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 (≥ 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. 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. Suicide rates increase with age, especially in Korea, and suicide rates among the elderly are almost 13-fold higher than those of teenagers.
Disclosure
The authors have no potential conflicts of interest to disclose.

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 - reviewing & editing: Park GJ, Lee JH, Kim SC, Kim H, Lee SW.

The suicide rate among the elderly has been decreasing, it remains high, at 48.6 persons per 100,000 in 2018.4 The elderly are likely to plan and choose highly lethal suicide methods rather than attempting suicide impulsively, thereby leading to higher suicide success rates.5,6 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.7 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.8,9 Social isolation and functional disability due to aging are known to interact with other factors and increase suicidal ideation and attempts.10-13

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.14 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.15 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.16 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.17,18

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.19 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
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)
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

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                      |                |                |                | < 0.001 |
| 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 (3.4–13.7) | 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.
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.
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. 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.

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. 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.\textsuperscript{15,20} 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.\textsuperscript{23} 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.\textsuperscript{9,10,12} 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.\textsuperscript{24} 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.\textsuperscript{15,20-22} 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.\textsuperscript{25,26} However, strong regulation and control of pesticides should be maintained as the suicide rate through pesticide poisoning is still high among the elderly.\textsuperscript{27} 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.\textsuperscript{28} 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.\textsuperscript{29,30} 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,\textsuperscript{31} recent studies conducted in Korea reported its effectiveness for reducing the risk of suicide.\textsuperscript{17,18}

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.

REFERENCES

1. World Health Organization. World health statistics 2019: monitoring health for the SDGs, sustainable development goals. https://apps.who.int/iris/bitstream/handle/10665/311696/WHO-DAD-2019.1-eng.pdf. Updated 2019. Accessed November 24, 2019.

2. OECD. Health statistics. https://stats.oecd.org/Directory.aspx?DataSetCode=HEALTH_STAT. Updated November 24, 2019.

3. OECD. Society at a glance 2019. https://doi.org/10.1787/soc_glance-2019-en. Updated November 30, 2019.

4. Statistics of Korea. Cause of death statistics in 2018. http://kosis.kr/statHtml/statHtml.do?orgId=101&tblId=DT_1B34E07&conn_path=I3. Updated 2018. Accessed November 28, 2019.

5. Kim H, Ahn JS, Kim H, Cha YS, Lee J, Kim MH, et al. Sociodemographic and clinical characteristics of old-old suicide attempters compared with young-old and middle-aged attempters. *Int J Geriatr Psychiatry* 2018;33(12):1717-26.

6. Woo S, Lee SW, Lee K, Seo WS, Lee J, Kim HC, et al. Characteristics of high-intent suicide attempters admitted to emergency departments. *J Korean Med Sci* 2018;33(41):e259.

7. McIntosh JL. Suicide prevention in the elderly (age 65–99). *Suicide Life Threat Behav* 1995;25(1):180-92.

8. Choi JW, Kim TH, Shin J, Han E. Poverty and suicide risk in older adults: a retrospective longitudinal cohort study. *Int J Geriatr Psychiatry* 2019;34(11):1565-71.

9. Wiktorsson S, Runeson B, Skoog I, Östling S, Waern M. Attempted suicide in the elderly: characteristics of suicide attempters 70 years and older and a general population comparison group. *Am J Geriatr Psychiatry* 2010;18(1):57-67.

10. Kim KH, Jeong KY, Lee JS, Choi HS, Hong HP, Ko YG. The characteristics of elderly patients with suicide attempts: a comparative study with non-elderly patients. *Ann Geriatr Med Res* 2016;20(4):209-20.

11. Fässberg MM, Cheung G, Canetto SS, Erlangsen A, Lapierre S, Lindner R, et al. A systematic review of physical illness, functional disability, and suicidal behaviour among older adults. *Aging Ment Health* 2016;20(2):166-94.

12. Park JJ, Yang JY, Han C, Park TW, Chung SK. Suicidal ideation among Korean elderly: risk factors and population attributable fractions. *Psychiatry* 2016;79(3):262-81.

13. Choi M, Kim DH, Lee K, Yi JS. Physical, psychological, and social risk factors affecting suicidal ideation among the elderly. *J Korean Neuropsychiatr Assoc* 2015;54(4):459-67.

14. Ministry of Welfare. 2019 White book: Korea suicide prevention center. http://spckorea-stat.or.kr/boadpublishview.do. Updated 2019. Accessed November 30, 2019.

15. Lim JY, Lee DH. Characteristics of drugs ingested for suicide attempts in the elderly. *J Korean Med Sci* 2018;33(11):e86.

16. Inagaki M, Kawashima Y, Kawanishi C, Yonemoto N, Sugimoto T, Furuno T, et al. Interventions to prevent repeat suicidal behavior in patients admitted to an emergency department for a suicide attempt: a meta-analysis. *J Affect Disord* 2015;175:66-78.
17. Kim H, Park J, Kweon K, Ahn J. Short- and long-term effects of case management on suicide prevention among individuals with previous suicide attempts: a survival analysis. *J Korean Med Sci* 2018;33(32):e203. [PUBMED](https://doi.org/10.3346/jkms.2020.35.e286) [CROSSREF](https://jkms.org)

18. Shin HJ, Park GI, In YN, Kim SC, Kim H, Lee SW. The effects of case management program completion on suicide risk among suicide attempters: a 5-year observational study. *Am J Emerg Med* 2019;37(10):1811-7. [PUBMED](https://doi.org/10.3346/jkms.2020.35.e286) [CROSSREF](https://jkms.org)

19. Park GI, Shin J, Kim SC, Na DS, Lee HI, Kim H, et al. Protective effect of helmet use on cervical injury in motorcycle crashes: a case-control study. *Injury* 2019;50(3):657-62. [PUBMED](https://doi.org/10.3346/jkms.2020.35.e286) [CROSSREF](https://jkms.org)

20. Kim YR, Choi KH, Oh Y, Lee HK, Kweon YS, Lee CT, et al. Elderly suicide attempters by self-poisoning in Korea. *Int Psychogeriatr* 2011;23(6):979-85. [PUBMED](https://doi.org/10.3346/jkms.2020.35.e286) [CROSSREF](https://jkms.org)

21. Pillans PI, Page CB, Ilango S, Kashchuk A, Isbister GK. Self-poisoning by older Australians: a cohort study. *Med J Aust* 2017;206(4):164-9. [PUBMED](https://doi.org/10.3346/jkms.2020.35.e286) [CROSSREF](https://jkms.org)

22. Ticehurst S, Carter GL, Clover KA, Whyte IM, Raymond J, Fryer J. Elderly patients with deliberate self-poisoning treated in an Australian general hospital. *Int Psychogeriatr* 2002;14(1):97-105. [PUBMED](https://doi.org/10.3346/jkms.2020.35.e286) [CROSSREF](https://jkms.org)

23. Lee HS, Han J, Kim JH, Kim S, Kim SH, Lee JS, et al. Epidemiologic characteristics of intentional poisoning: emergency department based injury in-depth surveillance during 2011-2015. *J Korean Soc Clin Toxicol* 2017;15(2):131-9. [PUBMED](https://doi.org/10.3346/jkms.2020.35.e286) [CROSSREF](https://jkms.org)

24. Dong X, Chang ES, Zeng P, Simon MA. Suicide in the global Chinese aging population: a review of risk and protective factors, consequences, and interventions. *Aging Dis* 2015;6(2):121-30. [PUBMED](https://doi.org/10.3346/jkms.2020.35.e286) [CROSSREF](https://jkms.org)

25. Kim J, Shin SD, Jeong S, Suh GI, Kwak YH. Effect of prohibiting the use of Paraquat on pesticide-associated mortality. *BMC Public Health* 2017;17(1):858. [PUBMED](https://doi.org/10.3346/jkms.2020.35.e286) [CROSSREF](https://jkms.org)

26. Cha ES, Chang SS, Gunnell D, Eddleston M, Khang YH, Lee WJ. Impact of paraquat regulation on suicide in South Korea. *Int J Epidemiol* 2016;45(2):470-9. [PUBMED](https://doi.org/10.3346/jkms.2020.35.e286) [CROSSREF](https://jkms.org)

27. Ko S, Cha ES, Choi Y, Kim J, Kim JH, Lee WI. The burden of acute pesticide poisoning and pesticide regulation in Korea. *J Korean Med Sci* 2018;33(31):e208. [PUBMED](https://doi.org/10.3346/jkms.2020.35.e286) [CROSSREF](https://jkms.org)

28. Kim SJ, Chung SP, Gil HW, Choi SC, Kim H, Kang C, et al. The poisoning information database covers a large proportion of real poisoning cases in Korea. *J Korean Med Sci* 2016;31(7):1037-41. [PUBMED](https://doi.org/10.3346/jkms.2020.35.e286) [CROSSREF](https://jkms.org)

29. Brooks SE, Burruss SK, Mukherjee K. Suicide in the elderly: a multidisciplinary approach to prevention. *Clin Geriatr Med* 2019;35(1):133-45. [PUBMED](https://doi.org/10.3346/jkms.2020.35.e286) [CROSSREF](https://jkms.org)

30. Oyama H, Koida J, Sakashita T, Kudo K. Community-based prevention for suicide in elderly by depression screening and follow-up. *Community Ment Health J* 2004;40(3):249-63. [PUBMED](https://doi.org/10.3346/jkms.2020.35.e286) [CROSSREF](https://jkms.org)

31. Hawton K, Witt KG, Taylor Salisbury TL, Arensman E, Gunnell D, Hazell P, et al. Psychosocial interventions for self-harm in adults. *Cochrane Database Syst Rev* 2016;(5):CD012189. [PUBMED](https://doi.org/10.3346/jkms.2020.35.e286) [CROSSREF](https://jkms.org)