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ORIGINAL RESEARCH

Self-harm characteristics of younger-old and older-old adults admitted to emergency departments: a nationwide study

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Abstract

Self-harm is a major risk factor for suicide or self-harm repetition. As the global population ages, it is important that older adults are not considered a homogeneous population group. In this study, we aimed to identify the characteristics of elderly self-harm and compare these between age groups who were admitted to emergency departments in South Korea. A retrospective study was conducted using the Emergency Department-based Injury In-depth Surveillance (EDIIS) database in South Korea. We included self-harm patients aged 65 years or more. Inclusions were divided into two groups by age: younger-old (65 to 79 years) and older-old (≥80 years). The primary outcome was the difference between two age groups; a secondary analysis was conducted to identify potential risk factors for in-hospital mortality among patients with self-harm. Among a total of 2,116,039 patients recorded in database, there was a total of 5986 self-harm patients. Self-harm incidence increased with age through the mid-70s, peaking at age 75 (3.59%, 95% confidence interval, 3.27%–3.91%). Two age groups showed significant differences in demographic variables, such as sex, alcohol consumption, injury location, and motivation. Risk factors for self-harm in older adults included older age, male sex, no alcohol consumption, emergency medical service use, and the method of self-harm. The incidence of self-harm among older adults peaked in the mid-70s and decreased thereafter. A higher mortality rate was observed among older-old adults, compared to younger-old adults, and this may be attributed to resilient physical status naturally derived from older age.

Keywords

Age factors; Emergency service; Hospital; Self-Harm; Suicide

1. Introduction

Suicide is a major public health issue worldwide [1, 2], particularly in South Korea, where the suicide rate has ranked the highest among all 38 developed nations of the Organization for Economic Cooperation and Development (OECD) since 2003 [3]. Suicide rates increase with age and have been shown to be almost 13-fold higher in older adults compared to teenagers [4]. Thus, suicide in older adults is expected to be an increasingly important problem, due to aging worldwide population. This is also a particular concern in South Korea, where the average life expectancy is 83.3 years and aging is projected to be the most rapid among OECD countries [5, 6]. As life expectancy becomes longer, there is a growing need to consider that older adults do not comprise a homogeneous population group. Some studies demonstrate that suicide rates differ remarkably among specific older age subgroups [7]. It is important to examine suicide patterns of older adults with age-specific subgroup classification.

Self-harm is defined as any act of self-poisoning or self-injury carried out by a person, irrespective of motivation [8]. Self-harm, sometimes called self-injurious behavior, is often considered to be on the spectrum of suicidal behaviors, with self-harm at the less intense end of the spectrum, and suicidal thinking, suicide attempts, and death by suicide on the continuum of increasing severity [9]. Self-harm is a major risk factor for self-harm repetition and suicide [10–12]. While self-harm and suicide are two distinct behaviors, they are both often linked to mental health problems Indeed, older adults who self-harm have a 67 times higher risk of committing suicide compared to younger adults [13]. An understanding of the nature of self-harm in later life is essential for the provision of more effective healthcare to older adults, particularly in the hospital emergency department, the first place where medical assistance is provided following self-harm or a suicide attempt [14].

There is a lack of studies investigating specific age groups of older adults. Classification of these groups varies from study to

study [15, 16]. In this study, we used a national injury registry to identify the characteristics of elderly self-harm and compare these between younger-old (65 to 79 years) and older-old (≥80 years) adults who were admitted to emergency departments in South Korea.

2. Methods

2.1 Study design and setting

This retrospective study used the Emergency Department-based Injury In-depth Surveillance (EDIIS) database in South Korea, which is a nationwide prospective database of patients with injuries admitted to 23 emergency departments, located in 13 of the 17 provinces of South Korea. This database is organized and financially supported by the Korea Disease Control and Prevention Agency, and it records injury-related information for the purpose of facilitating the planning of national policies in injury prevention. The Ministry of Health and Welfare designates emergency departments into three levels according to available resources and functional requirements. Level 1 (n = 19) and 2 (n = 110) emergency departments have more resources and better facilities for emergency care; level 1 should be staffed with trauma surgeons 24 h a day and 365 days a year, and level 2 must be staffed with emergency physicians 24 h a day and 365 days a year [17, 18]. All emergency departments associated with EDIIS are categorized as level 1 or 2.

2.2 Data source and collection

The EDIIS database collects the following data: patient demographic information, injury-related information, prehospital emergency medical service records, clinical findings, diagnostic assessment, medical treatment administered in emergency departments, emergency department disposition, and patient outcomes following admission.

Primary surveillance and data collection were performed by general physicians. The majority of the recorded information was supervised and corrected on a daily basis by emergency medicine physicians and trained research coordinators. Research coordinators regularly inputted surveillance data into a web-based database system at the Korea Disease Control and Prevention Agency, and all were required to have completed training before project participation. The data were reviewed every month by the project quality management committee, which provided regular feedback to maintain data quality. We used the EDIIS database from 01 January 2011 to 31 December 2018.

2.3 Participant selection

The main inclusion criterion was a patient age of ≥65 years. As the variable "intention of injury" in the EDIIS Registry was checked for all patients, we could include all patients aged ≥65 years. We tabulated the number of patients in each age group. Age groups with a wide confidence interval for self-harm incidence were excluded to avoid statistical bias. After excluding age groups with an extremely low incidence of self-harm, we finally included patients within the 65- to 94-year-old age range. Patients with missing outcome data were also excluded.

2.4 Outcome measures

Self-harm characteristics included the following self-harm injury variables: demographic characteristics, prehospital information (*e.g.*, sex, season of emergency department visit, emergency department visit method, alcohol consumption, injury location, suicide attempt history, self-harm method, self-harm motivation), and clinical information (*e.g.*, mental status, systolic blood pressure, heart rate, and respiration rate at the time of presentation to the emergency department; emergency department disposition, such as discharge to home, admission to general ward, transfer to intensive care unit, death, or others; result after admission; and in-hospital mortality). The total number of in-hospital mortalities was determined by combining the number of deaths that occurred in the emergency department and those that occurred after admission. The primary outcome was the comparison of characteristics of self-harm injury between age 65–79 age group and 80–95 age group. The secondary analysis was the analysis of risk factors for in-hospital mortality among patients with self-harm behavior.

2.5 Statistical analyses

Continuous variables are expressed as means and standard deviations with 95% confidence intervals; differences between groups were evaluated with the Student t-test or Mann-Whitney U test after testing for normality. Categorical variables are expressed as frequencies and percentages; Pearson's χ^2 analysis and Fisher's exact test were used to make inter-group comparisons. The level of statistical significance was set at $p < 0.05$. The self-harm incidence rate for 8 years from 2011 to 2018 and 95% confidence interval were calculated for each age (≥65 years). We calculated adjusted odds ratios and 95% confidence intervals for potential risk factors of in-hospital mortality by using a backward stepwise regression analysis at a significance level of $p < 0.25$. A two-sided p value of < 0.05 was defined as significant. All statistical analyses were performed with R version 3.6.0 (26 April 2019; R Foundation, Vienna, Austria).

3. Results

3.1 Study population

Among a total of 2,116,039 patients registered in the EDIIS database during the 8-year study period, 259,367 with trauma were aged ≥65 years. Following the exclusion of patients due to missing data (1736) or an age >95 years (1788), 256,397 patients were included in the final analysis. The process of subject selection is shown in Fig. 1. There was a total of 5986 patients (aged between 65 and 94 years) with self-harm behavior. The overall self-harm rate was 2.36%. Self-harm incidence increased with age through the mid-70s, peaking at age 75 years (3.59%, 95% confidence interval, 3.27%–3.91%) (Fig. 2).
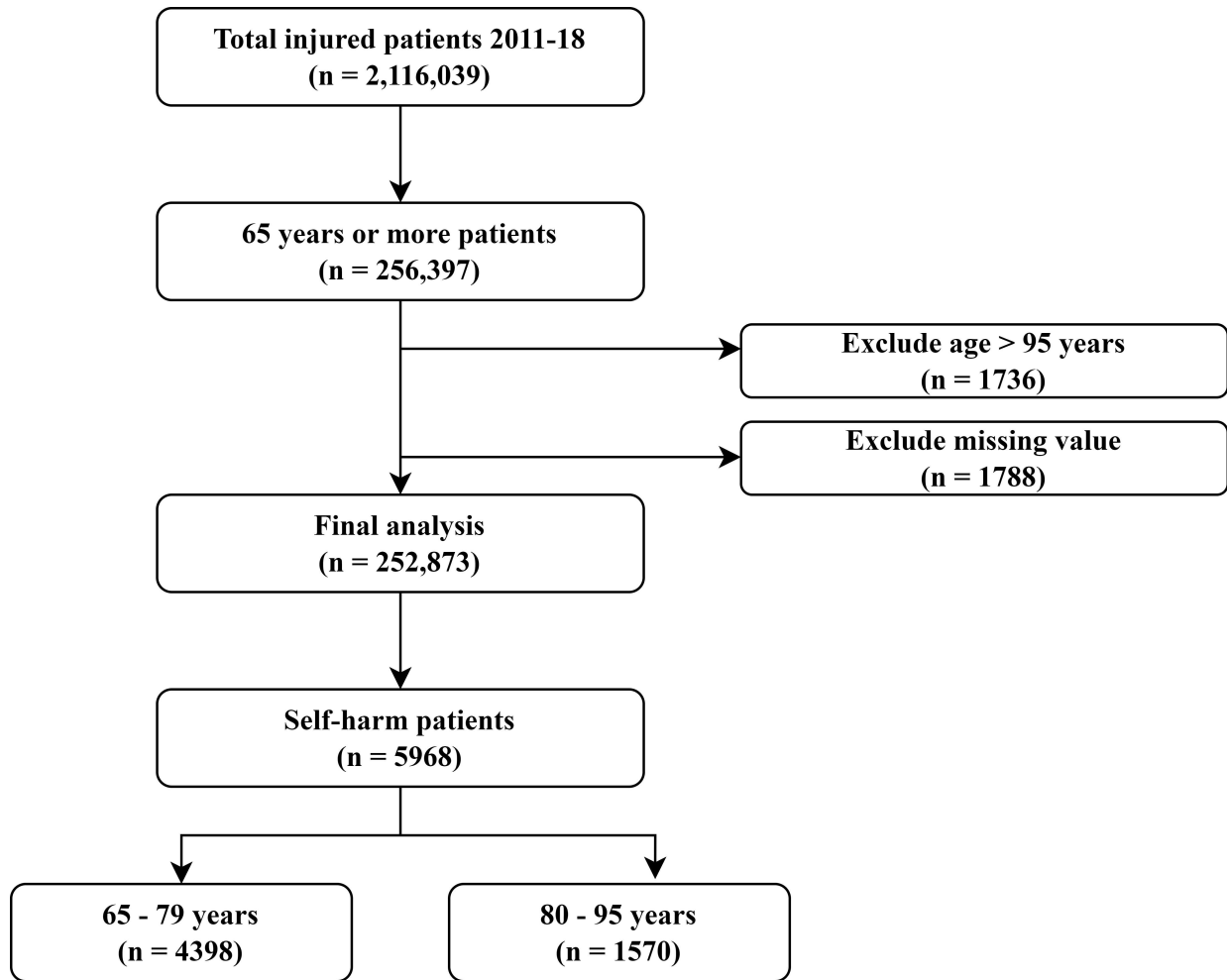
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┌─────────────────────────────────┐
│  Total injured patients 2011-18 │
│       (n = 2,116,039)           │
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                │
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│   65 years or more patients     │
│        (n = 256,397)            │
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                │                        ┌─────────────────────────────┐
                │───────────────────────▶│  Exclude age > 95 years     │
                │                        │       (n = 1736)            │
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                │───────────────────────▶│   Exclude missing value     │
                │                        │       (n = 1788)            │
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│         Final analysis          │
│        (n = 252,873)            │
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│      Self-harm patients         │
│         (n = 5968)              │
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        │                    │
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┌──────────────────┐  ┌──────────────────┐
│   65 - 79 years  │  │   80 - 95 years  │
│    (n = 4398)    │  │    (n = 1570)    │
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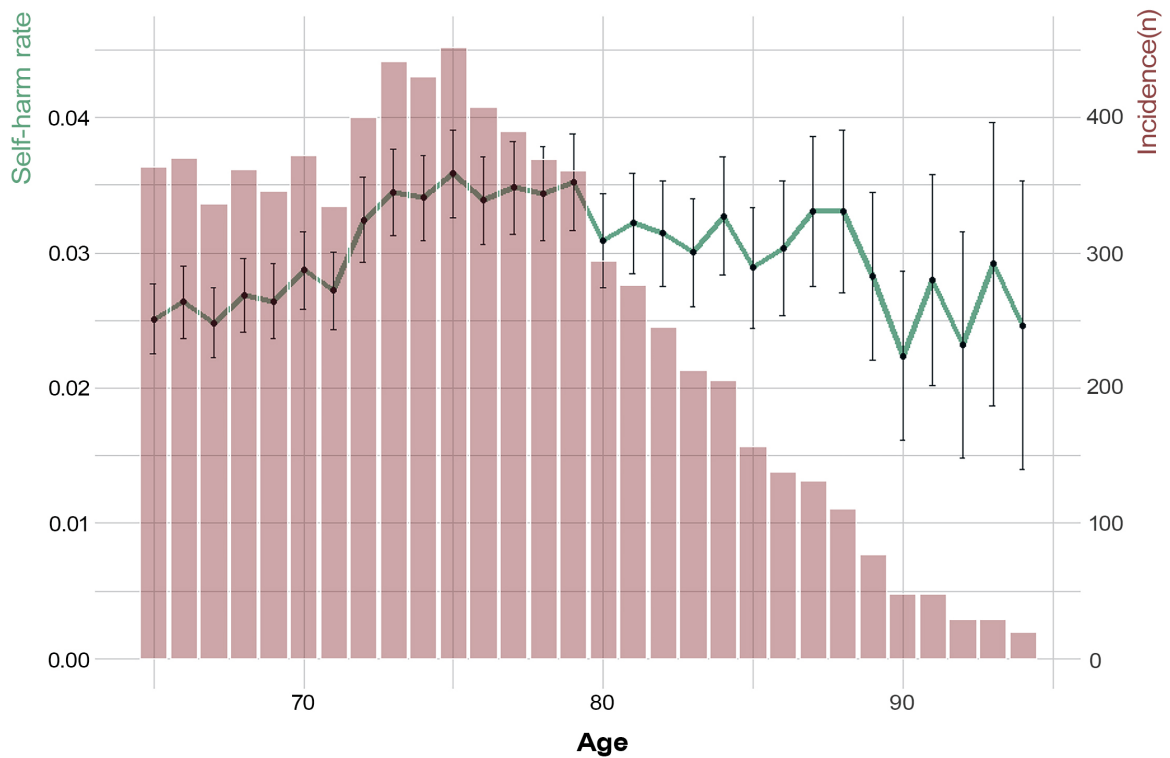**F I G U R E 1. Study population.**

F I G U R E 2. Incidence rate of self-harm in the study population.

T A B L E 1. Comparison of demographics and prehospital characteristics of patients between age subgroups.

	Total	65–79 years of age	80–94 years of age	*p* value
Number of patients	5968	4398	1570	
Sex: Male (%)	3457 (57.9)	2615 (59.5)	842 (53.6)	<0.05*
Age (median (IQR))	75.0 (70–80)	72.0 (68–76)	84.0 (81–86)	<0.05*
Visit season (%)				
Spring	1631 (27.3)	1210 (27.5)	421 (26.8)	
Summer	1637 (27.4)	1191 (27.1)	446 (28.4)	0.66
Fall	1532 (25.7)	1124 (25.6)	408 (26.0)	
Winter	1168 (19.6)	873 (19.8)	295 (18.8)	
Visit method: emergency medical service (%)	5244 (87.9)	3842 (87.4)	1402 (89.3)	0.05
Alcohol consumption (%)	1396 (23.4)	1172 (26.6)	224 (14.3)	<0.05*
Injury location: residential (%)	5390 (90.3)	3941 (89.6)	1449 (92.3)	<0.05*
Previous suicide history (%): One or more times	846 (14.2)	651 (14.8)	195 (12.4)	<0.05*
Motivation (%)				
Health problem	1734 (29.1)	1182 (26.9)	552 (35.2)	
Psychological problem	1379 (23.1)	1040 (23.6)	339 (21.6)	
Conflict with family or friend	1178 (19.7)	956 (21.7)	222 (14.1)	<0.05*
Death of family or friend	183 (3.1)	118 (2.7)	65 (4.1)	
Economic problem	176 (2.9)	159 (3.6)	17 (1.1)	
Other	1318 (22.1)	943 (21.4)	375 (23.9)	
Self-harm method (%)				
Poisoning	4906 (82.2)	3602 (81.9)	1304 (83.1)	
Cutting/Piercing	381 (6.4)	290 (6.6)	91 (5.8)	
Hanging/Strangulation	365 (6.1)	282 (6.4)	83 (5.3)	0.20
Fall from height	178 (3.0)	131 (3.0)	47 (3.0)	
Other	138 (2.3)	93 (2.1)	45 (2.9)	

*p < 0.05.

3.2 Self-harm characteristics

Patients with documented self-harm behavior were categorized into two groups according to age. The demographics and prehospital characteristics of the two groups are summarized in Table 1. There was no difference in the seasonal incidence of self-harm between the two groups. Self-harm in the 65–79 age group was more related to alcohol consumption compared to the 80–95 age group (26.6% versus 14.3%; *p* < 0.05). The location in which self-harm occurred was also significantly different between the two groups. In terms of the motivation for self-harm, health problems were more often a factor among patients in the 80- to 95-year-old age group compared to those in the 65–79 age group (29.1% versus 22.7%); in contrast, relationship problems were more often a factor in the 65–79 age group (18.8% versus 12.5%). There was no significant difference in self-harm method between the two age groups.

Table 2 shows the in-hospital characteristics of the two groups. More patients in the 80- to 95-year-old age group arrived in the emergency department with a poor mentality. Hospital mortality was significantly higher in the 80–95 age group.

Backward stepwise regression was performed to find the risk factors for in-hospital mortality of all inclusions. Variables such as season, location of injury, and previous suicide history were eliminated, after which the adjusted odds ratios were calculated for sex, age, ED visit method, alcohol relation, motivation, and self-harm method. Factors associated with in-hospital mortality across all older adults with self-harm behavior are shown in Table 3. In-hospital mortality was associated with older age, male sex, ED visit with emergency medical service, and self-harm method, including falling from a height, hanging, and poisoning. Falling from a height, among other factors, was strongly associated with in-hospital mortality.

4. Discussion

Self-harm among the elderly is an important public health concern, as it is a major risk factor for eventual suicide and life expectancy is increasing rapidly worldwide. However, most studies analyzing self-harm in the elderly have focused on older adults as a single group [19, 20]. This retrospective study used a large sample from the EDIIS database. Patients who were ≥65 years of age were categorized into a 65–79 age

TABLE 2. In-hospital characteristics of patients with self-harm behavior.

	Overall	65–79 years of age	80–94 years of age	p value
Number of patients	5968	4398	1570	
Mental status (%)				
Alert	2365 (39.6)	1769 (40.2)	596 (38.0)	
Verbal response	1015 (17.0)	752 (17.1)	263 (16.8)	
Pain response	1109 (18.6)	768 (17.5)	341 (21.7)	<0.05*
No response	600 (10.1)	424 (9.6)	176 (11.2)	
Unknown	879 (14.7)	685 (15.6)	194 (12.4)	
Systolic blood pressure (mmHg%)				
0–89	724 (12.1)	541 (12.3)	183 (11.7)	
>90	4459 (74.7)	3263 (74.2)	1196 (76.2)	0.27
Unknown	785 (13.2)	594 (13.5)	191 (12.2)	
Heart rate (%)				
0–59	563 (9.4)	403 (9.2)	160 (10.2)	
60–99	3537 (59.3)	2594 (59.0)	943 (60.1)	0.28
>100	1050 (17.6)	780 (17.7)	270 (17.2)	
Unknown	818 (13.7)	621 (14.1)	197 (12.5)	
Respiration rate (%)				
0–9	362 (6.1)	271 (6.2)	91 (5.8)	
10–29	4687 (78.5)	3441 (78.2)	1246 (79.4)	0.32
>30	139 (2.3)	96 (2.2)	43 (2.7)	
Unknown	780 (13.1)	590 (13.4)	190 (12.1)	
Emergency department outcome (%)				
Discharge	1519 (25.5)	1161 (26.4)	358 (22.8)	
Admission	3269 (54.8)	2395 (54.5)	874 (55.7)	<0.05*
Death	611 (10.2)	432 (9.8)	179 (11.4)	
Other	569 (9.5)	410 (9.3)	159 (10.1)	
Outcome after admission (%)				
Discharge	1953 (59.7)	1448 (60.5)	505 (57.8)	
Death	346 (10.6)	248 (10.4)	98 (11.2)	
Discharge against medical advice	281 (8.6)	222 (9.3)	59 (6.8)	<0.05*
Other	689 (21.1)	477 (19.9)	212 (24.3)	
Operation (%)	261 (6.3)	195 (6.5)	66 (5.6)	0.27
In-hospital mortality (%)	957 (16.0)	680 (15.5)	277 (17.6)	<0.05*

*p < 0.05.

T A B L E 3. Risk factors for in-hospital mortality of self-harm patients.

Independent variables	Adjusted odds ratio*	95% confidence interval
Age between 80 and 95 years	1.17	0.98–1.38
Sex (Male)	1.86[†]	1.58–2.20
Alcohol consumption	0.63[†]	0.51–0.77
Visit method: emergency medical service	1.80[†]	1.36–2.42
Motivation		
Psychological problem	0.70[†]	0.56–0.87
Conflict with family or friend	0.35[†]	0.27–0.46
Death of family or friend	0.71	0.45–1.10
Economic problem	0.54[†]	0.32–0.87
Health problem	0.66[†]	0.54–0.81
Self-harm method		-
Fall from height	21.84[†]	11.79–42.87
Hanging/Strangulation	10.01[†]	5.74–18.63
Poisoning	1.21	0.72–2.19
Cutting/Piercing	0.41[†]	0.20–0.85

Adjusted for age, sex, alcohol consumption, method of emergency department visit, motivation, and self-harm method.
[†]*Variables with significance.*

group (younger-old) and an 80–95 age group (older-old). We found that the incidence of self-harm peaked in the mid-70s and that the two groups exhibited significant differences in the motivation for self-harm and some demographic variables, such as sex, alcohol consumption status, previous suicide history, and injury location. There was no significant difference in vital signs at the time of the emergency department visit; however, older-old adults had a poorer mental status and a higher risk of in-hospital mortality. We chose the stepwise regression to find the relatively significant factors among many variables, although its statistical limitation due to multiple comparison. As a result, risk factors for self-harm in older adults included male sex, no alcohol consumption, emergency medical service use, and the method of self-harm (fall from height, hanging/strangulation).

The identified risk factors for in-hospital mortality across all age groups were identical to those reported in previous studies on self-harm and suicide [8, 21, 22]. Older men who had attempted self-harm (via fall from height, hanging, or poisoning) and did not consume alcohol were more likely to have been successful in their suicide attempt. However, these risk factors were not significantly different between the age groups. The effect of the naturally resilient physical status of older age could be influenced by the higher mortality of older-old rather than differences in prehospital characteristics.

Analyzing the characteristics of self-harm is important for preventing injuries and fatal outcomes. Our results showed that self-harm in younger-old adults was more frequently related to alcohol consumption; this suggested that self-harm in this age group was often an impulsive act [23, 24]. The higher prevalence of planned self-harm in older-old adults may account for their higher mortality rate.

The type of self-harm method used is an important predictor

of recurrent self-harm and subsequent mortality. It is well known that violent methods such as falls from height and cutting are more lethal than non-violent methods, such as self-poisoning. Lethal methods, are linked to fatal repetitive episodes [25]. However, there were no differences in self-harm methods between younger-old and older-old adults in the present study, despite a poorer mental status at the time of arrival at the emergency department and a higher hospital mortality rate in older-old adults. A similar method with different clinical outcomes might be due to the resilient physical status of older age compared with younger age. The motivation for self-harm among older-old adults was distinctly different from that of younger-old adults. While older-old adults were more frustrated by their health problems, they were less affected by relationship problems compared to younger-old adults. Previous studies have shown that physical illness in the elderly is linked to self-harm, which is often more severe compared to younger age groups [22, 26]. A multidisciplinary approach for understanding the orientation of self-harm is required in the emergency department, in order to decrease the incidence of suicide mortality [27, 28]. This study implies that case management of self-harm patients needs to focus especially on older-old people with health problems. This study could initiate the development of community-based suicide prevention programs that are age- and motivation-specific.

This study had some limitations. First, as this study retrospectively analyzed patient surveillance data from participating hospitals, sampling bias may have occurred. Potential sampling bias was likely minimal, as the participating hospitals were located in 13 of the 17 provinces in South Korea. However, the hospitals were also mainly located in urban rather than rural areas. Second, there were quite a few missing values for explanatory and outcome variables (*e.g.*, occupation and

education level) that were only defined as mandatory at admission. Although the large size of sample produced statistically significant results, missing data might have influenced the outcome with selection bias. Third, the registry only included patients who visited emergency departments; therefore, there may have been selection bias due to the fact that completed suicides and cases of self-harm that did not require emergency care were not accounted for. Fourth, various sociocultural factors such as religion, which possibly affects self-harm and suicide, were not considered in this study. Previous studies demonstrated that religious service attendance protects against suicide attempts and possibly protects against suicide [29, 30].

5. Conclusions

In conclusion, the incidence of self-harm in older adults peaked in the mid-70s and decreased thereafter. A higher mortality rate was observed among older-old adults, and this may be attributed to resilient physical status naturally derived from older age compared to younger age, although they have similar self-harm methods with different motivations. Therefore, prevention should focus on understanding self-harm motivations using a multidisciplinary approach.

AVAILABILITY OF DATA AND MATERIALS

The data presented in this study are available on reasonable request from the corresponding author.

AUTHOR CONTRIBUTIONS

KYJ—Conceptualization, data curation, formal analysis, writing original draft, visualization; WCC and TK—Methodology, writing review and editing, supervision. All authors have read and approved the manuscripts

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was approved by the Institutional Review Board of Ewha Womans University Seoul hospital (IRB no. SE-UMC 2021-11-042); the requirement for informed consent was waived due to the use of a retrospective study design. The study protocol satisfied the requirements specified under the Ministerial Decree of Health and Welfare passed by the National Bioethics Committee.

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CONFLICT OF INTEREST

The authors declare no conflict of interest. Won Chul Cha is serving as one of the Editorial Board members of this journal. We declare that Won Chul Cha had no involvement in the peer review of this article and has no access to information regarding its peer review. Full responsibility for the editorial process for this article was delegated to OK.

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