Psychiatry Research 330 (2023) 115613

Contents lists available at ScienceDirect

Psychiatry Research

journal homepage: www.elsevier.com/locate/psychres

Characteristics and risk factors of suicide among people who attempted self-harm in South Korea: A longitudinal National Cohort Study in South Korea

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ARTICLE INFO

Keywords:
People who attempted self-harm
Suicide
Longitudinal national cohort

ABSTRACT

Although self-harm is known as a significant risk factor for suicide, there are insufficient studies on the characteristics of people who self-harmed and the factors affecting suicide using a national dataset in Asia. This study aimed to identify demographic, clinical, and socioeconomic factors of individuals who attempted self-harm concerning suicide mortality. By analyzing the Korean National Health Insurance Service data from 2002 to 2020, we compared the people who attempted self-harm to the general population and explored factors affecting suicide by using the Cox proportional hazards model. Older age, female sex, lower socioeconomic status, and psychiatric conditions were associated with higher self-harm attempts. Suicide was more prevalent among males with mild disabilities, using fatal self-harm methods, and higher Charlson Comorbidity Index (CCI) scores. Socioeconomic factors that were significantly related to self-harm attempt were relatively less significant in the suicide survival analysis, while male gender, older age, fatal self-harm methods, high CCI scores, psychiatric diagnosis, and drinking habits were significantly associated with lower suicide survival rates. These results showed that demographic, clinical and socioeconomic factors affecting self-harm differ from those affecting actual suicidal death after self-harm. These insights may assist in developing targeted prevention strategies for specific populations.

1. Introduction

Suicide is a serious global public health issue and a leading cause of death worldwide. Globally, 703,000 individuals die by suicide every year (WHO, 2021). In particular, the suicide rate in South Korea was 24·6 per 100,000, which is more than twice the Organization for Economic Co-operation and Development (OECD) average (OECD, 2021). Although the overall suicide rate in other OECD countries has declined (Naghavi and Global Burden of Disease Self-Harm, 2019), South Korea's suicide rate has rapidly increased by approximately 46 % over the past 20 years (2000–2019). Compelling evidence suggests that suicide is caused by demographic, clinical, and socioeconomic risk factors (Chai et al., 2020; Garcia de la Garza et al., 2021; Gunak et al., 2021; Mok et al., 2018; Morgan et al., 2018). Previous research explained that the high suicide rate in Korea may be related to social disruption resulting from rapid industrialization and economic growth in South Korea as a macro factor (Blasco-Fontecilla et al., 2012). However, as a more microscopic and direct cause, self-harm has been reported to be related to suicidal behaviors.

Large cohort studies in OECD countries have identified other risk

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https://doi.org/10.1016/j.psychres.2023.115613
Received 27 April 2023; Received in revised form 15 November 2023; Accepted 17 November 2023
Available online 21 November 2023

factors strongly associated with the subsequent death of people who have attempted self-harm, including a history of self-harm, mental illness, comorbidities, and low income (Bostwick et al., 2016; Chai et al., 2020). Self-harm is one of the main risk factors for death by suicide (Bostwick et al., 2016). Previous studies have estimated that individuals who experience self-harm are approximately 25–37 times more likely to die by suicide than the general population (Hawton et al., 2003). From 5 % to 11 % of hospital-treated people who attempted self-harm died by suicide, a far higher proportion than that in the general population, where annual suicide rates are approximately 1 in 10,000 (Owens et al., 2002). The risk of suicide in the first year following self-harm was 49 times greater than that of the general population risk of suicide in England and Wales (Hawton et al., 2015).

Identifying and managing self-harm are significant opportunities to prevent subsequent suicide. Due to the high risk of suicide, relatively extensive studies have been conducted in Western countries on the characteristics and risk factors of suicide among people who have attempted self-harm (Geulayov et al., 2019, 2016; Parra-Uribe et al., 2017; Tidemalm et al., 2008). However, few studies in Asian countries have focused on this issue. This means that the risk factors are mostly confined to death by suicide in the general population and not to people who attempted self-harm (Choi et al., 2018; Kootbodien et al., 2020; Zaridze et al., 2014). Although previous studies have identified risk factors related to self-harm, they were limited by non-cohort study designs (Garcia de la Garza et al., 2021; Lim et al., 2014; Park et al., 2018), specific population restrictions (Chai et al., 2020; Gunak et al., 2021; Mok et al., 2018; Morgan et al., 2018), events with global impact, such as COVID-19 (Farooq et al., 2021; Wong et al., 2023; Woo et al., 2023), or the absence of objective validation for self-reported self-harm status and risk factors (Choi et al., 2018). Meanwhile, previous studies that identified risk factors for suicide death after self-harm based on cohort studies (Beckman et al., 2016; Madsen et al., 2013; Olfson et al., 2017; Runeson et al., 2016, 2010; Tidemalm et al., 2008) were all Western-based. While the studies have clarified the characteristics of self-harm groups and the risk factors for suicide after self-harm, none of these studies identified differences between people who lived through self-harm and those who committed suicide after self-harm.

To fill this gap in the evidence, we analyzed the characteristics of people who attempted self-harm and their risk factors for death by suicide using a longitudinal cohort database covering the national population of people admitted to all hospitals in South Korea due to a self-harm attempt over 20 years. We aimed to (1) identify the characteristics of people who attempted self-harm compared to the general population, (2) identify the characteristics of death by suicide after a self-harm attempt, and (3) investigate the risk factors for death by suicide after a self-harm attempt using survival analysis.

2. Method

2.1. Data sources

We used the South Korean National Health Insurance Service (KNHIS) database, an administrative database based on health insurance claims for the entire South Korean population. Since all citizens must subscribe to health insurance, the KNHIS includes two insurance types classified as National Health Insurance (NHI) and Medical Aid (MA) beneficiaries. Under the National Health Insurance Act, all citizens residing in South Korea become national health insurance beneficiaries, except MA beneficiaries (Song et al., 2014). Joining the NHI and paying premiums are compulsory. However, low-income families who below the poverty line are eligible for MA beneficiaries (hereafter referred to as medical benefits), and the state pays all or most of their medical expenses. 97 % of the people in South Korea are required to sign up for the NHI program, and the MA program provided coverage for the remaining 3 % of the population as of 2017 (Song et al., 2014).

As part of our retrospective analysis, we created a self-harm cohort to track individuals who had experienced at least one episode of self-harm between January 2002 and December 2020. The International Classification of Diseases version 10 (ICD-10) codes for intentional self-harm were used to define self-harm, including suicide attempts and non-suicidal self-harm (X60-X84).

The KNHIS (Ahn, 2020) is a universal coverage health insurance system that includes detailed treatment practices and prescriptions based on a fee-for-service payment model and the health information of all citizens who have signed up for national medical insurance in South Korea. The data included public data on healthcare utilization, such as disease diagnoses, drug prescriptions, and procedures; national health examination results, including smoking, drinking, physical measurements, and body measurements; and demographic and socioeconomic variables, such as age, sex, disability, and mortality of the entire South Korean population.

Statistics Korea (KOSTAT) (Park et al., 2016) links and provides the Cause of Death Statistics. We asked KOSTAT to link the cause and date of death for the case of death of all patients with self-harm, especially to identify death by suicide. The KNHIS data were linked to cause-of-death statistics based on the number of resident subjects. This study was performed through a retrospective analysis of data obtained from an existing database from which personal information was eliminated.

2.2. Study design

Of the 6350 patients who attempted self-harm, 18 with missing birth dates were excluded. The cohort database in this study comprised 6332 patients who experienced at least one episode of self-harm between January 2002 and December 2020 (Fig. 1). According to the ICD-10 criteria, deaths from causes of X60-X84 were defined as “Death by suicide,” and those who had attempted self-harm with X60-X84 but did not die were defined as “Lived through self-harm attempt.” Of the 6332 patients, 632 died from suicide during follow-up (10 %), and 638 (10 %) died from other causes.

Variables were classified into three categories to identify the characteristics of self-harm attempts and risk factors associated with death by suicide: demographic, medical history-related, and socioeconomic characteristics, and compared with the general population. Regarding demographic characteristic variables, age was divided into 10-year age groups and used in this study. However, for the survival analysis, age was re-coded as ⟨ 65 and ⟩ 65 years based on the criteria identifying the entry threshold for old age, possible retirement, eligibility for dedicated

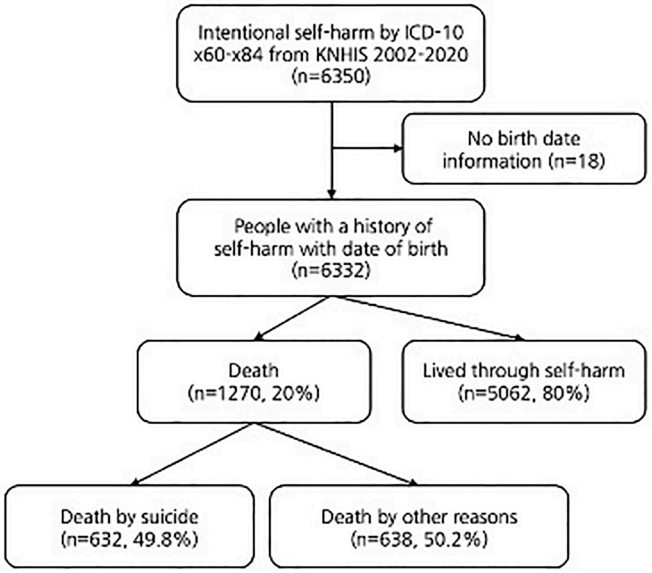

Fig. 1. Patient selection flow.

social programs= and medical benefits health insurance (De Leo and Giannotti, 2021).

Regarding clinical history-related characteristic variables, the severity of the self-harm method, Charlson Comorbidity Index (CCI) (Charlson et al., 1987), degree of disability, and psychiatric diagnosis (Hwangbo et al., 2020) history were included. The severity of self-harm was also assessed. According to previous studies (Spicer and Miller, 2000; Yeum et al., 2018), the severity of the self-harm method variable was defined as "non-fatal" for self-harm attempts with drugs (X = 60–64) and cutting (X = 78), and as "fatal" for self-harm attempts with other methods, including hanging, pesticide, and jumping from heights. A common method for comorbidity correction is the CCI, which includes allocating a specific weight of 1–6 points to 19 diseases determined by medical record surveys and then adjusting the sum of these weights. Based on the Korean legal criteria for evaluating the degree of disability, the degree of disability was defined as "no disability, mild, or severe." Psychiatric diagnosis refers to psychiatric diagnostic codes, including ICD-10 F00-F99 (mental and behavioral disorders). The psychiatric diagnosis history variable was defined as "no" when there was no psychiatric diagnosis history and "yes" when there was a psychiatric diagnosis history during the observation period.

Socioeconomic variables, included alcohol consumption, smoking status, and medical coverage. The variables for drinking and smoking were defined differently based on the level of consumption and recommendations from the healthcare providers. "NA" was used when the item was not measured due to non-drinking/non-smoking or unknown reason, "moderate" was used when the level of consumption was less severe but abstinence/quitting was recommended, and "severe" was used when the level of consumption was so severe that healthcare providers strongly recommended abstinence/quitting. The insurance types were classified as NHI or MA beneficiaries.

2.3. Statistical analysis

First, one-sample proportion tests were performed to examine differences in variables between people who attempted self-harm and the general population. We used indicators from the general population, officially provided by the Korean Statistical Information Service. Indicators related to the variables in this study were compared with the characteristics of self-harm attempters. The detailed values of each indicator for each year are listed in Supplementary Table 1.

Second, independent t-tests for continuous variables and chi-squared tests for categorical variables were performed to determine the differences in the variables between death by suicide and lived through self-harm groups among people who attempted self-harm.

Finally, the cumulative incidence of events was calculated using the Kaplan-Meier estimator of the relevant survival function and graphed with 95 percent confidence intervals to estimate the risk of death by suicide among people who attempted self-harm. Univariate and multivariate analyses using the Cox proportional hazards model were conducted to analyze the risk factors for death by suicide among people who attempted self-harm. A univariate Cox regression model was used to test the ability of potential baseline risk factors to predict suicide risk. We also performed multivariate analysis to identify the independent predictor variables. In the multivariate Cox regression model, statistically significant variables were selected and used in the univariate analysis. The threshold for statistical significance was set at $P < 0{\cdot}05$. STATA (version 17·0, STATA) and R software (version 3·3·2, R) were used for all statistical analyses.

3. Results

3.1. Differences in variables between the people who attempted self-harm and the general population in South Korea

Differences were observed in the variables between individuals who attempted self-harm and the general population (Table 1). Significant differences were observed between variables. Regarding demographic factors, females (52·3 %) and those aged 40 years or older were more common among people who attempted self-harm, whereas males and those aged 39 years or younger were more common among the general population. Regarding clinical history-related factors, both people who attempted self-harm and the general population had fewer disabled people. However, people who attempted self-harm (12·6 %) had a significantly higher proportion of disabled people than the general population (5·4 %). People with a psychiatric diagnosis (86·5 %) attempted self-harm more, whereas the general population had fewer psychiatric diagnoses (85·0 %).

Regarding socioeconomic factors, smokers (61·7 %), and medical aid beneficiaries (10·5 %) were more common among those who attempted self-harm, whereas non-smokers (77·0 %) and national health insurance beneficiaries (97·1 %) were more common among the general population. There were no significant differences in drinking habits between groups.

3.2. Differences in variables between the death-by-suicide group and the lived-through-self-harm group among people who attempted self-harm in South Korea

Table 2 shows the differences in the variables between the death by suicide and lived through self-harm groups among people who attempted self-harm. Regarding demographic factors, more males (62·7 %) and people aged 60 or older (48·0 %) died by suicide, whereas females (56·5 %) and those aged 59 years or younger (78·1 %) were more common among the lived-through-self-harm group.

Regarding clinical history-related factors, those with a history of fatal self-harm methods (77·8 %) and high CCI scores were more common in the suicide group than in the self-harm group. Both groups were mostly non-disabled and had a history of psychiatric diagnosis.

Table 1
Characteristics between the group of people who attempted self-harm and the general population in South Korea.

Variables	People who attempted self-harm (n = 6332)		General population[a] (n = 50,354,406)	P value
	N	%	%	
Demographic factor				
Gender				< 0·001
Female	3311	52·3	49·9	
Male	3021	47·7	50·1	
Age group				< 0·001
Under 20	554	8·7	22·3	
20–29	867	13·7	14·4	
30–39	883	13·9	16·3	
40–49	1084	17·1	16·9	
50–59	1123	17·7	13·7	
60–69	746	11·8	8·9	
70–79	660	10·4	5·3	
over 80	415	6·6	2·2	
Clinical history related factor				
Self-harm method severity				
Non-fatal	3603	56·9	NA	NA
Fatal	2729	43·1	NA	NA
Disability	795	12·6	5·4	< 0·001
Psychiatric diagnosis	5479	86·5	15·0	< 0·001
Socioeconomic factor				
Drinking	3897	61·5	60·3	0·051
Smoking	3907	61·7	23·0	< 0·001
Type of health insurance				< 0·001
National health insurance	5669	89·5	97·1	
Medical aid benefit	663	10·5	2·9	

[a] Average national population from 2002 to 2020, detailed in Supplementary Table 1.

Table 2
Differences between the death by suicide and lived through self-harm groups among people who attempted self-harm in South Korea ($n = 5694$).

Variables	Lived through self-harm group ($n = 5062$)	Death by suicide group ($n = 632$)	P value
Demographic factor			
Gender (n,%)			< 0·001
Female	2860 (56·5)	236 (37·3)	
Male	2202 (43·5)	396 (62·7)	
Age (n,%)			< 0·001
Under 20	536 (10·6)	15 (2·4)	
20–29	807 (15·9)	44 (7·0)	
30–39	784 (15·5)	69 (10·9)	
40–49	923 (18·2)	92 (14·6)	
50–59	907 (17·9)	109 (17·3)	
60–69	499 (9·9)	77 (12·2)	
70–79	383 (7·6)	127 (20·1)	
Over 80	223 (4·4)	99 (15·7)	
Clinical history related factor			
Self-harm method severity (n,%)			< 0·001
Non-fatal	3184 (62·9)	140 (22·2)	
Fatal	1878 (37·1)	492 (77·8)	
CCI (m, SD)	1·27 (1·4)	2·24 (1·6)	< 0·001
Disability (n,%)			< 0·001
Mild	355 (7·0)	93 (14·7)	
Severe	284 (5·6)	25 (4·0)	
No	4423 (87·4)	514 (81·3)	
Psychiatric diagnosis (n, %)			< 0·001
No	747 (14·8)	17 (2·7)	
Yes	4315 (85·2)	615 (97·3)	
Socioeconomic factor			
Drinking (n,%)			0·026
Moderate	2067 (40·8)	271 (42·9)	
Severe	1091 (21·6)	107 (16·9)	
NA	1904 (37·6)	254 (40·2)	
Smoking (n,%)			0·180
Moderate	2145 (42·4)	272 (43·0)	
Severe	1017 (20·1)	108 (17·1)	
NA	1900 (37·5)	252 (39·9)	
Type of health insurance (n,%)			0·422
National health insurance	4571 (90·3)	577 (91·3)	
Medical aid benefit	491 (9·7)	55 (8·7)	

However, the group that died by suicide had a higher rate of mild disability (5·6 %) and a higher rate of no history of psychiatric diagnosis (14·8 %) than the group that lived through self-harm.

Regarding socioeconomic factors, the proportion of moderate drinkers was high in both groups; however, when comparing the two groups, the proportion of moderate drinkers was higher in the group that died by suicide (42·9 %), and the proportion of heavy drinkers was higher among the group that lived through self-harm (21·6 %).

3.3. Survival analysis in a self-harm attempts group

The univariate Cox proportional hazards model indicated that male sex (HR=2, 95 % CI:1·78 −2·22) and older age (HR=4·54, 95 % CI:4–5) from demographic factors and self-harm methods with fatal severity (HR=2·69, 95 % CI:2·39–3·03) were highly and independently associated with an increased risk of suicide. Among the clinical history-related factors, a high CCI score (HR=1·71, 95 % CI:1·64 - 1·77) was significantly associated with an increased risk of suicide due to self-harm. The HR of the severely disabled group was 0·51, and the HR of the psychiatric diagnosis group was 1·64. Regarding socioeconomic factors, the group with drinking and smoking habits was more vulnerable to suicide than the non-drinkers and non-smokers, with HR of 1·25, and 1·17, respectively. The group receiving medical benefits was more vulnerable to suicide than the NHI group, with an HR of 1·4 (Fig. 2A).

All nine variables found to be of prognostic significance in the univariate analysis were entered into the multivariate model: sex, age, self-harm method, CCI, disability, psychiatric diagnosis, drinking habits, smoking habits, and medical benefits. In the multivariate Cox proportional hazards analysis, all variables except disability had a statistically significant impact on suicide survival rate. The multivariate Cox proportional hazards model indicated that male gender (HR = 1·61, 95 % CI:1·18 - 1·42, $P < 0·001$), older age group (HR = 1·44, 95 % CI:1·17 - 1·75, $P < 0·001$), self-harm method with fatal severity (HR = 2·19, 95 % CI:1·94 – 2·47, $P < 0·001$), high CCI score (HR = 1·52, 95 % CI:1·42 – 1·63, $P < 0·001$), psychiatric diagnosis (HR = 1·82, 95 % CI:1·47 – 2·25, $P < 0·001$), drinking habit (HR = 1·35, 95 % CI:1·17 – 1·56, $P < 0·001$), smoking habit (HR = 1·19, 95 % CI:1·03 – 1·36, $P = 0·016$), and MA benefit (HR=1·23, 95 % CI:1·04 – 1·45, $P = 0·014$) were significantly and independently associated with increased risk of suicide of people who attempted self-harm (Fig. 2B).

4. Discussion

This study found significant differences in the characteristics and risk factors associated with self-harm attempts and death by suicide after self-harm. People who attempted self-harm were more common among older individuals, women, those with a lower socioeconomic status, and those with psychiatric conditions or disabilities than in the general population. However, among those who attempted self-harm, those who died by suicide were more likely men with mild disabilities. Fatal methods of self-harm and high CCI scores were associated with an increased risk of suicide. Socioeconomic factors were significantly different between the general population and those who attempted self-harm; however, there was no significant difference in the comparison between the death by suicide group and the group that lived through self-harm, except for drinking. Male sex, older age, fatal self-harm methods, and high CCI scores were associated with a high risk of death by suicide among people who attempted self-harm.

We compared our results with previous studies on characteristics of self-harm attempts and risk factors for suicide deaths after self-harm. First, we found similar results to previous studies in Western countries in terms of demographic, clinical and socioeconomic characteristics of the people who attempted self-harm (Geulayov et al., 2016; Hawton et al., 2015; Olfson et al., 2017; Qin and Mehlum, 2020), but one difference in our study was found. The proportion of males who attempted self-harm was different from the previous studies. That is, in previous studies in Western countries, the proportion of males attempting self-harm was much lower than that of females (Hawton et al., 2015; Olfson et al., 2017). However, in our study, the proportions of male (47·7 %) and female (52·3 %) self-harm attempters were more even. No study has identified a definitive reason for the relatively high rate of self-harm attempts among Korean men, and further research is necessary to elucidate the causes. However, given the cultural stigma surrounding mental illness and negative attitudes toward seeking help, which is frequently observed among Asians and men (Kudva et al., 2020; Pattyn et al., 2015), it is likely that Korean men are also reluctant to seek assistance for mental health issues. This tendency may lead to underdiagnosis and undertreatment of underlying mental health conditions (McKenzie et al., 2022; Park et al., 2015), which may contribute to elevated self-harm attempts among Korean men. Second, numerous cohort studies in Western settings have successfully identified risk factors associated with suicide following self-harm incidents. We found that each study had slightly different suicide risk factors to focus on and identify e.g., repeated self-harm (Olfson et al., 2017), serious mental illness (Beckman et al., 2016; Runeson et al., 2016), social status such as employment status education (Madsen et al., 2013; Runeson et al.,

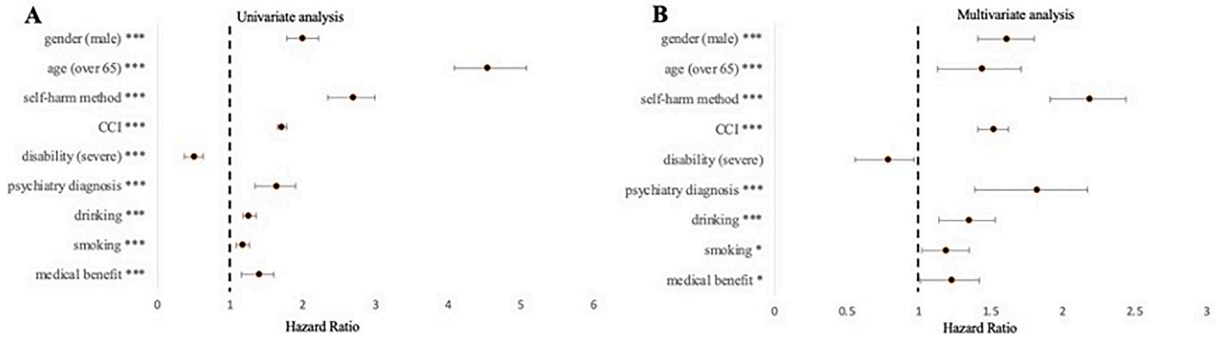

Fig. 2. Univariate and multivariate analysis of the risk factors in self-harm attempts group
Note: This figure displays the univariate (A) and multivariate analyses (B). (*$P < 0{\cdot}05$, **$P < 0{\cdot}01$, ***$P < 0{\cdot}001$).

2016), and suicidal family history (Beckman et al., 2016). However, when comparing our study with studies dealing with common risk factor variables, men, older age, and fatal self-harm methods were similarly identified as suicide risk factors after self-harm. Of course, even with similar results, some appeared differently depending on the sociological situation. For example, while firearms, hanging, and drowning were mentioned as fatal suicide methods in the West (Olfson et al., 2017; Runeson et al., 2016; Song et al., 2023), hanging and pesticide ingestion were found to be high risk suicide methods in our study.

The significance of this study is threefold. First, it is the first study to compare the characteristics of people who have attempted self-harm with the general population in South Korea. Second, we used a national longitudinal cohort in South Korea with comprehensive information to identify the characteristics and risk factors differentiating survivors from suicides among people who attempted self-harm. Third, we compared the characteristics observed in South Korea with those in the extensive Western literature, given the absence of adequately researched Asian studies.

Significant differences in demographics, clinical history, and socioeconomic factors were observed between individuals who attempted self-harm and the general population. Self-harm attempts are more prevalent among older adults and women. Elderly individuals who attempted self-harm were found to be at high risk for suicide, as documented in previous studies (Hawton et al., 2003; Parra-Uribe et al., 2017). The rate of self-harm attempts among individuals with disabilities was more than double that of the general population, and psychiatric diagnoses were more than five times higher. Moreover, the ratio of medical aid benefits and smoking history among those who attempted self-harm was significantly higher than that of the general population, with values of three and two times, respectively. Among socially marginalized groups in South Korea, excluding smokers, those with certain characteristics are known (Bostwick et al., 2016; Milner et al., 2012; Tidemalm et al., 2008) to have higher rates of depression and suicidal ideation, which may contribute to the high rate of suicide attempts. Therefore, to prevent suicide attempts proactively, it is necessary to establish a suicide prevention policy that considers these characteristics of people who attempt self-harm.

Survival analysis to identify risk factors among people who attempted self-harm revealed that the method of self-harm, severity of illness (CCI), and psychiatric diagnosis were highly significant risk factors for death by suicide, consistent with previous research (McKenzie et al., 2022; Milner et al., 2012; Park et al., 2015). Regarding psychiatric diagnoses, prior research (Park et al., 2015) has demonstrated that individuals with a history of self-harm who were previously diagnosed with psychiatric disorders or who received a diagnosis from a psychiatric department had a higher survival rate. Unexpectedly, while the self-harm attempt cohort had a significantly higher proportion of people with disabilities than the general population, disability was not a significant risk factor in the survival analysis of the self-harm attempt group. This finding differs from the 2022 survey finding that a higher severity of disability is associated with an increased risk of suicide-related outcomes (ideation, planning, and attempts) (Kim et al., 2023). In this study, the suicide rate among those who attempted self-harm was significantly higher in the mild disability group. This may indicate that people with severe disabilities have a high desire to attempt suicide. However, due to physical limitations in their ability to attempt suicide, the suicide rate in this study was low.

Our study has several limitations. One is the relatively small number of individuals with self-harm and deaths by suicide after self-harm, despite using national health insurance cohort data, which claims to contain all health-related information for the entire Korean population. This shortage of data can be attributed to three reasons. First, because the target population was patients hospitalized after a self-harm attempt, it was not possible to capture all cases of self-harm and suicide deaths in the country. Second, the reluctance to be coded as self-harm may have resulted in underestimating the number of people who attempted self-harm. A diagnosis of suicide or self-harm disqualifies an individual from receiving medical insurance benefits. It is anticipated that most bereaved families and individuals who engage in self-harm will strongly oppose the assignment of a self-harm-related diagnosis. This opposition is likely to pressure healthcare professionals to abstain from including ICD-10 diagnosis codes related to self-harm in official hospital records (Kim et al., 2023). However, the dataset used in this study provides a representative sample of the nation's self-harm population because it was systematically and descriptively collected from all hospitals in South Korea for all patients admitted after a self-harm attempt.

The second limitation was the potential incompleteness of psychiatric diagnosis history. In our study, a history of a psychiatric diagnosis was a distinguishing characteristic of people who attempted self-harm, and it was also one of the risk factors for death by suicide among people who attempted self-harm. To objectively assess the experience of psychiatric illness, this study employed the psychiatric diagnosis history variable determined by a hospital physician. However, it is well documented that a significant number of individuals with psychiatric disorders remain undiagnosed (Badamgarav et al., 2003; Downey et al., 2012), which raises the possibility that the data in our study may also be affected by this problem.

Third, we defined the severity of self-harm methods based on previous studies (Spicer and Miller, 2000; Yeum et al., 2018); however, fatalities can vary depending on where, how much, and how the method is used. For example, previous studies have defined drug overdose and pesticide use as non-fatal and fatal, respectively. However, in reality, large drug overdoses are more likely to be fatal than small amounts of pesticides. Future research should collect more information on deliberate self-injury methods to define their severity and use this as a variable.

Finally, our dataset did not include treatment or drug prescription

information. Even though some previous studies reported that mortality may vary depending on the treatment administered after hospitalization for self-harm (Kapur et al., 2015; Meza et al., 2023; Ougrin et al., 2021), this study focused on identifying the characteristics of suicidal deaths after self-harm since the Korean National Health Insurance Service (KNHIS) database we analyzed does not include such treatment variables but mainly the patients' demographic, clinical, and socioeconomic status. In future studies, the influence of treatments and interventions to prevent suicide will be better investigated by considering the information on treatment received after self-harm.

The results of our study may help develop the following two services to prevent suicide in self-harm attempters. First, detailed coding systems for sensitive diseases, such as self-harm and suicide, should be created. This is due to the relatively small number of hospital data-based self-harm attempts, which were the datasets in our study, indicating the absence of a related coding system. Accurate data collection using a coding system is the first step in developing research and treatment processes. Second, to reduce suicide deaths among self-harm attempters, we must develop guidelines for linked and follow-up treatments. In our study, male, elderly, and chronic patients with high CCI scores, those with a history of psychiatry, and those with mild disabilities were at a high risk of suicide among self-harm attempters. Therefore, it is necessary to carefully observe those with these risk factors among those who visit the emergency medical department for self-harm and determine whether they should be treated in conjunction.

In conclusion, this study found that people who attempted self-harm were more vulnerable in terms of demographic, socioeconomic, and clinical backgrounds than the general population, while deaths by suicide after self-harm were mainly in men who used fatal self-harm methods and were clinically vulnerable. The novelty of this study lies in its clear distinction between the characteristics of those who died by suicide and those who lived-through self-harm among people who attempted self-harm, based on national longitudinal cohort data from South Korea, an Asian country with high suicide rates. Additionally, more intensive interventions are needed for people at greater risk of death by suicide after self-harm. These findings provide a basis for researchers, public health professionals, and policymakers to develop targeted approaches to prevent self-harm and suicide in each population.

Ethics statement

This retrospective study was approved by the Institutional Review Board of Severance Hospital, Yonsei University College of Medicine. The requirement for informed consent was waived (IRB no. 4-2021-0950).

Funding source

This work was supported by an Institute of Information and Communications Technology Planning and Evaluation (IITP 2022-0-00064) grant funded by the Korean government (Ministry of Science and ICT [MSIT]) and the Korean Society of Medical Informatics.

Role of the funding source

Funding was mainly used for data use and research labor costs. The authors used and paid for the KNHIS data of patients who experienced self-harm at least once for the entire nation and Statistics Korea (KOSTAT) data of deceased patients with the causes of death.

CRediT authorship contribution statement

Hye Hyeon Kim: Conceptualization, Data curation, Investigation, Methodology, Formal analysis, Visualization, Writing – original draft, Writing – review & editing. **Jin Hyuk Lee:** Conceptualization, Data curation, Investigation, Methodology, Formal analysis, Visualization, Writing – original draft, Writing – review & editing. **In Han Song:** Conceptualization, Investigation, Methodology, Supervision, Writing – original draft, Writing – review & editing. **Yu Rang Park:** Conceptualization, Investigation, Methodology, Funding acquisition, Project administration, Supervision, Writing – original draft, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

This can be discussed by contacting the corresponding author.

Acknowledgments

Brain Korea 21 Project of the Ministry of Education and Science of the Republic of Korea.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.psychres.2023.115613.

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