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# Unique characteristics that distinguish suicide attempters from patients with nonsuicidal self-injury admitted to the emergency department following self-harm behavior: Psychological scales and biochemical markers

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## Abstract:

**OBJECTIVE:** The objective was to investigate the characteristics of suicide attempters as distinguished from nonsuicidal self-injury (NSSI) among those who are admitted to the emergency department (ED) following self-harm behavior using psychological scales and biochemical markers.

**MATERIALS AND METHODS:** The initial assessment forms and medical records of patients referred to the ED after self-harm behavior between March 2017 and December 2019 were retrospectively reviewed. Based on the patients' statements, two groups were formed: the NSSI group and the suicide attempt (SA) group.

**RESULTS:** This study included 578 patients, 76.6% ( $n = 443$ ) in the SA group and 23.4% ( $n = 135$ ) in the NSSI group. A univariate analysis comparing the SA and NSSI groups revealed that the SA group was statistically significantly associated with male sex, chronic disease, history of depression, unemployment, not seeking help after the attempt, reduced consciousness, and psychiatric consultation. Further, the SA group was older and showed higher Risk-Rescue Rating Scale (RRRS) value and white blood cell value compared to the NSSI group. However, multivariate logistic analysis did not produce statistically significant results for RRRS and any of the biological markers, with one exception for the accessibility to rescue item in the RRRS, where the NSSI group showed a statistically higher "ask for help" score compared to the SA group ( $P < 0.01$ ).

**CONCLUSIONS:** Among patients who were admitted to the ED following self-harm behaviors, the risk factors for SA as opposed to NSSI were chronic disease and not seeking help after the attempt. In addition, suicide attempters tended to be more cooperative in psychiatric consultation following ED admission. In clinical practice, patients admitted due to NSSI should be administered treatment equivalent to that for suicide attempters if they exhibit the characteristics of suicide attempters.

## Keywords:

Biomarkers, emergency service, hospital, self-injurious behavior, suicide

## Introduction

Suicide is a serious issue at the individual and societal level that can unbalance the

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### Box-ED Section

#### What is known about the topic?

Studies have rarely applied objective parameters in distinguishing between nonsuicidal self-injury (NSSI) and suicide attempt (SA).

#### What did this study ask?

What are the characteristics of suicide attempters as distinguished from NSSI patients using psychological scales and biochemical markers?

#### What did this study find?

The risk factors for SA as opposed to NSSI were chronic disease and not seeking help after the attempt.

#### Why does this study matter to clinicians?

Treatment for NSSI should be equivalent to that for SA if NSSI patients exhibit the characteristics of suicide attempters.

foundations of a household and the structures of states. A recent WHO report highlighted the need for improving the public health perception of suicide, prioritizing suicide prevention in public health agendas owing to an increase in suicide rates among middle-aged people worldwide.<sup>[1]</sup>

Among various self-harm behaviors, nonsuicidal self-injury (NSSI) refers to the intentional harming of one's body under a socially unacceptable purpose without suicidal intent. NSSI includes cutting, burning, scratching, banging or punching walls, and other self-injurious behaviors.<sup>[2,3]</sup>

The emergency department (ED) is frequently the first place where suicide attempters are taken, especially when primary care institutions or outpatient clinics are inaccessible. Therefore, the ED plays an important role in providing primary treatment for suicide attempters and triages them to determine whether they need inpatient treatment or short-term outpatient follow-up.

Most patients who engage in NSSI do not seek medical care. However, many patients who present to an ED after NSSI have serious injuries that require medical and psychiatric attention. Moreover, these injuries can lead to potentially fatal outcomes.

Therefore, emergency physicians first assess and treat patients who inflicted self-harm and determine the next course of care depending on the severity of the injuries, and providing accurate, consistent, and timely treatment plays an important role in determining the patient's subsequent course of condition.<sup>[4]</sup>

NSSI and suicidal attempts (SAs) are differentiated based on one's self-reported purpose of the behavior. While a suicide attempt is an act based on an intention to die, NSSI is performed in order to experience comfort. However,

depending on the situation, individuals may report that they had no suicidal intent only for convenience, and some studies reported that individuals are highly likely to give false statements about their behavioral intentions.<sup>[5]</sup>

Conventionally, psychopathology studies are heavily dependent on self-report instruments that ask about patients' thoughts and feelings; one important limitation of self-report instruments is that they sometimes require individuals to understand the mechanism underlying their own behaviors despite the difficulty of doing so. Therefore, it is important to measure objective risk factors in addition to using self-report processes in differentiating NSSI and SA.<sup>[6]</sup>

The severity of SAs is typically assessed based on the lethality and intent. Suicide lethality is generally assessed using the Risk-Rescue Rating Scale (RRRS) and Self-Inflicted Injury Severity Form.<sup>[7]</sup> On the other hand, suicide intent is usually assessed using the Suicide Intent Scale.<sup>[8]</sup> These scales have been utilized in identifying the risk for subsequent SAs and estimating the overall suicidal mortality.<sup>[9]</sup>

Inflammation is known to play a potentially critical role in suicide.<sup>[10]</sup> C-reactive protein (CRP), neutrophil-to-lymphocyte ratio (NLR), platelet-to-lymphocyte ratio (PLR), and systemic immune inflammation index (SII) are commonly used as biological markers of inflammation and can be obtained from hemogram parameters, which is an indicator that is used for the prediction, severity, and diagnosis of many diseases.<sup>[11]</sup> However, hemogram derivatives are rarely used in diagnosing and determining the severity of psychiatric disorders.<sup>[12]</sup>

Most past studies examining the risk factors specific to NSSI and not SA in adults have utilized a history of SA or NSSI, a history of psychiatric illness, and self-report data on recent stress and various symptoms. Thus, we aimed to identify the unique risk factors of the SA group compared to the NSSI group using the RRRS, which is based on objective parameters for the risk and possibility of rescue at the time of self-injury, and biochemical markers for inflammation, which are based on the blood test results taken at the time of hospital admission. Based on these findings, we hope to highlight the need for providing care and treatment equivalent to that provided to suicide attempters and even to patients who engaged in NSSI, if they exhibit the characteristics of suicide attempters.

## Materials and Methods

### Study design and setting

This retrospective study was conducted on patients who visited the ED of the general hospital in a large urban city of South Korea, from March 2017 to December

2019, following their self-harm behavior. Our primary dependent variable was the suicidal intent of self-injured patients after being referred to the ED. In the present study, these patients were classified into two groups based on the patients' statements: patients defined with NSSI (NSSI group) and those defined as having engaged in SAs (SA group). The patient data were collected prospectively, and the researchers retrospectively reviewed the data.

This study was approved by the Inje University College of Medicine, Institutional Review Board (IRB date and no.: 2019-12-011-001) and conformed to the ethical principles incorporated in the Declaration of Helsinki.

### Selection of participants

An annual average of 65,000 patients visit this hospital, and more than 9600 patients are hospitalized each year. Over 1300 patients are admitted to the intensive care unit (ICU) on an average each year.

During the study period, 642 patients were referred to the ED following their self-harm behavior. However, the study had a final sample of 578 patients after the exclusion of 64 patients, including 9 cases whose registrations were canceled because their requests for care were refused (patients signed voluntary discharge forms), 8 cases who left the hospital against medical advice after registration, 21 cases who referred to psychiatric hospitals after completion of ED evaluation, and 26 dead cases (i.e., 17 on arrival, 2 at the ED, and 7 during hospitalization).

Patients were also excluded from the study if they were referred to an outpatient psychiatry clinic other than the ED following their self-harm behavior [Figure 1].

### Methods and measurements

We referred all patients who visited the ED following self-harm behavior to the responsible case management team. The initial assessment forms were devised by this team under the supervision of a psychiatrist at the hospital of study. Patients who agreed to be managed by the case management team responded to all items on their forms. Meanwhile, the forms of those who did not agree were incomplete; therefore, we had to obtain as much information as possible from their electronic medical records (EMR). The initial assessment forms included information about their marital status, religious status, employment status, income level (with reference to the average monthly income of Korean workers, classified into  $\geq 2.5$  million KRW and  $< 2.5$  million KRW), education level (with reference to the mandatory education in Korea, classified into middle school graduate or lower and high school graduate or higher), family status, method of self-harm behavior, time from self-harm behavior to ED visit, location where the self-harm was attempted, request for help, companion at hospital visit, drinking

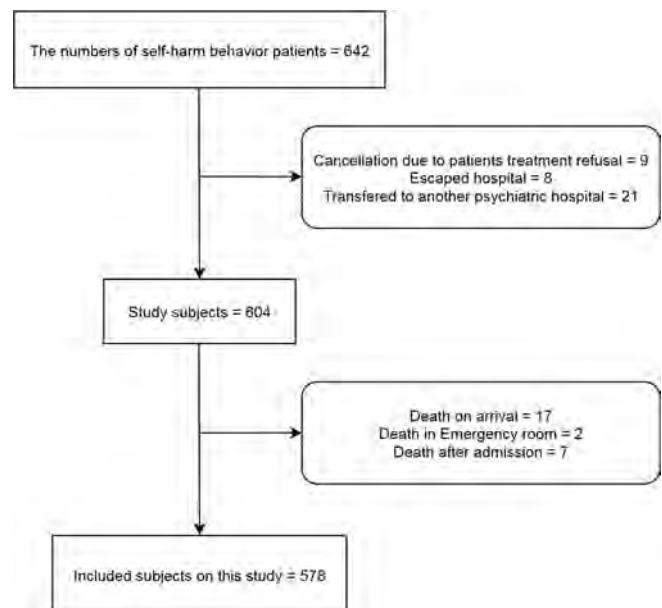


Figure 1: Patients selection flow chart

status, history of prior SAs, history of psychiatric care, psychiatric drug use, history of psychiatry admission, family psychiatric history, self-harm behavioral plan, and suicidal ideation during treatment.

From the patients' EMR, we collected the following data: sex; age; vital signs (systolic blood pressure, diastolic blood pressure, and heart rate); consciousness (alert: alert mentality; drowsy, stupor, and coma: altered mentality); type of referral (referral during business hours, i.e., from 9 a.m. to 5 p.m. on weekdays, or referral during off hours); RRRS scale = (risk rating/[risk rating + rescue rating])  $\times$  100, risk and rescue ratings are presented in Table 1; ED outcomes (ICU admission, general ward [GW] admission, and discharge), presumptive psychiatric diagnosis (depression, psychiatric disease other than depression, and no intervention or inability to diagnose); and physical status at the time of referral to the ED (chronic disease, acute disease, and physically healthy). Besides, white blood cell (WBC), hemoglobin, platelet, and CRP (normal or elevated CRP) were measured through blood sampling with venipuncture. Hemogram parameters were used to compute NLR, PLR, and SIII (NLR = neutrophils/lymphocytes; PLR = platelets/lymphocytes; and SIII = platelets  $\times$  neutrophils/lymphocytes). The presumptive diagnosis for the patients was confirmed only after an interview by the psychiatrist for the patients who had been requested a psychiatric consultation. The presumptive diagnosis for self-harm attempt patients who refused psychiatric consultation was classified as uninterrupted. Next, for uninterrupted patients, past psychiatric diagnoses were used by the patient's or the guardian's statement. For statistical convenience, presumptive psychiatric diagnosis was divided into the following three categories:

**Table 1: Risk and rescue rating**

Risk and rescue factors	Points		
	1	2	3
<b>Risk factors</b>			
Agent used	Ingestion, cutting, stabbing	Drowning, asphyxia, strangulation	Jumping, shooting
Impaired consciousness	Non in evidence	Confusion, semi-coma	Coma, deep coma
Lesions/toxicity	Mild	Moderate	Severe
Reversibility	Good, complete recovery expected	Fair, recovery expected with time	Poor, residuals expected if recovery
Treatment required	First aid, emergency room care	Admission, routine treatment	Intensive care, special treatment
<b>Rescue factors</b>			
Location	Remote	Unfamiliar, nonremote	Familiar
Person-initiating rescue (in case of self-rescue, the rescue score=5)	Passer by	Professional	Key person
Probability of discovery by any rescuer	Accidental discovery	Uncertain discovery	High, almost certain
Accessibility to rescue	Does not ask for help	Drops clues	Asks for help
Delay until discovery	>4 h	<4 h	Immediate ~ 1 h
Undue delay between discovery and treatment	Yes=-1 No=0	Yes=-1 No=0	Yes=-1 No=0

depression, psychiatric disease other than depression, and no intervention or impossible to diagnose. Data were collected, and RRRS values were determined by a senior emergency medicine resident under the supervision of an emergency medicine specialist.

### Statistical analysis

We divided the patients into NSSI group and SA group and compared their demographic variables, psychological scale (RRRS), and biochemical markers such as CRP, NLR, PLR, and SIII. Further, we compared disposition after ED assessment. Nominal variables were analyzed by Chi-square test or Fisher's exact test, and continuous measures were analyzed by independent *t*-test or Mann-Whitney U-test. To identify the factors associated with SA as opposed to NSSI, we performed a multivariate logistic regression analysis using the factors that statistically significantly differed in the univariate analysis. The multivariate logistic regression analysis process used backward step-wise selection (likelihood ratio). Adjusted odds ratios and 95% confidence intervals were computed with logistic regression. We applied Hosmer-Lemeshow's goodness-of-fit test to evaluate the fitness of a model in logistic regression. The significance level was set at  $P < 0.05$ , and all statistical analyses were performed using the SPSS 18.0 (SPSS Inc., Chicago, IL, USA) software.

## Results

### Baseline characteristics and comparison of characteristics between the suicide attempt group and nonsuicidal self-injury group

In the univariate analysis of the SA group and NSSI group, sex, age, mental health status, occupation, physical status, presumptive diagnosis, asking for help,

and RRRS significantly differed between the groups. The biological marker WBC and psychiatric consultation also significantly differed between the groups [Table 2].

### Types of self-harm attempts in the suicide attempt group and nonsuicidal self-injury group

The SA group and NSSI group statistically significantly differed in the types of self-harm attempts ( $P = 0.007$ ), and drug overdose was the most common type in both groups. Pesticide ingestion, asphyxia, gas inhalation, and jumping were the common types of self-harm attempts in SA group compared to the NSSI group [Table 3].

### Emergency department disposition decisions for the suicide attempt group and nonsuicidal self-injury group

The dispositions after ED assessment differed between the SA group and NSSI group at a  $P = 0.02$ , where psychiatric ward admission, GW admission, and ICU admission were more common in the SA group [Table 4].

### Multiple regression analysis for the suicide attempt group and nonsuicidal self-injury group

Multiple regression was performed with the factors that significantly differed between the SA group and NSSI group in the univariate analysis. The results showed that the two groups significantly differed in asking for help, chronic illness, and psychiatric consultation but not in the RRRS and WBC [Table 5].

## Discussion

This study is the first of its kind to apply both biological markers and psychological scales in differentiating between NSSI and SA among patients admitted to

**Table 2: Patients' demographic characteristics and univariate analysis**

Characteristics	Total (n=578), n (%)	95% CI	SA group (n=443), n (%)	NSSI group (n=135), n (%)	P
Sex (male)	200 (34.6)		164 (37.0)	36 (26.7)	0.03
Age (years)	38.6±19.1	37.0–40.1	39.9±19.6	34.4±16.9	<0.01
Referral during business hours	114 (19.7)		83 (18.7)	31 (23.0)	0.28
Altered mental status	159 (27.6)		134 (30.4)	25 (18.5)	<0.01
Educational level (middle school or lower)	126 (27.9)		94 (27.8)	32 (28.1)	0.96
Marital status (married)*	195 (38.2)		152 (38.2)	43 (35.8)	0.64
Religion	105 (26.6)		85 (29.0)	20 (19.8)	0.7
Occupation (employed)	296 (59.7)		208 (54.9)	88 (75.2)	<0.01
Housemate (presence)	197 (38.1)		151 (38.0)	46 (38.3)	0.95
Income (<2.5 million KRW per month)	234 (52.8)		188 (55.5)	46 (44.2)	0.12
Drinking	238 (42.5)		183 (42.9)	55 (41.4)	0.76
Attempted suicide before	229 (42.3)		181 (43.9)	48 (36.9)	0.16
Under the care of a psychiatrist	253 (56.1)		199 (56.7)	54 (54.0)	0.63
Admitted to a psychiatric ward before	96 (18.8)		72 (18.3)	24 (20.2)	0.65
Treated with psychiatric drugs	142 (38.5)		104 (38.4)	38 (38.8)	0.96
Family history of psychiatric disease	132 (25.9)		95 (24.8)	37 (29.4)	0.31
Physical status					
Healthy	423 (77.9)		312 (748)	111 (88.1)	<0.01
Acute illness	4 (0.7)		3 (0.7)	1 (0.8)	
Chronic illness	116 (21.4)		102 (24.5)	14 (11.1)	
Presumptive diagnosis					
MDD	337 (65.2)		309 (69.8)	68 (50.4)	<0.01
Psychiatric disorder other than MDD	69 (11.9)		53 (12.0)	16 (11.9)	
Uninterrupted or absence of psychiatric disease	132 (22.8)		81 (18.3)	51 (37.8)	
Ask for help	66 (12.0)		39 (10.2)	27 (21.4)	<0.01
Risk rescue rating score	35.9±8.2	35.2–36.5	36.5±8.3	33.8±7.5	<0.01
WBCs (/μL)	8383.5±3525.2	8059.4–8707.5	8562.9±3616.7	7708.5±3082.1	0.03
Hemoglobin (g/dL)	13.4±1.8	13.2–13.5	13.5±1.7	13.1±2.0	0.32
CRP (mg/dL)	0.5±1.6	0.4–0.7	0.6±1.8	0.3±0.5	0.08
SBP (mmHg)	124.7±49.3	120.6–128.7	125.7±55.2	121.4±21.3	0.38
DBP (mmHg)	75.5±22.9	73.6–77.3	76.0±25.1	73.8±13.5	0.35
HR (beats/min)	91.6±22.5	89.7–93.4	92.1±23.1	73.8±13.5	0.36
NLR	3.5±3.3	3.2–3.8	3.6±3.5	3.0±2.4	0.11
Platelet (×1000)	258.9±78.1	251.7–266.1	257.7±78.8	263.4±75.7	0.52
SIII (×1000)	867.7±801.6	794.0–941.4	884.2±813.6	805.7±755.8	0.40
PLR	0.15±0.10	0.14–0.16	0.15±0.11	0.15±0.07	0.94
Psychiatric consultation	278 (49.9)		230 (53.9)	48 (36.9)	<0.01

Data are presented as frequency (%) or mean±SD. \*The variable "marital status" had three values, namely married, having a registered relationship, and having a *de facto* relationship. CI=Confidence interval, MDD=Major depressive disorder, ER=Emergency room, SBP=Systolic blood pressure, DBP=Diastolic blood pressure, HR=Heart rate, CRP=C-reactive protein, NLR=Neutrophil-to-lymphocyte ratio, PLR=Platelet-to-lymphocyte ratio, SIII=Systemic Immune Inflammation Index, SD=Standard deviation, SA=Suicide attempt, NSSI=Nonsuicidal self-injury, CI=Confidence interval, WBC=White blood cell

the ED due to self-harm behavior. The multivariate logistic analysis indicated that none of the RRRS and biological markers were statistically significant, with the exception of the asking for help item of the accessibility to rescue domain in the RRRS, where asking for help was statistically significantly higher in the NSSI group than that in the SA group ( $P < 0.01$ ). These results can be understood in relation to the capability for suicide studied by Grandclerc *et al.* They argued that patients who engage in NSSI can eventually commit suicide, as their fear of suicide is diminished as they continuously engage in self-harm behaviors, which increases their capability for suicide. We can speculate that patients who performed NSSI asked for help more frequently than

suicide attempters because they yet had lower capability for suicide compared to suicide attempters.<sup>[13]</sup>

According to a systematic review on asking for help and suicide, less than half of the individuals with a suicidal risk asked for help. Among adults aged 18 years or older, only about 40% asked for help.<sup>[14]</sup>

In our study, multivariate logistic regression analysis revealed that the percentages of patients with chronic disease ( $P = 0.03$ ) and patients referred to psychiatric consultation ( $P < 0.01$ ) were statistically significantly higher in the SA group compared to the NSSI group.

**Table 3: Methods of self-harm in self-harm patients**

Methods of self-harm attempt	Total (n=578), n (%)	SA group (n=443), n (%)	NSSI group (n=135), n (%)	P
Drug overdose	282 (49.7)	218 (50.1)	64 (48.5)	<0.01
Stabbing	190 (33.5)	131 (30.1)	59 (44.7)	
Pesticide ingestion	27 (4.8)	26 (6.0)	1 (0.8)	
Asphyxia	22 (3.9)	21 (4.8)	1 (0.8)	
Gas inhalation	16 (2.8)	13 (3.0)	3 (2.3)	
Jumping	15 (2.6)	14 (3.2)	1 (0.8)	
Vehicle-based methods	1 (0.2)	1 (0.2)	0 (0)	
Others	14 (2.5)	11 (2.5)	3 (2.3)	

Data are presented as frequency (percentage) or mean±SD. Fisher's exact test was used. SA=Suicide attempt, NSSI=Nonsuicidal self-injury, SD=Standard deviation

**Table 4: Dispositions of emergency department assessments in self-harm patients**

ED disposition	Total (n=578)	SA group (n=443)	NSSI group (n=135)	P
Discharge	271 (76.3)	198 (72.5)	73 (89.0)	0.02
Psychiatric ward admission	31 (8.7)	27 (9.9)	4 (4.9)	
GW admission	20 (5.6)	18 (6.6)	2 (2.4)	
ICU admission	33 (9.3)	30 (11.0)	3 (3.7)	

ICU: Intensive care unit, SA=Suicide attempt, NSSI=Nonsuicidal self-injury, ED=Emergency department, GW=General ward

**Table 5: Multiple regression analysis for differentiation between nonsuicidal self-injury group and suicide attempt group**

	OR	95% CI	P
Sex (reference: male)	1.18	0.64–2.18	0.59
Age	1.00	0.99–1.02	0.78
Asking for help	0.35	0.18–0.69	<0.01
Chronic illness	2.39	1.11–5.16	0.03
MDD (reference value: uninterrupted or absence of psychiatric disease)	0.83	0.34–2.01	0.68
Occupation (employed)	0.58	0.32–1.03	0.64
RRRS score	1.02	0.98–1.07	0.33
Altered mental status	0.62	0.34–1.16	0.14
WBCs (μL)	1.00	1.00–1.00	0.06
Psychiatric consultation	2.26	1.32–3.87	<0.01

MDD=Major depressive disorder, CI=Confidence interval, OR=Odds ratio, WBC=White blood cell, RRRS=Risk-Rescue Rating Scale

Joshi *et al.* investigated the association between the prevalence of chronic disease and patients with suicidal ideation and attempt. They analyzed a total of 35,075 patients including 5773 patients who had suicidal ideation and 331 suicide attempters. They showed that compared to the non-SA control group, suicide attempters show a higher prevalence of chronic diseases such as cardiovascular disease, stroke, ischemic heart disease, renal failure, and depression.<sup>[15]</sup>

At the hospital of this study, all patients admitted to the ED for self-harm behavior are given an explanation about the need for and are recommended psychiatric consult; if patients decline, they have to sign a voluntary discharge form (patient or caregiver) before discharge. The differences in psychiatric consultation between the two groups may arise from the differences in the psychologically perceived severity by the patients and caregivers, resulting from the difference in the intent of suicide. In other words, many patients in the NSSI group refused psychiatric consultation because they did not consider their self-harm behaviors as serious, as they engaged in the behaviors just to experience comfort without suicidal intent.

Our results on the severity in the NSSI group and SA group showed that the percentages of ICU admission and ward admission were statistically significantly higher in the SA group than that in the NSSI group ( $P = 0.02$ ). This is in line with the general belief that NSSI incurs a relatively mild physical injury. However, there were no differences in the RRRS score between the two groups in the multivariate regression analysis. This suggests that the RRRS score is not a valid marker to be used to distinguish between NSSI and SA.

### Limitations

The limitations of this study are as follows: first, it was a single-center study. The institution where this research took place is located in a residential area in the vicinity of a large city, and multiple similarly sized institutions exist nearby. Therefore, it is impossible to rule out the possibility that patients attempting suicide may have been dispersed and admitted to the nearby hospitals.

Second, the institution where this research took place provides consultation and support services to all patients admitted for SAs. Patients who agreed to receive these services had fully completed initial assessment items. However, some patients who did not agree to receive these services declined to respond to the initial assessments. Although the missing data were supplemented with EMR to the maximum extent possible, the fact that these assessments were not completed could also constitute a limitation of this study.

Third, blood tests were not completed in all patients. Blood tests were not conducted when patients had attempted suicide through stabbing or simple lacerations. In addition, blood tests were not carried out when the patients strongly refused them.

Fourth, the level of inflammation may be affected by numerous factors, such as the standard medication taken by the patient, as well as the ongoing patient health impacted by diseases such as infections or cancer.

Therefore, the baseline values for the patient may differ. We suggest that a similar study should be conducted in future with a larger, multicentered, prospective design.

## Conclusions

Among patients admitted to the ED after engaging in self-harm behaviors, suicide attempters more commonly had a chronic disease and tended not to ask for help after self-harm behavior compared to patients who performed NSSI. Further, suicide attempters showed more favorable responses to psychiatric consultation. In clinical practice, patients admitted due to NSSI should be provided treatment equivalent to that for suicide attempters if they show the characteristics of suicide attempters.

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### Author contribution statement

1. Conceived and designed the experiments: Hye Jin Kim and Min Hyuk Kang
2. Performed the experiments: Min Hyuk Kang
3. Analyzed and interpreted the data: Hye Jin Kim and Min Hyuk Kang
4. Contributed reagents, materials, analysis tools, or data: Hye Jin Kim and Min Hyuk Kang
5. Wrote the paper: Hye Jin Kim and Min Hyuk Kang.

This list may be revised according to the research and article type.

### Conflicts of interest

None declared.

### Funding

None declared.

### Ethical Approval

Sanggye Paik Hospital, Inje University College of Medicine, Institutional Review Board (IRB date and no.: 2019-12-011-001).

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