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Development and psychometric evaluation of an abbreviated form of the revised suicide crisis inventory (A-SCI)-2 in major depression: A multicentric investigation

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ABSTRACT

Background: The present study utilized multidimensional item response theory (IRT) analyses to shorten the 61-item suicide crisis inventory (SCI-2) to an abbreviated version suitable for high-volume settings
Methods: Participants were adults with major depressive disorder (MDD) and healthy controls recruited from 24 tertiary care hospitals. The MDD sample was randomly split into training (Sample 1: 75 %) and validation (Sample 2: 25 %) datasets to perform IRT analyses, confirm the factor structure of the resultant scale, and assess convergent, discriminant, and incremental validity of the shortened scale(s).

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Results: We recruited 1196 patients (54.8 % female, M_{age}=38.1 years) and 1067 control participants (50.5 % female, M_{age}=36.7 years). The SCI-2 was shortened to an abbreviated 7-item version (A-SCI-2) with strong model fit in all three samples (Sample 1: n = 897, $\chi^2[14] = 54.76$, $p < .001$, CFI =.999, TLI =.998, RMSEA =.057, SRMR =.028; Sample 2: n = 299, $\chi^2[14] = 21.73$, $p = .084$, CFI =.999, TLI =.999, RMSEA =.043, SRMR =.030; and Controls: $\chi^2[14] = 63.11$, $p < .001$, CFI =.997, TLI =.996, RMSEA =.057, SRMR =.040) and retaining the original five-factor structure. Good to high internal consistency was noted in all 3 samples. Strong correlations were noted between the A-SCI-2 and the corresponding full scale, while convergent/discriminant validity correlations were comparable between shortened and full scales. The A-SCI-2 demonstrated modest incremental predictive validity.
Conclusion: The A-SCI-2 is a brief, valid, self-report tool to assess the SCS, and may be useful in busy practice settings.

1. Introduction

Despite more than half a century of research, the predictive accuracy of risk assessment tools for suicide remains alarmingly poor (Large et al., 2022). A major drawback of current risk assessment approaches is their overreliance on self-reported suicidal ideation (Menon, 2013). This is problematic for several reasons; suicidal ideation may fluctuate (Kleiman et al., 2017), be concealed (Blanchard and Farber, 2020), never experienced at all prior to suicide (LeMaster et al., 2004), or experienced just before the act (Deisenhammer et al., 2009), leaving little time for interventions. Thus, assessment models and tools that do not rely on the identification of suicidal ideation may be preferable.

One such model is the suicide crisis syndrome (SCS). The SCS is conceptualized as an acute, pre-suicidal, high-risk state with five core dimensions: (1) entrapment (state of cognitive hopelessness where one feels stuck with no alternatives), (2) affective disturbances, (3) loss of cognitive control, (4) hyperarousal, and (5) social withdrawal (Melzer et al., 2024). The revised Suicide Crisis Inventory (SCI-2) measures the SCS and has been validated across cultures and populations, including general adults (Chia-Yi Wu et al., 2022; Chistopolskaya et al., 2022; Menon et al., 2022; Peper-Nascimento et al., 2024) and psychiatric populations (Bloch-Elkouby et al., 2021; Menon et al., 2024). In these investigations, the SCI-2 has consistently demonstrated a five-factor structure and excellent internal consistency, good convergent and discriminant validity, and modest predictive validity (Bloch-Elkouby et al., 2021) for near-term suicidal thoughts and behaviors. However, its 61 items make it impractical for use in busy clinical settings.

There have been two recent attempts to develop a shorter version of the SCI-2. First, as a part of the Modular Assessment of Risk for Imminent Suicide (MARIS) (Hawes et al., 2017), eight items from the initial iteration of the SCI (called the Suicide Trigger State) were selected to assess SCS, some of which overlap with the SCI-2. However, the selection of these items was not based on any psychometric analysis, nor did they comprehensively assess all five domains of SCS. Second, De Luca et al. (2024) used machine learning (ML) models and Shapley Additive Explanation (SHAP) analysis to generate a 9-item SCI-2 short form (SCI-2-SF), based on items most predictive of suicidal behaviours. However, they noted that the low events-per-variable ratio may have impacted the reliability of their findings. Furthermore, the psychometric properties of the SCI-2-SF have not been evaluated so far.

Against this background, the present study had two objectives. First, we aimed to develop an abbreviated version of the revised SCI-2 (A-SCI-2) that would be more user-friendly in busy settings. Second, we aimed to examine the factor structure, reliability, and validity of the A-SCI-2 among patients with major depressive disorder (MDD) and healthy controls. Our hypothesis was that the A-SCI-2 would demonstrate the same five-factor structure as the original SCI-2 in both patient and control samples and demonstrate good reliability, convergent, discriminant, and incremental validity.

2. Methods

2.1. Study setting and design

Between November 2021 and August 2022, we used a cross-sectional, multicentric design (24 sites) to recruit eligible participants with MDD and healthy controls. A detailed description of study sites and reasons for onboarding them is available elsewhere (Menon et al., 2024). Participating sites were distributed across the five zones of the country and included public-sector teaching hospitals (n = 17), self-financing medical schools (n = 5), and private multispecialty hospitals (n = 2). The study was supported by the research and education foundation of the Indian Psychiatric Society and approved by the respective institutional ethics committees of all participating centres.

2.2. Participants

Eligible participants were adults (between 18 and 65 years) with MDD, diagnosed using the Diagnostic and Statistical Manual of Mental Disorders, fifth edition (DSM-5) by qualified psychiatrists. Those with intellectual disabilities and psychotic presentations were excluded. We recruited healthy controls from consenting non-biologically related patient attenders. This research was part of a larger study that aimed to validate the SCS construct in MDD in the Indian setting. Earlier, we reported the factor structure and psychometric properties of the expanded SCI-2 in MDD (Menon et al., 2024). In this paper, we report on the development and psychometric testing of the A-SCI-2.

2.3. Assessments

Suicide Crisis Inventory (SCI)-2 (Bloch-Elkouby et al., 2021): This is a 61-item self-report measure that assesses various dimensions of the SCS. All items are rated on a 5-point Likert scale ranging from 0 (“not at all”) to 4 (“extremely”). The tool comprises 5 subscales covering different dimensions of the SCS, namely, entrapment (10 items), affective disturbance (18 items), loss of cognitive control (15 items), hyperarousal (13 items), and social withdrawal (5 items). The SCI-2 has demonstrated good psychometric properties, both in psychiatric and non-clinical populations (Menon et al., 2022, 2024).

Columbia Suicide Severity Rating Scale (C-SSRS) (Posner et al., 2011): This is a widely used semi-structured interview that supports the assessment of the full spectrum of lifetime and current suicide-related behaviours and quantifies their severity. The questions can distinguish between suicidal and non-suicidal behaviours. The scale had high sensitivity and specificity for identifying lifetime suicide attempts and good convergent, divergent, and predictive validity (Posner et al., 2011). Qualified psychiatrists administered the C-SSRS to identify past-month suicidal ideation (scores), lifetime suicide attempt (yes/no), and check the criterion validity of the A-SCI-2. The Cronbach’s α in the study sample was .84 for past-month suicidal ideation in the MDD sample and .76 in the control sample.

Patient Health Questionnaire (PHQ)-9 (Kroenke et al., 2001): This

is a 9-item self-report measure designed to screen for depressive symptoms and assess their severity. Total scores range from 0 to 27, with individual items rated on a 4-point Likert scale. The tool demonstrated good reliability, construct, and criterion validity for major depression. We correlated the PHQ-9 total scores with the A-SCI-2 short scales and their corresponding full scales to assess convergent validity in the sample. The Cronbach's α in the MDD and control samples, respectively, were .87 and .91.

Generalized Anxiety Disorder (GAD)-7 (Spitzer et al., 2006): This is a 7-item self-report measure designed to assess anxiety symptom severity. Items are rated on a 4-point Likert scale, with total scale scores ranging from 0 to 21. Good reliability and construct, criterion, and factorial validity have been demonstrated. We correlated the total GAD-7 scores with the A-SCI-2 short scales and their corresponding full scales to assess convergent validity in the sample. The Cronbach's α in the MDD and control samples were .87 and .90, respectively.

Perceived Stress Scale (PSS)-10 (Cohen et al., 1983): This is a widely used 10-item self-report measure to assess subjective perceptions of recent stress. Items are rated on a 5-point Likert scale, with total scores ranging from 0 to 40. The tool demonstrated adequate reliability, convergent, and predictive validity. We correlated the total PSS-10 scores with the A-SCI-2 short scales and their corresponding full scales to assess convergent validity in the MDD sample; the scale was not administered in the control sample. Cronbach's α in the MDD group was .69.

Presumptive Stressful Life Events Scale (PSLES) (Singh et al., 1984)**:** This 51-item self-report measure was specifically developed to assess the presence of lifetime or past-month stressful life events within the Indian setting. While PSS-10 measures self-appraisal of stress, the PSLES quantifies the number and magnitude of discrete life events through a curated checklist. We summed the number of life events reported by participants (Singh et al., 1984) and used it as a continuous measure to check the convergent validity of the A-SCI-2 and SCI-2. The Cronbach's α in the MDD sample was .89.

Connor Davidson Resilience Scale (CD-RISC)-10 (Connor and Davidson, 2003): This 10-item self-report measure seeks to quantify psychological resilience among respondents. Items are rated on a 5-point Likert scale, with total scores ranging from 0 to 40. Higher CD-RISC-10 scores suggest greater resilience. Good test-retest reliability and adequate convergent and divergent validity have been shown. Further, the tool demonstrated good psychometric properties in MDD patients in our setting (Menon et al., 2024). We correlated the total CD-RISC scores with the A-SCI-2 and SCI-2 to assess discriminant validity in the MDD sample (the CD-RISC was not administered in the control sample). The Cronbach's α in the MDD sample was .93.

We translated all the measures into six local languages (Hindi, Marathi, Tamil, Bengali, Odiya, and Malayalam) to ensure validity and diversity of responses. These were the official languages in the states where the participating sites were located. All translations followed the World Health Organization (WHO) protocol (World Health Organization, 2016) and involved forward translations, review by an expert panel, back translations, and pre-testing in participants to identify unacceptable words or expressions.

2.4. Data analytic strategy

The MDD patient sample data were first randomly split into training (Sample 1: 75 %, $n = 897$) and validation (Sample 2: 25 %; $n = 299$) datasets, using the set.seed() function to ensure reproducibility of subsamples. Sample 1 was used for all psychometric analyses (i.e., factor analysis, item response theory [IRT]), while Sample 1, Sample 2, and the control sample data (Sample 3) were used to replicate the final shortened scale's factor structure, reliability, and convergent, discriminant, and incremental validity.

2.4.1. Preliminary item and dimensionality checks

Items were first assessed for normality to ensure that item skewness and kurtosis did not exceed 2–3, or 7–8, respectively (Curran et al., 1996; Finney and DiStefano, 2006). Next, the dimensionality of the SCI-2 was examined through a series of confirmatory factor analyses (CFAs). Specifically, CFAs were conducted to compare the one-factor and five-factor (i.e., entrapment, affective disturbances, loss of cognitive control, hyperarousal, social withdrawal) structures of the SCI-2, as specified by both theory (Rogers et al., 2017; Schuck et al., 2019) and empirical evidence (Bloch-Elkouby et al., 2021; Chia-Yi Wu et al., 2022; Chistopolskaya et al., 2022; Menon et al., 2022; Park et al., 2023; Peper-Nascimento et al., 2024), including in these samples (Menon et al., 2024). We also assessed a bifactor model (Reise, 2012), given recent evidence that a bifactor model may be the best-fitting structure of the SCS (Rogers et al., 2024) (see Supplemental Figure 1 for an illustration of the three models tested). Comparison of models was guided by the scaled chi-square difference test and root mean square error of approximation (RMSEA) values (Cudeck and Henly, 2003; MacCallum, 2003). Because items were ordinal, weighted least squares estimation (WLSMV) was used.

Model fit was evaluated using standard criteria (Hu and Bentler, 1999), with good model fit indicated by a non-significant chi-square statistic, comparative fit index (CFI) $\geq .95$, Tucker-Lewis index (TLI) $\geq .95$, RMSEA $\leq .08$, and standardized root mean residual (SRMR) $\leq .08$. Items that did not significantly load ($\geq |.35|$) on their respective factors in expected directions were removed from consideration from the shortened scale.

Because the bifactor model exhibited superior fit, numerous ancillary bifactor-specific model-based psychometric indices were calculated to determine whether specific factors (which accounted for variance in each subdomain after accounting for shared variance captured in a general factor) provided incremental information above and beyond the general factor (reflecting the SCS holistically), as well as how well the item set reflected a latent variable, including the utility of using these items in the specification of a measurement model (see Rodriguez et al., 2016). Model-level indices included the percentage of uncontaminated correlations (Reise et al., 2013) and average response parameter bias (Rodriguez et al., 2016). Factor-level indices included explained common variance (ECV; Reise et al., 2010; Stucky and Edelen, 2014), omega reliability coefficients (McDonald, 1999; Reise, 2012; Zinbarg et al., 2005), construct replicability (Hancock, Mueller, 2001), and factor determinacy (Grice, 2001). Finally, item-level indices included individual explained common variance (I-ECV; Stucky and Edelen, 2014).

2.4.2. Item Reductions

IRT was conducted using the *mirt* R package (Chalmers, 2012). Given the ordinal/polytomous nature of the data, a graded response model (Samejima, 1997) was used to evaluate and reduce the SCI-2 to a briefer set of items that accurately represent the latent trait. We examined means, standard deviations, medians, corrected item-total correlations, difficulty values, and discrimination parameters for each item.

Difficulty values provide information regarding where a particular item functions best along the latent trait; items with higher difficulty values are expected to be endorsed at higher levels of the latent trait (and lower difficulty values endorsed at lower levels of the latent trait).

Discrimination parameters provide information on how well an item can discriminate between those who are higher versus lower on the latent trait. These parameters can be interpreted as very low (.01–.34), low (.35–.64), moderate (.65–1.34), high (1.35–1.69), and very high ($\geq$ 1.70) values (Baker and Kim, 2004).

Difficulty values of items with high discrimination parameters (i.e., 1.35 +, indicating that these items were highly differential) and high corrected item-total correlations (indicating that these items corresponded well with the latent trait on each factor) were examined alongside each factor's item information function curve. Specifically, nonredundant items that covered the largest area of the latent construct

continuum were selected for final inclusion on each subscale.

2.4.3. Replication of factor structure

CFAs of the resultant A-SCI-2 were estimated in all three samples to ensure the replicability of the scale. Model fit was evaluated using the same criteria. Cronbach's alpha was also computed to examine internal consistency of the final items across all samples.

2.4.4. Convergent, discriminant, and incremental validity

Bivariate correlations between the A-SCI-2 and (1) the full SCI-2, and (2) other mental health-related constructs, such as depression, anxiety, perceived stress, resilience, suicidal ideation, and lifetime suicide attempts were computed in all three samples to examine the shortened scale's convergent and discriminant validity. All variables were examined for normality (i.e., skewness $\leq |2|$), and log-transformed, if necessary, prior to conducting analyses.

Furthermore, incremental validity was assessed through two hierarchical regressions: (1) a linear regression examining A-SCI-2 total/subscale scores in relation to suicidal ideation, above and beyond age, gender, depression, anxiety, and perceived stress (MDD sample only); and (2) a logistic regression examining A-SCI-2 total/subscale scores in relation to a lifetime suicide attempt, controlling for age, gender, depression, anxiety, and perceived stress (MDD sample only). All analyses were conducted in R using the *lavaan* (Rosseel, 2012), *semTools* (Jorgensen et al., 2012), and *psych* (Revelle, 2007) packages.

3. Results

3.1. Participant characteristics

Detailed sociodemographic characteristics for the full and stratified sample (i.e., MDD vs. controls, n = 1196 and 1067, respectively) are presented in Table 1. The mean age of MDD patients was 38.1 years (SD = 12.2). Majority of the MDD sample self-identified as female (54.8 %), married (67.1 %), had a mean of 11.4 years of schooling, unemployed (48.5 %), came from a nuclear family (65.1 %), and were urban residents (48.5 %). The mean age of the control group was 36.7 years (SD = 11.4). Most of the participants self-identified as female (50.5 %), were married (67.5 %), had a mean of 13.0 years of schooling, had worked (71.8 %), came from a nuclear family (67.9 %), and were urban inhabitants (48.8 %). Among the MDD sample, 189 (16.0 %) and 108 (9.1 %) had a lifetime and past-month history of suicide attempt, respectively; the corresponding numbers in the control sample were 10 (0.9 %) and 3 (0.3 %), respectively.

Table 1
Sample Characteristics.

Variable	Full Sample (N = 2263)	MDD Participants (n = 1196)	Control Participants (n = 1067)
Gender			
Male	1063 (47.2)	535 (45.2)	528 (49.5)
Female	1188 (52.8)	649 (54.8)	539 (50.5)
Age [Mean (SD)]	37.4 (11.8)	38.13 (12.2)	36.70 (11.4)
Marital Status			
Single	705 (31.3)	365 (30.8)	340 (31.9)
Married	1514 (67.3)	794 (67.1)	720 (67.5)
Separated	30 (1.3)	25 (2.1)	5 (0.5)
Other	2 (0.1)	0 (0.0)	2 (0.2)
Years of Education [Mean (SD)]	12.2 (4.9)	11.4 (4.8)	13.0 (4.9)
Employment Status			
Unemployed	875 (38.9)	574 (48.5)	301 (28.2)
Unskilled Worker	150 (6.7)	69 (5.8)	81 (7.6)
Semi-Skilled Worker	211 (9.4)	110 (9.3)	101 (9.5)
Skilled Worker	205 (9.1)	80 (6.8)	125 (11.7)
Clerical/Shop-Owner/ Farmer	273 (12.1)	144 (12.2)	129 (12.1)
Semi-Professional	199 (8.8)	95 (8.0)	104 (9.7)
Professional	338 (15.0)	112 (9.5)	226 (21.2)
Family Type			
Nuclear	1496 (66.5)	771 (65.1)	725 (67.9)
Joint	452 (20.1)	238 (20.1)	214 (20.1)
Extended	279 (12.4)	159 (13.4)	120 (11.2)
Living Alone	24 (1.1)	16 (1.4)	8 (0.7)
Locality			
Urban	1092 (48.5)	571 (48.2)	521 (48.8)
Semiurban	546 (24.3)	243 (20.5)	303 (28.4)
Rural	613 (27.2)	370 (31.3)	243 (22.8)
Lifetime Suicide Attempt (Yes)	199 (8.8)	189 (16.0)	10 (0.9)
Past-Month Suicide Attempt (Yes)	111 (4.9)	108 (9.1)	3 (0.3)

Values expressed as n(%); MDD = major depressive disorder; SD = standard deviation

3.2. Preliminary item and dimensionality checks (Sample 1)

All items demonstrated normal skewness/kurtosis (i.e., $\leq |2|$); thus, no items were removed on this basis. Results of CFAs indicated that the one-factor ($\chi^2[1769] = 13{,}271.06$, $p < .001$, CFI =.99, TLI =.98, RMSEA =.09, SRMR =.06), five-factor ($\chi^2[1759] = 12{,}117.72$, $p < .001$, CFI =.99, TLI =.99, RMSEA =.08, SRMR =.06), and bifactor ($\chi^2[1708] = 9078.73$, $p < .001$, CFI =.99, TLI =.99, RMSEA =.07, SRMR =.06) models all exhibited adequate to good fit. Standardized factor loadings are presented in Table 2. Comparison of these models indicated that the five-factor model was superior to the one-factor model ($\Delta\chi^2[10] = 158.04$, $p < .001$, ΔRMSEA =.004) and that the bifactor model was superior to the five-factor model ($\Delta\chi^2[51] = 2475.3$, $p < .001$, ΔRMSEA =.012); thus, the bifactor model was retained for subsequent analyses. Consistent with previous studies, the five reverse-coded items (Items 3, 24, 28, 34, and 37) did not significantly load and/or loaded in inconsistent directions compared to theory; as such, these five items were removed from consideration for the shortened scale.

Bifactor model indices indicated that, overall, the SCI-2 was best conceptualized as a primarily unidimensional model, despite the presence of some multidimensionality. First, the ECV statistic, which represents the proportion of common variance across items explained by a particular factor (Reise et al., 2010), was .86 for the general factor, .11 for entrapment, .13 for affective disturbances, .13 for loss of cognitive control, .17 for hyperarousal, and .23 for social withdrawal. Given that scores $\geq$ .80 reflect unidimensionality with relatively low bias (Bonifay et al., 2015; Stucky and Edelen, 2014), this supports a shortened SCI-2 that is unidimensional in nature. Moreover, the percentage of uncontaminated correlations value was .79; when this value is greater than .70, the common variance can be considered essentially unidimensional (Rodriguez et al., 2016). This was further supported by the average relative parameter bias, which compares item loadings on the general factor (from the bifactor model) with loadings on a single factor (from the unidimensional model). With an upper limit of 10–15 % for this parameter, as per Muthén et al. (1987) and others (Rodriguez et al., 2016); the value of 1.5 % found in this sample posed no concern.

Next, several omega coefficients were computed: omega for the general factor (ω =.98; interpreted as the reliability of the multidimensional composite total score), omega for specific factors (entrapment ω =.94, affective disturbances ω =.95, loss of cognitive control ω =.94, hyperarousal ω =.93, and social withdrawal ω =.87; interpreted as the reliability of the multidimensional composite subscale scores), omega hierarchical (ωH =.97; the proportion of total score variance that can be attributed to the general factor after accounting for all specific factors, which is interpreted as the degree to which the total score

Table 2
Standardized Factor Loadings from Confirmatory Factor Analyses of Full Suicide Crisis Inventory (SCI)-2.

Scale/Item	One-Factor	Five-Factor	Bifactor - General	Bifactor - Specific	I-ECV
Entrapment					
SCI2	.73	.76	.71	.33	.82
SCI4	.64	.66	.61	.34	.76
SCI15	.76	.79	.75	.26	.91
SCI19	.74	.77	.72	.34	.83
SCI25	.70	.73	.69	.22	.92
SCI27	.78	.81	.78	.15	.97
SCI35	.71	.74	.70	.19	.95
SCI39	.82	.85	.80	.35	.85
SCI56	.82	.86	.81	.29	.90
SCI58	.76	.79	.76	.09	.99
AD					
SCI1	.70	.71	.70	-.21	.92
SCI3	.04	.04	.04	-.22	—
SCI6	.58	.59	.59	.18	.91
SCI8	.68	.68	.68	.04	1.00
SCI10	.64	.65	.64	-.07	1.00
SCI12	.58	.59	.58	.54	.53
SCI13	.62	.62	.62	.16	.94
SCI18	.58	.59	.59	.28	.82
SCI22	.63	.63	.63	.50	.59
SCI28	-.14	-.14	-.14	-.23	—
SCI30	.65	.65	.65	-.06	.99
SCI38	.70	.70	.70	-.22	.93
SCI43	.83	.84	.82	-.25	.92
SCI44	.85	.86	.84	-.30	.89
SCI45	.82	.83	.82	-.17	.95
SCI46	.82	.83	.82	-.25	.91
SCI50	.67	.68	.68	.35	.79
SCI54	.85	.86	.85	-.24	.92
CC					
SCI5	.63	.65	.64	.07	.98
SCI9	.53	.55	.54	-.15	.98
SCI11	.67	.69	.68	-.13	1.00
SCI14	.72	.74	.70	.39	.72
SCI17	.72	.75	.72	.17	.95
SCI24	-.61	-.63	-.62	.17	—
SCI26	.75	.77	.74	.26	.89
SCI33	.70	.72	.70	.19	.89
SCI34	-.59	-.61	-.61	.41	—
SCI37	-.48	-.49	-.50	.46	—
SCI48	.78	.81	.77	.24	.94
SCI51	.75	.77	.74	.26	.84
SCI57	.72	.75	.70	.40	.68
SCI59	.75	.77	.74	.21	.92
SCI61	.77	.79	.76	.28	.86
Hyperarousal					
SCI7	.65	.89	.66	-.08	.99
SCI16	.66	.67	.66	.08	.98
SCI20	.56	.58	.56	.04	.99
SCI21	.68	.69	.68	.02	1.00
SCI29	.65	.67	.64	.18	.91
SCI32	.61	.63	.61	.12	.96
SCI36	.74	.76	.74	.08	.99
SCI41	.65	.66	.61	.62	.48
SCI42	.61	.63	.57	.60	.46
SCI47	.73	.75	.74	-.18	.95
SCI49	.73	.75	.73	.07	.99
SCI53	.66	.68	.64	.46	.66
SCI60	.69	.71	.68	.22	.91
SW					
SCI23	.74	.82	.74	.08	.99
SCI31	.63	.69	.62	.26	.85
SCI40	.68	.75	.67	.39	.74
SCI52	.63	.69	.61	.46	.64
SCI55	.70	.78	.69	.46	.69

AD = Affective Disturbance; CC = Loss of Cognitive Control; SW = Social Withdrawal.

reflects the general factor), and omega hierarchical subscales (entrapment ωHS =.09, affective disturbances ωHS =.001, loss of cognitive control ωHS =.08, hyperarousal ωHS =.07, and social withdrawal ωHS =.18; the proportion of subscale score variance that can be attributed to the specific factors after accounting for the general factor, or the degree to which the subscale score reflects the target dimension). The ωH score of .97 indicates that the SCI-2 total score predominantly reflects a single general factor and is sufficiently reliable (Reise et al., 2013).

On the other hand, as evidenced by ωHS coefficients less than .50, the subfactor scores' reliabilities are overwhelmingly inflated by the general factor and do not reliably measure a subdomain construct. This is further supported by the factor determinacy and construct replicability metrics. The factor determinacy value for the general factor (.99) was within acceptable limits (>.90, see Gorsuch, 1983), whereas the values for the specific factors (.78–.88) were not. Likewise, construct replicability scores indicated that the general factor (.98, with a recommended cutoff of .80; see Hancock, Mueller, 2001) reflected a well-defined latent construct, but the specific factors did not (.43–.63).

Together, these metrics supported the use of the general factor but not the specific factors, which can be interpreted as nuisance variance (Boyle, 1991). Thus, despite the presence of some multidimensionality, the use of the SCI-2 as a unidimensional instrument was warranted, and we proceeded with item reduction through this framework. Because items with I-ECV values ≥ .80 best represent the unidimensional trait and should be retained for IRT analyses (Stucky and Edelen, 2014), these values were examined (see Table 2). A total of 12 items had I-ECV values less than .80 (1 from the original entrapment subscale, 3 from affective disturbances, 2 from loss of cognitive control, 3 from hyperarousal, and 3 from social withdrawal) and were, thus, removed from subsequent IRT analyses. This resulted in 44 items remaining for consideration in the A-SCI-2.

3.3. Item reductions (Sample 1)

A graded response model was then conducted to reduce the items included in the SCI-2 to an abbreviated, non-redundant set of items. This model exhibited adequate to good fit ($M^2[770] = 3333.18$, $p < .001$, CFI =.94, TLI =.94, RMSEA =.06, SRMR =.06). Each individual item exhibited strong fit (S-χ^2 RMSEAs =.000–.022). Item-level frequencies of each response, means, standard deviations, medians, corrected item-total correlations, difficulty values, and discrimination parameters are presented in Table 3.

These values, as well as individual Item Information Curves (see Supplemental Figure 2), were examined to reduce the item pool. Seventeen items (Items 5, 6, 7, 8, 9, 10, 11, 13, 16, 18, 20, 21, 29, 30, 31, 32, and 60) were initially excluded because they provided very little information (< 1; Thorpe and Favia, 2012), reducing the item pool to 27 items. The remaining items were assessed on a joint Item Information Curve to determine which items provided unique information across the latent trait. Ultimately, this resulted in the reduction of the item pool from 27 items to 7 items that were highly discriminant across varying levels of difficulty and loaded onto a single factor (see Supplemental Figure 3). See Supplemental Figure 4 for the Test Information Function curve, which illustrates that the A-SCI-2 as a whole is informative for measuring a group of individuals with a wide range of SCS symptoms (-3 SD to +3 SD of the latent trait).

The final version of the A-SCI-2 consisted of 7 items representing the original Entrapment (Items 56 and 58), Affective Disturbances (Items 43, 44, and 54), and Hyperarousal (Items 7 and 32) subscales. These items are bolded in Supplemental Table 1. The marginal reliability of these items was .92, indicating that the overall scale is highly reliable, particularly within −2 SD and + 2 SD (see Supplemental Figure 5 for a visualization of marginal reliability across levels of SCS).

Table 3
Item Response Theory Information for the Suicide Crisis Inventory (SCI)-2 in Training Dataset.

Item	Freq. 0	Freq. 1	Freq. 2	Freq. 3	Freq. 4	Median	Mean	SD	Item-Total	Diff. 1	Diff. 2	Diff. 3	Diff. 4	Disc.
Entrap.														
SCI2	125	192	223	210	137	2	2.05	1.28	.68	-1.41	-.49	.34	1.30	2.06
SCI15	128	183	222	220	134	3	2.43	1.20	.72	-1.31	-.51	.27	1.26	2.32
SCI19	104	166	254	243	120	2	1.93	1.11	.70	-1.51	-.67	.26	1.40	2.12
SCI25	92	137	221	300	137	2	2.29	1.20	.64	-1.70	-.87	-.02	1.33	1.90
SCI27	137	1159	215	228	148	2	2.10	1.31	.73	-1.24	-.55	.19	1.15	2.41
SCI35	71	129	196	298	193	3	2.47	1.21	.66	-1.85	-.96	-.19	.99	1.99
SCI39	125	171	210	226	155	2	2.13	1.30	.77	-1.24	-.53	.18	1.06	2.86
SCI56	149	161	230	221	126	2	2.02	1.29	.77	-1.13	-.49	.29	1.24	2.76
SCI58	194	183	211	208	91	2	1.80	1.30	.69	-1.04	-.32	.48	1.61	2.07
AD														
SCI1	86	171	213	254	163	2	2.67	1.24	.66	-1.72	-.74	.08	1.18	1.95
SCI6	132	184	200	267	104	2	2.03	1.25	.54	-1.77	-.64	.28	1.99	1.24
SCI8	207	192	173	202	113	2	1.80	1.36	.61	-1.12	-.28	.46	1.66	1.56
SCI10	89	142	230	270	156	2	2.30	1.22	.59	-1.93	-.96	.02	1.36	1.86
SCI13	86	165	260	269	107	2	2.16	1.16	.57	-2.08	-.88	.28	1.86	1.37
SCI18	268	198	198	135	88	1	1.52	1.32	.51	-.96	.01	1.07	2.25	1.56
SCI30	83	105	237	279	183	3	2.42	1.21	.60	-1.96	-1.15	-.09	1.18	1.57
SCI38	72	106	248	291	170	3	2.43	1.16	.65	-1.90	-1.09	-.05	1.17	1.86
SCI43	111	184	237	221	134	2	2.09	1.25	.78	-1.30	-.50	.28	1.18	2.89
SCI44	113	155	214	246	159	2	2.21	1.28	.79	-1.26	-.58	.12	1.02	3.22
SCI45	129	152	221	236	149	2	2.14	1.29	.76	-1.25	-.59	.18	1.13	2.66
SCI46	121	160	208	241	157	2	2.17	1.30	.76	-1.27	-.57	.15	1.08	2.79
SCI54	89	154	245	226	173	2	2.27	1.24	.79	-1.43	-.67	.15	.98	3.10
CC														
SCI5	79	121	202	312	173	3	2.42	1.20	.59	-2.04	-1.11	-.18	1.26	1.52
SCI9	90	192	173	202	113	2	1.93	1.11	.50	-2.23	-.64	.79	2.42	1.20
SCI11	119	153	231	242	142	2	2.15	1.27	.61	-1.65	-.76	.21	1.43	1.58
SCI17	84	129	230	289	155	3	2.34	1.20	.68	-1.72	-.92	-.03	1.19	2.06
SCI26	61	126	203	245	152	3	2.45	1.14	.69	-1.91	-.97	-.18	1.20	2.11
SCI33	96	150	222	284	135	2	2.24	1.21	.66	-1.65	-.77	.09	1.37	1.89
SCI48	72	151	220	273	171	3	2.36	1.20	.73	-1.69	-.80	-.02	1.05	2.42
SCI51	119	207	221	216	124	2	2.02	1.25	.70	-1.42	-.46	.35	1.41	2.01
SCI59	167	166	192	221	141	2	2.00	1.35	.68	-1.20	-.48	.24	1.29	1.94
SCI61	76	133	218	286	174	3	2.39	1.20	.72	-1.70	-.88	-.06	1.06	2.25
Hyp.														
SCI7	132	179	260	214	102	2	1.97	1.22	.61	-1.56	-.57	.52	1.79	1.52
SCI16	284	201	191	135	76	1	1.46	1.31	.57	-.78	.07	1.01	2.14	1.39
SCI20	176	211	212	166	122	2	1.83	1.32	.51	-1.44	-.33	.68	1.83	1.24
SCI21	55	115	220	286	211	3	2.54	1.16	.62	-2.20	-1.20	-.21	.99	1.70
SCI29	303	188	199	130	67	1	1.40	1.29	.56	-.74	.10	1.15	2.40	1.27
SCI32	151	232	239	177	88	2	1.80	1.22	.56	-1.52	-.35	.73	1.99	1.41
SCI36	150	165	237	204	131	2	2.00	1.30	.68	-1.23	-.52	.34	1.32	2.11
SCI47	59	140	262	271	155	2	2.36	1.14	.67	-1.98	-.96	.04	1.22	1.97
SCI49	180	215	222	163	107	2	1.78	1.29	.67	-1.13	-.23	.63	1.55	1.89
SCI60	213	196	206	162	110	2	1.73	1.34	.62	-1.04	-.24	.62	1.61	1.68
SW														
SCI23	125	155	240	209	158	2	2.14	1.29	.69	-1.40	-.65	.23	1.17	2.06
SCI31	118	196	261	207	105	2	1.98	1.21	.58	-1.73	-.60	.52	1.80	1.45

AD = Affective Disturbance; CC = Loss of Cognitive Control; Entrap. = Entrapment; Hyp. = Hyperarousal; SD = Standard Deviation; SW = Social Withdrawal.

3.4. Replication of factor structure (samples 1, 2, and 3)

The final version of the A-SCI-2 exhibited strong model fit in Sample 1 (χ^2[14] = 54.76, $p < .001$, CFI =.999, TLI =.998, RMSEA =.057, SRMR =.028), Sample 2 (χ^2[14] = 21.73, $p = .084$, CFI =.999, TLI =.999, RMSEA =.043, SRMR =.030), and Sample 3 (χ^2[14] = 63.11, $p < .001$, CFI =.997, TLI =.996, RMSEA =.057, SRMR =.040). Standardized factor loadings are presented in Supplemental Table 2. Internal consistency of the total score was good or high in all three samples (αs = .89,.89, and.90).

3.5. Convergent, discriminant, and incremental validity (samples 1, 2, and 3)

Correlations between the A-SCI-2 and the SCI-2 were very high in Sample 1 ($r = .94$), Sample 2 ($r = .94$), and Sample 3 ($r = .84$), supporting the use of the shortened scale to assess the SCS construct. Likewise, the strength of correlations with other suicide risk and protective factors (e.g., depression, anxiety, stress, resilience, suicidal ideation, lifetime suicide attempts) was comparable across the shortened and full scales, supporting the utility of the A-SCI-2. Detailed statistics are presented in Table 4. Of note, the rate of psychopathology in the healthy controls (Sample 3) was minimal; thus, all continuous variables underwent a natural logarithmic transformation to correct for non-normality. Nevertheless, correlations remained minimally different between the A-SCI-2/SCI-2 and symptoms of depression, anxiety, and suicide-related outcomes in this sample.

Linear regressions predicting past-month suicidal ideation were estimated in the MDD and control samples to examine whether the A-SCI-2 was uniquely associated with suicidal ideation, controlling for participant age and sex, depression, anxiety, and stress (MDD sample only). Detailed statistics from both samples are presented in Table 5. In the MDD sample, 17.2 % of the variance in suicidal ideation was explained, whereas in the control sample, 20.6 % of the variance was explained. The A-SCI-2 was significantly and uniquely associated with past-month suicidal ideation in both samples. Multicollinearity was not an issue in this analysis (MDD sample: variance inflation factor [VIFs] = 1.01–2.37; control sample: VIFs = 1.01–3.72).

Table 4
Correlations between the Abbreviated Suicide Crisis Inventory (A-SCI-2), Full SCI-2, and Other Psychological Constructs across Samples.

Variable	A-SCI-2	SCI-2
Sample 1		
PHQ-9	.61***	.65***
GAD-7	.59***	.61***
PSS	.42***	.46***
PSLES	-.18***	-.18***
CD-RISC	-.13***	-.16***
SI	.33***	.34***
Lifetime SA	.15***	.16***
Sample 2		
PHQ-9	.55***	.58***
GAD-7	.56***	.56***
PSS	.46***	.49***
PSLES	-.15**	-.16**
CD-RISC	-.18**	-.16**
SI	.34***	.39***
Lifetime SA	.21***	.24***
Sample 3		
PHQ-9	.49***	.53***
GAD-7	.48***	.55***
SI	.36***	.36***
Lifetime SA	.24***	.20***

CD-RISC = Connor Davidson Resilience Scale; Full = SCI; GAD = Generalized Anxiety Disorder-7; Short = A-SCI-2; PHQ = Patient Health Questionnaire-9; PSLES = Presumptive Stressful Life Events Scale; PSS = Perceived Stress Scale; SA = Suicide Attempt; SI = Suicide Ideation.
$^{**}p < 0.01$; $^{***}p < 0.001$

Table 5
Linear Regressions Predicting Suicidal Ideation in each Sample.

MDD Sample				
Predictor	**B**	**SE**	***p***	**95 % CI**
Age	-.01	.00	**< .001**	**-.02, −.005**
Sex	.16	.08	.054	-.003,.32
Depression	.05	.01	**< .001**	**.03,.07**
Anxiety	-.01	.01	.569	-.03,.02
Perceived Stress	.04	.01	**< .001**	**.03,.06**
A-SCI-2	.03	.01	**< .001**	**.02,.05**
Control Sample				
Predictor	**B**	**SE**	***p***	**95 % CI**
Age	-.000	.001	.934	-.002,.002
Sex	.04	.02	.120	-.01,.09
Depression	.01	.01	**.034**	**.001,.02**
Anxiety	.02	.01	**.013**	**.004,.03**
A-SCI-2	.03	.004	**< .001**	**.02,.03**

A-SCI-2 = Abbreviated Suicide Crisis Inventory - 2; CI = Confidence Interval; MDD = Major Depressive Disorder; SE = Standard Error. In the MDD sample, the overall model was significant ($F[6, 1177] = 41.88$, $p < .001$) and explained 17.2 % of the variance in suicidal ideation. In the control sample, the overall model was significant ($F[5, 928] = 48.24$, $p < .001$) and explained 20.6 % of the variance in suicidal ideation.

Finally, logistic regressions predicting lifetime suicide attempts were estimated in the MDD and control samples to examine whether the A-SCI-2 was uniquely related to lifetime suicide attempts, controlling for participant age and sex, depression, anxiety, and perceived stress (see Table 6 for detailed results). These models explained 6.9 % and 42.2 % (Nagelkerke R^2) of the variance in the MDD and control samples, respectively. In both samples, the A-SCI-2 was uniquely associated with increased odds of reporting a lifetime suicide attempt. Multicollinearity was not a concern in either sample (MDD sample: VIFs = 1.01–2.06; control sample: 1.10–4.14).

4. Discussion

We aimed to develop a briefer, user-friendly version of the SCI-2 in adults with MDD and examine its psychometric properties. After a series of analyses involving assumption checks, IRT, factor structure, item dimensionality checks, internal consistency, and convergent, discriminant, and incremental validity, the final measure (A-SCI-2) consisted of 7 items, with three of the original SCI-2 subscales (entrapment, affective disturbance, and hyperarousal) represented in a unidimensional factor structure, that can be used to reliably and validly indicate the presence and severity of the SCS. Notably, the final version of the A-SCI-2 showed good model fit in both clinical and non-clinical (control) samples, indicating its potential for general use.

Table 6
Logistic Regressions Predicting Lifetime Suicide Attempts in each Sample.

MDD Sample					
Predictor	**B**	**SE**	***p***	**OR**	**95 % CI**
Age	-.01	.01	.224	.99	.98, 1.01
Sex	.18	.16	.280	1.19	.87, 1.65
Depression	.05	.02	**.022**	**1.05**	**1.01, 1.09**
Anxiety	-.02	.02	.312	.98	.93, 1.02
Perceived Stress	.03	.02	.059	1.03	1.00, 1.07
A-SCI-2	.04	.02	**.008**	**1.04**	**1.01, 1.08**
Control Sample					
Predictor	**B**	**SE**	***p***	**OR**	**95 % CI**
Age	-.04	.04	.370	.96	.88, 1.04
Sex	-.20	.80	.806	.82	.17, 4.19
Depression	.03	.10	.803	1.03	.83, 1.24
Anxiety	.03	.11	.808	1.03	.83, 1.29
A-SCI-2	.24	.06	**< .001**	**1.27**	**1.13, 1.44**

A-SCI-2 = Abbreviated Suicide Crisis Inventory - 2; CI = Confidence Interval; MDD = Major Depressive Disorder; OR = Odds Ratio; SE = Standard Error. In the MDD sample, the model was significant ($\chi^2[6] = 49.09$, $p < .001$) and explained 6.9 % of the variance (Nagelkerke R^2) in lifetime suicide attempts. In the control sample, the model was significant ($\chi^2[5] = 45.12$, $p < .001$) and explained 42.2 % (Nagelkerke R^2) of the variance in lifetime suicide attempts.

The observed bifactor structure of the SCI-2 aligned with theory (Rogers et al., 2017; Schuck et al., 2019) and recent evidence (Rogers et al., 2025), though evidence elsewhere also supports the one-factor and five-factor structures (Chia-Yi Wu et al., 2022; Park et al., 2023; Peper-Nascimento et al., 2024), including in the index sample (Menon et al., 2024). Together, these results point to the construct validity and generalizability of the A-SCI-2. Internal consistency was good to high across all samples, and strong correlations between the abridged and full scales supported the clinical relevance of the A-SCI-2. Convergent and discriminant validity checks of the A-SCI-2 were similar to the full scale, further supporting the potential clinical utility of the A-SCI-2.

Finally, we found modest incremental validity for A-SCI-2. Whereas the A-SCI-2 was associated with past-month suicidal ideation in both MDD and control samples (over and above age, sex, depression, anxiety, and perceived stress), the regression models explained more variance in past-month suicidal ideation and lifetime suicide attempts in the control sample. Future work must examine the incremental validity of A-SCI-2 in different subpopulations and how best the A-SCI-2 can be combined with traditional risk and protective factors to predict prospective suicidal behavior.

The A-SCI-2 differed from the 9-item SCI-2-SF (De Luca et al., 2024) in several respects, primarily due to cultural and language factors. For instance, an entrapment item in SCI-2-SF ("Did you feel there was no exit?") was probably less clear than the equivalent item in the A-SCI-2 ("Did you feel there is no escape?"); respondents may not understand the word 'exit' in Indian context as much as 'escape'. Similarly, the affective disturbance item in SCI-2-SF ("Did you feel any unusually intense or deep negative feelings or mood swings?") performed poorly compared to the corresponding A-SCI-2 item ("Did you feel that your emotional pain was unbearable?"). These differences suggest the need to test the A-SCI-2 across cultures, where societal factors may influence the understanding and interpretation of distress-related behaviors.

4.1. Implications of findings

In the recent past, the SCS has received increased research attention for its purported utility in identifying individuals at increased near-term risk of suicide (Galynker et al., 2024). Given that such at-risk individuals are likely to present in busy emergency and outpatient settings, a brief yet psychometrically sound instrument for assessing SCS would be valuable; it is this gap that the 7-item A-SCI-2 seeks to fill. Its brevity supports initial assessment and ongoing monitoring of at-risk patients, with the potential for ecological momentary assessment of fluctuating suicide risk (Bryan et al., 2020; Rudd, 2006).

Notably, the A-SCI-2 assesses SCS in a dimensional fashion and may be best used in combination with traditional suicide risk assessment interviews for optimal assessment of suicide risk. This integrative approach is crucial, given the limited predictive accuracy of any single measure for a phenomenon as complex and multifactorial as suicide. Further research is needed to determine how best to incorporate the A-SCI-2 into existing risk assessment paradigms for optimum clinical benefits.

4.2. Limitations and strengths

Important strengths of the study were the inclusion of a control group to establish generalizability of the tool in a non-clinical sample, the recruitment of a sizeable, linguistically diverse sample collected from all major zones of the country, and the examination of psychometric properties of the A-SCI-2. However, there are a few noteworthy limitations. First, the cross-sectional study design precluded testing temporal stability, test-retest reliability, and predictive validity of the A-SCI-2. This is an important consideration for future research.

Second, given that we have not quantified between-site heterogeneity in patient characteristics, our findings must be interpreted with due caution. Third, we did not establish measurement invariance across the languages used for SCI-2 administration and between study populations (MDD vs controls)/subgroups (e.g., male vs female; young vs old); future work must address this limitation. Fourth, the convergent/discriminant validity checks could be further strengthened by including suicide-specific measures, such as the Suicide Rumination Scale (Rogers et al., 2022). This would enhance support for the A-SCI-2, as rumination and cognitive inflexibility are core features of the SCS (Melzer et al., 2024). They would also be strengthened through the use of other methods that do not rely on self-report; a limitation of this work was the sole inclusion of self-report measures, which may increase shared-method variance and thus artificially inflate correlations. Likewise, the incremental validity of A-SCI-2 may be examined against other suicide risk assessment measures that quantify constructs such as hopelessness, perceived burdensomeness, and thwarted belongingness; more rigorous analyses (e.g., multitrait-multimethod models) could be tested in future work as well.

Fifth, we examined the psychometric properties of the A-SCI-2 only in MDD and control samples. Future studies should assess its validity in other high-risk groups, such as recently discharged inpatients or individuals with multiple risk factors, to enhance its utility and impact. Sixth, given the moderating role of cultural factors such as societal acceptability of suicide as a method of dealing with one's life stressors (Galynker, 2023), the generalizability of our findings to other cultures and settings remains to be established. Seventh, further studies are needed to determine the optimum cutoff of A-SCI-2 to optimize the diagnosis of SCS and improve the tool's predictive power. Future work must also reexamine the content validity of A-SCI-2 to assess its conceptual breadth and coverage. Finally, qualitative cognitive interviews with participants may be conducted to ensure the interpretability of items.

4.3. Conclusions

The current version of the A-SCI-2, which we have developed, is a brief, 7-item, self-report instrument that can be reliably and validly used to assess the presence and severity of the SCS in MDD in busy settings. It needs to be tested for incremental predictive validity, over and above traditional risk factors, across settings and clinical at-risk populations to identify populations that may benefit most from targeted interventions. As a parting note of caution, given the complex, multidimensional nature of suicidal behaviour, it is likely that no single instrument will ever achieve a satisfactory prediction. The implicit message is that tools like the A-SCI-2 would need to be combined with traditional risk assessment approaches to have optimum validity, utility, and impact.

CRediT authorship contribution statement

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Declaration of Competing Interest

Authors have no conflicts to declare with regard to the contents of this manuscript.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.ajp.2026.104897.

Data Availability

The data that support the findings of this study are available from the corresponding author, Vikas Menon, upon reasonable request.

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