



# Factors predicting meaningful suicide attempts: multiple attempts and index methods

Chungmo Koo, Goeun Bae<sup>1</sup>, Heoung Jin Kim<sup>2</sup>, Sohyun Eun<sup>2</sup>, Seo Hee Yoon<sup>2</sup>,  
Moon Kyu Kim<sup>2</sup>, Hyun Soo Chung<sup>1</sup>, Hye Eun Kwon<sup>3</sup>

*Department of Pediatrics, Dankook University Hospital, Cheonan; <sup>1</sup>Department of Emergency Medicine, Severance Hospital, Yonsei University College of Medicine, Seoul; <sup>2</sup>Department of Pediatrics, Severance Children's Hospital, Yonsei University College of Medicine, Seoul; <sup>3</sup>Department of Pediatrics, International St. Mary's Hospital, Catholic Kwandong University College of Medicine, Incheon, Republic of Korea*

**Purpose:** This study investigated the association of the index method, defined as the method used in the first suicide attempt (SA), with the outcome of SAs among adolescents.

**Methods:** The study analyzed medical records of 227 adolescents aged 10-18 years with clear SAs who visited the emergency department of Severance Hospital in Seoul, Korea from January 2007 through February 2021, focusing on the index methods and meaningful SAs defined as hospitalization, death or transfer to another hospital for psychiatric hospitalization. The association of the index method with the meaningful SAs was quantified using logistic regression.

**Results:** Among the 227 adolescents, 80 underwent the meaningful SAs (35.2%). The adolescents with the meaningful SA chose drug intoxication, fall, and hanging as the index methods more frequently than those without the outcome, whereas they showed a reverse pattern in cutting ( $P < 0.001$ ). The association of fall or cutting with the meaningful SAs remained significant after adjustment (fall: adjusted odds ratio, 6.93 [95% confidence interval, 1.70-28.26]; cutting: 0.39 [0.17-0.91]; compared with those undergoing drug intoxication). Multiple SAs were also associated with the meaningful SA (1.76 [1.04-3.13]).

**Conclusion:** This study identifies the index method and multiple SAs as factors associated with the meaningful SA among adolescents in the emergency department. This finding may be helpful in interviewing adolescents with SAs.

**Key words:** Adolescent; Patient Reported Outcome Measures; Poisoning; Suicide, Attempted; Suicide, Completed

## Introduction

In adolescents, a previous suicide attempt (SA) is associated with its recurrence<sup>1,2</sup>. Among self-harms

in adults, drug intoxication (DI) as the method at initial SA is associated with a 2.5–5-fold decrease in recurrent attempts compared to hanging<sup>3,4</sup>. However, switching to more lethal methods is a predictor of completed suicide in adults (adjusted hazard ratio, 7.05)<sup>5</sup>. In patients aged 10–24 years with DI, those aged 10–17 years have a 1.3-fold higher risk of repeated self-harm than those aged 18–24 years<sup>6</sup>. Despite the lower severity of suicidal intention and the overuse of over-the-counter medicine in adolescents<sup>7</sup>, their higher rate of repetition of SAs may lead to fatal outcomes. There is a scarcity of studies focusing on the completed suicide rate with severity in adolescents, beyond the rate of recurrence.

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### Corresponding author

Chungmo Koo (ORCID 0000-0003-1434-6988)

Department of Pediatrics, Dankook University Hospital, 201 Manghyang-ro, Dongnam-gu, Cheonan 31116, Republic of Korea

Tel: +82-10-5403-4502 Fax: +82-41-556-1090

E-mail: cm0904@DKUH.co.kr

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From this viewpoint, we focused on index methods of SAs, defined as the methods used at initial SAs, to investigate factors predicting the outcome of SAs among adolescents in emergency settings.

## Methods

### 1. Study design, setting, population, and protocol

This retrospective, medical record-based study was performed on adolescents aged 10–18 years who visited the emergency department (ED) of Severance Hospital in Seoul, Korea from January 2007 through February 2021. The study was approved by the institutional review board with a waiver for informed consent (IRB no. 4–2021–0693).

The meaningful SA was defined as “emergency hospitalization,” “death” or “transfer to another hospital for psychiatric hospitalization.” This definition was based on the outcomes that may disrupt the adolescents’ normal lives. Only the initial meaningful SA was considered valid for those with multiple meaningful SAs, indicating that data following the first meaningful SA were excluded. Adolescents with a clear intentional SA received the International Classification of Diseases, 10th Revision diagnostic codes of “suicidal ideation (R45.8),” “self-harm (T76),” “drug intoxication (T28, T36–40, T42–46, T49–56, T60, T62, T65, T88),” “hanging (W76, X70)” or “dead on arrival (R98).” We also reviewed their medical histories to identify those who did not have “suicidal ideation” as a co-diagnosis to exclude cases of accidental injury. Exclusion criteria were accidental injury, suicidal idea without attempts, and unavailable psychiatric history.

### 2. Variables of interest

To analyze the characteristics of the study population, we collected information regarding sex, age with age groups (10–14, 15, 16, and 17–18 years), psychiatric history, the index method (DI, falling, cutting, hanging, and others), the number of SAs,

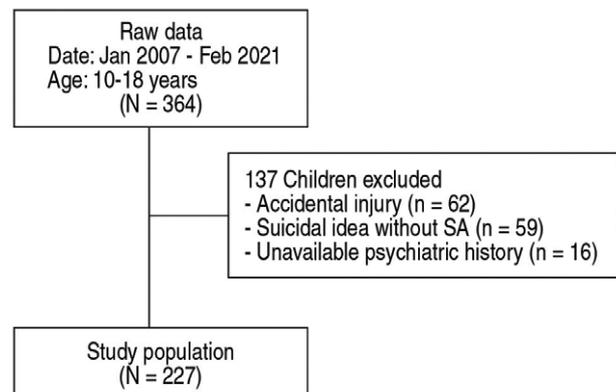
and the number of changes in the methods of SAs. Neither changes in the type of drugs in adolescents with DI nor those in the intensity or anatomical region in patients with cutting was regarded as changes in the methods. DI was defined as all types and amounts of potentially lethal drugs whereas previous studies distinguished between different types of drugs and found that specific drugs carried higher risks<sup>6</sup>. The meaningful SA defined above was the primary outcome. “No meaningful SA” was defined as “discharge” or “voluntary discharge” as the secondary outcome for subanalysis of some factors.

### 3. Statistical analyses

Categorical variables were expressed as numbers and percentages. We used Fisher exact tests and chi-square tests for trends. Associations of the independent variables with the meaningful SA were analyzed using multivariable logistic regression. SPSS ver. 26.0 for Windows (IBM Corp., Armonk, NY) was used for the analysis.

## Results

Among 364 adolescents with possible suicidal idea or attempt, 227 were selected as the study population (Fig. 1). The meaningful SAs (80 [35.2%]) comprised 71 hospitalizations, 8 deaths, and 1 transfer.



**Fig. 1.** Flowchart for the selection of study population. SA: suicide attempt.

Table 1 lists the characteristics of the study population according to the meaningful SAs. Among the index methods, cutting was most common (50.7%). The adolescents with meaningful SA chose DI, fall, and hanging as the index methods more frequently than those without meaningful SA ( $P < 0.001$ ). Multiple (i.e., recurrent) SAs were reported by 118 adolescents (52.0%) with a lower frequency in those with meaningful SA (57.1% vs. 42.5%;  $P = 0.038$ ). Of the 118 adolescents, 72 changed the methods once and 14 twice or more.

The regression analysis showed that sex, age group, psychiatric history, and the number of changes in the methods of SAs had no significant associations with the meaningful SAs (Table 2). The adjusted odds ratio of fall as the index method was 6.93 (95% con-

fidence interval, 1.70–28.26; compared with those with DI) whereas the adjusted odds ratio of cutting was 0.39 (0.17–0.91; compared with the same reference). In addition, multiple SAs were associated with the meaningful SA (1.76 [1.04–3.13]).

Of the 80 adolescents with meaningful SAs, 46 (57.5%) obtained the outcomes at the first attempt whereas the remaining 34 (42.5%) did in 2 or more attempts. The former group tended to choose DI (29/46) as the index method whereas the latter mostly chose cutting (30/34). Among the 30 adolescents who chose cutting, only 8 did as the final method, which led to the meaningful SA. The other 22 adolescents chose the following final methods: 12 DIs, 3 fallings, 3 hangings, and 4 others. Adolescents who chose falling or hanging as the

**Table 1.** Characteristics of the study population according to the meaningful SAs

Variable	Total (N = 227)	No meaningful SA (N = 147)	Meaningful SA (N = 80)	P value
Girls	180 (79.3)	117 (79.6)	63 (78.7)	0.881
Age, y	16.0 (14.0-17.0)	16.0 (14.0-16.5)	16.0 (14.0-17.0)	0.340
Age group, y				0.153
10-14	63 (27.8)*	41 (27.9)*	22 (27.5)	
15	41 (18.1)*	27 (18.4)*	14 (17.5)	
16	56 (24.7)*	42 (28.6)*	14 (17.5)	
17-18	67 (29.5)*	37 (25.2)*	30 (37.5)	
Psychiatric history				0.874
No history	97 (42.7)	61 (41.5)	36 (45.0)*	
MDD	104 (45.8)	69 (46.9)	35 (43.8)*	
Other than MDD	26 (11.5)	17 (11.6)	9 (11.3)*	
Index methods of SA				< 0.001
Drug intoxication	79 (34.8)	46 (31.3)*	33 (41.3)*	
Fall	16 (7.0)	3 (2.0)*	13 (16.3)*	
Cutting	115 (50.7)	85 (57.8)*	30 (37.5)*	
Hanging	8 (3.5)	4 (2.7)*	4 (5.0)*	
Others <sup>†</sup>	9 (4.0)	9 (6.1)*	0 (0)*	
Multiple SAs	118 (52.0)	84 (57.1)	34 (42.5)	0.038
No. of changes in methods of SAs				0.258
0	32 (27.1) <sup>‡</sup>	24 (75.0) <sup>§</sup>	8 (25.0) <sup>‡§</sup>	
1	72 (61.0) <sup>‡</sup>	53 (73.6) <sup>§</sup>	19 (26.4) <sup>§</sup>	
≥ 2	14 (11.9) <sup>‡</sup>	7 (50.0) <sup>§</sup>	7 (50.0) <sup>§</sup>	

Values are expressed as numbers (%) or medians (interquartile ranges).

\* The sums of proportions are not equal to 100% due to rounding.

<sup>†</sup> Six, combined methods; 2, carbon monoxide intoxication; and 1, choking.

<sup>‡</sup> The denominators are 118.

<sup>§</sup> The denominators are 32, 72, and 14 in the order of rows.

SA: suicide attempt, MDD: major depressive disorder.

index methods did not experience multiple SAs.

## Discussion

This study shows the independent association of the index methods of SAs with the outcomes. Compared to DI as the index method, fall and cutting were associated more strongly and weakly, respectively, with the meaningful SA, suggesting that the more fatal the method, the more fatal the outcome (Table 2). Furthermore, the adolescents who chose cutting tended to change their final methods of SAs to more fatal ones, such as DI, in their subsequent attempts, rather than to repeat the cutting (see the last paragraph in Results), though the

difference was not significant. This finding suggests a potential association between repetition of SAs and changes to more fatal methods. In addition, multiple SAs were associated with the outcomes despite the non-significant association of the number of changes in the methods of SAs with the meaningful SA (Table 2). With more studies on the above-mentioned potential association, changing methods may be a factor for SA-related outcomes in EDs.

We defined the meaningful SAs in a broader fashion unlike previous studies focusing on an individual death<sup>3</sup>. This broader definition was intended to provide care for adolescents with SA before the occurrence of the completed suicide.

An adult study showed that hanging, drowning or jumping as the index methods had stronger associations with the eventually completed suicide than DI, while cutting or piercing showed a similar degree of association with the outcome using the same reference<sup>8</sup>. In that study, 60.9% of the adults who chose DI and 15.8% of those who did cutting or piercing used the same methods at the eventual completed suicide<sup>8</sup>. Clearly, fatal methods result in greater lethality than non-fatal methods<sup>9,10</sup>. These studies support our finding that cutting had a weaker association with the meaningful SA than DI.

This study has several limitations. First, the adolescents' psychiatric histories could vary when the histories were based solely on their memories, suggesting a possibility of missing or incorrect data. Second, the data were collected in a single center where the adolescents who were on the psychiatric follow-up could be hospitalized more readily, regardless of their severity. Third, we did not include long-term outcomes as in several previous studies<sup>6,11,12</sup>.

This study identifies predictors of the meaningful SAs, including the index methods and multiple SAs, in adolescents who visited the ED. Therefore, information on the index methods should be obtained from adolescents with SAs in EDs. In adolescents with multiple SAs, changes in the methods of SAs may be additionally considered.

**Table 2.** Associations between patient characteristics and the meaningful SA

Variable	Adjusted OR (95% CI)	P value
Girls	1.12 (0.49-2.58)	0.784
Age group, y		
10-14	Reference	Reference
15	0.93 (0.38-2.28)	0.869
16	0.85 (0.35-2.06)	0.717
17-18	1.72 (0.77-3.87)	0.190
Psychiatric history		
No history	Reference	Reference
MDD	1.04 (0.53-2.04)	0.921
Other than MDD	0.98 (0.34-2.85)	0.974
Index methods of SA		
Drug intoxication	Reference	Reference
Fall	6.93 (1.70-28.26)	0.007
Cutting	0.39 (0.17-0.91)	0.030
Hanging	1.58 (0.35-7.07)	0.548
Others	NA	NA
Multiple SAs	1.76 (1.04-3.13)	0.036
No. of changes in methods of SAs*		
0	Reference	Reference
1	1.19 (0.50-2.81)	0.693
≥ 2	2.96 (0.76-11.08)	0.117

Values are expressed as point estimates.

\* This independent variable was analyzed in 118 adolescents with multiple SAs.

SA: suicide attempt, OR: odds ratio, CI: confidence interval, MDD: major depressive disorder.

## ORCID

Chungmo Koo (<https://orcid.org/0000-0003-1434-6988>)  
 Goeun Bae (<https://orcid.org/0000-0001-5058-6423>)  
 Heung Jin Kim (<https://orcid.org/0000-0002-1486-5182>)  
 Sohyun Eun (<https://orcid.org/0000-0002-9598-7519>)  
 Seo Hee Yoon (<https://orcid.org/0000-0002-8361-9815>)  
 Moon Kyu Kim (<https://orcid.org/0000-0001-6186-3991>)  
 Hyun Soo Chung (<https://orcid.org/0000-0001-6110-1495>)  
 Hye Eun Kwon (<https://orcid.org/0000-0001-5180-4218>)

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