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# The Characteristics of Elderly Individuals Who Attempted Suicide by Poisoning: a Nationwide Cross-sectional Study in Korea

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## ABSTRACT

**Background:** Suicide among the elderly is a public health concern, as life expectancy is increasing rapidly and suicide rates increase with age. In Korea, self-poisoning is the most common method of attempted suicide. This study aimed to evaluate the characteristics of attempted suicide by self-poisoning among the elderly and to identify risk factors related to the suicide attempts.

**Methods:** A cross-sectional observational study was conducted using the Emergency Department-based Injury In-depth Surveillance database in Korea. We included all adult patients visiting the emergency department (ED) who attempted suicide by poisoning between January 2011 and December 2017 and stratified according to age: the elderly ( $\geq 65$  years old) and the younger group. Characteristics and risk factors for attempted suicide by poisoning among the elderly were evaluated using stepwise regression analysis.

**Results:** Among 25,904 adult patients, 5,164 (19.9%) were classified as elderly. The elderly were more likely to be admitted to hospital and intensive care units, the average ED length of stay was longer, and total mortality was higher than that of the younger group. Male sex, low socioeconomic status, poor physical health, pesticide use, lower alcohol consumption, and fewer prior suicide attempts were found to be risk factors for suicide among the elderly.

**Conclusion:** Self-poisoning among the elderly is associated with poorer clinical outcomes than in younger adult patients. Suicide among the elderly is a potentially preventable public health problem, and with proper identification of the associated risk factors, appropriate multidisciplinary intervention strategies can be implemented.

**Keywords:** Suicide; Elderly; Poisoning; Risk Factors

## INTRODUCTION

Suicide is a serious public health burden worldwide, with nearly 800,000 deaths from suicide in 2016.<sup>1</sup> An estimated 24.6 persons per 100,000 died from suicide in 2016 in Korea, which has had a top suicide rate among the Organization for Economic Co-operation and Development countries since 2003.<sup>2</sup> Suicide rates increase with age, especially in Korea, and suicide rates among the elderly are almost 13-fold higher than those of teenagers.<sup>3</sup> Though

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**Author Contributions**

Conceptualization: Song SJ, Park GJ.  
Methodology: Park GJ. Formal analysis:  
Song SJ, Park GJ. Investigation: Lee JH. Data  
curation: Park GJ, Kim H, Lee SW. Writing  
- original draft: Song SJ, Park GJ. Writing -  
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the suicide rate among the elderly has been decreasing, it remains high, at 48.6 persons per 100,000 in 2018.<sup>4</sup>

The elderly are likely to plan and choose highly lethal suicide methods rather than attempting suicide impulsively, thereby leading to higher suicide success rates.<sup>5,6</sup> Among the elderly, more complex factors are known to contribute to suicide, which is in contrast to younger individuals, where a single dominant factor is often the root cause.<sup>7</sup> Mental illness such as depression, as well as physical illness due to chronic disease, and low socioeconomic status are independent risk factors for suicide attempts.<sup>8-10</sup> Social isolation and functional disability due to aging are known to interact with other factors and increase suicidal ideation and attempts.<sup>11-13</sup>

According to the National Emergency Department Information System data in 2017, which is a nationwide emergency department (ED)-based database in Korea, self-poisoning was the most common method among those who attempted suicide. The proportion of choosing self-poisoning as a suicide attempt increased with age, from 2.9% among those aged < 9 years, to 76.7% among individuals in their 80s.<sup>14</sup> One study conducted in Korea reported that among drug-related suicide attempts, the elderly used hypnotics more frequently, and had a higher admission rate and required longer hospital stays.<sup>15</sup> Because the ED is the first place where medical intervention takes place after suicide attempts, it is important to provide adequate medical assistance in the ED to those who attempted suicide.<sup>16</sup> Korea has been providing an ED-based case management program for people who attempt suicide since 2013. Though it has the advantage of providing psychosocial treatment and rehabilitation programs to these patients, it has only reported limited clinical outcomes so far.<sup>17,18</sup>

To our knowledge, there is no nationwide research on the clinical characteristics of elderly patients who attempted poisoning by suicide in Korea. The purpose of this study was to evaluate the characteristics of elderly patients who attempted suicide by poisoning, and to identify risk factors affecting suicide attempts.

## METHODS

### Study design and setting, data source

This was a cross-sectional observational study using the Emergency Department-based Injury In-depth Surveillance (EDIIS) database in Korea. The EDIIS is a nationwide prospective database of injured patients visiting the ED, which is supported by the Korea Centers for Disease Control and Prevention (KCDC). The EDIIS was established in 2006 in 5 hospitals, and now 23 EDs gather injury-related information for the development of national strategies in injury prevention.

The EDIIS was constructed based on the core dataset of the International Classification of External Causes of Injuries by the World Health Organization.<sup>19</sup> The database comprises 58 items including the patient's demographics, injury-related information, emergency medical service (EMS) records, clinical findings, diagnosis and medical treatment in the ED, and patient outcomes. Primary surveillance data were collected by general physicians in each ED, and the recorded information was supervised and revised by emergency physicians and trained research coordinators. All research coordinators were required to train in coding, how to manage surveillance data, and coding instruction, and they regularly uploaded the

data into a web-based database system of the KCDC. The quality management committee reviewed the data monthly and provided regular feedback for quality assurance.

### Study population

The study population included all adult patients visiting the ED who attempted suicide by poisoning between January 2011 and December 2017. Using the raw database, data were extracted when the intention of injury variable was “self-harm and suicide” and the mechanism of injury variable was “poisoning.” Patients who were younger than 19 years of age, attempted suicide by another method, and had missing values for ED outcome were excluded.

### Main outcomes

The primary outcome was to analyze the characteristics of elderly patients who attempted suicide by poisoning. The secondary outcome was to identify risk factors for suicide attempts among the elderly.

### Variables and measurements

The main exposure variable was elderly patients, which was defined as someone older than 65 years. We collected information on the demographic variables (age, sex, type of insurance, occupation, and education level), day of injury (weekend, weekday), time of injury (day [06H00–18H00]), suicide-related information (suicide place, suicide motive, type of self-poisoned substance [analgesics, psychiatric drugs, other drugs, pesticide, gas, and others], previous suicide attempts, and alcohol consumption), EMS use, and hospital information (time interval from injury to ED arrival, mental status and initial vital signs at the ED, length of ED stay, ED outcome, and total mortality).

### Statistical analysis

Continuous variables were expressed as medians and interquartile ranges, and categorical variables were expressed as counts and proportions. Between-group differences were compared using the Wilcoxon rank sum test and Pearson's  $\chi^2$  test. We calculated adjusted odds ratios with 95% confidence intervals using forward stepwise regression analysis to evaluate independent risk factors affecting elderly patients who attempted suicide by poisoning at a significance level of  $< 0.25$ . A two-sided  $P$  value of  $< 0.05$  was defined as significant. All statistical analyses were performed using SAS software, version 9.4 (SAS Institute Inc., Cary, NC, USA).

### Ethics statement

This study was approved by the Institutional Review Board (IRB) of Chungbuk National University Hospital (IRB No. 2019-11-020). Informed consent was waived, and patient information was anonymized prior to analysis.

## RESULTS

A total of 44,480 patients visited the ED for suicide attempts during the study period. Patients younger than 19 years old and missing values for ED outcomes were excluded. Out of 40,677 adult patients, 25,904 (63.8%) attempted suicide by poisoning, of which elderly patients accounted for 19.9% thereof (5,164) (**Fig. 1**).

Elderly patients were more likely to be male and unemployed with an education level below high school, and use EMS (all  $P < 0.001$ ). Less alcohol consumption at the time of

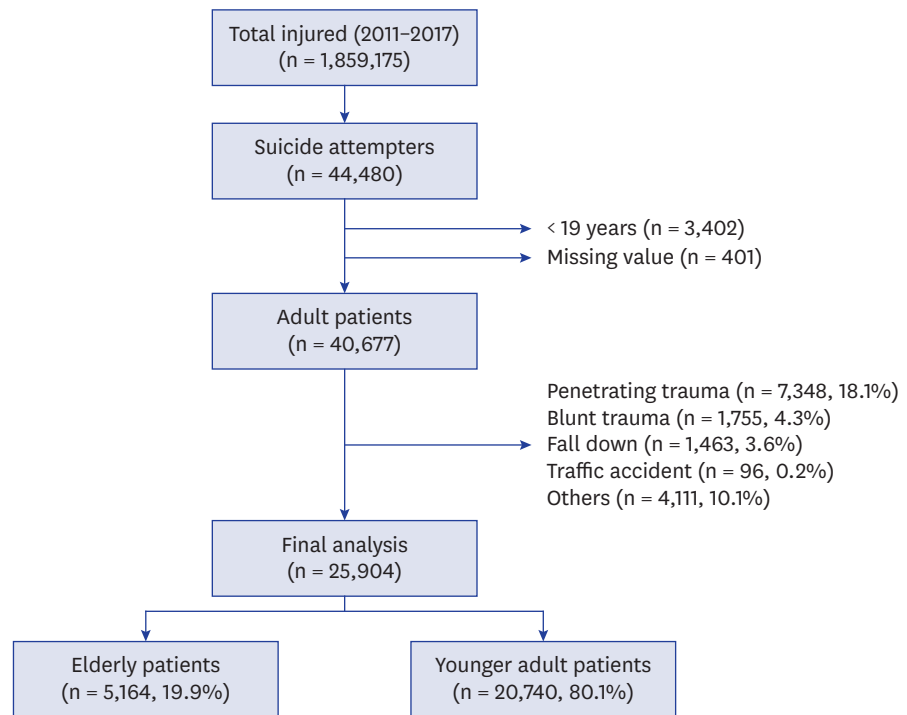


Fig. 1. Study population.

ED visit and, no prior suicide history were observed in the elderly compared to younger patients (45.9% vs. 25.4% for alcohol consumption, and 55.1% vs. 66.6% for no previous suicide attempts, respectively, all  $P < 0.001$ ). Among the type of self-poisoned substances, psychiatric drugs (43.4%) were the most common, but elderly patients more used pesticides (50.3%). The most common suicide motive among all patients was an interpersonal problem (32.2%) but, a large proportion of elderly patients attempted suicide due to poor physical health (26.7%). The interval from injury to ED arrival, and ED length of stay were longer, and admission rates to hospital and intensive care units (ICU) were higher among the elderly (all  $P < 0.001$ ). Elderly patients showed greater mortality than the younger group (13.8% vs. 2.9%,  $P < 0.001$ ) (Table 1).

Table 1. Demographics of individuals who attempted suicide by poisoning, by age

Variables	Total	Younger (< 65)	Elderly (≥ 65)	P value
Total	25,904 (100)	20,740 (80.1)	5,164 (19.9)	
Age, yr	46 (34–60)	42 (31–51)	75 (70–80)	< 0.001
Sex, male	11,174 (43.1)	8,350 (40.3)	2,824 (54.7)	< 0.001
Type of insurance				< 0.001
National health insurance	19,556 (75.5)	15,512 (74.8)	4,044 (78.3)	
Medical aid	1,990 (7.7)	1,656 (8.0)	334 (6.5)	
Others	4,358 (16.8)	3,572 (17.2)	786 (15.2)	
Occupation				< 0.001
Unemployed	4,450 (17.2)	2,419 (11.7)	2,031 (39.3)	
Employed	5,802 (22.4)	5,039 (24.3)	763 (14.8)	
Unknown	15,652 (60.4)	13,282 (64.0)	2,370 (45.9)	
Education level				< 0.001
High school or less	4,409 (17.0)	2,983 (14.4)	1,426 (27.6)	
College or more	1,004 (3.9)	940 (4.5)	64 (1.2)	
Others	20,491 (79.1)	16,817 (81.1)	3,674 (71.1)	

(continued to the next page)

**Table 1.** (Continued) Demographics of individuals who attempted suicide by poisoning, by age

Variables	Total	Younger (< 65)	Elderly (≥ 65)	P value
Weekend	7,416 (28.6)	5,921 (28.5)	1,495 (29.0)	0.568
Season				< 0.001
Spring	6,638 (25.6)	5,215 (25.1)	1,423 (27.6)	
Summer	7,193 (27.8)	5,772 (27.8)	1,421 (27.5)	
Fall	6,490 (25.1)	5,152 (24.8)	1,338 (25.9)	
Winter	5,583 (21.6)	4,601 (22.2)	982 (19.0)	
Time of injury				< 0.001
06:00–18:00	12,648 (48.8)	9,364 (45.1)	3,284 (63.6)	
18:00–06:00	13,256 (51.2)	11,376 (54.9)	1,880 (36.4)	
Suicide place				0.144
Indoor	23,382 (90.3)	18,684 (90.1)	4,698 (91.0)	
Outdoor	2,391 (9.2)	1,951 (9.4)	440 (8.5)	
Others	131 (0.5)	105 (0.5)	26 (0.5)	
Alcohol consumption	10,832 (41.8)	9,518 (45.9)	1,314 (25.4)	< 0.001
Type of self-administered poison				< 0.001
Analgesics	1,599 (6.2)	1,517 (7.3)	82 (1.6)	
Psychiatric drugs	11,238 (43.4)	9,532 (46.0)	1,706 (33.0)	
Other drugs	1,988 (7.7)	1,705 (8.2)	283 (5.5)	
Pesticides	6,113 (23.6)	3,514 (16.9)	2,599 (50.3)	
Gas	3,248 (12.5)	3,079 (14.8)	169 (3.3)	
Others	1,718 (6.6)	1,393 (6.7)	325 (6.3)	
Suicide intention				< 0.001
Interpersonal	8,330 (32.2)	7,238 (34.9)	1,092 (21.1)	
Physical health	2,644 (10.2)	1,264 (6.1)	1,380 (26.7)	
Psychiatric problems	6,138 (23.7)	5,151 (24.8)	987 (19.1)	
School or work-related problems	663 (2.6)	640 (3.1)	23 (0.4)	
Economic problems	1,277 (4.9)	1,174 (5.7)	103 (2.0)	
Others	6,852 (26.5)	5,273 (25.4)	1,579 (30.6)	
Previous suicide attempts				< 0.001
None	14,872 (57.4)	11,432 (55.1)	3,440 (66.6)	
EMS use	20,477 (79.0)	15,977 (77.0)	4,500 (87.1)	< 0.001
Mental status				< 0.001
Alert	12,384 (47.8)	10,444 (50.4)	1,940 (37.6)	
Verbal response	5,018 (19.4)	4,042 (19.5)	976 (18.9)	
Painful stimulus	3,434 (13.3)	2,374 (11.4)	1,060 (20.5)	
Unresponsive	927 (3.6)	557 (2.7)	370 (7.2)	
Unknown	4,141 (16.0)	3,323 (16.0)	818 (15.8)	
Vital signs				
SBP	120 (107–140)	120 (108–138)	126 (105–149)	< 0.001
HR	88 (77–101)	88 (78–102)	84 (73–97)	< 0.001
RR	20 (18–20)	20 (18–20)	20 (18–20)	< 0.001
Time interval from injury to ED, hr	2.0 (1.0–5.0)	2.0 (1.0–4.9)	2.2 (1.0–5.3)	< 0.001
ED Length of stay, hr	6.5 (3.4–13.7)	6.5 (3.4–13.3)	7.0 (3.3–17.3)	< 0.001
ED outcome				< 0.001
Discharge	12,286 (47.4)	11,018 (53.1)	1,268 (24.6)	
Transfer	1,879 (7.3)	1,347 (6.5)	532 (10.3)	
Admission	11,039 (42.6)	8,042 (38.8)	2,997 (58.0)	
Death	700 (2.7)	333 (1.6)	367 (7.1)	
ICU admission	5,800 (22.4)	3,958 (19.1)	1,842 (35.7)	< 0.001
Total mortality	1,306 (5.0)	594 (2.9)	712 (13.8)	< 0.001

Data are presented as number (%) or median (interquartile range).

EMS = emergency medical service, SBP = systolic blood pressure, HR = heart rate, RR = respiratory rate, ED = emergency department, ICU = intensive care unit.

Though the mortality rate of patients who attempted suicide in both groups decreased across the study period, the mortality rate of the elderly patients was 6-fold higher than that of the younger group (Fig. 2). Fig. 3 shows the trends in the type of self-administered poison on a 10-year age band. The proportion of psychiatric drugs was high across all age groups and

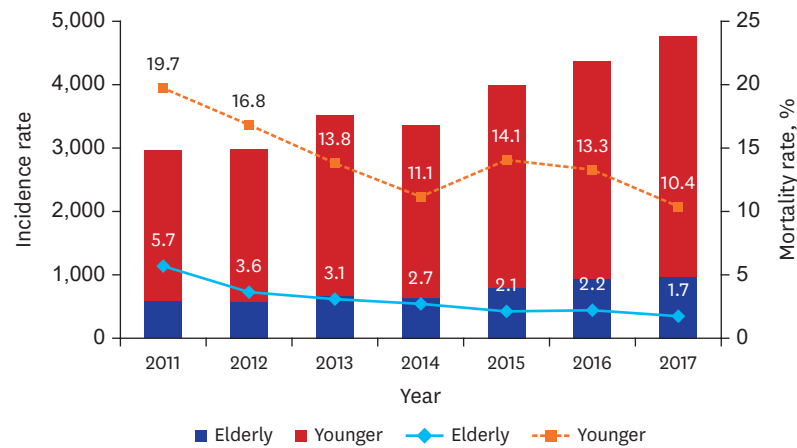


Fig. 2. Incidence and mortality rate of individuals who attempted suicide by poisoning across the study period.

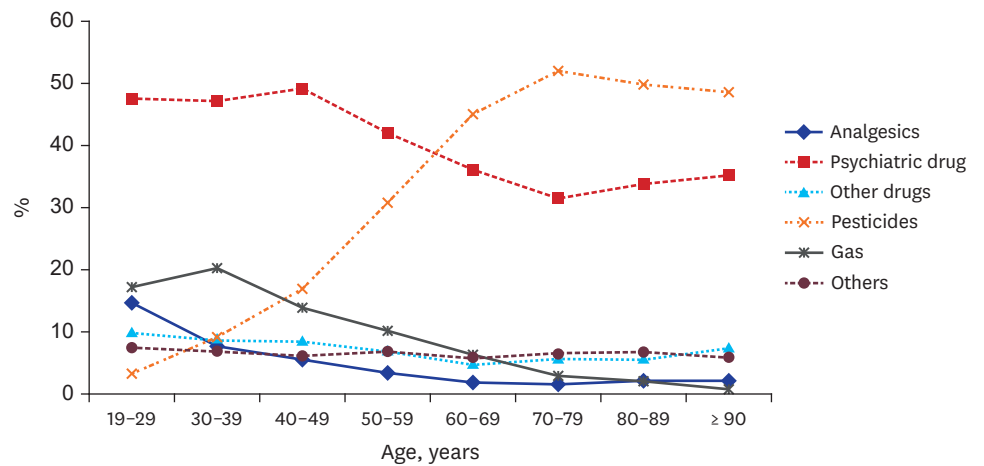


Fig. 3. Trends in the type of self-administered poison by 10-year age band.

pesticides were the most common substance for self-poisoning among those aged > 60 years. Fig. 4 shows the differences in mortality rates by self-administered poison between the two groups. It was found that 79.5% of the elderly patients died from pesticide poisoning, while in the non-elderly group, 59.1% died from pesticide, and 24.4% died of gas-poisoning.

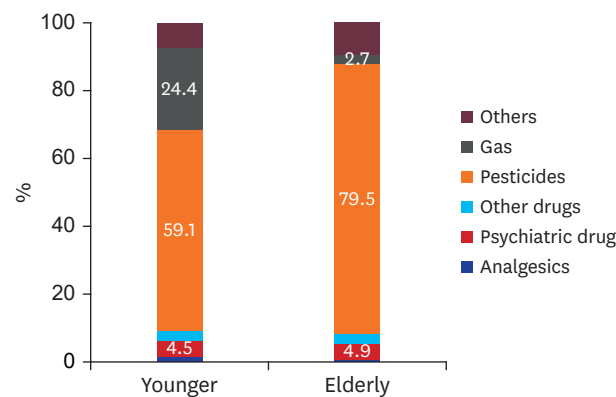


Fig. 4. Differences in mortality rate by self-administered poison between elderly and younger patients.

**Table 2.** Risk factors for elderly patients who attempt suicide

Independent variables	Adjusted OR (95% CI) <sup>a</sup>
Sex, male	1.416 (1.311–1.530)
Occupation	
Unemployed	5.639 (5.039–6.311)
Others	1.391 (1.242–1.558)
Education level	
High school or less	5.650 (4.206–7.590)
Others	4.761 (3.550–6.383)
Time of injury, day (06:00–18:00)	1.574 (1.462–1.695)
Type of insurance	
National health insurance	1.616 (1.455–1.795)
Medical aid	0.875 (0.741–1.034)
Alcohol consumption	0.428 (0.395–0.464)
Type of self-administered poison	
Analgesics	0.274 (0.209–0.359)
Psychiatric drugs	0.882 (0.762–1.022)
Other drugs	0.775 (0.638–0.941)
Pesticides	2.868 (2.471–3.329)
Gas	0.238 (0.193–0.295)
Suicide intention	
Interpersonal	0.534 (0.484–0.589)
Physical health	2.483 (2.215–2.783)
Psychiatric problems	0.567 (0.512–0.627)
School or work-related problems	0.123 (0.079–0.190)
Economic problems	0.261 (0.207–0.329)
Previous suicide attempts, none	1.473 (1.363–1.591)

Hosmer and Lemeshow Goodness-of-Fit:  $\chi^2 = 6.18$  ( $P = 0.63$ ).

OR = odds ratio, CI = confidence interval.

<sup>a</sup>Adjusted for sex, type of insurance, occupation, education level, time of injury, alcohol consumption, type of self-administered poison, suicide intention, and previous suicide attempts.

Factors that were identified as independent risk factors among elderly patients who attempted suicide were: male sex, unemployed status, an education level of high school or less, being injured during the day-time, having national health insurance, no alcohol consumption, the use of pesticides in the suicide attempts, poor medical health as a suicide intention, and no prior suicide attempt history (Table 2).

## DISCUSSION

Suicide among the elderly is an important public health concern as life expectancy is increasing rapidly and suicide rates increase with age. According to Korean statistics, hanging is the most common suicide method, affecting 12.7 persons per 100,000 (52.3%), but among those who attempted suicide and subsequently visited the ED, self-poisoning was the predominant suicide method.<sup>14</sup> Therefore, it is necessary to identify the characteristics of elderly patients who attempt poisoning and classify the substances ingested. In our study, elderly patients who attempted suicide by poisoning were more likely to be admitted to a hospital and ICU, and the average ED length of stay was longer and total mortality higher than in younger patients. All these poor outcomes were consistent with previous studies, which implied more distinct suicide intent or lower physical resilience among the elderly.<sup>15,20,21</sup>

There are some variations in the frequency of self-administered poisons. Two studies conducted in Australia reported that benzodiazepine was the most commonly ingested drug for poisoning by elderly patients.<sup>21,22</sup> Other studies conducted in a single medical center

in Korea showed that the most commonly ingested drugs among elderly patients were hypnotics (59.1%) and psychotropics (54.6%), respectively.<sup>15,20</sup> However, when expanding the scope of the self-administered poison to drugs, a 5-year observational study in Korea reported that the most common self-administered substance was pesticides in male patients and sedative-hypnotics in female patients.<sup>23</sup> Our results also showed that the proportion of those who self-administered pesticides increased with age, and accordingly, the mortality rate in the elderly was higher than in the younger patients.

Risk factors associated with elderly patients who attempted suicide through poisoning were similar in previous reports.<sup>9,10,12</sup> Being male, with a low socioeconomic status (such as being unemployed) and education level, and poor physical health as a suicide intention were independent risk factors for suicide attempts by poisoning among the elderly, which were consistent with previous studies. Poor physical health, caused by multiple comorbidities as well as frailty due to aging, may exacerbate the lethality of suicide attempts and therefore, is known to be a unique risk factor for suicide among the elderly. Various types of stressors such as the death of a spouse, family discord, loneliness, and poor social support, were difficult to evaluate from our results, and may contribute to suicidal ideation and attempts among the elderly.<sup>24</sup> Elderly patients who attempted suicide by poisoning showed specific characteristics at the ED visit: lower alcohol consumption, a history of fewer prior suicide attempts and fewer treatments for psychiatric illnesses, with diagnosed mental disorder such as depression. These factors were related to the fact that elderly patients tended to plan suicide attempts rather than being impulsive, and used pesticides to ensure a higher success rate.<sup>15,20-22</sup> By identifying those risk factors, we should be able to identify the elderly who are at high risk for suicide, and apply proper strategies for suicide prevention.

Pesticides are well known to be fatal substances that are directly linked to death. In Korea, paraquat has been prohibited since 2011, and several studies have reported a decrease in suicide rates using this method since then.<sup>25,26</sup> However, strong regulation and control of pesticides should be maintained as the suicide rate through pesticide poisoning is still high among the elderly.<sup>27</sup> Similarly, in Korea, there is an effort to establish a poisoning information database to provide emergency treatment information for patients presenting to the ED with poisoning.<sup>28</sup> Community-based suicide prevention programs are also effective for enhancing physical health, reducing stress, and decreasing depressive symptoms. It can identify the elderly at high risk for suicide, and provide additional timely interventions.<sup>29,30</sup> Case management provides those who attempt suicide with psychosocial treatment from ED admission, and links them to the appropriate community services. Although the clinical effect of case management on suicide prevention has been reported to be controversial,<sup>31</sup> recent studies conducted in Korea reported its effectiveness for reducing the risk of suicide.<sup>17,18</sup>

This study has several limitations. First, this is a retrospective observational study and may have potential confounders that influenced the exposure and outcomes. Second, there are quite a few missing values for some variables, such as occupation or education level because they are defined as mandatory variables only at admission. Finally, since the EDIIS database used in this study comprises mainly injury-related information, and certain psychosocial variables such as psychiatric disorders (especially like depression), current psychiatric medication, marital status, and cohabitant status, which are known to be important risk factors for suicide attempts in the elderly, were not available; therefore, it is difficult to generalize the results of our study.



In conclusion, attempted suicide by poisoning among the elderly is associated with poor clinical outcomes compared to that among younger patients. Male sex, low socioeconomic status, poor physical health, pesticide use, lower alcohol consumption, and a history of fewer prior suicide attempts were found to be risk factors for suicide among the elderly. Suicide among the elderly is a potentially preventable public health problem, where further multidisciplinary interventions are needed.

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