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The Relationship Between the Suicide Crisis Syndrome and Suicidal Ideation in Adolescents: A Preliminary Validation Study Using Data from the Young-HUNT3 epidemiological study

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Abstract

Background

Suicide among youth has increased over past decades and is now among the most common causes of death for adolesecents. Suicidal ideation, the traditional basis of risk assessment, has serious limitations in predicting imminent risk, necessitating novel modes of risk assessment. The Suicide Crisis Syndrome (SCS) is an acute cognitive-affective state that has been shown to be predictive of near-term suicidal thoughts and behavior. It is currently under consideration for inclusion in DSM as a suicide-specific disorder. To date, the SCS has not been tested in adolescents. The present study examines the concurrent validity of the SCS with regard to suicidal ideation using data from an epidemiological study of adolecent health, the Norwegian Young-HUNT3 study.

Methods

The sample included 8,199 adolescents, aged 13–20, who participated in the Young HUNT3 study, administered between 2006 and 2008 in the Trøndelag district of Norway. Of these, 3,212 respondents answered a question on history of suicidal ideation. The SCS was assessed by a proxy measure (SCS-YHP) derived from the survey items. The association between the SCS-YHP and suicidal ideation was assessed through several logistic regression analyses. Sensitivity analyses were performed to test two additional formats of the SCS-YHP, maintaining the same items but reducing the stringency of the criteria to increase the case rate.

Results

Concurrent validity was strong for all three formats. Odds ratios ranged from 6.72 to 11.75 and were significant, at minimum, at the .002 level, such that adolescents who were rated as SCS positive, by any of 3 different formats, were approximately 7–12 times more likely to report a history of suicidal ideation. These associations remained significant after controlling for age and sex. Sensitivity and specificity were also high; 67 to 78% for sensitivity and 77–78% for specificity across the three formats, the most stringent format having the strongest sensitivity/specificity.

Conclusions

As an important first step, this study provides prelmimary evidence of concurrent validity for the Suicide Crisis Syndrome among adolescents. Future research can aim to replicate these findings with a validated measure of the SCS for youth and to test predictive validity to suicidal behavior.

Background

Suicide is one of the main causes of death globally. In 2021, an estimated 727,000 people died by suicide [1], more than died by breast cancer, war, homicide, HIV/AIDS or malaria. Suicide is a particularly serious problem among youth and was the 4th most common cause of death among people aged 15–19 worldwide in 2021. Although the rate of youth suicide is higher among males than females [2], at a ratio of about 5 to 2 [3], suicide is the 2nd most common cause of death for females in this age group [1]. In recent decades, the rate of youth suicide has increased in several countries, including the United States, United Kingdom, Australia, and Canada [4]. Likewise, suicide rates among youth aged 10–24 rose from 1980 to 2020 in North America, Central-South America, and Asia-Oceania [3]. Clearly, youth suicide is a pressing public health problem requiring effective preventative strategies.

Suicidal behavior in adolescents may differ from that in adults in a number of dimensions. Adolescents tend to be more impulsive and affectively reactive than adults [5–7]. Likewise, they are more sensitive to interpersonal difficulties, which serve as a major trigger for suicidal behavior [8]. In a comparison of adult and adolescent psychiatric admissions following suicidal ideation or behavior, Parellada and colleagues [9] found that adolescents tended to use less lethal methods, were more uncertain in their intent and engaged in more impulsive behavior [9]. In a 2018 review by Steele and colleagues, adolescent risk factors for suicides and suicidal behaviors included insomnia, perceived burdensomeness, bullying, school problems, and recent conflict with a family or a romantic partner. In contrast, risk factors for adults included being male, substance abuse, low education, occupational, financial or legal distress and being single, divorced or widowed. Psychiatric illness, particularly depression, and prior suicide attempts crossed generational boundaries [10].

Cyber bullying, in particular, has received more attention of late, and may be particularly damaging to adolescent girls [2, 9]. Likewise, social media has come to play an increasingly dominant role in adolescents' lives and more frequent use has been linked to poorer mental health and suicidal ideation [2, 11, 12]. Possible mechanisms include sleep interference, distraction from other activities, negative social comparisons, perceived peer exclusion and cyber bullying.

Traditionally, suicide risk assessment has relied almost exclusively on self-reported suicidal ideation (SI) [13], which poses numerous challenges [14–16]. Suicidal individuals may choose not to disclose SI [17], often to avoid hospitalization, embarrassment, or feared judgment [18]. Likewise, SI is highly variable and can fluctuate dramatically throughout the day [19]. In studies by Deisenhammer and colleagues [20] and Paashaus and colleagues [21], more than 40% of study participants reported less than 10 minutes between the onset of SI and suicidal action. This time frame might be even shorter among adolescents given their elevated impulsivity.

In response to these limitations, increasing attention in recent years has been directed to the concept of a suicidal mental state. The Suicide Crisis Syndrome (SCS), in particular, has been extensively researched. The SCS has shown robust associations with near-term suicidal behavior (See [22, 23] for reviews) and is currently under consideration for inclusion in the Diagnostic and Statistical Manual for Psychiatric Disorders (DSM-5-TR) [24]. The SCS describes a hyperaroused, negative affective-cognitive

state characterized by a profound sense of entrapment. Fifteen symptoms are categorized into 5 criteria that together comprise a unified construct [25]. Criterion A is Entrapment, defined as an overpowering sense of being trapped in an intolerable and inescapable situation. Criterion B, Associated Features, has four subcriteria. Criterion B1, Affective Distress, refers to acute and severe emotional distress, psychological pain or mood lability. Criterion B2, Disturbances in Arousal, refers to a hyperaroused and agitated state characterized by hypervigilance, extreme tension or insomnia. Criterion B3, Loss of Cognitive Control, refers to a profusion of negative thoughts, overwhelming rumination and the inability to shift attention or think flexibly. Criterion B4, Acute Social Withdrawal, refers to a recent and abrupt withdrawal from social connections and/or evasive communication. Individuals meet criteria for SCS if they score positively on at least one symptom from all 5 domains [26].

To date, all studies published on the SCS have been conducted with adult populations. Across multiple independent samples, confirmatory factor analyses have shown SCS to be a coherent, unitary construct with five separate subdomains [27–29]. Within both clinical and community adult samples, the SCS was found to predict near-term suicidal ideation and behavior [27, 30] and did so over and above traditional risk factors such as depressive symptoms and suicidal ideation [27, 31]. A measure of the SCS was also shown to predict long term risk of suicide death[1]. Further, discriminant validity over depression, obsessive compulsive disorder, personality and posttraumatic stress disorders have also been demonstrated [32]. Moreover, measures of the SCS have been adapted and implemented into standard clinical procedures in psychiatric settings in the United States [33, 34] and Hungary [35], where they have demonstrated high clinical utility with regard to clinical decision making [33].

Because of adolescents' unique developmental challenges, exclusive reliance on suicidal ideation for risk assessment might be even more problematic than with adults. Adolescents are known to be more impulsive and emotionally reactive even than younger children and are often reluctant to confide in adults [5, 36]. As such, assessment of an acute negative affect state may be of heightened clinical utility in suicide prevention. Moreover, such a state may be more easily detected by parents, teachers, friends and other family members, allowing for more timely interventions, even when adolescents are reluctant to self-disclose SI. Likewise, adolescents themselves can be educated to recognize these symptoms and to seek out support before they escalate to a dangerous level. Currently, there are no published studies of SCS in adolescents although an Israeli study of 335 adolescents presenting to the emergency room has been completed and publicly presented[2]. Of note, the Barzilay study assesses a clinical population, such that SCS remains untested in the general adolescent population.

The present study assesses the relationship between SCS symptoms and history of suicidal ideation in a sample of 3,195 adolescents surveyed in the Young-HUNT3 epidemiological study from the Trøndelag district of Norway. Although, as noted above, SI is a problematic marker of imminent risk of suicide, it is still a worthwhile target of study. It is indicative in and of itself of a high level of distress and the risk of either suicidal attempt or death by suicide is meaningfully higher in people with suicidal ideation than without [37–39]. Specifically, in an epidemiological study of 6,483 adolescents in the United States, one

third of the participants with SI later attempted suicide [40]. Moreover, as a preliminary step, it is critical to link SCS among adolescents with an established marker of suicidal risk.

The HUNT studies are designed to provide a comprehensive picture of public health in the Norwegian district of Trøndelag and include a section on mental health. Young-HUNT3 was aimed at adolescents aged 13 to 20 and conducted between 2006 and 2008. Although Young-HUNT3 did not include a validated measure of SCS, items from the mental health section of the survey were extracted to create a proxy measure of SCS, a research design which has been utilized previously [26]. Likewise, across many fields of study, proxy or derived measures are frequently used with epidemiological data when the phenomenon of interest was not addressed in the original research design [41–43]. Of note, this study serves as a companion study to an initial SCS-HUNT study, testing the predictive validity of a proxy measure of SCS in adults to deliberate self-harm and death by suicide[1].

The hypotheses tested in this study are:

1. Adolescents who meet criteria for SCS will have reported an increased rate of lifetime suicidal ideation, with high levels of sensitivity and specificity.
2. SCS will show incremental concurrent validity for suicidal ideation, after controlling for age and sex, two characteristics previously associated with suicidal risk [1, 3].
3. Suicidal ideation will be independently associated with each of the 5 SCS criteria after controlling for intercorrelations.

To the extent these hypotheses are supported, this will provide an important first step in demonstrating construct validity for the SCS in adolescents.

Methods

Collaboration

This study was conducted as part of a collaboration between a research team at the Icahn School of Medicine at Mount Sinai in New York City and researchers at the Norwegian University of Science and Technology (NTNU) in Trondheim, Norway. A collaboration agreement between the two institutions specified the scope of work and the procedures for data sharing. The project was approved by the Regional Committee for Medical and Health Research Ethics – Southeast Norway (ref. 2018/1037).

Source of Data

The Trøndelag Health Study (Helseundersokelsen i Trøndelag: HUNT) is a population-wide survey on health and health behaviors sent to all residents of Trøndelag County in Norway. HUNT is a collaboration between HUNT Research Centre (Faculty of Medicine and Health Sciences, Norwegian University of Science and Technology NTNU), Trøndelag County Council, Central Norway Regional Health Authority,

and the Norwegian Institute of Public Health. HUNT3 was the third of a series starting in 1984 and took place between October, 2006 and June, 2008.

Young-HUNT3 was the adolescent component of HUNT3. Recruitment took place largely through junior high and high schools. After the principal of each of the 66 schools in the district gave written consent for the school's participation, invitation letters were sent to all students and their parents or guardians describing the study and use of data. All participants and parents of those under age 16 provided written informed consent. For all participating students, an anonymized questionnaire was administered in a school classroom in an "exam-like setting." Approximately one month later, a nurse visited the school for follow-up interviews and physical measurements. Data for this study was drawn solely from the questionnaire.

Adolescents not in school were contacted by mail and invited to complete the questionnaire and to attend an adult screening site. Young-HUNT was approved by the Norwegian Data Inspectorate, the Regional and National Committees for Medical and Health Research Ethics and the Norwegian Directorate of Health. See [44] for a detailed description of the Young-HUNT studies.

Participants

Of the 10,464 adolescents invited to participate in the Young-HUNT3 study, 5,614 (53.7%) were in junior high school, 4,357 (41,6%) were in high school, and 493 (4.7%) were not in school. Of those invited, 8,200 (78.4%) completed the questionnaire. The response rate was 84.6% for junior high students, 76.6% for high school students, and 23.3% for adolescents not in school [44].

Measures

Proxy SCS measure (SCS-YHP)

Items for the proxy Young-HUNT3 SCS (SCS-YHP) were extracted from the baseline questionnaire, which incorporated items from multiple sources. Items for Criteria A, B1, B2 and B3a were drawn from the 5-item Hopkins Symptoms Checklist (HSCL-5), a widely used, 5-item questionnaire measuring emotional distress [45]. Additional items assessing social isolation and insomnia (Criteria B3b and B4) were extracted from questionnaires designed by the Norwegian Institute of Public Health. See Table 1 for description of the items and scoring criteria.

Table 1

Scoring Criteria for the SCS Proxy Measures *Note*. SCS YHP = Suicide crisis Syndrome Young-HUNT Proxy. Variables in the HUNT study can be reviewed at the following link: https://hunt-db.medisin.ntnu.no/hunt-db/variablelist

SCS Criteria	Data Source	HUNT Variables	Coding Scheme
Criterion A: Entrapment	Hopkins Symptom Checklist (SCL-5)	Last 14 days felt hopelessness when you think of the future?	4 = Very bothered
Criterion B1: Affective Disturbance	Hopkins Symptom Checklist (SCL-5)		B1b or B1c
Criterion B1b: Depressive Turmoil	Hopkins Symptom Checklist (SCL-5)	Last 14 days felt dejected or sad?	4 = Very bothered
Criterion B1c: Extreme Anxiety	Hopkins Symptom Checklist (SCL-5)	Last 14 days been constantly afraid and anxious?	4 = Very bothered
Criterion B2: Loss of Cognitive Control	Hopkins Symptom Checklist (SCL-5)	Last 14 days worried too much about various things?	4 = Very bothered
Criterion B3: Hyperarousal			B3a or B3b
Criterion B3a: Agitation	Hopkins Symptom Checklist (SCL-5)	Last 14 days felt tense or uneasy?	4 = Very bothered
Criterion B3b: Global Insomnia	Norwegian Institute of Public Health	Last month had difficulty falling asleep in the evening?	1 = Almost every night
Criterion B3b: Global Insomnia	Norwegian Institute of Public Health	Last month woke too early and couldn't fall asleep again?	1 = Almost every night
Criterion B4: Acute Social Withdrawal	Norwegian Institute of Public Health		Any of the items below are positive
	Norwegian Institute of Public Health	How many close friends? Those you can confide in and who help you when you need help.	1 = None or one
	Norwegian Institute of Public Health	How often have you visited someone you know?	1 = None
	Norwegian Institute of Public Health	How often have you gone out with friends more than two hours in a row?	1 = None

SCS Criteria	Data Source	HUNT Variables	Coding Scheme
Criterion A3: Entrapment modified		Last 14 days felt hopelessness when you think of the future?	3 = quite bothered or 4 = very bothered
Criterion B1.3: Affective Disturbance modified		Last 14 days been constantly afraid and anxious?	3 = quite bothered or 4 = very bothered or B1b
SCS-YHP 1	Calculated Scores	See above	SCS A, B1, B2, B3 and B4
SCS-YHP 2	Calculated Scores	See above	SCS A and B1, B2, B3 or B4
SCS-YHP 3	Calculated Scores	See above	SCS A3, B1.3, B2, B3, and B4

Note. SCS YHP = Suicide crisis Syndrome Young-HUNT Proxy. Variables in the HUNT study can be reviewed at the following link: https://hunt-db.medisin.ntnu.no/hunt-db/variablelist

SCS-YHP is a binary variable marking the presence or absence of SCS. In keeping with previously established criteria for the proposed DSM diagnosis [22, 32], participants with at least one symptom in each domain were rated to meet criteria for that domain. The number of domains required for the final binary rating of SCS varied, however, as is detailed below.

Initially, the SCS-YHP was designed theoretically, based on face validity. As there were no means of measuring criterion validity within the Young-HUNT3 dataset, we developed two alternative versions to provide sensitivity analyses of the relationship between SCS and suicidal ideation.

SCS-YHP 1. This first measure was the most stringent. In accord with the proposed DSM SCS criteria, a positive rating on all 5 criteria was required for a positive SCS diagnosis.

SCS-YHP 2. Because of the small percent of study participants scoring positively using SCS-YHP 1 (N = 19, 0.24%), a less stringent measure was designed, requiring only Criterion A plus any of Criteria B1-B4 to be positive. Although these criteria differ from the proposed DSM SCS diagnostic criteria, a similar metric has been successfully used clinically in hospital systems in Chicago, Illinois [33, 34] and Pecs, Hungary [35]. Further, prior studies have demonstrated predictive validity with different combinations of the 5 SCS criteria [27]. In all such cases, however, Entrapment/Frantic Hopelessness (Criterion A) is required.

SCS-YHP 3. To maintain consistency with the proposed DSM SCS diagnosis but still relax inclusion criteria, a second alternative scoring system was designed. SCS-YHP 3 maintained the requirement of all 5 SCS criteria but loosened the criteria for Criterion A and Criterion B1 (See Table 1).

[INSERT Table 1 **HERE]**

Suicidal Ideation

Suicidal ideation was assessed with the question: Have you ever had thoughts of taking your own life? History of suicidal behavior (e.g., attempts, gestures) was not assessed in Young-HUNT3 so could not be assessed in this study.

Demographic and clinical characteristics

Information on age, sex, and impairment due to mental health problems (coded no, a little, somewhat or severely) was also extracted from the baseline questionnaire. In Young-HUNT3, sex was coded only as male vs. female.

Data Analysis

Initial analyses provided descriptive data to characterize the SCS results in this sample. To test concurrent validity in Hypothesis 1, logistic regression regressed suicidal ideation on SCS-YHP. Sensitivity and specificity were also assessed. To test incremental validity in Hypotheses 2, age and sex were added to the models. Due to the low case rate for all three models, positive and negative predictive values were not calculated as they are dependent on prevalence within the population [46]. To test the independent validity of each domain in Hypothesis 3, SI was regressed against all five domain scores. Given the potential for heteroscedasticity in the data, we utilized robust standard errors to enhance the reliability of our estimates. For sensitivity analyses, all hypotheses were tested using all three SCS-HP formats. Missing data was handled listwise; only records with complete data were included in each analysis. To preserve power given the low case rate, we elected to include all available data in each analysis even though sample size varied depending on the variables included. All data was analyzed with STATA v. 180/MP. The AI platform POE was used solely to help format commands for data analysis in STATA.

Results

The entire sample used for analysis included 8,199 participants. Of these, 8,041 had sufficient data for SCS-HYP 1; 19 participants (0.23%) rated SCS positive and 8,022 (97.8%) rated negative. With the more inclusive SCS-YHP 2, there was, as expected, a larger case rate (N = 176, 2.21% of 7,979). The final model, SCS-YHP 3, yielded 25 cases (0.31% of 8,039). Although not consistent across SCS-YHP formats, participants meeting criteria for SCS were younger than their non-SCS counterparts and more likely to be females than males. Across all 3 formats, participants meeting criteria for SCS reported dramatically higher rates of impairment due to a mental health condition, at least 20 times more likely to rate high/severe impairment vs. no/a little. See Table 2.

Table 2
Demographic and Clinical Features in Relation to SCS

SCS Format	SCS	No SCS	Statistic	p value	Effect Size
SCS-YHP 1 (N = 8,041)	19 (0.23%)	8,022 (99.8%)	---	---	
Sex			$c^2(1) = 4.05$	.044	OR = 2.74, 95% CI: 0.99, 7.6
Female	14 (%)	4,056 (%)	---	---	*Fisher's exact = 0.06, p > .05
Male	5 (%)	3,966 (%)	---	---	
Age: mean (sd)	16.71 ± 1.67	15.88 ± 1.74	t(8,039)= -2.07	.039	Cohen's d = 0.49
Impairment			$c^2(1) = 131.91$	< .00001	OR = 31.82, 95% CI: 12.6, 80.29
No, a little	162 (2.23%)	7,089 (88.6%)	---	---	
Somewhat/ severely	8 (42.1%)	11 (57.9%)	---	---	
SCS-YHP 2 (N = 7,977)	176 (2.21%)	7801 (97.8%)	---	---	
Sex			$c^2(1) = 23.53$	0.001	OR = 2.17, 95% CI: 1.60, 3.00
Female	121 (2.99%)	3922 (97.0%)	---	---	
Male	55 (1.40%)	3881 (98.6)	---	---	
Age: mean (sd)	16.47 ± 1.69	15.87 ± 1.74	t [7,977] = -4.49	< .001	Cohen's d = 0.35
Impairment			$c^2(1) = 456.68$	< .00001	OR = 20.8, 95% CI: 14.2, 30.7
No, a little	125 (1.77%)	6,939 (98.2%)	---	---	
Somewhat/severely	45 (27.3%)	120 (72.7%)	---	---	
SCS-YHP 3 (N = 8039)	25 (0.31%)	8,014 (99.69%)	---	---	

Note. SCS YHP = Suicide crisis Syndrome Young-HUNT Proxy. OR= Odds Ratio. *Fisher's exact test provided [by socsci] when cell size is 6 or under. (Cohen's d first checked on POE and then validated on socsclstatistics.com/effectsize/default3.aspx OR's provided by POE

SCS Format	SCS	No SCS	Statistic	p value	Effect Size
Sex			$c^2(1) = 6.46$	0.011	OR = 3.11, 95% CI: 1.24, 7.71
Female	19 (0.47%)	4,051 (99.53%)	---	---	Fisher's exact = 0.147, p<.05
Male	6 (0.15%)	3,963 (99.85%)	---	---	
Age: mean (sd)	16.38 ± 1.81	15.88 ± 1.74	t (8037) = -1.43	0.15	Cohen's d = 0.28
Impairment			$c^2(1) = 130.32$	< .00001	OR = 26.4, 95% CI: 11.4, 61.3
No, a little	15 (0.02%)	7,083 (99.79%)	---	---	
Somewhat/ severely	9 (5.29%)	161 (94.70%)	---	---	

Note. SCS YHP = Suicide crisis Syndrome Young-HUNT Proxy. OR= Odds Ratio. *Fisher's exact test provided [by socsci] when cell size is 6 or under. (Cohen's d first checked on POE and then validated on socsclstatistics.com/effectsize/default3.aspx OR's provided by POE

[INSERT Table 2 **HERE]**

Concurrent Validity (Hypothesis 1)

Reported history of suicidal ideation was remarkably common in this sample. Almost a quarter (N = 743, 23%) of the participants who answered the question (N = 3,212) reported a history of suicidal ideation.

Concurrent validity was strong for all three formats, as presented in Table 3. Odds ratios ranged from 6.72 to 11.75 and were significant, at minimum, at the .002 level. This suggests that adolescents who were rated as SCS positive, by any of 3 different formats, were approximately 7–12 times more likely to report a history of suicidal ideation. Of note the highest odds ratio was achieved for the most stringent model (SCS-YHP 1) although this difference between models was not significant, as indicated by the overlapping 95% confidence intervals.

Sensitivity and specificity for each format were as follows: 77.8% and 77.0% for SCS-YHP 1; 67.0% and 78.3% for SCS-YHP 2; and 66.7% and 77.1% for SCS-YHP 3.

Table 3
Prediction to Suicidal Thoughts of the Three SCS formats: Logistic Regression Analyses

SCS Format	SI	No SI	OR	95%LLCI	95%ULCI	p value
SCS-YHP 1	7 (78%)	2 (22%)	11.75	2.44	56.71	.002
No SCS-YHP 1 (ref.)	731 (23%)	2,455 (77%)				
SCS-YHP 2	61 (67%)	30 (33%)	7.35	4.71	11.48	< .001
No SCS-YHP 2 (ref.)	666 (22%)	2,408 (78%)				
SCS-YHP 3	8 (67%)	4 (33%)	6.72	2.02	22.39	.002
No SCS-YHP 3 (ref.)	730 (23%)	2,453 (77%)				

Note. SCS = Suicide Crisis Syndrome. SCS 1 requires all 5 criteria to be present, which parallels the proposed DSM diagnosis but generated a minimal cell size. SCS 2 requires Criterion A to be present plus one of Criteria B1-B4. This is less stringent but generates a larger cell size (N = 91 in this analysis). SCS3 requires all 5 SCS criteria be met as with SCS 1 but relaxes the requirements for Criteria A and B1.

Incremental Validity (Hypothesis 2)

For each format, concurrent validity held strong when age and sex were entered into the models. Adjusted odds ratios for the SCS ranged from 6.13 to 10.59. Although female sex was a significant risk factor in the three models, age was not. In this case too, the SCS-YHP1 achieved the highest odds ratio but the difference was not significant. (See Table 4).

Table 4
Incremental Validity to Suicidal Ideation of Each SCS Format Controlled for Age and Sex

SCS Format	SI	No SI	OR	95%LLCI	95%ULCI	p value
SCS-YHP 1 (N = 3,195)						
SCS 1	7 (78%)	2 (22%)	10.59	2.15	52.13	.004
No SCS 1 (ref.)	731 (23%)	2,455 (77%)				
Male	311 (20%)	1,228 (80%)	0.73	0.62	0.86	< .001
Female (ref.)	432 (26%)	1,241 (74%)				
Age: mean (sd)	17.61 (0.9)	17.63 (0.9)	0.97	0.88	1.06	.472
SCS-YHP 2 (N = 3,165)						
SCS 2	61 (67%)	30 (33%)	7.09	4.51	11.14	< .001
No SCS 2 (ref.)	666 (22%)	2,408 (78%)				
Male	311 (20%)	1,228 (80%)	0.75	0.63	0.89	.001
Female (ref.)	432 (26%)	1,241 (74%)				
Age: mean (sd)	17.61 (0.9)	17.63 (0.9)	0.96	0.87	1.05	.385
SCS-YHP 3 (N = 3,195)						
SCS 3	8 (67%)	4 (33%)	6.13	1.84	20.37	.003
No SCS 3 (ref.)	730 (23%)	2,453 (77%)				
Male	311 (20%)	1,228 (80%)	0.73	0.62	0.86	< .001
Female (ref.)	432 (26%)	1,241				

Note. SCS = Suicide Crisis Syndrome. SI= Suicidal Ideation. OR= Odds Ratio. SCS 1 requires all 5 criteria to be present, which parallels the proposed DSM diagnosis but generated a minimal cell size. SCS 2 requires Criterion A to be present plus one of Criteria B1-B4. This is less stringent but generates a larger cell size (N = 91 in this analysis). SCS3 requires all 5 SCS criteria be met as with SCS 1 but relaxes the requirements for Criteria A and B1.

SCS Format	SI	No SI	OR	95%LLCI	95%ULCI	p value
		(74%)				
Age: mean (sd)	17.61 (0.9)	17.63 (0.9)	0.97	0.88	1.06	.492

Note. SCS = Suicide Crisis Syndrome. SI= Suicidal Ideation. OR= Odds Ratio. SCS 1 requires all 5 criteria to be present, which parallels the proposed DSM diagnosis but generated a minimal cell size. SCS 2 requires Criterion A to be present plus one of Criteria B1-B4. This is less stringent but generates a larger cell size (N = 91 in this analysis). SCS3 requires all 5 SCS criteria be met as with SCS 1 but relaxes the requirements for Criteria A and B1.

Independent validity of Each SCS Criterion (Hypothesis 3)

To test the independent relationships between the 5 SCS criteria and history of suicidal thoughts, two analyses were run, the first with the original 5 criteria and the second replacing Criteria A and B1 with the less stringent versions of these criteria used in SCS-YHP 3. In the first more stringent model, each SCS criterion was independently associated with suicidal thoughts. In the second model, all but B4, acute social withdrawal, were independently associated with suicidal thoughts. (See Table 5).

Table 5
Independent Contributions of Each SCS criterion to Prediction of Concurrent Suicidal Thoughts

SCS Criterion	**SI** **N (%)**	**No SI** **N (%)**	**AOR**	**95%ULCI**	**95%LLCI**	**p value**
Model 1 (N = 3070)						
SCS A	74 (62.2)	45 (37.8)	2.44	1.48	4.00	< .001
No SCS A (ref)	654 (21.4)	2,395 (78.6)				
SCS B1	94 (72.9)	35 (27.1)	3.87	2.39	6.25	< .001
No SCS B1 (ref)	629 (20.8)	2,397 (79.2)				
SCS B2	136 (59.1)	94 (40.9)	2.88	2.03	4.07	< .001
No SCS B2 (ref)	588 (20.0)	2349 (80.0)				
SCS B3	111 (48.7)	117 (51.3)	1.77	1.27	2.47	.001
No SCS B3 (ref)	605 (20.9)	2287 (79.1)				
SCS B4	148 (29.6)	352 (70.4)	1.31	1.03	1.65	.025
No SCS B4 (ref)	578 (21.9)	2063 (78.1)				
Model 2 (N = 3071)	SI N (%)	No SI N (%)	AOR	95%ULCI	95%LLCI	p value
*SCS3 A	209 (51.0)	201 (49.0)	2.66	2.06	3.44	< .001
No SCS3 A (ref)	519 (18.8)	2239 (81.2)				
*SCS3 B1	137 (64.9)	74 (35.1)	3.22	2.22	4.66	< .001
No SCS3 B1 (ref)	587 (19.9)	2358 (80.1)				
SCS B2	136 (59.1)	94 (40.9)	2.21	1.54	3.18	< .001
No SCS B2 (ref)	588 (20.0)	2349 (80.0)				

Note. SCS = Suicide Crisis Syndrome, AOR = adjusted odds ratio, LLCI = lower limit confidence interval, ULCI = upper limit confidence interval, *alternative, less stringent formats for Criteria SCS A and SCS B1 entered into Model 2 with the other SCS criteria.

SCS Criterion	SI N (%)	No SI N (%)	AOR	95%ULCI	95%LLCI	p value
SCS B3	111 (48.7)	117 (51.3)	1.64	1.16	2.30	.005
No SCS B3 (ref)	605 (20.9)	2287 (79.1)				
SCS B4	148 (29.6)	352 (70.4)	1.24	0.98	1.58	.074
No SCS B4 (ref)	578 (21.9)	2063 (78.1)				

Note. SCS = Suicide Crisis Syndrome, AOR = adjusted odds ratio, LLCI = lower limit confidence interval, ULCI = upper limit confidence interval, *alternative, less stringent formats for Criteria SCS A and SCS B1 entered into Model 2 with the other SCS criteria.

Discussion

The primary aim of this paper was to provide initial validation of the Suicide Crisis Syndrome in adolescents, specifically in a community population. We hypothesized that a proxy measure of the SCS extracted from the epidemiological Young-HUNT3 study would be associated with a history of suicidal ideation in youth aged 13–20, that this relationship would have high sensitivity and specificity, and that it would be sustained after controlling for age and sex. Additionally, we hypothesized that each SCS domain would be independently associated with suicidal ideation. Indeed, in all three SCS formats, our hypotheses were supported, with the exception of SCS Criterion B4 in the analysis of SCS-YHP 3.

This is, to our knowledge, one of the first studies showing construct validity for SCS in adolescents and the first within the general population. We believe that SCS can provide a valuable addition to suicide prevention in adolescents, who are often reluctant to disclose suicidal ideation to adults. Moreover, adolescents exhibit greater emotional reactivity and impulsivity than adults [6, 7], which serve as strong drivers of suicidal behavior in this age group [8]. SCS, a hyper-aroused, negative affect state, characterized by loss of cognitive control, precisely focuses on an emotionally dysregulated mental state strongly associated with suicidal thoughts and behavior [22, 23]. To the extent that family, friends, clinicians, teachers and adolescents themselves are educated about SCS, this can potentially provide a valuable early warning system for suicidal risk, flagging the possible need for intervention and support. Future research can demonstrate whether the clinical utility of SCS already documented in adults [33, 34] can generalize to adolescents. Future research can also investigate treatment options for SCS as a stand-alone syndrome.

In all three formats, the SCS-YHP showed relatively strong sensitivity and specificity. Sensitivity is arguably most important in risk assessment, such that people at risk are flagged and not overlooked. Lower specificity can be mitigated by treating the measure as an initial screen, identifying the need for further evaluation. Nonetheless, our specificity was also high, which is not always the case with suicide risk protocols [47, 48].

At this stage, the incidence of SCS in adolescence is not known. Incidence in community populations of adults has ranged from 3.6% to 16.2% across countries [49]. However, the reliance on self-selected samples in the online surveys used to collect these data may overestimate the incidence in the population while the use of proxy measures, such as the one in the current study and in the adult HUNT3 study[1], likely underestimates the incidence. Importantly, in this epidemiological study, 23% of survey respondents who answered the question reported a history of suicidal ideation. Even if the 60% of survey participants with missing data denied history of SI, that would still indicate prior or current SI in at least 9.2% of this community population of adolescents. According to the Anne E. Casey Foundation [50], in 2022–2023 in the United States, an estimated 18% of adolescents had at least one major depressive episode in the past year, while 20% reported symptoms of anxiety and 31% had a mental, emotional, developmental or behavioral problem. Given these statistics, it is highly likely that the actual incidence of SCS is higher than found in this study.

SCS was strongly associated with self-reported severe mental health impairment, with odds ratios consistently above 20. This supports the notion of SCS as a stand-alone psychiatric disorder, associated with distress and dysfunction even outside of its relation to suicide risk. We also found that older adolescents and females vs. males were more likely to meet criteria for SCS on the SCS-YHP, although this was not consistent across SCS-YHP formats. That females report a higher incidence of SCS than males is consistent with robust findings in the literature of greater incidence of depression, suicidal ideation and other internalizing disorders in girls and women [3. 51] The extent to which this reflects a true difference in prevalence rather than self-disclosure remains unclear [15, 52] but it has also been shown that males are more likely to manifest emotional distress in externalizing disorders, that is in action rather than in subjective experience [53, 54]. In this regard, clinician ratings might offer advantages over self-report questionnaires. In adult samples, SCS has been more common in younger people [49], which is not consistent with the present findings. The younger age of participants without SCS may reflect the presence of pubertal or pre-pubertal adolescents who may not have fully encountered the challenges of adolescence, a consistent finding among youth studies [51]. That the participation rate was highest (86%) among junior high students, who required parental consent, also suggests a possible self-selection bias towards greater health concerns in older students who elected to participate in the HUNT survey.

Limitations

The findings of this study should be considered in the context of its limitations. For one, SCS was measured with a proxy measure extracted from the Young-HUNT3 study, which has not been validated against other validated SCS measures. While this proxy measure lacked evidence of criterion validity, that is convergent validity with published and validated measures of the SCS, its association with SI, as demonstrated across multiple formats, provides preliminary indication of construct validity. Likewise, proxy measures have frequently been derived from epidemiological data that did not include the measures of interest in its original design. This has been done across multiple fields, including suicide research and mental health [41–43]. Future research should replicate the current findings with validated

SCS measures, such as the Suicide Crisis Inventory, 2nd edition (SCI-2) [27], the SCS-Checklist (SCS-C) [22], the SCI-short form (SCI-SF) [55, 56], or the Abbreviated SCS-C (A-SCS-C) [33, 34]. The Youth Suicide Crisis Inventory (Y-SCI) from the Barzilay group shows particular promise for adolescents[2]. Additionally, although the use of an epidemiological study enhanced generalizability, the pattern of missing data introduced the possible confound of self-selection bias. Moreover, the findings may not generalize to other countries and cultures. Nonetheless, SCS in adults has shown remarkable consistency across cultures, for example, in Russia [57], Brazil [58], and Korea [28]. Further, these findings, which are based upon data from 2006 to 2008, may not generalize to the present time, where social media plays such a central role in adolescent lives. This might both amplify pre-existing suicidal risk factors (e.g., sleep disturbance) and introduce new ones (e.g., cyberbullying) [59]. Nonetheless, we can speculate that these new circumstances might heighten the relevance of SCS among adolescents. Finally, this study did not measure the association with or prediction of suicidal behavior, gestures or death by suicide. Rather it measured lifetime SI. As noted above, while SI is far less dangerous than either suicidal behavior or death by suicide, and the characteristics of individuals with SB and who die by suicide vary to some extent [60], SI is nonetheless an established and widely used measure of suicidal risk [13] and a meaningful marker of psychological distress. As such, evidence of SCS's association with SI can serve as a needed first step in validating the SCS among adolescents. Future research will need to assess the predictive validity of SCS in adolescents to suicidal behavior. Likewise, prior studies have shown SCS to be associated with both recent and lifetime suicidal thoughts and behavior [27, 30, 61]. One way to understand this is that some individuals may have a propensity towards SCS, such that it recurs under stress. To the extent this is the case, education about SCS might prove a potent preventative tool.

Conclusions

In conclusion, in the context of its limitations, the present study provides important preliminary evidence of the construct validity of Suicidal Crisis Syndrome in a community-based adolescent population. Future research can replicate and expand upon these findings, supporting the development of a potentially valuable new tool for prevention of adolescent suicide and suicide-related behavior.

Abbreviations

SI, suicidal ideation; SCS, Suicide Crisis Syndrome; DSM-5-TR, Diagnostic and Statistical Manual for Psychiatric Disorders, 5th Edition, Text Revision; NTNU, Norwegian University of Science and Technology; HUNT, The Trøndelag Health Study (*Helseundersokelsen i Trøndelag*); SCS-YHP, proxy Young-HUNT3 SCS; HSCL-5, the 5-item Hopkins Symptoms Checklist; SCI-2 Suicide Crisis Inventory, 2nd edition; SCS-C, the Suicide Crisis Syndrome Checklist; SCI-SF, the Suicide Crisis Inventory short form; A-SCS-C, Abbreviated Suicide Crisis Syndrome Checklist; Y-SCI, Youth Suicide Crisis Inventory.

Declarations

Ethics approval and consent to participate

The project was approved by the Regional Committee for Medical and Health Research Ethics – Southeast Norway (ref. 2018/1037) in accordance with the Declaration of Helsinki.

Consent for publication

Written informed consent was obtained from all participants and parents of those under age 16.

Availability for data and materials

The HUNT data can be accessed from the HUNT Research Centre but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. To access HUNT data, researchers must gain project approval from the Regional Committee for Medical and Health Research Ethics and submit an application to the HUNT Research Centre. Applications must be made via a collaboration with a Norwegian principal investigator. More information is available at www.ntnu.edu/hunt/data

Competing interests

The authors declare that they have no competing interests.

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Authors contributions

IG, AEV, and ZY initiated the project, designed the study aims, selected the items for the SCS-YHP, and edited the manuscript. LJC designed and performed the data analysis, performed the literature review and wrote up the results. TF helped prepare the data set, ran the data analysis in conjunction with LJC, and reviewed the manuscript. SBE reviewed and edited the manuscript and consulted on data analysis. SK and OKD organized and extracted the relevant data from the HUNT study, reviewed the manuscript, and provided expertise on HUNT processes. BY contributed to the literature review and edited the manuscript.

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Footnotes

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