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Psychometric Properties of the Acquired Capability for Suicide Scale in Mexican Adolescents

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ABSTRACT

Introduction. There is a dearth of valid and reliable psychometric scales to measure Acquired Capability for Suicide in adolescents, who are among the most vulnerable group for suicide attempts in Mexico. **Objective.** To obtain the reliability and structural, convergent, and predictive validity, as well as a sensitivity and specificity test of the adapted version of the ACSS in Mexican adolescents. Additionally, we tested whether the adapted structure of the scale is consistent for both clinical and non-clinical adolescent populations. **Method.** A Confirmatory Factor Analysis, invariance test and reliability analyses were obtained from a sample of 429 Mexican adolescents (73% non-clinical and 27% clinical participants). Then, a refined version of ACSS (ACSS-AP) was applied to a different sample of 345 adolescents diagnosed with psychiatric disorders, to determine its convergent validity with related constructs, and its predictive validity through a simple linear regression to predict lifetime suicide attempts. The sensitivity and specificity of the instrument were evaluated using the occurrence of lifetime suicide attempts, analyzed through a binomial logistic regression model. **Results.** A factor structure is proposed for each sub-sample; the Fearlessness about death factor is stable across both clinical and non-clinical populations, while the Pain tolerance factor in the clinical sample is assessed through more severe pain exposure events. The fit indices for both scales were excellent. The reliability for non-clinical adolescents (α = .67 -ω = .71-) was lower compared to clinical adolescents (α = .87 -ω = .87-). The scale correlated positively with a moderate strength with its nomological network and predicted lifetime suicide attempts explaining 16.4% of the variance. The overall classification accuracy of the model was 80.3%. **Discussion and conclusion.** ACSS-AP showed validity and reliability in clinical populations. Acquired capability manifests differently in clinical and non-clinical adolescent populations.

Keywords: Suicide attempt, adolescents, measurement, risk factors.

RESUMEN

Introducción. Existe una escasez de escalas psicométricas válidas y confiables para medir la Capacidad Adquirida del Suicidio en adolescentes, quienes se encuentran entre el grupo más vulnerable para los intentos de suicidio en México. **Objetivo.** Obtener la confiabilidad y validez estructural, convergente y predictiva, así como una prueba de sensibilidad y especificidad de la versión adaptada del ACSS en adolescentes mexicanos. Adicionalmente, se probó si la estructura adaptada es consistente en población clínica y no clínica. **Método.** Se realizó un Análisis Factorial Confirmatorio, pruebas de invarianza y confiabilidad en una muestra de 429 adolescentes mexicanos (73% no clínicos y 27% clínicos). La versión refinada del ACSS (ACSS-AP) se aplicó a 345 adolescentes con trastornos psiquiátricos, para determinar su validez convergente con constructos relacionados, y su validez predictiva mediante una regresión lineal simple para predecir los intentos suicidas a lo largo de la vida. La sensibilidad y especificidad del instrumento fue evaluada usando la ocurrencia de intentos suicidas a lo largo de la vida, analizada a través de un modelo de regresión logística binomial. **Resultados.** Se propone una estructura factorial para cada submuestra; el factor Valentía ante la muerte es estable en ambas submuestras, mientras que Tolerancia al dolor es evaluado mediante eventos de exposición al dolor más severos en la muestra clínica. Los índices de ajuste de ambas escalas fueron excelentes. La confiabilidad para los no clínicos (α = .67 -ω = .71-) fue menor en comparación con los clínicos (α = .87 -ω = .87-). La escala correlacionó moderada y positivamente con su red nomológica y predijo los intentos de suicidio en un 16.4%. El porcentaje de clasificación global del modelo fue del 80.3%. **Discusión y conclusión.** La ACSS-AP mostró validez y confiabilidad en poblaciones clínicas. La capacidad adquirida se manifiesta diferente en ambas muestras.

Palabras clave: Intento de suicidio, adolescentes, medición, factores de riesgo.

INTRODUCTION

The suicide mortality rate in Mexico has exhibited a consistent upward trend. Between 2014 and 2021, the rate rose from 6.09 to 6.84 per 100,000 inhabitants (Institute for Health Metrics and Evaluation [IHME], 2024). Over the past decade, this increase reached 22%, with a higher rise among women (37%) (Borges et al., 2019). Globally, individuals aged 15–29 constitute the most vulnerable group (IHME, 2020; Organización Mundial de la Salud [OMS], 2021; Instituto Nacional de Estadística, Geografía e Informática [INEGI], 2023), with adolescents aged 13–15 showing the highest increase in lifetime suicide attempts (Valdez-Santiago et al., 2021).

The Interpersonal Psychological Theory of Suicide (Joiner, 2005) is a second-generation framework (Yöyen & Keleş, 2024) that seeks to understand why the desire to die is insufficient to predict a suicide attempt. This parsimonious theory has demonstrated empirical support and explanatory power, even when controlling for widely studied factors such as mood disorders, personality traits, or family history, and highlights the importance of interpersonal factors and social context (Chu et al., 2017; Van Orden et al., 2010).

An acquired capability for suicide (ACS) is the belief that he or she is capable of ending his or her own life. Joiner's theory posits that engaging in lethal self-harm requires habituation to fear and pain involved in self-harm (Van Orden et al., 2008; Van Orden et al., 2010; Joiner, 2005).

Thus, ACS is built on two main factors: pain tolerance and fearlessness about death (Van Orden et al., 2008). Its nomological network includes impulsivity, a related condition for its acquisition (Van Orden et al., 2010), and other variables in Joiner's model (2005; Van Orden et al., 2010; Van Orden 2015).

Instruments to measure ACS have been developed and tested in adult Anglo-Saxon populations, but adaptations and testing are needed for other vulnerable populations, like adolescents from diverse cultural contexts. Additionally, many scales fail to fully align with the two dimensions proposed by the theory (Joiner, 2005; Van Orden et al., 2008). Despite their strong psychometric properties, examples include the ACSS-FAD (Acquired Capability for Suicide Scale – Fearlessness about Death; Ribeiro et al., 2014; *SRMR* = .03 - .05, *CFI* = .93 - .99, *TLI* = .90 - .98, *RMSEA* = .04 - .06), the ACWRSS (Acquired Capability with Rehearsal for Suicide Scale; George et al., 2016; $X^2_{(11)} = 17.24$, $p = .10$, *RMSEA* = .030 [90% *CI* = .000 - .057], *CFI* = .997, *TLI* = .994, $\alpha = .83$), and Rimkeviciene et al.'s proposal (2017; *CMIN/DF* = 2.98, *RMSEA* = .05, *CFI* = .95; R^2 = 47%). Although Ribeiro et al. (2014) included 10 – 20% of Latin American participants, participants in these scales were predominantly Caucasian Australian adults.

There are other scales available to measure the two proposed factors of ACS, such as the ACSS (Van Orden et al., 2008), the GCSQ (German Capability for Suicide Questionnaire; Wachtel et al., 2014), and an adaptation of the ACSS for the Mexican population (Rangel-Villafaña et al., 2023). The GCSQ showed acceptable adjustment indices (*CFI* = .94, *RMSEA* = .09 [90% *CI* = .07 - 1.1], *SRMR* = .07, α Fearlessness about death = .90, α Pain tolerance = .77), however, it was evaluated in a Caucasian adult population residing in Germany; while no formal psychometric studies have been done for the ACSS, with only reliability being reported as $\alpha = .84$ in general population. The Mexican adaptation of ACSS (Rangel-Villafaña et al., 2023) was studied with an adult general population, underwent confirmatory factor analyses, and yielded excellent adjustment indices (*RMSEA* = .011, *CFI* = .99, *TLI* = .99, *IFI* = .99, *NFI* = .91, $X^2 = 86.75$, *DF* = 84, $p = .397$; α=.77). Items in Mexican Spanish were carefully chosen to suit the language and cultural context.

The main objective of this study was to obtain the reliability and structural, convergent, and predictive validity, as well as a sensitivity and specificity test of the adapted version of the ACSS (Rangel-Villafaña et al., 2023) in Mexican adolescents. An additional objective was to investigate whether the adapted scale structure is consistent for both clinical and non-clinical adolescent populations.

METHOD

The ACSS (Rangel-Villafaña et al., 2023) was adapted for Mexican adolescents by modifying item wording (DeVellis, 2017 & Furr, 2018) to ensure comprehension. Three expert judges evaluated inter-judge agreement (80% satisfaction) and provided qualitative opinions on content validity through three iterative rounds. Aiken's V coefficient with a desired value of at least .70, Type I Error $p < .05$ (Charter, 2003) and its confidence interval ensuring a lower limit of at least .70 (Merino & Livia, 2009) were computed for content validity (Appendix).

To achieve the aims of this study, two phases were conducted: Phase I – Confirmatory Factor Analysis and Reliability, and Phase II – Convergent and Predictive Validity; sensitivity and specificity.

Design

Development of psychometric properties of a measurement scale.

Phase I - Confirmatory Factor Analysis and Reliability

Participants

The sample included 429 adolescents (71.3% female) aged

13 to 18 years (M_{age} = 15.9, SD_{age} = 1.2). Two subsamples were recruited: non-clinical (73%) and clinical (27%). Adolescents with adequate comprehension skills, allowing them to understand and complete the items of the scale, were invited to participate.

In the non-clinical group, most participants were female (67.4%) and lived with their nuclear family (81.5%). Additionally, 80.5% of the sample were exclusively students, with 42.8% enrolled in the second semester of high school. In the clinical group, 81.9% were female, most were also exclusively students (78.4%), and 19.1% were in the third year of middle school. The majority lived with their nuclear family (63.8%). Furthermore, 93.8% presented psychiatric comorbidities, with 65.2% having three or four diagnoses, primarily mixed types (internalizing and externalizing disorders, 55.8%).

Settings

Public schools in three cities in Mexico, and the Hospital Psiquiátrico Infantil "Dr. Juan N. Navarro" (HPIJNN).

Measures

Sociodemographic Questionnaire. This consisted of general data about the participants, including their age, occupation, psychiatric diagnosis, living arrangements, and other relevant information.

Acquired Capability for Suicide Scale, version adapted for Mexican adolescents. It consisted of 23 items with six response options intended to measure two factors: Fearlessness about death and Pain tolerance.

Procedure

The scale was administered to 445 adolescents through both face-to-face and online modalities, depending on the conditions arising from the COVID-19 pandemic. Prior to participating, the adolescents and their guardians provided verbal and written assent and consent, respectively.

Bias

The items of the ACSS were randomized in the electronic version, and three printed versions were created with the items in different order.

Statistical analysis

We used IBM SPSS® version 26. Cases with near-zero or extreme standard deviations (≥ 3; Simms et al., 2019) and those with errors on the commitment question were excluded, resulting in a final sample of 429 participants. No cases or items were eliminated due to < 10% missing values. Little's MCAR test (χ^2 = 76.60, p > .05) confirmed randomness, allowing simple imputation using the median of adjacent points (Pardo-Merino & Ruiz-Díaz, 2005).

To analyze the original scale's structure, we used IBM SPSS® AMOS graphics version 26. Items were examined for variance explained (≥ .20; Hooper et al., 2008) and factor loadings (≥ .40; Bandalos & Finney, 2010; Guadagnoli & Velicer, 1988; Hogarty et al., 2005). Items with values below these cutoff points and with high correlated errors were considered for elimination if theoretically justified (Brown, 2015; Pituch & Stevens, 2016; Lloret-Segura et al., 2014). Adjustment indices calculated included Chi-squared/Degrees of freedom (< 3), Comparative Adjustment Index (*CFI* ≥ .95), Mean Square Error of Approximation with 90% confidence interval (*RMSEA* < .05), and *pClose* (p > .05) (Hu & Bentler, 1999). We maintained those items that made the best contribution to the evaluated model.

If the scale did not meet desirable adjustment indices, items from the item pool constructed during the content validity were added to improve structural validity. This iterative refinement process, along with the specification and respecification of the model, continued until satisfactory fit indices were achieved, without neglecting the individual contributions of each item.

Total scores were calculated for each respondent. Since data were not normally distributed (*K-S* = .067, p < .01), the Mann-Whitney U test compared scores between non-clinical and clinical populations. Post hoc analyses examined power and effect size. Configural, metric, scalar, and strict invariance analyses compared both populations. The better-fitting population served as the base for refining the other. The final versions and their reliability were assessed using Cronbach's α and McDonald's ω, as well as the percentage of explained variance.

Phase II - Convergent and predictive validity; sensitivity and specificity

Participants

The sample included 345 clinical adolescents (73.6% females), aged 13 to 18 years (M_{age} = 15.2, SD_{age} = 1.4). Adolescents with adequate comprehension skills, allowing them to understand and complete the items of the scale, were invited to participate. 46.2% of the sample were hospitalized with an average stay of M = 7.6 days (SD = 6.4), and 53.8% received outpatient care. Most (55.4%) had three or four psychiatric diagnoses, predominantly of a mixed type (internalizing and externalizing; 52.4%). 78% of the sample reported having attempted suicide at least once in their lifetime, with the majority having made five attempts (76%). The average age of onset was M = 12.6 years (SD = 2.3).

Settings

Hospital Psiquiátrico Infantil “Dr. Juan N. Navarro” (HPIJNN).

Measures

Acquired Capability for Suicide Scale for clinical adoles-

cent population (ACSS-AP). A version derived from Phase I of this study.

Interpersonal Needs Questionnaire (Silva et al., 2018). The scale comprises 15 items with seven response options, grouped into two factors: Thwarted belongingness and Perceived burdensomeness. In this sample, nine items demonstrated effective performance: Five for the first factor and four for the second. Psychometric properties for this sample were α = .87 for the overall scale, .93 for Perceived Burdensomeness, and .80 for Thwarted Belongingness; *CMIN/DF* = 1.65, *CFI* = .993, *RMSEA* = .041, *pClose* = .73.

Impulsivity Scale (Climent et al., 1989; González-Forteza et al., 1997). Five items that assess the frequency of impulsive traits on a scale ranging from five to 20 points. The reliability was α = .76, and the fit indices were *CMIN/DF* = 2.25, *CFI* = .98, *RMSEA* = .056; *pClose* = .347.

Beck Suicide Ideation Scale (Artasánchez-Franco, 1999; Beck & Steer, 1993). Items one, two, three and five measured passive suicidal ideation (Forkmann et al., 2021); their psychometric properties were α = .88; *CMIN/DF* = .325, *CFI* = 1.000, *RMSEA* = .000, *pClose* = .880. Items four, six, seven, eight and nine measured active suicidal ideation (Forkmann et al., 2021) with psychometric properties of α = .86; *CMIN/DF* = 1.358, *CFI* = .999, *RMSEA* = .030, *pClose* = .60.

Lifetime Suicide Attempts: A dichotomous and continuous variable measured by the questions: *"¿alguna vez te has herido, cortado, intoxicado o hecho daño a propósito con intención de quitarte la vida?" [have you ever purposely hurt, cut, intoxicated, or harmed yourself with intent to take your own life?]* and *"¿cuántas veces te has herido, cortado, intoxicado, o hecho daño a propósito para tratar de quitarte la vida?" [How many times have you intentionally harmed, cut, poisoned, or injured yourself in an attempt to take your own life?]* (CIP-DERS; González-Forteza & Jiménez-Tapia, 2019).

Procedure

Adolescents and their legal guardians who agreed to participate in the study provided their assent and informed consent, respectively. The scales were administered to a total of 396 adolescents; those who were hospitalized received a printed version, while those in outpatient care completed the electronic version.

Statistical analysis

We used IBM SPSS® version 26. Univariate assumptions were checked for each variable in the ACS nomological network using specified psychometric instruments. Outliers for lifetime suicide attempts (identified as z-scores ≥ 3) were removed, resulting in a final sample of 345 adolescents. Multivariate analyses included a predicted vs. residual plot to ensure no outliers affecting the distribution. Both univariate and multivariate analyses assumed normality (skewness and kurtosis ≤ 2; Miles & Shervin, 2011).

The Pearson Product-Moment coefficient was obtained to confirm a positive association between ACS, measured with the proposed scale, and the rest of the constructs as evidence of convergent validity. Predictive validity was assessed using simple linear regression between ACS and lifetime suicide attempts, examining model significance and explained variance. Sensitivity and specificity analyses were conducted using a binomial logistic regression model, with the same dependent variable measured dichotomously.

Significance was examined using the Hosmer & Lemeshow test. The overall classification accuracy, the percentages of correctly classified positive and negative cases, and the explained variance percentages were evaluated using Cox and Snell and Nagelkerke indices.

Ethical considerations

This study was conducted following the principles of the Declaration of Helsinki. Recruitment, consent, and data collection procedures were approved by the Research Ethics Committee of the Hospital Psiquiátrico Infantil "Dr. Juan N. Navarro" (HPIJNN), in Mexico (approval number PI3/01/0921).

RESULTS

Phase I - Confirmatory Factor Analysis and reliability

We performed four CFA, one for the original items and factor structure (Version 1), and three for different adapted versions. Version 2 excluded items from the original scale that did not meet minimum factor loadings and explained variances. Version 3 excluded newly created items from the item pool suggested by the expert judges during the scale adaptation period, to observe their behaviour with the rest of the items and their corresponding factor and identify those that were not functioning correctly. Version 4 excluded newly created items that did not meet expected values.

The first part of the Table 1 presents the factor solutions and goodness-of-fit indices for the four versions for comparison.

Given the minimal differences in goodness-of-fit indices between Version 2 and Version 4, and the preference for a parsimonious structure, Version 2 was chosen as the base model for the CFA. This model, shown in Figure 1, will be referred to as ACSS – A.

The Mann-Whitney U test compared the mean ranges of the non-clinical and clinical population for the total ACSS – A score. Results indicated a statistically significant mean difference *(U* = 10985, $p < .001$), with the clinical

Table 1
Goodness of fit indices for different CFA of ACSS and ACSS in clinical population

	ACSS			
Index	*Original scale (Version 1) 14 items, two factors*	*Refined version 1 (Version 2) Seven items, two factors*	*Version 2 with newly created items (Version 3) 16 items, two factors*	*Refined version 3 (Version 4) Eight items, two factors*
CMIN/DF	7.692	1.131	7.259	1.148
CFI	.689	.998	.748	.998
RMSEA	.125	.018	.121	.019
pClose	.000	.931	.000	.964
	ACSS – clinical population			
Index	*Original scale (Version 1) 14 items, two factors*	*Refined version 1 (Version 2) Seven items, two factors*	*Version 2 with newly created items (Version 3) 13 items, two factors*	*Version 2 with newly created items (Version 3) 13 items, two factors*
CMIN/DF	2.699	1.663	1.195	1.069
CFI	.722	.975	.984	.995
RMSEA	.122	.076	.041	.024
pClose	.000	.212	.638	.753

population (*Mean Range* = 276.80) scoring higher than the non-clinical population (*Mean Range* = 192.10). Post-hoc tests showed a power of $1 - \beta = .99$ and an effect size $d = .72$, indicating a major difference in the clinical population.

The invariance analysis results between the non-clinical and clinical populations are in Table 2. The significant Chi-square difference ($\Delta\chi^2$) indicated a lack of invariance between both populations in metric, scalar, and strict models. In the non-clinical sample, the regression weights of each item were significant, but not in the clinical sample.

Therefore, a new factor structure was needed for the clinical population. The scale's reliability for the non-clinical population was $\alpha = .669$ ($\omega = .71$) for the total scale, $\alpha = .663$ ($\omega = .63$) for Pain Tolerance, and $\alpha = .849$ ($\omega = .86$) for Fearlessness about death, explaining 50.6% of the variance.

The second part of Table 1 displays the goodness-of-fit indices for the original scale and various item-filtered versions for the clinical population. Version 4, which exhibited the best fit indices, was chosen as the final scale for the clinical population (ACSS – AP, Figure 2). This version consisted of 10 items: six for Pain Tolerance and four for Fearlessness about death. The overall reliability was $\alpha = .869$ ($\omega = .87$), with $\alpha = .80$ ($\omega = .81$) for Pain Tolerance and $\alpha = .86$ ($\omega = .86$) for Fearlessness about death, explaining 52.6% of the variance.

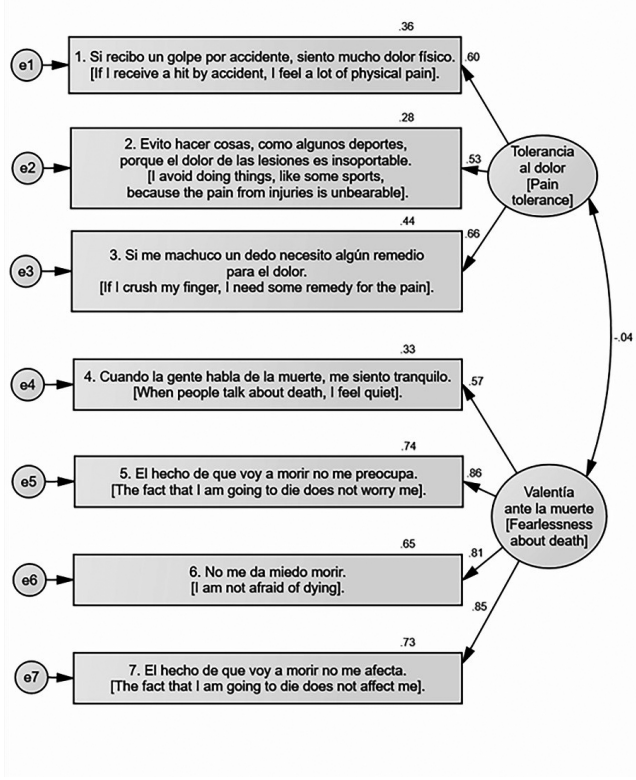

Figure 1. Final Factor Solution for the complete sample of ACSS – A.

Table 2
Analysis of invariance between the non-clinical and clinical population for ACSS – A

Model	*χ^2 (df)*	*χ^2/df*	*CFI*	*RMSEA (90% CI)*	*Δ χ^2 (df) p > .05*	*ΔCFI ≤ .01*	*ΔRMSEA ≤ .015*
M1. Configural invariance (Baseline)	32.824 (26)	1.262	.993	025 (.000 - .048)			
M2. Metric or weak invarvance (restricted *λ*)	45.151 (31)	1.456	.985	.033 (.003 - .052)	**12.327 (5), *p* = .031**	-.008	.008
M3. Scalar or strong invariance (*λ* and τ restricted)	66.803 (38)	1.758	.970	.042 (.025 - .059)	**33.979 (12), *p* = .001**	-.015	.009
M4. Strict invariance (*λ*, τ and *θ* restricted)	82.617 (48)	1.721	.964	.041 (.025 - .056)	**49.793 (22), *p* = .001**	-.006	-.001

Phase II – Convergent and predictive validity; sensitivity and specificity

Table 3 presents the descriptive statistics for each variable in the nomological network of ACS, including overall scales and their factors. The skewness and kurtosis for each variable were approximately 1, appropriate for normal distributions (Miles & Shervin, 2011). Pearson's correlation coefficients indicate statistically significant positive associations between constructs ($p < .01$), except for Thwarted belongingness with lifetime suicide attempts ($p = .102$).

The INQ and ACSS – AP scales exhibit high to very high correlations with their factors ($r > .7$; Cohen, 1988), as theoretically expected. ACSS – AP correlations with other constructs are moderate ($r > .4$; Cohen, 1988), with Thwarted belongingness having the lowest correlation ($r = .3$), although all statistically significant ($p < .01$). High correlations are also observed between INQ and impulsivity, active and passive suicidal ideation, with Perceived burdensomeness predominating over Thwarted belongingness ($r > .6$).

Simple linear regression showed ACS significantly predicted lifetime suicide attempts ($\beta = .40$, $t = 8.3$, $p < .001$, 95% *CI* [.091-.15]) in adolescents with psychiatric disorders, explaining 16.4% of the variance ($F_{(1,343)} = 68.44$, $p < .001$).

The binomial logistic regression model was statistically reliable ($X^2 = 49.252$, $DF = 1$, $p = .000$), and the Hosmer & Lemeshow test indicated a good fit to the data ($X^2 = 11.792$, $DF = 8$, $p = .161$). The model explained between 13.3%$_{\text{Cox and Snell}}$ and 20.9%$_{\text{Nagelkerke}}$ of the variance in the occurrence of lifetime suicide attempts among adolescents. The overall correct classification was 80.3%, with the model correctly predicting 96% of cases in which individuals had attempted suicide at least once in their lifetime and 18.6% of those without suicide attempts.

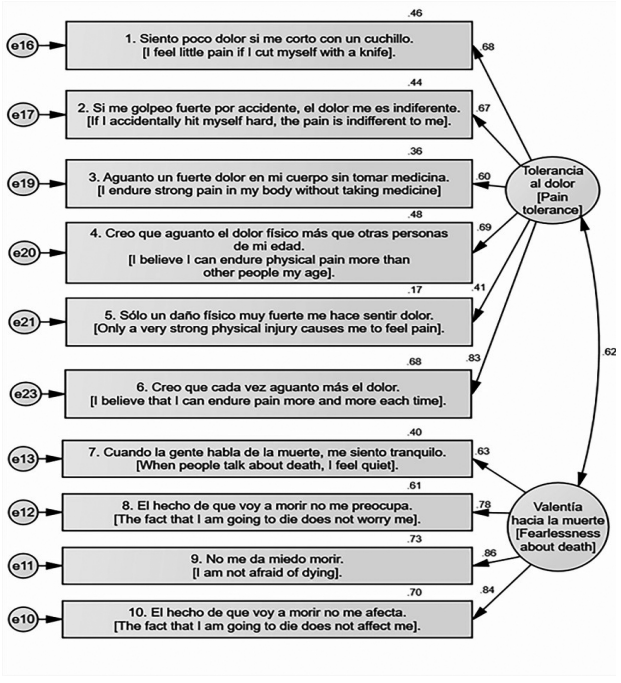

Figure 2. ACSS – AP Final Factor Solution.
Note: For the Pain Tolerance factor, items one and two are original, and the rest are newly created. For the Fearlessness about death factor, all items are the original ones. All items are scored directly.

DISCUSSION AND CONCLUSION

This study aimed to establish the psychometric properties of the Acquired Capability for Suicide Scale (Rangel-Villafaña et al., 2023) in Mexican adolescents, exploring its equivalence across clinical and non-clinical populations.

A significant finding was the distinct structuring of Pain Tolerance between these groups. In the non-clinical sample, the items phrased in the same direction as the original scale to measure non-tolerance to pain performed better (e.g., *"Si recibo un golpe por accidente, siento mucho dolor físico" [If I accidentally receive a blow, I feel a lot of physical pain]*), whereas the clinical sample responded more favorably to items assessing pain tolerance, particularly those depicting severe pain exposure situations (e.g., *"Sólo un daño físico muy fuerte me hace sentir dolor" [Only very strong physical harm makes me feel pain]*).

Table 3
Descriptive statistics and correlations for all measures for Phase II

Model	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
1 Acquired Capability for Suicide Scale	1									
2 Pain tolerance	.913**	1								
3 Fearlessness about death	.850**	.561**	1							
4 Interpersonal Needs	.507**	.461**	.432**	1						
5 Thwarted belongingness	.263**	.203**	.271**	.771**	1					
6 Perceived burdensomeness	.542**	.520**	.428**	.887**	.389**	1				
7 Impulsivity	.459**	.410**	.402**	.660**	.390**	.671**	1			
8 Passive suicidal ideation	.562**	.479**	.521**	.746**	.498**	.718**	.771**	1		
9 Active suicidal ideation	.514**	.451**	.460**	.714**	.428**	.722**	.888**	.856**	1	
10 Lifetime suicide attempts	.408**	.397**	.315**	.281**	.102	.333**	.346**	.275**	.327**	1
Minimum value	0	0	0	9	4	5	0	0	0	0
Maximum value	50	30	20	63	28	35	2	8	10	18
Mean	25.7	13.9	11.9	30.2	14.5	15.7	.54	2.7	2.3	4
Standard Deviation	13.1	8.4	6.5	14.6	7.3	10.09	.73	2.5	2.9	3.9
Skewness	-.2	-.03	-.4	.33	.09	.6	.98	.6	1.03	1.3
Kurtosis	-.95	-1.04	-1.14	-.8	-1.09	-1.05	-.5	-.81	-.2	1.7

Note: Acquired Capability for Suicide Scale – psychiatric adolescent version. ** Correlation is significant at the .01 level (two-tailed).

The difference in item phrasing was supported by feedback from clinical respondents, who normalized situations involving minor injuries or continuing physical activities despite pain. This suggests lower sensitivity to minor pain in they, likely due to their increased exposure to intense pain situations such as self-inflicted burns or suicide attempts (Van Orden et al., 2008; Van Orden et al., 2010), resulting in a larger effect size, highlighting the need for tailored item formulation. It is important to note that measuring pain tolerance through self-report can be complex as it is subjective and influenced by perception biases; objective measures are suggested as a more reliable method, such as electrical stimulation, the cold pressor task, thermal stimulators, or mechanical pressure devices. Among these, electrical stimulation has demonstrated greater objectivity, reliability, and patient-friendliness in assessing pain (Edwards & Fillingim, 2007; Wachtel et al., 2015*; Wagemakers et al., 2019).

Two items performed poorly in both samples: *"Evito participar en peleas porque no soporto el dolor físico que generan" [I avoid getting into fights because I can't stand the physical pain they generate]*, where adolescents noted reasons other than pain for avoiding fights, and *"Necesito tomar medicamentos para quitar algún dolor físico" ["I need to take medication to relieve any physical pain"]*, which was redundant with item three (Figure 1) and thus eliminated.

Regarding Fearlessness about death, the items that performed well were consistent across both non-clinical and clinical populations, indicating a stable manifestation of the construct. These items assessed emotions related to death, such as fear or worry. Two removed items focused on the act of dying rather than the associated emotions, (e.g., *"Podría matarme a mí mismo si quisiera" ["I could kill myself if I wanted to"]*. Although this item could theoretically be considered highly relevant to the construct, its performance within the overall model was suboptimal, likely because the other items were measuring emotions related to death rather than the act of dying itself. According to Hinkin (1995), at least three items are needed for them to cluster together. Probably including more items related to the act of dying might group them into another factor (Rimkeviciene et al., 2017), potentially forming a subdimension or a more precise measure. In the German version (Wachtel et al., 2014), this item did not contribute to Fearlessness about death but was retained as a single item for ACS. Ribeiro et al. (2014) suggested that items assessing Fearlessness about one's own death, rather than death in general, may better capture the construct.

Furthermore, several items that did not effectively measure Fearlessness about death were removed due to their focus on other constructs. E.g., *"Imaginar mi muerte no me asusta" [Imagining my death does not scare me]* primarily reflects suicidal ideation, while *"El miedo a morir me inquieta" [The fear of dying worries me]* is worded in reverse and is not aligned with the other items. *"Me asusta el dolor asociado a morir" [I'm scared of the pain associated with dying]* primarily assesses pain related to death.

It is also important to consider the cultural context in Mexico, where death is celebrated during *Día de los Muertos*, viewed traditionally with humor and satire. Consequently, the concept of death may not evoke fear among Mexicans. Therefore, items like *"La posibilidad de morir me causa ansiedad" [The possibility of dying causes me anxiety]* or *"Pensar en mi propia muerte me causa curiosidad" [Thinking about my own death causes me curiosity]* were not effective in either sample. The latter item also overlaps closely with suicidal ideation. This leads to the need to consider cultural influences in specific populations in order to determine the functioning of items intended to assess the construct.

It is worth mentioning that, in addition to the theoretical inconsistencies identified through the qualitative analysis of the eliminated items, these items did not exhibit statistically satisfactory performance. Consequently, their contribution to the total variance of the model was minimal or even detrimental, which justified their removal.

The reliability of both the full scale and Pain Tolerance scale was lower in the non-clinical sample. This suggests that the scale may lack sensitivity in detecting ACS in adolescents without significant suicidal behavior or with lower levels of it (Rogers et al., 2021). In contrast, adolescents with psychiatric disorders who often experience more severe and frequent pain, showed higher reliability for the scale and this factor (Van Orden et al., 2008; Van Orden et al., 2010). Fearlessness about death exhibited greater stability across both populations, with higher reliability.

The ACSS – AP scale demonstrated a positive and moderately strong relationship (Cohen, 1988) with theoretically expected constructs (Van Orden et al., 2008; Van Orden et al., 2010; Van Orden et al., 2015), indicating convergent validity. Thwarted belongingness and perceived burdensomeness showed statistically significant moderate associations, consistent with findings in clinical adolescent samples (King et al., 2019; Horton et al., 2015). Surprisingly, the correlation between ACS and lifetime suicide attempts was higher than previously reported (r = .09, p = .027; Chu et al., 2017); however, it is crucial to note that only four studies included adolescents in this meta-analysis.

Impulsivity is identified as a contributing factor to the ACS (Van Orden et al., 2010), although Bender et al. (2011) and Witte et al. (2008), suggest it does not directly relate to ACS. Instead, impulsive individuals may encounter more painful and provocative events (PPEs), facilitating capability acquisition. This study found a direct, significant and moderate correlation between impulsivity and ACS (Cohen, 1988). However, this does not imply causation, and further exploration through mediation models involving PPEs is warranted to better elucidate their relationship.

Regarding suicidal ideation, studies generally do not differentiate between passive and active ideation when evaluating the IPTS model (Baertschi et al., 2017). Nonetheless, the results reported here align with those for general suicidal ideation in adolescents (Horton et al., 2015; King et al., 2019).

Joiner (2005) proposes that the ACS becomes significant when interacting with thwarted belongingness and perceived burdensomeness (Van Orden et al., 2008, 2010). While research indicates variability in its direct prediction of suicide attempts (Chu et al., 2017), the theory emphasizes ACS as a predictor of future, rather than past attempts. This study, which examines past attempts, serves as a proxy measure aligned with theoretical propositions.

This study found a direct contribution to variance of 16.4%, consistent with satisfactory results reported in 40% of cross-sectional studies included in Chu et al.'s meta-analysis (2017), and other studies with clinical adolescent samples (Horton et al., 2015; Czyz et al., 2014). While the explained variance is small, it is important to consider other factors established by the theory in prediction that were not included in the linear regression model (e. g. three-way interaction between thwarted belongingness, perceived burdensomeness and acquired capability for suicide; Joiner et al., 2009). Consequently, the explained variance should not be viewed in isolation but rather as a reflection of the instrument's contribution within a broader explanatory framework. Moreover, predicting future attempts requires conducting a longitudinal study, which can be considered a potential line of future research.

Regarding the sensitivity and specificity test, while a considerable correct classification rate was obtained (80.3%), particularly with a high sensitivity rate (96%), it is important to note that the analysis was conducted using the occurrence of suicide attempts among adolescents as the dependent variable. This variable serves as a proxy, given the absence of a gold standard for comparative evaluation of the instrument. An analysis using ROC curves would be highly recommended if such a criterion were available.

This study has other limitations, one of them is the absence of evidence regarding divergent and discriminant validity. Future research should incorporate additional scales that are part of the nomological network of ACS to confirm that the scale exclusively measures the construct of interest.

Additionally, in the Fearlessness about death factor, items assessing emotions related to death were included, while those addressing the act of dying were excluded. To mitigate this limitation, we recommend including more items that focus on the act of dying itself, aligning with suggestions from prior research (Wachtel et al., 2014; Ribeiro et al., 2014; Rimkeviciene et al., 2017).

It is also important to note that in Phase I, the sample was limited to students, which means that the representativeness of adolescents in the study may be affected by the exclusion of those without access to education. Similarly, in both phases, a high percentage of participants were women, and specifically in Phase II, participants were exclusive-

ly recruited from a psychiatric hospital. The higher prevalence of women aligns with the current epidemiology of suicide-related behavior (Borges et al., 2019). However, the representativeness of the population and the generalizability of the findings are limited to contexts where the severity of the phenomenon is higher, excluding community samples or those in primary care settings.

Despite these limitations, this study provides a valuable contribution by proposing a valid and reliable scale for measuring ACS in Mexican adolescents, particularly in psychiatric and high-risk populations, which has not been previously documented in the literature. Given the sustained increase in suicide attempts among adolescents in Mexico, and the urgent need to implement actions to reduce these figures, this tool presents itself as a valuable resource to, initially, begin gathering evidence on the functioning of the IPTS in this population (Stewart et al., 2015). If explanatory models of suicide attempts are developed with a robust level of evidence, public resources could be directed towards targeted therapeutic interventions, thus achieving greater effectiveness for those in need.

Finally, according to invariance analysis, this study provides evidence for the non-generalization of the scale tested in the general population. Therefore, understanding the phenomenon should differentiate between those with a history of lifetime suicide attempts and those without, and the tools should be specific to each subgroup.

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Conflict of interests

The authors declare they have no financial interests.

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APPENDIX

Adaptation of the ACSS (Rangel-Villafaña et al., 2023) for Mexican adolescents.

In the first instance, an adaptation procedure was carried out on the items that make up the scale with the aim of making them easily understandable for adolescents.

Evidence of content validity was obtained from the judgment of experts, who evaluated two aspects: a) the relevance of each of the items, in terms of its congruence with its theoretical meaning, and b) the coverage of the dimension evaluated, ensuring that it was made up of necessary and sufficient items.

Method

Participants

To gather expert opinions, 21 professionals with experience in adolescent psychology or education and the construction of psychometric instruments were recruited as judges, in three different and iterative rounds. Additionally, 18 adolescents aged 13 to 18 were recruited to participate in the study: Ten of them from public schools were involved in cognitive laboratories, while eight adolescents from the Hospital Psiquiátrico Infantil "Dr. Juan N. Navarro" were recruited to pilot the scale.

Measure

Acquired Capability for Suicide Scale for adult Mexican population (Rangel-Villafaña et al., 2023) comprises 14 items with five response options, grouped into two factors: Fearlessness about death and Pain tolerance. The scale showed excellent adjustment indices for the Mexican university population, with $RMSEA$ = .011, CFI = .99, TLI = .99, IFI = .99, NFI = .91, X^2 = 86.75, DF = 84, and p = .39, and explained 58% of the variance.

Procedure

The phrasing of the items on the ACSS was evaluated based on criteria outlined by DeVellis (2017) and Furr (2018), considering language, length, grammatical simplicity, precision of terms, double negations, and directionality. Modifications were made to ensure comprehension by the adolescent population. The response options were adjusted from five to six points to eliminate the neutral response option, aiming to increase the accuracy, reliability, and discriminative capacity of the scale (Calleja et al., 2019; Grande & Abascal, 2017; Simms et al., 2019).

A first version of the scale was obtained by submitting it to three expert judges in three iterative rounds to evaluate the inter-judge agreement and provide their qualitative opinions on content validity.

An online cognitive laboratory was conducted with a group of adolescents to evaluate the understanding of the items. The strategy used the concurrent, group, and scrutiny method (Nolin & Chandler, 1996). The participants and their legal guardians provided verbal and written consent and assent, respectively, prior to participating. Based on the participants' feedback, the items were reformulated to produce a second version of the scale. This version included a commitment question to detect cases of random answers (Fonseca-Pedrero et al., 2009). Eight additional adolescents evaluated the design, instructions, and response options of the scale (Streiner et al., 2015), leading to the final print and electronic versions.

Data analytic strategy

A scale ranging from 0 to 14 points was utilized to assess each item (Furr, 2018; DeVellis, 2017). Those items that scored less than 14 points were identified for modification. Inter-judge reliability was calculated for each expert round, with a criterion of 80% satisfaction. The first round evaluated (a) the clarity of the wording, (b) the theoretical consistency with the defined dimension, and (c) the logical relationship between the items and the dimension. The second and third rounds focused solely on the understanding of the items by adolescents (Argimon-Pallás & Jiménez-Villa, 2013).

To establish content validity, the relevance of each item and its coverage of the underlying dimension were evaluated using a 5-point Likert scale. Aiken's V coefficient was calculated, with a desired value of at least .70 and Type I Error $p <$ .05 (Charter, 2003). The confidence interval for Aiken's V was also computed, with a lower limit of at least .70 (Merino & Livia, 2009). Whenever an item scored less than 5 points, expert judges were asked to provide suggestions for modifying

the wording. These proposals were then discussed with the research team.

Results

The qualitative evaluation of the items revealed that eight out of the original 14 items required adjustments (57.14%). The results of inter-judge agreements for each of the expert rounds are presented in **Table S1.**

Table S1
Percentage of items that reached an 80% inter-judge agreement

		Pain tolerance (Items in agreement/total)	*Fearlessness about death (Items in agreement/total)*
Round 1	Clarity	**57.14%** (4/7)	**42.85%** (3/7)
	Theoretical maintenance	**71.4%** (5/7)	100% (7/7)
	Logic	100% (7/7)	100% (7/7)
Round 2	Understanding	**61.53%** (8/13)	100% (7/7)
Round 3	Understanding	100% (8/8)	**67%** (4/6)

Note: Percentages that did not reach an 80% agreement are highlighted in bold. The Fearlessness about death factor did not reach an 80% inter-judge agreement in the third round. This outcome occurred because two of the items evaluated still posed challenges in understanding for adolescents, as noted by the experts. A consecutive increase from round to round was not anticipated, as the evaluations focused solely on items that proved difficult for adolescents to comprehend.

In the first round, the clarity of the wording for both factors was insufficient (inter-judge agreement < 80%), and there were issues with maintaining the theoretical concept of Pain Tolerance. Consequently, they suggested the inclusion of new items to cover the domain of this dimension (DeVellis, 2017), resulting in 13 items for the second group of experts. However, according to the second group of experts, adolescents still had difficulties in comprehending the factor, and therefore, they requested the inclusion of new items to improve the clarity of the scale. For the third round, only newly created and problematic items from the previous rounds (eight for Pain Tolerance and six for Fearlessness about death) were evaluated, so a consecutive improvement in the inter-judge agreement compared to the previous round was not expected. The understanding was better for the first factor, but for the second factor, two items were still not understandable, so the criterion of 80% agreement was not reached. These items were further discussed, and a consensus reached by the research team, and then asked to adolescents for their opinions in the cognitive laboratories. The relevance of the items and coverage of the dimensions for the three rounds of judges to ensure content validity are shown in **Table S2**. The table indicates that the

Table S2
Aiken's V and Lower Limit of CI for item Relevance and Coverage of ACSS dimensions

		Pain tolerance	*Fearlessness about death*
Round 1	R- Aiken's V (Items/total)	85.7% (6/7)	100% (7/7)
	C- Aiken's V (LL CI)	.75 (.40)	1 (.67)
Round 2	R- Aiken's V (Items/total)	92.3% (12/13)	85.7% (6/7)
	C- Aiken's V (LL CI)	.94 (.83)	.90 (.77)
Round 3	R- Aiken's V (Item/total)	100% (8/8)	100% (6/6)
	C- Aiken's V (LL CI)	.8 (.83)	.8 (.83)

Note: R refers to the relevance of each item that makes up the dimension. The number of items that reached an inter-judge agreement of 80% is expressed in percentage. In parentheses, the number of items that obtained it (numerator) is expressed in comparison with the total of items evaluated (denominator). C corresponds to the coverage of the dimension by the items and in parentheses, the Lower Limit of the Confidence Interval (LL CI) is expressed for Aiken's V.

relevance of the items achieved the minimum agreement of 80% (Aiken's V ≥ .70 for each item). For the coverage of each dimension, the value of Aiken's V also met the satisfactory criterion (≥ .70). Because the items evaluated in each round were only those that the judges considered to be poorly understood, no consecutive round-to-round increase was expected for item relevance and dimension coverage.

Although the Lower Limit of the Confidence Interval (LL CI) was below .70 for the first round, it was because only two judges evaluated it, and the calculation is sensitive to the number of participating judges. In the end, both Aiken's V and LL CI met the expected cut-off point, resulting in content validity with a 23-item version.

Regarding the cognitive laboratories, the adolescents provided feedback suggesting simplifying the wording of some items. However, not all suggestions were incorporated as they were related to other theoretical dimensions.

Table S3 presents the minimum and maximum values of the descriptive statistics for the items, along with the percentage of items that fall outside the acceptable range (considering 23 items as a total).

Table S3
Descriptive statistics of items

	$\bar{x}$	*SD*	*Answer options*	*High freq. opt.*	*Floor/ Ceiling*	*Skewness / Kurtosis*	*Inter-item corr.*	*Item-Total corr.*	*Extr. group discrim.*
Rank	1.45 - 4.19	1.24 -1.85	0 - 5				-.15 - .75		
Proportion of items out of acceptable range	39.1%	21.7%	0%	8%	8% / 21.7%	8% / 60.8%		0%	4%

Note: $\bar{x}$ = Mean; *SD* = Standard Deviation; High freq. opt. = High frequent options; Inter-item corr. = Inter – item correlation; Item-total corr. = Item – total correlation; Extr. group discrim. = Extreme group discrimination.

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