

# Psychometric evaluation of the Korean version of the Suicidal Ideation Scale in mentally ill patients living in the community

Jin Sil Han RN, MPH (Deputy director)<sup>1</sup>, Eun-Hyun Lee RN, PhD (Associate Professor)<sup>2</sup>, Tongwoo Suh MD, DrPH (Director)<sup>1</sup> and Chang Hyung Hong MD, PhD (Professor)<sup>3</sup>

<sup>1</sup>Gimpo Mental Health Center, Gimpo, South Korea, <sup>2</sup>Graduate School of Public Health, Ajou University, Suwon, South Korea and

<sup>3</sup>Department of Psychiatry and Behavioral Sciences, School of Medicine, Ajou University, Suwon, South Korea

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**Objective:** The purpose of this study was to translate the Suicidal Ideation Scale (SIS) into Korean (SIS-K) and then evaluate its psychometric properties in mentally ill Korean patients living in the community.

**Methods:** The SIS-K was translated into Korean using a translation and back-translation technique. A sample of 396 patients with mental disorders was recruited from regional mental health centres in Korea. Factorial-construct validity was tested using both exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). The data were randomly split into two subsamples: one used for EFA to identify the underlying structure of the items, and the other used for CFA to test whether the underlying structure was supported by actual data. Convergent validity, known-groups validity and internal-consistency reliability were tested.

**Results:** Exploratory factor analysis extracted nine items clustered into two subscales that accounted for 68.59% of the variance. One item ('I feel there is no solution to my problems other than taking my own life') was deleted. The structure of the two subscales was supported by CFA. The SIS-K score was moderately correlated with depression, and the scale demonstrated convergent validity. The SIS-K scores were significantly higher in patients who had attempted suicide, implying the presence of satisfactory known-groups validity. Cronbach's alpha of the total SIS-K was 0.91.

**Conclusions:** The study has demonstrated the excellent psychometric properties of the SIS-K. The SIS-K is brief and easy to complete, and so it can be applied in both practice and research to patients with mental disorders. This cultural validation of the SIS-K will promote both domestic and international studies of suicidal ideation.

**Keywords:** psychometric properties, suicidal ideation, reliability, validity, translation, Korea.

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## Introduction

Suicide is a global phenomenon. Every year more than 800 000 people die due to suicide, which makes it the 10th leading cause of death worldwide (1, 2). Suicide is a particularly important health issue in South Korea. According to the Organization for Economic Co-operation and Development (3), the suicide rate in South Korea is 33.3 deaths per 100 000 people, which is the top among OECD countries. Statistics Korea (4) reported that the suicide rate increased more than twofold during the decade up to 2012, and suicide is now fourth leading

cause of Korean deaths after cancer, cerebrovascular disease and heart disease.

Suicidal ideation is well known as being a risk or precursor for future suicide attempt or completed suicide (5, 6), especially among people with mental disorders (7, 8). Therefore, nurse professionals need to be able to accurately screen or assess suicidal ideation in order to prevent and predict both attempted and completed suicides.

Several instruments are available for measuring suicidal ideation (9–12), but they are associated with several shortcomings such as being burdensome due to their length, requiring a high reading level and/or lacking psychometric properties (especially a factorial construct) (13–15). Among them, the Suicidal Ideation Scale (SIS), measuring a 'continuum of suicidal ideation ranging from covert suicidal thoughts to more overt intense ideation and, ultimately, actual suicidal attempts' (9):

### Correspondence to:

Eun-Hyun Lee, Graduate School of Public Health, Ajou University, 164, Worldcup-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do 443-380, South Korea.

E-mail: ehlee@ajou.ac.kr

175), is short, comprising a total of 104 words in 10 items, and it demands only a low reading level and low level of literacy (14). In addition, the SIS is a self-reported measure, rather than requiring an interview with a clinician or other trained person. In other words, these practical advantages of the SIS being less burdensome and more comprehensible to respondents make it feasible to apply in a busy practice. From a psychometric perspective, the internal-consistency reliability, concurrent validity and discriminant validity of the SIS have been demonstrated in both nonclinical and military clinical populations in the USA (9, 13), while its factorial-construct validity was at best only marginally satisfied and hence requiring further investigation. However, no psychometric study of the SIS has been conducted in other cultures (including Korea) to our knowledge. The Food and Drug Administration Guidance Committee noted that the application of an instrument in another target population or language is considered to be a new situation (16). Therefore, the SIS needs to be evaluated psychometrically before it can be applied to a Korean population. The purpose of this study was to translate the SIS into Korean and then measure the psychometric properties of the Korean version of the SIS (SIS-K) in mentally ill Korean patients living in the community.

## Methods

### Study design

This study performed a secondary data analysis to translate the SIS and evaluate the following psychometric properties of the SIS-K: factorial-construct validity, convergent validity, known-groups validity and internal-consistency reliability.

### Data collection

Data for this study were obtained from a cross-sectional survey study with mentally ill patients registered at 11 regional community mental health centres in South Korea (17). Inclusion criteria for the participants on the study were (i) diagnosed with schizophrenia, manic depressive disorder or depression; (ii) aged at least 19 years; (iii) no problem with cognitive function based on patient records; and (iv) articulate in the Korean language. Potential participants were informed about this study by certified mental health professionals who were not participating in their care or treatments. If they agreed to participate, they were required to sign a formal consent form and to complete the questionnaires. Ethical approval was obtained from a university medical ethics committee.

### Instruments

*Suicidal Ideation Scale and its cultural translation.* The SIS is a self-reported instrument comprising two subscales: suicidal desire (four items) and suicidal resolved plan/preparation (six items) (9). Each item is scored on a Likert-type scale from 1 (*never*) to 5 (*always*), with the total score ranging from 10 to 50, and a higher score indicating greater suicidal ideation. The original English version of the SIS was obtained from one of its original developers and translated into Korean using a translation and back-translation technique (18). Bilingual laypersons and measurement experts were independently involved in each translation and back-translation process, which focused on semantic equivalence rather than word-to-word equivalence. A panel of three psychiatric health professionals reviewed jargon and grammar in the Korean version and finalised a potential SIS-K. The putative SIS-K was administered to 10 mentally ill patients registered in a regional community mental health centre to evaluate the comprehensibility and feasibility of the scale. These patients completed the scale within 2–3 minutes without experiencing difficulties understanding any of the words, and there were no missing values.

*Patient Health Questionnaire-9.* The Patient Health Questionnaire-9 (PHQ-9) is a brief self-reported instrument measuring depressive symptoms that focuses on diagnostic criteria used in the Diagnostic and Statistical Manual of Mental Disorders-IV (DSM-IV) (19). The nine PHQ-9 items are scored on a four-point scale from 0 to 3, and the questions relate to experiences during the previous 2 weeks. This study used the Korean version produced by An et al. (20) and that study demonstrated that the Korean version exhibited internal-consistency reliability, criterion validity and known-groups validity. Cronbach's alpha in the present study was 0.86.

*Suicide-attempt status.* Participants were categorised into two groups based on the question of 'Have you ever attempted suicide?' with response options of yes (attempter) and no (nonattempter).

### Data analysis

SPSS for Windows (version 21) and AMOS (version 18) were used to analyse the data. A cross-validation approach – involving both exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) – was used for the factorial-construct validity of the SIS-K. The data were split into two subsamples using a function in the SPSS program involving the random sampling of approximately 50% of cases. Subsample 1 was used for EFA to assess the structural underlying construct of the SIS-K,

while subsample 2 was used for CFA to identify the fit of the underlying construct from the EFA to the observed data. The sample size for each subsample satisfied the requirement that at least seven times the total number of items or at least a total of 100 cases are required (21).

Before conducting EFA with subsample 1, Bartlett's test of sphericity and the Kaiser–Meyer–Olkin (KMO) measure were applied to identify the sampling adequacy for factor analysis (22). Principal-components analysis was conducted for EFA, in which oblique rotation was used due to a strong correlation ( $r = 0.84$ ) previously being found between the two subscales of the SIS (13). Factors with an eigenvalue exceeding 1 were extracted, and the factor loading criterion – representing the correlation of each item with given factors – was set at an absolute value of  $\geq 0.40$  (23). Multidimensional scaling was used as a geographical complementary method for EFA, in which a set of items is clustered closely in a space, with at least two dimensions (24).

For the CFA with subsample 2, a maximum-likelihood estimation method was performed. Since the traditional chi-square fit index in CFA is known to be dependent on the sample size and overly stringent for evaluating the exact fit (25, 26), the following criteria were used to determine whether the model provided a good fit: ratio of the  $\chi^2$  value to the degrees of freedom (CMIN/DF)  $< 3.0$ , goodness-of-fit index (GFI)  $> 0.95$ , root-mean-square residual (RMR)  $< 0.05$ , root-mean-square error of approximation (RMSEA)  $< 0.80$ , comparative fit index (CFI)  $> 0.95$  and normed fit index (NFI)  $> 0.95$  (27).

A prior hypothesis for convergent validity in this study was that suicidal ideation has a moderate correlation with depressive symptoms (28). Therefore, convergent validity was tested with the PHQ-9 using Pearson's correlation. A prior hypothesis for known-groups validity in this study was that the suicidal ideation score would be higher in suicide attempters than in nonattempters (9). This known-groups validity was analysed using the  $t$ -test and Cohen's effect size ( $d$ ).

Internal-consistency reliability was evaluated using Cronbach's alpha, where a value of 0.70–0.95 is considered to indicate acceptable internal consistency (21). General characteristics and their differences between the subsamples were analysed using descriptive statistics,  $\chi^2$  test and Fisher's exact test.

## Results

### Factorial-construct validity using a cross-validation approach

Table 1 presents the general characteristics of subsample 1 for EFA and subsample 2 for CFA, which did not differ significantly between these two subsamples.

Subsample 1 was appropriate for factor analysis, with a KMO-measure sampling adequacy of 0.87, and as

**Table 1** General characteristics

Variable	Subsample 1 n (%)	Subsample 2 n (%)	$\chi^2$ or Fisher's exact test (p)
Gender			0.011 (0.918)
Male	120 (60.6)	119 (60.1)	
Female	78 (39.4)	79 (39.9)	
Age (years)			1.279 (0.734)
(43.74 $\pm$ 11.31, mean $\pm$ SD)			
19–29	20 (10.1)	26 (13.2)	
30–39	47 (23.7)	48 (24.2)	
40–49	60 (30.3)	61 (30.8)	
$\geq 50$	71 (35.9)	63 (31.8)	
Marital status			0.271 (0.873)
Unmarried	144 (72.7)	140 (70.7)	
Married/living together	21 (10.6)	24 (12.1)	
Divorced/widow(er)	33 (16.7)	34 (17.2)	
Education			2.065 (0.559)
Elementary school	23 (11.6)	21 (10.6)	
Middle school	31 (15.7)	28 (14.2)	
High school	113 (57.0)	107 (54.0)	
College and above	31 (15.7)	42 (21.2)	
Monthly income (KRW)			3.783 (0.257)
Less than 1 000 000	115 (58.1)	131 (66.1)	
1 000 000–1 999 999	47 (23.7)	33 (16.7)	
2 000 000 and above	35 (17.7)	33 (16.7)	
Data missing	1 (0.5)	1 (0.5)	
Diagnosis			0.316 (0.854)
Schizophrenia	174 (87.9)	171 (86.4)	
Bipolar disorder	10 (5.0)	10 (5.0)	
Depressive disorder	14 (7.1)	17 (8.6)	
Duration of disease (years)			0.105 (0.949)
$\leq 10$	62 (31.3)	64 (32.4)	
11–20	66 (33.3)	67 (33.8)	
$\geq 21$	70 (35.4)	67 (33.8)	
Medication			1.233 (0.745)
Antipsychotic drug	159 (80.3)	152 (76.8)	
Antidepressant drug	12 (6.1)	11 (5.6)	
Mood-stabilising drug	10 (5.0)	13 (6.6)	
Combination	17 (8.6)	22 (11.0)	

SD, standard deviation; KRW, South Korean won.

indicated by Bartlett's test of the sphericity significance level ( $\chi^2 = 1248.34$ ,  $p < 0.001$ ). The EFA extracted a two-factor solution (eigenvalues  $> 1$ ) that explained 68.37% of the total variance. All of the items except item 9 meaningfully loaded on one of the two factors (Table 2); item 9 loaded meaningfully on both factors 1 and 2. Therefore, Cronbach's alpha was calculated for all of the items to decide whether that item could be eliminated. This yielded an Cronbach's alpha of the total scale of 0.91, and this value did not change when item 9 was deleted. In addition, the corrected item-total correlation of item 9 was strong, with a correlation coefficient of 0.79, implying that item 9 was redundant among the other items (29). The distance maps showing Euclidean

**Table 2** Exploratory factor analysis (EFA) and factor loadings

Item no.	Abbreviated item	First EFA		Second EFA	
		Factor 1	Factor 2	Factor 1	Factor 2
1	Thinking of suicide methods	<b>0.841</b>	-0.010	<b>0.841</b>	-0.020
2	Informed someone about suicide	<b>0.838</b>	0.059	<b>0.836</b>	0.056
3	Life will end by suicide	<b>0.693</b>	-0.137	<b>0.694</b>	-0.143
4	Made suicide attempts	<b>0.705</b>	-0.085	<b>0.706</b>	-0.080
5	Life is worthless	-0.079	<b>-0.936</b>	-0.068	<b>-0.939</b>
6	Feel like giving up	-0.078	<b>-0.938</b>	-0.069	<b>-0.933</b>
7	Wish to end life	0.116	<b>-0.758</b>	0.126	<b>-0.761</b>
8	Burdensome to everyone	0.185	<b>-0.698</b>	0.191	<b>-0.687</b>
9	No solution to problems	<b>0.442</b>	<b>-0.484</b>		
10	Have come close to suicide	<b>0.814</b>	0.063	<b>0.814</b>	0.060
Eigenvalue		5.826	1.011	5.163	1.010
Percentage of explained variance		58.26	10.11	57.36	11.23

Kaiser–Meyer–Olkin = 0.87, Bartlett’s  $\chi^2 = 1248.34$  ( $p < 0.001$ ) for the first EFA.

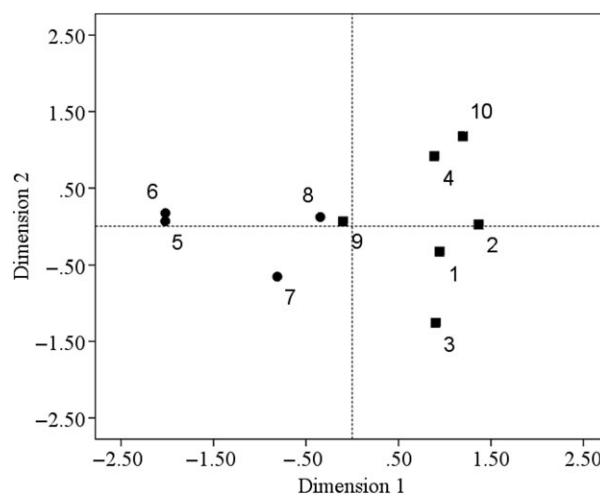
Kaiser–Meyer–Olkin = 0.85, Bartlett’s  $\chi^2 = 1043.95$  ( $p < 0.001$ ) for the second EFA.

Factor 1: suicidal resolved plans/preparation; Factor 2: suicidal desire.

Boldface numbers: absolute value of factor loading  $> 0.40$ .

distances indicated that item 9 was located almost in the centre for the two-dimensional solution (standardised residual sum of squares = 0.09,  $R^2 = 0.95$ ) (Fig. 1). The original SIS includes item 9 in the subscale of suicidal resolved plan/preparation along with items 1, 2, 3, 4 and 10. However, item 9 is not tightly clustered with the items of that subscale in Fig. 1. Item 9 was also distinct from items 5, 6 and 7. Together, these observations indicated that item 9 could be deleted in this study; EFA was then performed. Finally, a two-factor solution with nine items was extracted that explained 68.59% of the total variance (Table 2).

With subsample 2, CFA was performed with the two-factor model extracted by the EFA (Table 3). The fit indices were partially satisfied:  $\chi^2 = 58.758$  [ $p < 0.001$ , degrees of freedom (df) = 26], CMIN/DF = 2.260, GFI = 0.940, RMR = 0.039, RMSEA = 0.080, CFI = 0.966, and NFI = 0.942. Modification indices were therefore inspected to identify potential model misspecification, which revealed that the error terms between items 4 and 10 were connected (Fig. 2). This modified



**Figure 1** Two-dimensional solution. ●: Item numbers included in the suicidal desire subscale, and their locations indicating the Euclidean distance. ■: Item numbers included in the suicidal resolved plan/preparation subscale, and their locations indicating the Euclidean distance.

model was re-estimated, which significantly decreased  $\chi^2$  (df = 25) to 39.136 (difference in  $\chi^2 = 19.622$ ,  $p < 0.001$ ). The modified model provided an excellent fit to the data, with CMIN/DF = 1.565, GFI = 0.961, RMR = 0.033, RMSEA = 0.054, CFI = 0.986 and NFI = 0.961 (Table 3). All of the standardised loadings of the modified model significantly loaded on the two latent factors, with values ranging from 0.613 to 0.860.

*Convergent validity with the total sample*

As hypothesised, the SIS-K was significantly correlated with the PHQ-9 ( $r = 0.65$ ,  $p < 0.001$ ). The subscales of suicidal desire and suicidal resolved plan/preparation were also moderately correlated with the PHQ-9 ( $r = 0.64$ ,  $p < 0.001$ , and  $r = 0.55$ ,  $p < 0.001$ , respectively). These values indicated that the SIS-K had satisfactory convergent validity.

*Known-groups validity with the total sample*

As expected, the score on the SIS-K was significantly higher for the suicide attempters ( $17.98 \pm 8.43$ , mean  $\pm$  SD; range = 9–45) than for the nonattempters ( $13.40 \pm 5.75$ , range = 9–35) ( $t = 6.34$ ,  $p < 0.001$ ,  $d = 0.63$ ). This finding supported the known-groups validity of the SIS-K.

*Internal-consistency reliability with the total sample*

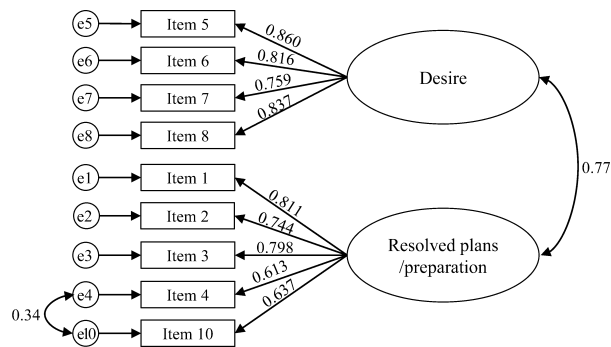
Cronbach’s alpha of the total SIS-K of 0.91 indicated excellent internal-consistency reliability. The values for

**Table 3** Summary of fit indices from confirmatory factor analysis

	$\chi^2$	df	$\Delta\chi^2$	CMIN/DF	GFI	RMR	RMSEA	CFI	NFI
SIS-K	58.785*	26		2.260	0.940	0.039	0.080	0.966	0.942
Modified SIS-K	39.136*	25	19.662*	1.565	0.961	0.033	0.054	0.986	0.961

df, degrees of freedom;  $\Delta\chi^2$ , difference in  $\chi^2$ ; CMIN/DF, ratio of  $\chi^2$  to degrees of freedom; GFI, goodness-of-fit index; RMR, root-mean-square residual; RMSEA, root-mean-square error of approximation; CFI, comparative fit index; NFI, normed fit index; SIS-K, Korean version of Suicidal Ideation Scale.

\* $p < 0.001$ .

**Figure 2** Modified two-factor model of the SIS-K. e: Error term.

the two subscales were also above the criterion of 0.70: 0.88 for the suicidal desire subscale and 0.85 for the suicidal resolved plan/preparation subscale.

## Discussion

The SIS is an instrument for screening and assessing suicidal ideation, and this study translated it into Korean and evaluated the psychometric properties of the SIS-K in a mentally ill Korean population living in the community. The findings supported that the culturally adapted SIS-K exhibits excellent reliability and validity. The assessment of the factorial-construct validity using EFA in this study demonstrated that the SIS-K comprises two subscales: suicidal desire and resolved plans/preparation. This two-factor structure is consistent with a previous study of the SIS in clinical patients in the USA (13). However, item 9 ('I feel there is no solution to my problems other than taking my own life') exhibited inconsistent loading in the EFA: the item meaningfully loaded on both factors in the present study, while it loaded on only one factor (the resolved plans/preparation subscale) in the USA study. Item 9 could be removed based on the results of the statistical analysis in this study, and so the SIS-K finally comprised nine items. The authors of the USA study reported that including 10 items in a two-factor solution accounted for only 32.45% of the total variance, which is below the standard criterion of 50% (30), indicating the need for further investigation. In

contrast, the present study found that 68.59% of the variance in the nine items was explained by the two-factor solution, implying that the two-factor solution was satisfactory.

The two-factor structure of the SIS-K comprising nine items was empirically supported by CFA in this study. However, the CFA revealed covariance between the error terms of item 4 ('I have made attempts to kill myself') and 10 ('I have come close to taking my own life'). Such error covariance may occur when the contents of the items overlap (27). Therefore, further study is needed to identify whether or not there exists content overlap between the items.

The principle of convergent validity is that a hypothesis is formulated about the relationship of the instrument under study with other instruments measuring a similar construct (30). As expected, the present study demonstrated the convergent validity of the SIS-K, with a moderate correlation with depressive symptoms. This is consistent with a similar correlation ( $r = 0.55$ ) being found when applying the English version of the SIS to university students (9) for depressive symptoms, as measured using the Center for Epidemiologic Studies Depression Scale (31).

Known-groups validity is demonstrated when the mean scores for the instrument under study differ in subgroups of participants with known different characteristics (32). As expected, the SIS-K scores were higher for suicide attempters than for nonattempters. In addition, Cohen's  $d$  (corresponding to the magnitude of the difference) for the SIS-K exceeded the standard cut-off for a moderate effect size, of 0.5 (33), implying not only statistically significant but also in practical group differences.

In this study, Cronbach's alpha of the total SIS-K was 0.91. This is identical to the value for the English version of the SIS obtained in 1277 military clinical patients (13), and a little above the value of 0.86 for the English version obtained in 215 university students (9). These consistent findings imply that the SIS may have a good internal-consistency reliability across languages.

The SIS-K is shorter than other existing and frequently used self-reported instruments, such as the Beck Scale for



Suicide Ideation (19 items) (10), the Modified Scale for Suicidal Ideation (18 items) (11) and Reynolds' Suicidal Ideation Questionnaire (30 items) and its short version (15 items) (12). This might make the SIS-K more feasible to use in a busy nursing practice and to apply in a large survey (especially in a telephone survey). The Beck Scale for Suicide Ideation requires a reading level at least equivalent to that of a high-school graduate, whereas the SIS requires a low reading level and so is more useful for respondents with low education levels (14). This means that the psychometrically verified SIS-K may be more applicable for mentally ill patients, especially those with a low education level.

The limitations of this study are the lack of test-retest reliability and responsiveness tests. In other words, the temporal stability and the ability of the SIS-K to detect changes over time in the construct to be measured (suicidal ideation) were not evaluated. Further research with a longitudinal design therefore should be conducted to evaluate the test-retest reliability and responsiveness of the SIS-K.

## Conclusion

In this study, the culturally adapted SIS-K consists of nine items in two subscales. The SIS-K exhibits excellent factorial-construct validity, convergent validity, known-

groups validity and internal-consistency reliability. In addition, it is brief and easy to complete, and so it can be applied in both practice and research to patients with mental disorders. This cultural validation of the SIS-K will promote both domestic and international studies of suicidal ideation.

## Author contribution

Jin Sil Han was responsible for data collection, data analysis and drafted the manuscript. Eun-Hyun Lee conceptualised the study, analysed, interpreted the data and finalised the manuscript. Tongwoo Suh and Chang Hyung Hong provided feedback on the analysis and also critically revised the manuscript. All authors read and approved the final manuscript.

## Ethical approval

Institutional Review Board of Ajou University Hospital (approval no. AJIRB-SBR-SUR-14-264).

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