis of poisoning agents. (A) Distribution of poisoning agents over ten years. (B) Distribution of age groups according to poisoning agent.

scription and non-prescription medication-induced poisonings, in contrast to a decrease in pesticide-related poisonings. This study emphasizes the changing landscape of drug poisoning in South Korea, highlighting the need for targeted healthcare interventions and policies, especially considering the evolving patterns of substance use and the varying effects across different demographic groups.

Lower mortality rates and shorter hospital stays were potentially associated with changes in the medications used. Ten years ago, South Korea had a high pesticide-related mortality rate [14]. Many of the available pesticides were highly toxic, lethal in small doses, and exacerbated complications, which decreased the likelihood of recovery. However, the sale and distribution of these highly toxic pesticides were completely prohibited by 2012 [15, 16]. This regulation not only restricted the general public's access to pesticides but also significantly reduced the number of poisonings caused by pesticides [3]. Studies have reported a decline in poisoning-related fatalities in other nations caused by similar restrictions on toxic substances [17]. This is similar to the global trend of excluding highly toxic substances, and the results of the recent trend in Korea indicated that similar restrictions on toxic substances in other nations can be an effective strategy for reducing poisoning-related fatalities, thereby highlighting the importance of stringent regulations on hazardous materials for improving global health outcomes.

This study revealed a shift in drug poisoning trends in South Korea, which can be contextualized by comparing with international studies. In particular, Jalal *et al.* [18] (2018) in the United States highlights a long-term exponential growth in drug overdose mortality since 1979, with variability in the dominance of specific drugs across different regions and times [18]. This result aligns with this observation of changing patterns of drug poisoning in South Korea, indicating a broader, more dynamic global trend. However, the changing trends in drug types in the United States varied from those in South Korea. Land *et al.* [19] (2021) focused on adult opioid poisonings in the United States and revealed a decline in overall opioid poisonings but an alarming increase in illicit opioid poisonings since 2010, indicating shifting dynamics in substance abuse [19]. Patients in South Korea differ because of the low frequency of deaths due to opioids [3], as confirmed by the recent trends. Additionally, Hernández-Calle *et al.* [20] (2022) in Spain revealed increasing trends in both accidental and intentional drug poisonings among older adults [20], congruent with this observation of the heightened vulnerability of older adults in South Korea. These comparisons emphasized the complexity of global drug poisoning trends and the importance of understanding regional variations to inform public health strategies and healthcare practices.

However, a more stringent regulatory framework for toxic substances and an advanced medical system have helped reduce fatalities, and South Korea has been making continuous efforts in the field of pharmacovigilance for the last three decades [21]. Additionally, clinical toxicologists in South Korea have developed emergency databases, designed antidote preparation and distribution systems, and implemented advanced toxicological service systems [22]. A recent collaboration between clinicians and the regional government estab-

lished the Seoul Poison Control Center with initiatives aimed at preventing toxic substance exposure [23]. This organization aimed to develop a comprehensive database that consolidates disparate information on various toxic substances to provide high-quality data to both clinicians and the general public. They intended to continually accumulate information on toxic substances, particularly those for which local data is scarce, and to develop a robust surveillance system. This has been associated with reduced poison-related fatalities and shortened hospital stays.

In contrast, prescription and over-the-counter drug poisonings have increased in frequency. Particularly, the ease of access to over-the-counter medications, especially through convenience stores, has increased the cases of abuse that result in hospitalizations [24–26]. Further, reports indicate an increase in the misuse of over-the-counter drugs, particularly among the elderly [27, 28]. These tendencies have become especially evident in the past decade, and measures are necessary to control them.

The impact of the coronavirus disease-2019 (COVID-19) pandemic cannot be overlooked. Intentional poisonings increased during the pandemic [12], particularly among females and individuals in their 20s [29]. Additionally, the length of time patients had in emergency rooms significantly increased. The pandemic dominated the year 2020, thus it exhibited the highest rates of intentional poisonings (70.6%) and a significant proportion were female (58.0%). The pandemic had strong associations with elevated depression, anxiety and suicide levels, indicating these trends in poisonings as an extension of these difficulties [11, 30, 31]. Further research is required to reach more concrete conclusions on this issue.

The results of this study have significant clinical and policy implications. The increase in drug poisonings due to prescription and non-prescription medications calls for heightened vigilance among clinicians in prescribing practices and patient education. This includes the need for routine monitoring and follow-up, particularly in older adults who are more prone to longer hospital stays and higher mortality rates. From a policy perspective, this study highlights the importance of continuous surveillance and the adaptation of healthcare policies to reflect the evolving nature of drug poisoning. Policies that promote safe prescribing practices, effective patient education programs, and targeted interventions for high-risk groups are essential. Additionally, the observed decrease in pesticide-related poisonings indicates the effectiveness of existing regulations, thereby reinforcing the need for stringent control measures and continuous evaluation of their impact on public health.

This study had some limitations. First, the data do not reflect all patients hospitalized for drug poisoning. Those who did not fall into the category of patients with injury may have been categorized with other physical issues, despite suffering from drug overdose-related physical symptoms. Consequently, underestimation was possible. Second, we recognize the importance of detailed analysis of specific toxic agents such as recreational drugs and illegal substances. However, this data limitation prevents us from disaggregating these specific substances from broader categories. This limitation reflects a gap in data collection methods, thereby hindering precise

analysis of trends in these drugs. Future research would benefit from more granular data to allow targeted analyses of recreational and illegal drug use, which is crucial for informed public health policies and clinical practices. Finally, gaining a comprehensive understanding of a patient's medical history and the hospital treatment process is difficult due to the nature of the data. Thus, any analysis beyond simple trends was challenging, and its interpretation was restricted.

5. Conclusions

South Korea has experienced a significant decrease in hospitalizations and mortality rates due to drug poisoning over the past decade, which can be associated with strict policies on toxic substances and medical advances. However, prescription and over-the-counter drug poisonings are increasing and are exacerbated by the pandemic's mental health effects. Additionally, challenges, such as the COVID-19 pandemic, exacerbate the need for continuous monitoring, adaptation, and intervention to ensure public health security.

AVAILABILITY OF DATA AND MATERIALS

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

AUTHOR CONTRIBUTIONS

CA—conceptualized the study and performed the methodology; performed the supervision and wrote the original draft. JHK and SH—contributed to visualization. CA and JHK—performed the investigation; reviewed and edited the article.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

KDCA has enabled research using this database, and this work was exempt from the consent and review by the institutional review board of Chung-Ang University Hospital because of the anonymity of the study data.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

SUPPLEMENTARY MATERIAL

Supplementary material associated with this article can be found, in the online version, at <https://oss.signavitae.com/mre-signavitae/article/1788087249287430144/attachment/Supplementary%20material.docx>.

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