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Retrospective analysis of elderly poisoning cases admitted to emergency departments: A two-center study

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Abstract

This study aims to analyze demographic, clinical, and biochemical markers of geriatric individuals admitted to emergency clinics due to poisoning to develop preventive public health projects for poisoning prevention. This study was a two-center study. Patients were categorized into accidental, suicide, and misuse groups, and the patient's clinical and laboratory data were compared. The study included individuals aged 65 and over admitted to hospital emergencies between June 1, 2021, and June 1, 2023. The mean age of the patients admitted with poisoning was 71.7±6.3 years, and the median was 70 (65-90). 69.2% (n=27) of the patients were female, and 30.8% (n=12) were male. Common causes included misuse and suicidal poisoning, drug ingestion, corrosive substance exposure, and pesticide poisoning, Antidepressants and analgesic drugs were the most common agents. There was a statistically significant difference between the mean age rank scores of patients categorized into 3 groups: accidental, suicidal, and misuse (H(3):11.186, p=0.004). The risk of being elderly in accidental poisoning and abuse (non-suicide) patients was 1.203 times that of suicide patients. In other words, it was 20% higher (odds ratio=1.203, CI 95% [1.001-1.446], p=0.049). The mean rank score of troponin values differed significantly between the groups (p=0.027). The study highlights the high rate of poisoning among the elderly, especially women, and suggests preventive public health projects, increased public awareness, and strengthened health policies to improve their quality of life.

Keywords: Aged, biomarkers, drug misuse, poisoning, public health, suicide, attempted

Introduction

Positive developments, such as the rise in socioeconomic and cultural levels of societies and conscious nutrition, lead to a decrease in the frequency of infectious diseases. However, in addition to these positive effects, advances in industrialization and agriculture, together with the effects of chemicals used in these sectors, have paved the way for an increase in the incidence of poisonings, which are usually accidental in childhood and mostly intentional in adults [1,2]. Poisonings may lead to various complications, depending on the type of causative agent and the duration of the transportation of individuals to emergency services. Understanding acute poisoning patterns in a country and region is crucial for developing preventive strategies, limiting substance availability, offering safer alternatives, and diagnosing cases with nonspecific symptoms [3]. The high morbidity and mortality rate when a possible acute poisoning is suspected in the evaluation made as a result of presentation to emergency services makes it important to perform diagnosis and treatment rapidly [4].

Etiology and demographic characteristics should be clearly known for the approach to poisoning cases. After the first intervention, life support is provided to patients in intensive care units, the agent of poisoning is determined, and specific treatment is administered [5]. The increase in the elderly patient population brings along a series of problems for this patient group [6,7]. The World Health Organization (WHO) considers people over the age of 60 to be elderly [8].

However, in industrialized and developing countries, including Türkiye, the age of 65 is considered the beginning of old age [9,10].

It has been emphasized that inappropriate drug use constitutes an important health problem for the elderly, and the potential

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of many drugs to cause poisoning increases [11]. The decrease in biological functions in individuals in the geriatric age group leads to an increased risk of intoxication with drugs and other substances. In addition, increased use of drugs by the elderly increases the risk of inappropriate drug use [12]. In this period, the decrease in the first passage effect of drugs through the liver and/or intestine and the decrease in body water content adversely affect the distribution of drugs [13]. When the etiologic causes of poisoning in the elderly are examined, there are poisonings that occur by accident and/or overdose in chronic drug use, as well as poisonings with suicidal intent [14]. In this context, it is necessary to systematically determine the characteristics of poisoning cases frequently observed in the geriatric age group in order to develop preventive public health projects for the prevention of poisoning.

The main aim of this study was to reveal the importance of these data by analyzing the demographic and clinical characteristics, and laboratory parameters,of geriatric individuals admitted to the emergency clinic due to poisoning and to determine the causes of poisoning in a way to contribute to the literature.

Material and Methods

This retrospective, cross-sectionalstudy was conducted in collaboration with the Emergency Medicine Clinic of Niğde Ömer Halisdemir University Training and Research Hospital and the Department of Emergency Medicine of Kafkas University Practice and Research Hospital following the approval of the Non-Interventional Clinical Research Ethics Committee of Kafkas University Faculty of Medicine No. 337 dated 9/11/2023. This study was conducted in strict adherence to the principles of the Declaration of Helsinki (2013 revision). Demographic (age, gender), clinical (time of admission, nature of poisoning, etiological agents, comorbidities, hospitalization status and duration, mortality status), and routine laboratory data (hemogram, biochemistry, blood gases) were recorded in an Excel database. Patients were categorized into 3 different groups according to the nature of poisoning: accidental, abuse, and misuse, in order to understand which types of poisoning cases are more common in the elderly and to contribute to emergency management.

And clinical and laboratory data were compared between these groups. In addition, the patients were divided into two groups as suicide and non-suicide (accidental+misuse) and the estimated risk analysis of the parameter(s) that statistically significant differed between these two groups was performed. Logistic regression analysis was used for this purpose.

Inclusion and exclusion criteria

This study includes the data of elderly individuals admitted to hospital emergencies with acute poisoning between June 1, 2021, and June 1, 2023. The study consisted of individuals aged 65 years and over and included all patients admitted within the first 24 hours after acute poisoning. Exclusion criteria included patients under the age of 65, patients admitted after 24 hours, patients whose clinical course could not be followed, whose data were not clearly accessible, or patients who left hospital emergencies without permission. In addition, patients with end-stage renal disease, patients with liver failure, and patients with sepsis, in whom troponin levels were expected to be high, were excluded from the study. Since it was considered that all poisoning patients over the age of 65 would be included in the study, an apriori power analysis was not performed. Since it was a retrospective study, there was no need to obtain a voluntary consent form.

Statistics

The SPSS 22 (IBM Corporation, Armonk, New York, USA) package program was used for the analysis of the study data. For categorical variables, descriptive statistics were shown as numbers and percentages. For non-categorical variables, mean and standard deviation (SD) were used for those with a normal distribution, and median and minimum-maximum (min-max) were used for those without a normal distribution. The normality of the quantitative data was tested with the Shapiro-Wilk test. The student's t test or ANOVA was used to compare the averages of normally distributed data; the Mann-Whitney U or Kruskal-Wallis H test was used for those that did not. The Fisher's exact test, was used for comparing qualitative data. The Spearman correlation analysis was performed between quantitative data. A univariate binary logistic regression analysis was performed and the risk coefficient was given for the variable or variables that showed statistically significant differences between the groups. All p-values were two-tailed, and statistical significance was considered as a p-value <0.05. According to the two-tailed correlation post-hoc analysis with 95% confidence ($1-\alpha$) and $d=0.5$ effect size using the G*Power [15] program, the power of the test was determined as 92 with a sample size=39.

Results

A total of 39 patients were included in the study. The mean age of the patients admitted with poisoning was 71.7±6.3 years, and the median value was 70 (65-90). 69.2% (n=27) of the patients were female, and 30.8% (n=12) were male. Of the total 39 patients, 34 (87.2%) had at least one chronic disease. 29 patients (74.4%) had essential hypertension (HT), 12 (30.8%) had diabetes mellitus (DM), 18 (46.2%) had coronary artery disease (CAD), four (10.3%) had cerebrovascular disease (CVD), and two (5.1%) had chronic heart failure (CHF). When the patients were grouped according to the time of presentation, 13 (33.3%) patients presented to the emergency department between 08:01-16:00, 19 (48.7%) patients between 16:01-00:00, and 7 (17.9%) patients between 00:01-08:00. Hospitalization was recommended for 69.2% of the patients. In addition, a statistically significant difference was found in hospitalizations between 08:01 and 16:00 ($p=0.042$). It was determined that misuse and suicidal poisoning were observed equally (38.5%; n=15) and were the most common reasons for admission to poisonings in elderly individuals. The

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lowest rate (23.1%; n=9) was accidental poisoning. Demographic and clinical characteristics of the patients were presented in Table 1. According to the causes of poisoning, 26 (66.7%) patients had drug ingestion, 7 (17.9%) had corrosive substance exposure, 5 (12.8%) had pesticide poisoning, and 1 case had ethyl alcohol poisoning. When the agents causing poisoning were classified according to type, antidepressants were the most common, and analgesic drugs were the second most common (Table 2). When the patients were compared according to hospitalization status, no statistically significant effect of age, glasgow coma score (GCS) and laboratory findings was found (p>0.05).

Table 1. Basic demographic and clinical characteristics

Variables	N=39	Suicide (n=15)	Misuse (n=15)	Accidental (n=9)	p
Age, (SD)	71.7±6.3	12.47 (mean rank)	23.5 (mean rank)	26.72 (mean rank)	0.004*
Median (min-max)	70 (65-90)				
	n (%)	**n (expected)**	**n (expected)**	**n (expected)**	
Gender					
Male	12 (30.8)	4 (4.6)	4 (4.6)	4 (2.8)	0.615**
Female	27 (69.2)	11 (10.4)	11 (10.4)	5 (6.2)	
Chronic diseases					
Yes	34 (87.2)	11 (13.1)	14 (13.1)	9 (7.8)	0.251**
HT	29 (74.4)	9 (11.2)	12 (11.2)	8 (6.7)	0.335**
DM	12 (30.8)	5 (4.6)	5 (4.6)	2(2.8)	0.824**
CAD	18 (46.2)	9 (6.9)	6 (6.9)	3 (4.2)	0.466**
CVD	4 (10.3)	1 (1.5)	2 (1.5)	1 (0.9)	1.000**
CHF	2 (5.1)	1 (0.8)	0 (0.8)	1 (0.5)	0.696**
Time of presentation					
08:01-16:00	13 (33.3)	7 (5)	2 (5)	4 (3)	
16:01-24:00	19 (48.7)	5 (7.3)	11 (7.3)	3 (4.4)	0.158**
00:01-08:00	7 (18)	3 (2.7)	2 (2.7)	2 (1.6)	
Hospital admission, n (%)	27 (69.2)	13 (10.4)	8 (10.4)	6 (6.2)	0.132**
In-hospital mortality	0 (0)				

SD: standart deviation, min-max: minimum-maximum, HT: hypertension, DM: diabetes mellitus, CAD: coronary artery disease, CVD: cerebrovascular disease, CHF: congestive heart failure, * Kruskal -Wallis H test; ** Fisher's Exact test

Table 2. Classification of poisoning agents according to type

Agents	n	Percent (%)
Analgesic	8	20.5
Anti-epileptic	1	2.6
Rodenticide	1	2.6
Dishwashing detergent	2	5.1
Anti-depressant	9	23.1
Bleach	5	12.8
Insecticide	4	10.3
Anti-psychotic	4	10.3
Anti-hypertensive	1	2.6
Anti-diabetic	2	5.1
Ethyl alcohol	1	2.6
Antiseptic-gargle	1	2.6
Total	39	100%

There was a statistically significant difference between the mean age rank scores of patients categorized into 3 groups: accidental, suicidal, and misuse (H(3):11.186, p=0.004). Post-hoc tests (Mann Whitney U) revealed that this difference was due to the difference in mean rank scores between suicidal and accidental groups (mean rank scores of 9.37 and 17.72, respectively; p=0.005).In addition, the mean rank score of troponin values differed significantly between the groups (p=0.027). In the post hoc test, this difference was observed between the accidental and misuse groups; it was higher in the accidental group and lower in the misuse group (mean rank scores of 16.67 and 10.00, respectively; p=0.023). However, there was no significant difference between the groups (total n=38, one patient with alcohol intoxication was excluded from the analysis) in terms of the mean GCS rank score (p=0.097).

There was no statistically significant difference between the accidental, suicide, and misuse groups (total n=39) in terms of hemoglobin (hgb), hemotocrit (hct), and mean corpuscular volume (MCV) values according to the Anova (for hgb) and Kruskal-Wallis (for MCV and hct) tests (p=0.523, p=0.526, p=0.283, respectively). On the other hand, when the patients were categorized according to intoxication agents (n=38) (drugs, pesticides, and corrosive agents), a statistically significant

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difference was found between the groups in terms of hgb values in the one- way ANOVA test (p=0.024) (Figure 1). According to the post hoc test, it was determined that this difference was caused by the corrosive group and the drug group (p=0.018); hgb values of patients poisoned with corrosive agents were statistically significantly lower. In addition, Kruskal-Wallis test revealed statistically significant differences between the groups in terms of MCV and hct values (p=0.045 and p=0.015, respectively). According to the post hoc tests (Mann-Whitney U), it was determined that this difference was caused by the patients poisoned with corrosive agents; statistically, hct values were lower and MCV values were higher. These results are presented in Table 3. Correlation analysis revealed a negative correlation between GCS and troponin and creatine kinase-myocardial band (CK-MB) (r=-0.370, p=0.021; r=-0.402, p=0.011, respectively), a negative correlation between lenght of hospital time and hemoglobin (r=-0.479, p=0.011). Table 4 shows the risk estimates of independent variables between suicidal and non-suicidal groups by binary logistic regression analysis. In this table, only the age parameter was found to be statistically significant between the groups. The risk of being elderly in accidental poisoning and abuse (non-suicide) patients was 1.203 times that of suicide patients. In other words, it was 20% higher (odds ratio=1.203, CI 95% [1.001-1.446], p=0.049).

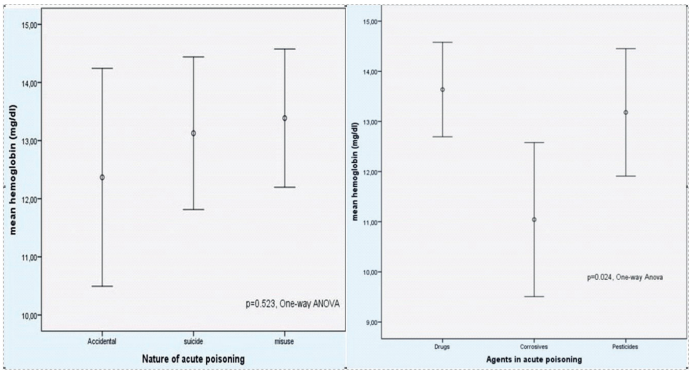

Figure 1. Comparison of hemoglobin values in patients according to poisoning type and agent. While no significant difference was found according to the type of poisoning, a statistically significant difference was found according to the agent of poisoning

Table 3. Comparison of biochemical and clinical parameters in patient groups

	Groups			Kruskal-Wallis		Post Hoc test (Mann-Whitney)		
Variables	**Accidental**	**Suicide**	**Misuse**	**χ2**	**p**	**Difference between groups**	**u**	**p**
Age, n=39 mean rank	26.72	12.47	23.5	11.186	0.004	**Accidental- suicide**	20.5	0.005
Troponin, ng/L, n=39 mean rank	26.89	21.43	14.43	7.202	0.026	**Accidental- misuse**	30	0.023
GCS, n=39 mean rank	19.88	22	14	4.665	0.097			
Hct, % n=39 mean rank	14.83	22.27	20.83	2.522	0.283			
MCV, fL n=39 mean rank	23.78	18.90	18.83	1.285	0.526			
Variables	**Drugs**	**Pesticides**	**Corrosives**	**F /χ2**	**p**	**Post Hoc (Tukey and Mann Whitney U)**		
Hgb (mg/dL) n=38 mean	for between groups: mean and sum of square: 18.548; 37.096			4.145*	0.024*	**Drugs-corrosives**	-2.592**	0.018**
Hct, % n=38 mean rank	22.1	21.4	8.5	8.425	0.015	**Drugs-corrosives** **Corrosives-pesticides**	28 3.5	0.006 0.023
MCV, fL n=38 mean rank	19.1	11	27.07	6.211	0.045	**Corrosives-pesticides**	3	0.018

GCS: glasgow coma score, Hct: hemotocrit, MCV: mean corpuscular volume, Hgb: hemoglobin, *Anova, **Tukey, mean difference (I-J)

Table 4. Univariate logistic regresyon model

Factors	**B**	**SE**	**Exp(B) (Odds ratio)**	**CI 95% (Lower-upper)**	**p**
Age	0.185	0.094	1.203	1.001-1.446	**0.049**
Constant	-12.616	6.574	0.000		0.055
Gender female (male)	-0.318	0.727	0.727	0.175-3.023	0.661
Constant	0.534	0.363	1.706		0.142
Troponin	-.03	0.07	0.970	0.845-1.113	0.666
Constant	0.753	0.739	2.123		0.308
Lenght of hospital stay	-0.350	0.264	0.705	0.420-1.183	0.185
Constant	0.835	0.679	2.306		0.219
GCS	0.662	0.551	1.863	0.633-5.483	0.259
Constant	-8.655	8.155	0.000		0.289
Hemoglobin	-0.024	0.147	0.976	0.732-1.301	0.869
Constant	0.786	1.946	2.195		0.686

B: regresyon coefficient, Exp(B): exponential value of B, SE: standart error, CI: confidence interval, GCS: glasgow coma score, Reference: suicide group, For age, Model (block 1) summary: -2 Log likelihood: 45.703, Nagelkerke R2=0.201; Hosmer and Lemeshow test: sig.=0.058; omnibus test of model coefficient: χ2=6.236, sig.=0.013

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Discussion

Poisonings constitute an important part of emergency room admissions in hospitals [16]. In our country and worldwide, it is observed that the elderly population is increasing with the prolongation of human life [17]. Inappropriate drug use in the elderly is an important health problem. The potential of many drugs to cause poisoning is increasing, and there is a significant increase in the number of suicidal drug intakes, especially in elderly patients [13,18]. This situation emerges as a serious problem that needs to be taken into consideration with the increase in the elderly population and related problems. In a study focusing on the elderly, it was reported that poisonings related to the use of prescription drugs were the most common. Drug intake is usually realized for drug misuse or suicidal purposes [13]. In other studies, the frequency of suicide among elderly individuals has been emphasized, and although there are etiologic differences, it is similar to young suicide cases [18,19]. In our study, it was determined with a rate of 77% that the majority of cases were overdoses due to misuse of existing medications and suicidal intention. At this point, we believe that primary health care, mental health services, a multi-layered prevention program at the social and community level, as well as methods implemented through social support within the family, can reduce the risk of suicide. In addition, for drug overdose poisoning, we believe that timely and controlled administration of medications in the presence of a caregiver and careful information by physicians on the dosage and timing of medication use can reduce the rate of overdose-related poisoning.

In our study, it was observed that the female sex ratio was higher in poisoning cases. Our findings are consistent with the literature and reveal that female dominance shows a similar trend in all age groups, especially in suicidal poisonings [20,21]. The main reason for this situation is that approximately 40% of all poisoning cases are caused by suicidal poisoning, and this group is dominated by women. In our study, suicidal drug intake is more common in the evening and night hours, similar to the literature, in contrast to accidental poisonings and poisonings caused by reasons such as misuse of drugs [1,22]. Since all poisonings were included in our study model, poisoning cases occurring during daytime and evening hours are similar to the literature and are more common. The main reason for this situation can be said to be the significant increase in overdose poisoning applications due to misuse of chronic medications used by the patients, and cleaning products and pesticide poisonings can also be said to be the main factors in the formation of this proportional difference.

Various studies in the literature reveal significant differences between the factors causing intoxication. While some of these studies emphasized that analgesic drug intoxications were more prominent, other studies pointed out that antidepressant drug intoxications were more prominent [23-25]. We assess the potential contribution of controlling the use of non-prescription medicines to reducing drug-induced poisoning. While poisoning due to ingestion of corrosive substances and pesticide ingestion are usually cases in which daytime and accidental ingestions are prominent, hospitalization rates after drug ingestion generally vary between 17% and 60% in the literature. However, in our study sample, these rates were close to 70% [1,26]. We think that the main reason for this situation is that corrosive and pesticide poisonings cause serious complications and mortality, which is why hospitalization rates are high and statistically significant.

It is known that blood parameters including glucose, urea, creatinine, sodium, potassium, aspartateaminotransferase (AST), alanine amino transferase (ALT), bilirubin, hemoglobin, hematocrit, and pH in patients with mortal course in intoxications hospitalized in an intensive care unit differ statistically compared to living patients [27]. In a study conducted by Ertekin et al., it was reported that hemoglobin, glucose, urea, creatine, and sub values were generally in the normal reference range at the time of first presentation in cases of intoxication, and there were statistical differences with the blood values taken at the 2nd hour [28] Yılmaz et al. also reported in their study on acute drug intoxications that the blood parameters of the patients at the time of initial presentation to the hospital were generally within the normal reference range [29]. In our study, the initial blood parameters of the patients were generally found to be within the normal reference range. We can say that the main possible reasons for this situation are that the toxic effects of the drugs did not emerge in the early period and that a large amount of toxic drugs did not enter the circulation. Patients admitted to emergency departments with poisoning in the study centers are evaluated, treated, and followed up according to the recommendations of the 114 National Poison Advisory Center and their clinical conditions. In this situation, regardless of the laboratory results, the 114 poison counseling center typically advises hospitalization for patients who experience side effects or drug overdose effects. Therefore, we believe that there is no difference in initial blood parameters between hospitalized and non-hospitalized patients

In our study, according to the nature of intoxication, the mean troponin values of patients with accidental ingestion were statistically significantly higher than the other groups. Although serious confounding conditions that may affect troponin values were excluded from the study, it is difficult to say that troponin elevation was due to intoxication. On the other hand, we can say that possible causes such as chronic cardiovascular diseases, rhythm disorders, clinically inconsistent high troponin levels, or possible toxic effect of medications in elderly patients could lead to this condition. It is also a fact that pesticide group drugs are responsible for cardiac damage [30-32].

Şencan et al. found that GCS levels were generally low in acute pesticide and organophosphate poisoning cases [33]. Our study was not compatible with the information in the literature. No difference was found in patients categorized into three groups according to the nature and type of intoxication.However, when only one patient with alcohol intoxication was included in the analysis, although it was statistically significant, it was

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not clinically significant. This patient's low GCS was an outlier, and this data was not included in the analysis to minimize the possibility of Type 1 error. On the other hand, due to the high toxicity of the pesticide group, which affects all body systems, we think that the clinical condition of the patients deteriorates rapidly, which leads to an increase in hospitalization rates.

In our study, a statistically significant difference was found between the mean ages of suicidal, accidental, and misuse groups. It was found that this difference was due to the suicidal and accidental groups; the mean age of the accidental group was higher and the mean age of the suicidal group was lower. Furthermore, in our logistic regression model, the age of the patients divided into two groups was higher in the non-suicide group (accidental+misuse). When elderly patients were categorized according to age, it was found that suicide attempts were more frequent in relatively younger patients. Our findings are consistent with the literature. In a study by Mazer-Amirshahi et al., approximately 90% of poisoning cases were found in the population aged 60 years and younger [34]. Zhang et al. also reported that poisonings were most common in the young patient group, and hospital admissions were most common after suicide attempts [35]. In our study, the patients'hemoglobin values showed a difference according to the nature of poisoning (accidental,suicide or misuse). We found a negative correlation between hgb and length of hospitalization. In parallel with our study, a study investigating the relationship between anemia, depression, and suicide attempts in women reported that anemia and depression did not have a predictive value for suicide but increased the duration of hospitalization. Similarly, we found no association between low hemoglobin and suicide attempt. However, the patients admitted following ingestion of corrosive substances exhibit low hemoglobin and high MCV, which are statistically significant but lack clinical significance. We think that this difference is due to the small number of cases of accidental ingestion (type 1 error possibility) and that no early differences would occur in larger patient groups. We found a negative correlation between troponin and CK-MB values and GCS in our study. Salim et al. reported similar findings to ours in their study on head traumas. It was reported that patients with severe head trauma with high troponin levels exhibited lower GCS, and there was a correlation between troponin levels and the severity of head trauma [36]. However, we need large-scale studies to demonstrate the relationship between troponin, low GCS and the severity of poisoning in acute poisoning.

Limitations

This study has some important limitations. First, due to the retrospective design of the study, data analysis could not be performed for all other factors (psychiatric, sociocultural, economic level, etc.). Larger prospective studies on the causes of poisoning are needed. Second, a small sample size. This limits the generalizability of the findings. Third, this study was based on data obtained only from the Department of Emergency Medicine of Niğde Ömer Halisdemir University Training and Research Hospital and Kafkas University Application and Research Hospital. Data from these hospitals may not fully reflect the characteristics of a general population.

Conclusion

This study analyzed in detail the demographic and clinical characteristics of poisoning cases among the elderly. The findings, which focus especially on drug side effects, overdoses, and suicide attempts, reveal that poisoning in the elderly population constitutes an important health problem. Women were found to be at higher risk, especially for suicidal poisonings, and this was emphasized as a serious problem in the elderly population. It was also found that the mean ages of patients in the non-suicide group (accidental+misuse) was higher. These findings provide an important contribution to understanding and preventing the risks of poisoning the elderly. The results of the study emphasize the necessity of developing preventive public health projects to prevent drug-related poisonings in the elderly, especially suicidal poisonings. It was found that poisonings were more common in the evening and night hours, and this was associated with drug misuse and overdose poisonings. Therefore, promoting conscious drug use, increasing precautions against toxic substances in the home environment, and providing rapid intervention in emergencies are critical for the prevention of poisoning in the elderly.

In light of these findings, it is necessary to adopt a multidisciplinary approach, increase public awareness, and strengthen health policies to reduce poisoning among the elderly. This will be an important step to protect the health and improve the quality of life of the elderly population.

Conflict of Interests
The authors declare that there is no conflict of interest in the study.

Financial Disclosure
The authors declare that they have received no financial support for the study.

Ethical Approval
This study was approved by the Non-Interventional Clinical Research Ethics Committee of Kafkas University Faculty of Medicine No. 337 dated 9/11/2023.

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