scientific reports

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Impact of the COVID-19 pandemic on poisoning induced out of hospital cardiac arrest in South Korea retrospective observational study

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Poisoning-induced out-of-hospital cardiac arrest has characteristics distinct from cardiogenic out-of-hospital cardiac arrest, with external factors such as patient intent and environmental influences playing crucial roles. The coronavirus disease 2019 (COVID-19) pandemic has altered societal and healthcare dynamics, potentially influencing poisoning-induced out-of-hospital cardiac arrest outcomes. This study aimed to evaluate the impact of the pandemic on poisoning-induced out-of-hospital cardiac arrest characteristics and survival in South Korea. Participants: Adult patients (aged ≥ 19 years) who experienced poisoning-induced out-of-hospital cardiac arrest before and during the COVID-19 pandemic. This study utilized data from the Out-of-Hospital Cardiac Arrest Surveillance Database from 2016 to 2022. Poisoning-induced out-of-hospital cardiac arrest cases were compared before and during the pandemic by analyzing patient demographics, poisoning agents, prehospital interventions, and outcomes. Multivariate logistic regression identified predictors of survival. During the pandemic, poisoning-induced out-of-hospital cardiac arrest cases involving alcohol, organic solvents, and unspecified drugs increased, while pesticide-related cases declined. Bystander cardiopulmonary resuscitation rates rose, yet survival rates fell (adjusted OR 0.59, CI 0.44–0.80). Prehospital return of spontaneous circulation and witnessed arrests remained the strongest predictors of survival (adjusted OR 13.93 and 4.09, respectively). The COVID-19 pandemic initially impacted poisoning-induced out-of-hospital cardiac arrest outcomes, particularly during its early stages, while later outcomes showed resilience in the emergency medical system. These findings highlight the importance of adaptable public health strategies to address vulnerabilities during large-scale crises.

Keywords COVID-19, Out-of-hospital cardiac arrest, Poisoning, Public Health, Republic of Korea, Survival

Poisoning-induced out-of-hospital cardiac arrest has characteristics distinct from cardiogenic cardiac arrest[1–3]. Specifically, it tends to occur in younger individuals, presents with a lower proportion of shockable rhythms, and is observed less frequently, all of which are associated with lower survival rates[3–6]. Geographical variations in poisoning-induced out-of-hospital cardiac arrest characteristics have also been documented. In the United States, opioid and cocaine overdoses significantly contribute to out-of-hospital cardiac arrest mortality[4,6–8], whereas pesticide-induced cardiac arrest has historically been more common in South Korea[3,9,10]. However, recent restrictions on the distribution of highly toxic pesticides have reduced pesticide-related poisonings, influencing both hospital stay duration and survival rates[3,11]. Unlike the unpredictability of cardiogenic cardiac arrest, poisoning-induced out-of-hospital cardiac arrest is more influenced by patient intent, environmental factors, and regional characteristics, which can affect treatment outcomes.

During the coronavirus disease 2019 (COVID-19) pandemic, factors such as social activity restrictions, enforced self-quarantine, and limited access to healthcare facilities significantly altered the baseline characteristics of patients who experienced out-of-hospital cardiac arrest compared to the pre-pandemic period. Previous

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studies have shown that these societal changes, coupled with the overwhelming strain on healthcare systems, affected the treatment and survival outcomes of various medical conditions, including out-of-hospital cardiac arrest[12–14]. Social isolation, delayed emergency responses, and reduced hospital capacity may have influenced out-of-hospital cardiac arrest outcomes during the pandemic. However, the specific impact of these changes on poisoning-induced out-of-hospital cardiac arrest remains unclear, warranting further investigation.

Since poisoning-induced out-of-hospital cardiac arrest differs from cardiogenic out-of-hospital cardiac arrest in its dependence on external factors like patient intent and environmental influences, it is critical to assess whether the pandemic has had a measurable impact on poisoning-induced out-of-hospital cardiac arrest treatment outcomes[3,10,15]. Unlike cardiogenic out-of-hospital cardiac arrest, which is often unpredictable and sudden, poisoning-induced out-of-hospital cardiac arrest can result from deliberate actions or exposure to harmful substances, making it more sensitive to changes in external conditions, such as access to timely medical interventions and public health policies. Despite the potential importance of this topic, no previous studies have specifically analyzed how the COVID-19 pandemic may have affected poisoning-induced out-of-hospital cardiac arrest outcomes. This research gap underscores the relevance of the present study.

In this study, we aimed to assess the impact of the COVID-19 pandemic on the characteristics, treatment, and outcomes of poisoning-induced out-of-hospital cardiac arrest cases in South Korea. By analyzing nationwide data from a 7-year period, we aimed to identify shifts in poisoning agents, patient demographics, and survival outcomes before and during the pandemic. Additionally, we investigated the influence of various factors, such as toxic substance types, cardiac arrest locations, and prehospital interventions, on poisoning-induced out-of-hospital cardiac arrest outcomes. This analysis is critical for understanding how the pandemic has impacted poisoning-induced out-of-hospital cardiac arrest in South Korea and may provide insights for improving future public health strategies.

Results

Baseline characteristics of patients

A total of 217,356 patients who experienced out-of-hospital cardiac arrest between January 2016 and December 2022 were identified. After excluding patients aged < 19 years ($n = 3,116$), those with do-not-resuscitate orders ($n = 390$), and those with insufficient data ($n = 735$), the final cohort comprised 2,496 patients who had experienced poisoning-induced out-of-hospital cardiac arrest, including 1,506 patients before the pandemic and 990 during the COVID-19 pandemic (Fig. 1).

Patients who experienced poisoning-induced out-of-hospital cardiac arrest were significantly younger than patients who experienced non-poisoning-induced out-of-hospital cardiac arrest (mean age 56.4 vs. 68.0 years, $P < 0.001$). Additionally, a smaller proportion of poisoning-induced out-of-hospital cardiac arrest cases were witnessed (17.7% vs. 50.6%, $P < 0.001$), and they had lower rates of prehospital return of spontaneous circulation

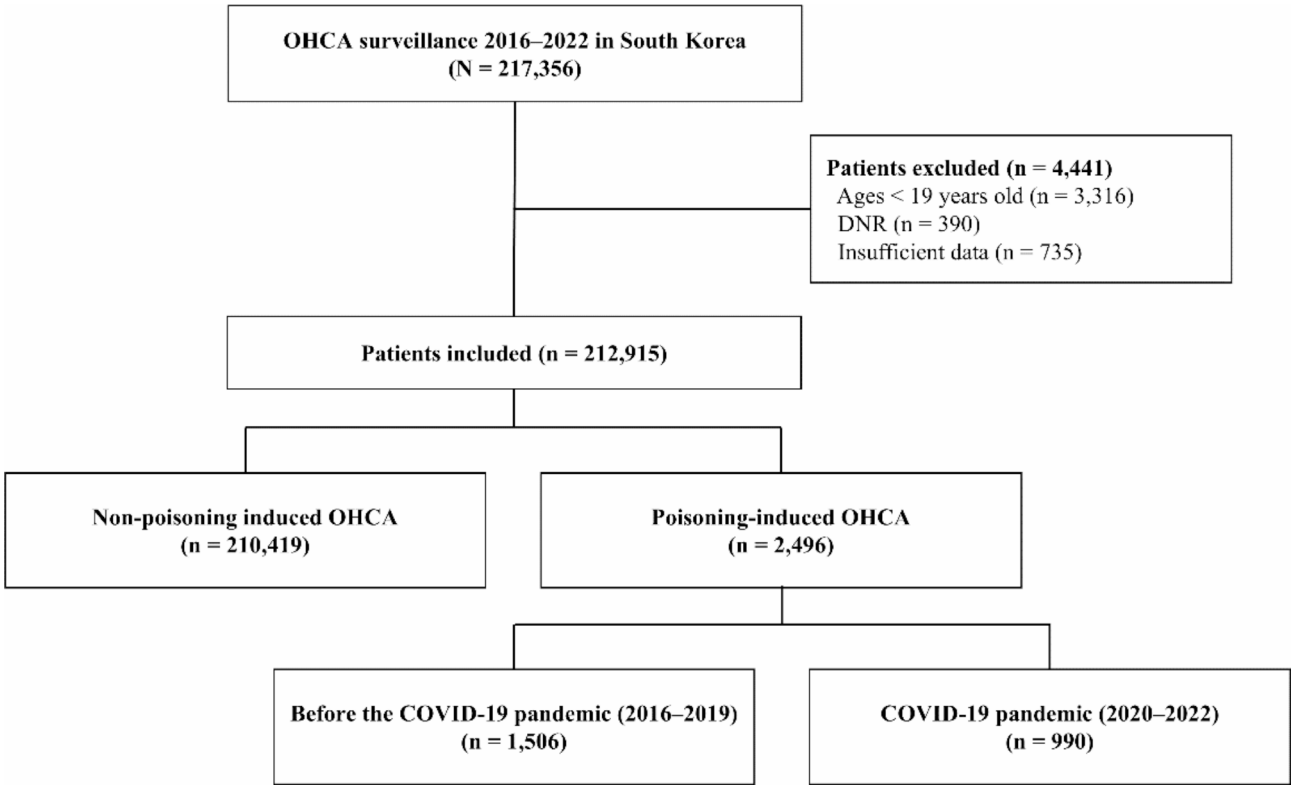

Fig. 1. Flow chart of the study population. DNR, do-not-resuscitate; OHCA, out-of-hospital cardiac arrest; COVID-19, coronavirus disease 2019.

Variable	Before the pandemic ($n=1,506$)	COVID-19 pandemic ($n=990$)	*P*-value
Sex, Male	989 (65.7%)	636 (64.2%)	0.28
Age, years	57.0 ± 18.2	55.5 ± 19.6	0.06
Witness	248 (16.5%)	194 (19.6%)	0.05
Bystander CPR	371 (24.6%)	374 (37.8%)	< 0.001
Place of arrest At home Others In-ambulance	879 (58.4%) 519 (34.5%) 108 (7.2%)	531 (53.6%) 356 (36.0%) 103 (10.4%)	0.006
Prehospital rhythms, shockable	42 (2.9%)	23 (2.4%)	0.52
Prehospital ROSC	72 (4.8%)	49 (4.9%)	0.92
Time from EMS call to hospital arrival	35.7 ± 17.1	41.3 ± 21.6	< 0.001
ROSC	417 (27.7%)	272 (27.5%)	0.94
Survival to discharge	178 (11.9%)	93 (9.4%)	0.06
Favorable neurological outcome (CPC 1 or 2)	33 (10.2%)	19 (7.0%)	0.28

Table 1. Baseline characteristics of out-of-hospital cardiac arrest during the pandemic compared with before the pandemic. Values are presented as number (%) or mean ± standard deviation (SD). CPC, cerebral performance category; CPR, cardiopulmonary resuscitation; COVID-19, coronavirus disease 2019; ROSC, return of spontaneous circulation.

Poisoning Agents	Before the pandemic* ($n=1,506$)	During the pandemic* ($n=990$)	*P*-value
Non-opioid analgesics and antipyretics	5 (0.3%)	7 (0.7%)	0.30
Antiepileptic, sedative-hypnotic, anti-Parkinsonism, and psychotropic drugs	126 (8.4%)	81 (8.2%)	0.93
Narcotics and hallucinogens	4 (0.3%)	2 (0.2%)	1.00
Other drugs acting on the autonomic nervous system	8 (0.5%)	2 (0.2%)	0.34
Other and unspecified drugs, medicaments, and biological substances	37 (2.5%)	85 (8.6%)	< 0.001
Other gases and vapors	679 (45.1%)	424 (42.8%)	0.28
Pesticides	497 (33.0%)	287 (29.0%)	0.04
Organic solvents and halogenated hydrocarbons and their vapors	12 (0.8%)	35 (3.5%)	< 0.001
Alcohol	1 (0.1%)	11 (1.1%)	0.001
Other and unspecified chemicals and noxious substances	155 (10.3%)	69 (7.0%)	0.006

Table 2. Poisoning agents during pandemic compared with before the COVID-19 pandemic. Values are presented as number (%). *The period before the pandemic is from 2016 to 2019, while the pandemic period is from 2020 to 2022.

(ROSC) (4.8% vs. 7.7%, $P<0.001$). Survival to discharge was not significantly different (10.9% vs. 11.8%, $P=0.18$), while favorable neurological outcomes were less frequent among patients who experienced poisoning-induced out-of-hospital cardiac arrest compared to patients who experienced non-poisoning-induced out-of-hospital cardiac arrest (8.7% vs. 15.5%, $P<0.001$) (Supplementary Table S1).

Characteristics of out-of-hospital cardiac arrest before and during the COVID-19 pandemic

Table 1 compares out-of-hospital cardiac arrest cases before and during the COVID-19 pandemic. The proportion of males remained consistent between the two periods (65.7% before the pandemic vs. 64.2% during the pandemic; $P=0.28$). Patients during the pandemic were slightly younger than those before the pandemic (mean age 57.0 ± 18.2 years before the pandemic vs. 55.5 ± 19.6 years during the pandemic, $P=0.06$). A notable increase was observed in the proportion of patients with out-of-hospital cardiac arrest who received bystander cardiopulmonary resuscitation (CPR) during the pandemic (24.6% before the pandemic vs. 37.8% during the pandemic, $P<0.001$). Ambulance arrests were more frequent during the pandemic than before (7.2% before the pandemic vs. 10.4% during the pandemic; $P=0.006$). No significant differences were noted in prehospital ROSC rates (4.8% before the pandemic vs. 4.9% during the pandemic, $P=0.92$) or survival to discharge (11.9% before the pandemic vs. 9.4% during the pandemic, $P=0.06$).

Poisoning agents before and during the COVID-19 pandemic

The distribution of poisoning agents leading to out-of-hospital cardiac arrest before and during the pandemic is shown in Table 2. A significant increase in the incidence of out-of-hospital cardiac arrest caused by unspecified drugs and biological substances was observed during the pandemic (2.5% before the pandemic vs. 8.6% during

Factor	Survival to discharge		Favorable neurological outcomes	
	Crude OR (95% CI)	Adjusted OR (95% CI)	Crude OR (95% CI)	Adjusted OR (95% CI)
Sex, male	0.75 (0.58–0.97)	0.72 (0.54–0.96)	0.55 (0.31–0.97)	0.46 (0.24–0.88)
Age, years	0.99 (0.98–1.00)	0.98 (0.98–0.99)	0.98 (0.96–0.99)	0.98 (0.96–0.99)
Prehospital ROSC	15.79 (10.65–23.63)	13.93 (9.09–21.52)	10.22 (5.60-19.18)	11.04 (5.87–21.48)
Witness	4.72 (3.61–6.16)	4.09 (2.95–5.65)	1.72 (0.97–3.05)	1.76 (0.90–3.47)
Bystander CPR	2.38 (1.84–3.07)	1.44 (1.05–1.95)	1.45 (0.82–2.60)	-
Arrest at home	0.46 (0.36–0.60)	0.69 (0.51–0.92)	0.51 (0.27–0.91)	0.66 (0.32–1.30)
Time from EMS call to hospital arrival	1.00 (1.00–1.01)	-	1.00 (0.99–1.01)	-
Pandemic	0.77 (0.59–1.00)	0.59 (0.44–0.80)	0.67 (0.36–1.19)	0.55 (0.28–1.05)

Table 3. Univariate and multivariate logistic regression analysis of outcomes. The multivariate logistic regression analysis model was backward stepwise and adjusted for these factors. CI, confidence interval; CPR, cardiopulmonary resuscitation; EMS, emergency medical services; OR, odd ratios; ROSC, return of spontaneous circulation.

Period	Patients	Survival to discharge		Favorable neurological outcomes	
		Rate	*p*-value*	Rate	*p*-value*
2016	416	13.5%	1.000	9.1%	1.000
2017	360	12.5%	0.673	8.6%	0.919
2018	366	9.9%	0.114	16.5%	0.154
2019	364	11.3%	0.356	6.5%	0.540
2020	295	7.1%	0.007	3.0%	0.133
2021	340	11.5%	0.398	5.9%	0.412
2022	355	9.3%	0.068	10.6%	0.733

Table 4. Yearly segmented analysis of outcomes including survival to discharge and favorable neurological outcomes. *P-values represent the statistical significance of the comparison between each year's outcomes and those of 2016.

the pandemic; $P < 0.001$). Similarly, poisonings from organic solvents and halogenated hydrocarbons increased (0.8% before the pandemic vs. 3.5% during the pandemic; $P < 0.001$). Alcohol-related poisonings were also more frequent during the pandemic (0.1% before the pandemic vs. 1.1% during the pandemic; $P = 0.001$). In contrast, the incidence of pesticide-related out-of-hospital cardiac arrest decreased during the pandemic (33.0% before the pandemic vs. 29.0% during the pandemic; $P = 0.04$).

Predictors of outcomes

Multivariate analysis showed that prehospital ROSC was the strongest predictor of both survival (adjusted OR 13.93, 95% CI 9.09–21.52) and favorable neurological outcomes (adjusted OR 11.04, 95% CI 5.87–21.48). Male sex, older age, and arrests at home were associated with worse outcomes, while witnessed arrests improved survival (adjusted OR 4.09, 95% CI 2.95–5.65). The COVID-19 pandemic significantly reduced survival rates (adjusted OR 0.59, 95% CI 0.44–0.80) and showed a non-significant trend toward worse neurological outcomes. Bystander CPR improved survival but its effect on neurological outcomes was not significant (Table 3).

Segmented analysis for each year

Survival rates for poisoning-induced out-of-hospital cardiac arrest were compared between the pre-pandemic (2016–2019) and pandemic periods (2020–2022). While survival rates were generally lower during the pandemic, statistical significance was observed only in 2020 (7.1%, $p = 0.007$ compared to 2016). Favorable neurological outcomes showed no significant differences across most years, although a decreasing trend in favorable neurological outcomes was noted during the pandemic period. These results suggest limited evidence for statistically significant differences in outcomes between the pre-pandemic and pandemic periods, except for the survival rate in 2020 (Table 4; Fig. 2).

Discussion

This analysis examined the characteristics and clinical outcomes of patients who experienced poisoning-induced out-of-hospital cardiac arrest during the COVID-19 pandemic using data from a nationwide database. The hypothesis posited that the COVID-19 pandemic significantly impacted the characteristics and outcomes of poisoning-induced out-of-hospital cardiac arrest in South Korea. The analysis revealed differences in patient characteristics, types of poisoning agents, and survival outcomes between the two periods. During the pandemic,

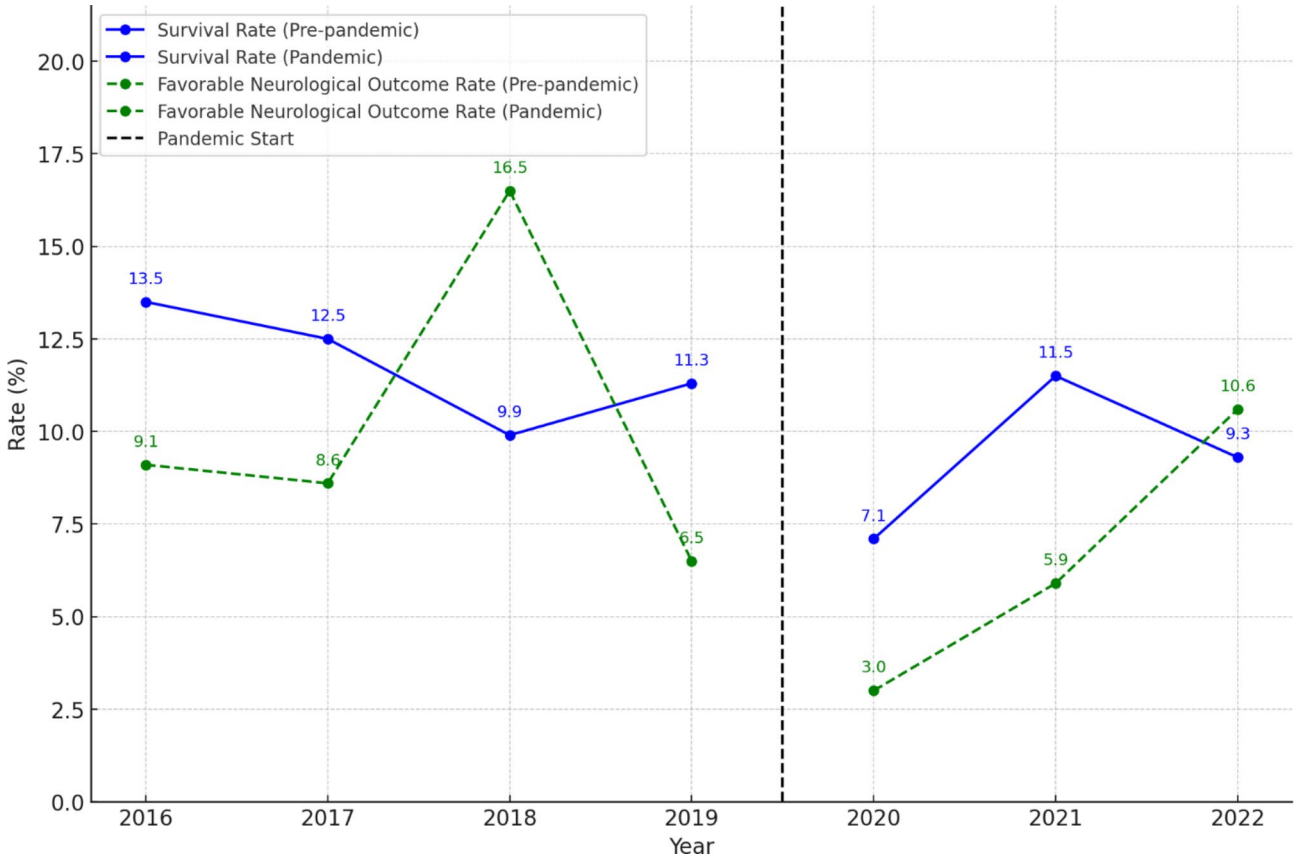

Fig. 2. Yearly survival and neurological outcomes rates comparison (2016–2022).

there was a notable increase in alcohol- and organic solvent-related poisonings, whereas pesticide-related poisonings decreased. Despite an increase in bystander CPR, survival rates declined during the pandemic. However, statistical significance in survival outcomes was observed only in 2020 ($p = 0.007$ compared to 2016), while ROSC and favorable neurological outcomes showed no significant differences across most years. Thus, the pandemic's influence on poisoning-induced out-of-hospital cardiac arrest outcomes appears limited to specific contexts rather than consistent trends across the entire pandemic period.

The COVID-19 pandemic led to significant changes in poisoning-induced out-of-hospital cardiac arrest characteristics, particularly an increase in cases involving unspecified drugs, organic solvents, and alcohol poisoning. These changes can be attributed to various pandemic-related factors, including social isolation, mental health challenges, increased substance use, and reduced access to medical care. Previous studies have reported that COVID-19 lockdowns significantly altered patterns of intoxication, leading to delays in treatment and poorer health outcomes[16,17]. Social limitations imposed during the COVID-19 pandemic, including self-quarantine, social distancing, and restricted activities, profoundly impacted mental health, contributing to its deterioration during this period[18–20]. While South Korea effectively curbed the early spread of COVID-19 through strong public health policies, the effects of social limitations on the mental health of the general population may not have been addressed with equal focus. Several studies reported an increase in substance abuse during the pandemic, highlighting broader social and health implications[21,22].

The segmented analysis provided a more nuanced understanding of the outcomes. Survival rates did not significantly differ between pre-pandemic and pandemic periods, except for a notable decline in 2020. This decline coincided with the peak healthcare disruptions caused by the pandemic, including delayed emergency response times, limited hospital resources, and overwhelmed medical systems[12–14]. These factors likely contributed to lower survival rates immediately following the pandemic's onset. In subsequent years, survival rates improved, suggesting that the resilience of the emergency medical system mitigated further adverse effects. While favorable neurological outcomes did not show statistically significant differences throughout the study period, their stability highlights the overall effectiveness of emergency response systems even during crisis periods. In the poisoning-induced out-of-hospital cardiac arrest group, higher rates of witnessed arrests and bystander CPR during the pandemic differed from previous studies comparing out-of-hospital cardiac arrest cases during the pandemic[12–14]. The unchanged rates of prehospital ROSC and other key outcomes, such as survival to discharge, suggest that despite changes in the nature of poisoning-induced out-of-hospital cardiac arrest cases during the pandemic, the overall effectiveness of EMS remained relatively consistent.

Prehospital ROSC and witnessed arrests were the strongest predictors of survival in patients who experienced poisoning-induced out-of-hospital cardiac arrest, consistent with previous research on out-of-hospital cardiac

arrest outcomes[23,24]. Additionally, prehospital ROSC was identified as the strongest predictor of favorable neurological outcomes (adjusted OR 11.04, 95% CI 5.87–21.48), emphasizing its critical role not only in survival but also in neurological recovery. The observation that male sex and cardiac arrests occurring at home correlate with poorer outcomes, including unfavorable neurological outcomes (adjusted OR for males 0.46, 95% CI 0.24–0.88), highlights the need for focused attention on these groups, especially during crisis periods like a pandemic when access to healthcare and bystander assistance may be constrained. It is plausible that the rise in at-home cardiac arrests was linked to limitations on outdoor activities during the pandemic. Specifically, arrests occurring at home may be less frequent as a patient's condition worsens, and any delay in immediate treatment following drug ingestion can considerably escalate the risk of adverse outcomes[25,26]. These characteristics highlight the need for public health policies to address specific vulnerabilities during crises.

This study has several limitations. First, while data were sourced from a nationwide database, detailed information regarding individual poisoning agents, exact timing of exposure, and dosage was not available. This lack of granularity restricted the ability to fully comprehend the specific toxicological dynamics involved in each poisoning-induced out-of-hospital cardiac arrest case. For instance, critical agents such as calcium channel blockers, β-blockers, and caffeine, which are known to cause severe toxicity in overdose, were not explicitly documented, limiting the ability to analyze their specific impact. Second, the retrospective design of this study may have introduced selection bias, particularly regarding the classification of poisoning agents. Moreover, while the impact of delayed medical interventions due to the pandemic has been inferred, it was not directly measured, complicating the quantification of the precise influence of response times and hospital resource limitations on survival outcomes. Finally, although the study spanned a substantial period of the COVID-19 pandemic, the evolving nature of healthcare policies and the changing burden of the virus over time could have influenced the results variably at different stages of the pandemic.

In conclusion, the COVID-19 pandemic significantly impacted the characteristics and clinical outcomes of patients who experienced poisoning-induced out-of-hospital cardiac arrest in South Korea. While survival rates declined significantly in 2020 due to pandemic-related healthcare disruptions, no consistent or statistically significant differences in ROSC and favorable neurological outcomes were observed across other years. These findings underscore the resilience of the emergency medical system in maintaining outcomes despite systemic challenges. To address the rise in alcohol- and drug-related poisonings during the pandemic, public health strategies such as mental health support, substance abuse prevention, and telehealth services should be prioritized. The decrease in pesticide-related poisonings highlights the potential for stricter regulations on harmful substances and promoting safer alternatives to achieve sustained reductions. Prehospital ROSC and witnessed arrests were the strongest survival predictors, highlighting the critical role of swift intervention and bystander involvement. These insights underscore the necessity for flexible public health strategies capable of addressing the distinct challenges presented by major crises such as the COVID-19 pandemic, especially in managing poisonings and ensuring prompt emergency care access. Further research is essential to understand the long-term trends in poisoning-induced out-of-hospital cardiac arrest and evaluate the impact of specific interventions during health crises.

Methods

Study design, setting, and data source

This retrospective observational study investigated the characteristics of adult patients (aged 19 years and older) who experienced poisoning-induced out-of-hospital cardiac arrest during the COVID-19 pandemic, comparing them with cases from the pre-pandemic period. The age criterion of ≥ 19 years was chosen based on South Korea's legal definition of adulthood, which reflects the minimum age for legal access to substances often implicated in poisoning cases. Data from January 2016 to December 2022 were analyzed, with 2016–2019 designated as the pre-pandemic period and 2020–2022 as the pandemic period. The study utilized data from the Out-of-Hospital Cardiac Arrest Surveillance (OHCAS) database, a nationwide population-based registry managed by the Korea Disease Control and Prevention Agency (KDCA) (https://www.kdca.go.kr/). The OHCAS database is publicly available data collected by KDCA for public purposes and records approximately 30,000 cardiac arrest cases annually, including all acute cardiac arrest patients transported to medical facilities by EMS.

This study was conducted in accordance with the principles of the Declaration of Helsinki. This study used data from the KDCA (Research Management Number KDCA-12-02-CA-2024-000039), and it is clear that the results of the study are not related to the KDCA. Additionally, this study was exempted from review by the Institutional Review Board of Chung-Ang University Hospital because the study data were anonymous (2409-017-19542) and did not require informed consent.

In South Korea, the public EMS system operates continuously, 24 h a day, year-round, and is managed by 19 fire departments under the National Fire Agency[16]. When an out-of-hospital cardiac arrest occurs, an EMS team is dispatched following an emergency call, and the patient is transported to a hospital. During transport, paramedics perform CPR using automated external defibrillators. Advanced airway management may also be employed under physician supervision, although no medications for advanced cardiac life support are permitted[17]. Upon hospital arrival, any toxic substances identified at the scene are communicated to the receiving medical team, and post-resuscitation care is provided according to the hospital's protocol.

OHCAS data were obtained from both EMS registries and hospital medical records. KDCA medical reviewers visited hospitals to review the records of cardiac arrest patients and assessed treatments and outcomes following the Utstein Style guidelines[18] and the Resuscitation Outcomes Consortium Project[19]. The database captures comprehensive information, including patient demographics, EMS interventions, emergency department care, hospital procedures, and discharge outcomes, such as survival and neurological status.

In this study, patients who experienced poisoning-induced out-of-hospital cardiac arrest were defined as those whose cardiac arrest was attributed to poisoning, as documented in the OHCAS database. Poisoning

agents were categorized into ten groups based on established classification methods: (1) non-opioid analgesics and antipyretics; (2) antiepileptic, sedative-hypnotic, anti-Parkinsonism, and psychotropic drugs; (3) narcotics and hallucinogens; (4) autonomic nervous system agents; (5) unspecified drugs and biological substances; (6) gases and vapors; (7) pesticides; (8) organic solvents and halogenated hydrocarbons; (9) alcohol; and (10) other chemicals and noxious substances. These classifications were derived from previously established methods in the literature[3,10]. Patients aged 18 years or younger, those with do-not-resuscitate orders, incomplete prehospital data, or unknown final outcomes were excluded.

Variables and outcome measures

The study collected a range of variables, including age, sex, location of cardiac arrest (home, other locations, or in the ambulance), whether the arrest was witnessed, whether bystander CPR was performed, initial cardiac rhythm (shockable or non-shockable), time from EMS call to hospital arrival, and both prehospital and in-hospital ROSC. A shockable rhythm was defined as pulseless ventricular tachycardia or ventricular fibrillation on initial assessment.

The primary outcome of interest was survival to discharge, defined as either discharge to home or transfer to another medical facility for long-term care following acute treatment. Secondary outcomes included ROSC and favorable neurological outcomes, defined as a Cerebral Performance Category (CPC) score of 1 or 2.

Statistical analyses

Data were analyzed using Microsoft Excel 2019 (Microsoft, Redmond, WA, USA) and the R programming language (version 4.4.1; R Foundation for Statistical Computing, Vienna, Austria). Descriptive statistics summarized baseline characteristics. Continuous variables were presented as mean ± standard deviation (SD) and analyzed using Student's t-test for normally distributed data. Categorical variables were expressed as frequencies and percentages, with group comparisons conducted using the chi-square (χ^2) test or Fisher's exact test, as appropriate.

Multivariate logistic regression using a stepwise method was conducted to identify predictors of outcomes. Covariates, including the binary variable indicating whether the arrest was a poisoning-induced out-of-hospital cardiac arrest or non-poisoning-induced out-of-hospital cardiac arrest, were adjusted in the analysis. Additional covariates included sex, age, prehospital ROSC, witnessed arrest, bystander CPR, arrest location (home), time from EMS call to hospital arrival, and the pandemic period (during vs. pre-COVID-19). Odd ratios (ORs) with 95% confidence intervals (CIs) were calculated for outcomes stratified by poisoning group.

To address potential bias due to regression to the mean, segmented analysis was performed by dividing the study period into yearly intervals from 2016 to 2022. Each year was analyzed separately, with 2016 used as the reference year for statistical comparisons. Differences in survival rates and favorable neurological outcomes between 2016 and subsequent years were evaluated using chi-square (χ^2) tests, and p-values were calculated to determine statistical significance. This approach allowed for the assessment of yearly trends and the impact of the pandemic over time while accounting for baseline variations in outcomes. Statistical significance was set at $P < 0.05$.

Data availability

The datasets used and analyzed in this study are available from the corresponding author on reasonable request.

Received: 9 October 2024; Accepted: 17 January 2025
Published online: 08 April 2025

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Author contributions

YTO and CA wrote the manuscript. YTO and JHK extracted the data. CA and YP developed the concept, designed experiments, analysed the results, revised the manuscript, and supervised the manuscript. All authors reviewed and approved the final manuscript. CA an YP contributed equally as the corresponding author.

Funding

This research was supported by a grant of the Korea Health Technology R&D Project through the Korea Health Industry Development Institute (KHIDI), funded by the Ministry of Health & Welfare, Republic of Korea (grant number: RS-2022-KH129835).

Declarations

Competing interests

The authors declare no competing interests.

Additional information

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1038/s41598-025-87346-4.

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