

Reliability and Validity of the Full-Length Greek-Cypriot Version of the Children's Depression Inventory 2

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Objective: Childhood depression has become a serious concern in recent years. Therefore, it is important for healthcare professionals to have a reliable instrument for measuring depressive symptoms adapted to their culture and language. The Children's Depression Inventory 2 (CDI-2) is a tool that has been widely used in many countries. The present study aimed to investigate the internal consistency reliability and construct validity of the full-length 28-item Greek-Cypriot version of the CDI-2: Self Report (CDI-2:SR) among schoolchildren in Cyprus.

Methods: A methodological instrument validation design was performed between 2020 and 2023 on a nationwide random sample of schoolchildren in Cyprus recruited from public elementary schools. A total of 420 Cypriot children aged 11–13 years were included in the study. Internal

consistency was determined, and factor analysis was performed to examine the psychometric properties of the CDI-2:SR.

Results: The internal consistency of the CDI-2:SR was adequate. In addition, factor analysis indicated a two-factor solution, with the first factor reflecting social-emotional problems and the second factor representing cognitive-behavioral problems.

Conclusions: The Greek Cypriot version of the instrument appeared to be satisfactory in terms of reliability and validity for screening depressive symptoms in children.

Psych Res Clin Pract. 2025; 7:261–268; doi: 10.1176/appi.prcp.20250033

The international public health emergency status of COVID-19 has been associated with significant disruptions in the daily lives of young people worldwide, including depressive symptoms (1). Depressive symptoms are part of several psychiatric diseases with detrimental consequences, especially in young individuals (2). Depressive symptoms that develop in childhood have a more severe impact on emotion (3). Adolescents with depression tend to isolate themselves socially, making them vulnerable to severe depressive symptoms (3–5). Overall, children and adolescents with depressive symptoms are at risk for a range of negative outcomes, including poor academic performance, low self-esteem, disengagement, and suicidal ideation (6).

The Children's Depression Inventory (CDI) questionnaire was first developed by Kovacs (7) to detect depressive symptoms among those aged 7–17 years (7, 8). The official publication of the instrument was made by the Multi-Health System Inc. (MHS) in 1992 (9).

The CDI was initially built upon the foundation of the Beck Depression Inventory, a tool created to identify variations in depressive symptoms among adults and

children. Particularly, the CDI considered the diverse manifestations of depressive symptomatology across various age phases, spanning from childhood to adoles-

HIGHLIGHTS

- The Greek-Cypriot version of Children's Depression Inventory 2 (CDI-2) demonstrates high internal consistency (Cronbach's $\alpha = 0.907$) and good factorial validity.
- Factor analysis revealed a two-factor structure, distinguishing between emotional and functional problems.
- The CDI-2 can serve as a reliable screening tool for early detection of depressive symptoms in Greek-Cypriot schoolchildren.
- Strong intercorrelations among subscales support the robust psychometric properties of the instrument.
- The findings highlight the need for culturally adapted assessment tools to improve early intervention in child and adolescent mental health.

cence. These dimensions encompassed cognitive, affective, behavioral, interpersonal, and developmental perspectives (7, 10).

The CDI has been translated and adapted into over 20 languages and countries, including Arabic (11), Spanish (12), Dutch (13), German (14), Greek (15), Italian (16), Malaysian (17), Chinese (18), Japanese (19), and Cyprus (20), and is currently used in many countries with high sensitivity and moderate specificity (13–15, 20).

Kovacs (21) developed a second, 28-item Children's Depression Inventory 2: Self Report (CDI-2:SR) with an updated normative sample for controlling the birth cohort effect, compared to the one developed in 1992 (21). Some items in the CDI were formulated in the CDI-2:SR to better capture the fundamental symptoms of children's depressive symptoms and to provide clearer questions. Furthermore, a short version of CDI-2:SR, has been developed (21, 22). Specifically, the CDI-2:SR Short Form, which includes 12 items, was designed to provide a quicker and more accurate assessment of depressive symptoms in children and adolescents. The CDI-2:SR Short Form has been widely used in clinical and research settings to date (23–29). However, while the CDI-2:SR Short Form offers advantages in terms of time efficiency and practicality, it may not provide the same comprehensive assessment as the full-length CDI-2:SR. A more detailed evaluation of depressive symptoms is required. If a comprehensive diagnostic assessment is needed, it may be more appropriate to use the full CDI-2:SR (23).

Indeed, the CDI-2:SR has adequate internal consistency reliability, with Cronbach's alpha values ranging from 0.67 to 0.91 for the entire scale and subscales (30, 31) in both clinical and non-clinical populations. It has been shown that the CDI-2:SR offers adequate screening accuracy (32) according to sensitivity and specificity measures (25); however, there is scarce data on the validity of the CDI-2:SR, mainly in terms of consistency, reliability, and construct validity (30, 33).

Available norms may not accurately reflect different populations in other nations with different social and cultural backgrounds because standardized samples come from a few countries (e.g., the USA) (21). Therefore, the CDI-2:SR may be more effective in young people from different backgrounds if more translations and norms are available (21). Hence, it is crucial to examine whether the CDI-2:SR measures depression consistently and accurately across diverse cultural contexts, since the CDI-2:SR has not been used in the Greek-Cypriot population before, the metric properties of the tool must be tested.

Additionally, since depression is a disorder that lacks identifiable markers, it is crucial to acknowledge and recognize the symptoms in order to effectively identify depression in children and adolescents. Therefore, the utilization of screening instruments becomes an essential tool for enabling early detection and intervention (34).

The present study aimed to investigate the internal consistency reliability, and factorial validity of the full-length 28-item Greek-Cypriot version of the CDI-2:SR among schoolchildren in Cyprus aged 11–13.

MATERIALS AND METHODS

Methods

Design and Data Collection. A methodological instrument validation design was performed between 2020 and 2023 in a nationwide random sample of public elementary schools in Cyprus. The target population was schoolchildren aged 11–13. The following phases were included in the validation process: (a) translation of the tool from English to Greek and vice versa to create the Greek version of the tool, (b) internal consistency reliability aimed at testing the reliability of the tool, and (c) conducting factor analysis aimed at testing the factorial validity of the instrument.

Sampling and Procedures. Data were collected from students in their final year of public elementary school, aged 11–13 years (6th grade), regardless of their gender, age, or nationality. Cyprus's educational system is divided into four levels. Early childhood education (ages 3–6), primary education (ages 6–12), secondary education (ages 12–18), and tertiary education (ages 18 and above). Full-time education is compulsory for all children between the ages of 5 and 15 years (35).

An adequate sample size for the factor analysis was at least 210 participants for a satisfactory ratio of N to the number of model parameters that is, according to the guideline of maintaining a minimum of 10 participants for each variable (10:1) (36). Specifically, a random selection process was employed to select 27 primary schools from both public and private institutions across the country ($n = 800$), which was implemented using a lottery-based method. However, 7 schools declined to participate ($n = 150$), 200 students did not obtain parental consent to participate, and 25 students were absent during the data collection period. The final sample consisted of 420 participants (response rate: 65%).

Ethical Considerations. Cyprus National Bioethics Committee (Refs. No: 2020/4) and the Ministry of Education, Sports, and Youth of the Republic of Cyprus approved the study. All parents provided written informed consent. Participation was voluntary and anonymous. Participants were informed that their parents would sign a consent form but could drop out at any time if they chose. To ensure ethical compliance and child safety, the parental consent form included contact details for national child mental health services as well as a collaborating child psychiatrist. Parents were informed that they could reach out directly to these professionals if they had concerns

regarding their child's mental health. This study followed all legal procedures governing the law on the protection of natural persons against the processing of personal data.

Materials

Instruments

The CDI-2

The CDI-2:SR consists of 28 items divided into two scales: Emotional Problems (EP) and Functional Problems (FP). The EP scale consists of two subscales: the negative mood/physical symptoms subscale (9 items, subscale range 0–18) and the negative self-esteem subscale (6 items, subscale range 0–12). The EP scale score reflects the degree of dysphoric affect, including sadness and guilt (21). The FP scale includes the interpersonal problems subscale (5 items, subscale range 0–10) and the ineffectiveness subscale (8 items, subscale range 0–16), which assesses the severity of symptoms related to the quality of interaction with peers, school, and family (21). The full-length SR of the items included in the CDI-2 are scored as follows: “0” indicating absence of symptoms; “1” indicating mild symptoms; and “2” indicating severe symptoms. Total CDI-2:SR scores ranged from 0 to 56.

It is important to note that the CDI-2:SR is a screening tool that allows the assessment of the severity of depressive symptoms instead of providing a clinical diagnosis of depression. Higher scores indicate more depressive symptoms (21).

The CDI-2:SR had not been used in the Greek-Cypriot population before this study. The instrument was translated into Greek according to relevant guidelines (37, 38). The original English questionnaire was translated and back-translated by two bilingual (Greek and English) academics who worked independently. To create a single version of each translated item, two translated versions were compared. As a result, the final Greek CDI-2:SR questionnaire was created.

Data Analysis

The internal consistency reliability of the CDI-2:SR scale and its subscales was evaluated using Cronbach's alpha. Additionally, Guttman split-half reliability was calculated for the full CDI-2:SR scale. Item-total correlations and inter-correlations between subscales were also examined to further assess internal consistency.

To assess construct validity, both confirmatory factor analysis (CFA) and exploratory factor analysis (EFA) were performed.

CFA was initially conducted to test the theoretical structure of the CDI-2:SR, including one-factor, two-factor (EP and FP), and second-order models with four lower-order subscales. CFA models were evaluated using standard fit indices: comparative fit index, Tucker–Lewis index, root mean square error of approximation, and standardized root mean square residual (39–41). The CFA results indicated poor to marginal model fit and the presence of

estimation issues in some models (e.g., negative latent variances and identification warnings), prompting further investigation through EFA.

Subsequently, an EFA was conducted using the maximum likelihood (ML) extraction method, which allows for the estimation of model-based fit indices. The Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity were used to assess the suitability of the data for factor analysis. Factors were retained based on eigenvalues >1.0 (Kaiser's criterion, Kaiser (41)), and the scree plot was examined to support factor retention decisions. Promax (oblique) rotation was applied, as it allows for the identification of correlated factors, which are commonly expected in psychological constructs such as depressive symptoms. Given the theoretical and empirical assumption that latent dimensions of depression are inter-related rather than orthogonal, oblique rotation was deemed more appropriate than orthogonal methods (e.g., varimax), which assume factor independence (42).

For all statistical analyses, a *p*-value <0.05 was considered statistically significant. Data were analyzed using SPSS version 19 for descriptive, reliability. For CFA and EFA the statistical program JAMOVI was used.

RESULTS

Descriptive Statistics

The final sample consisted of 420 children (response rate: 65%); Of them, 200 (47.6%) were boys and 220 (52.4%) were girls, with ages ranging from 10 to 13 years (mean = 11.20, SD = 0.43). In terms of socioeconomic background, the majority of participants (*n* = 116, 27.6%) reported an annual family income between €19,501–€39,500, while the smallest group (*n* = 85, 27.6%) reported an income of ≤€19,500 (Table 1).

Internal Consistency of the CDI-2

The Greek version of the CDI-2 appeared to have adequate internal consistency in terms of Cronbach's alpha (0.907),

TABLE 1. Characteristics of the sample (N = 420).

	Frequency (N)	Percentage (%)
Age		
10–11	330	78.6
12–13	90	21.4
Sex		
Boys	200	47.6
Girls	220	52.4
Ethnicity		
Cypriot	428	86.2
Greek	28	5.1
Other ethnicities	48	8.7
Family incomes		
≤€19,500	85	20.2
€19,501–39,501	116	27.6
€39,501–49,000	113	26.9
≥€49,001	106	25.2

and the Guttman split-half coefficient was 0.88. Cronbach's alpha was adequate for the CDI-2 subscale. Specifically, the relevant values were 0.882 for EP and 0.920 for FP (Table 2).

Construct Validity

Factor Analysis. Factor analysis was performed to explore the underlying dimensions that explained the relationships between multiple items. Using ML with criteria of eigenvalues equal to or greater than one, factor analysis explained 51.1% of the variance; Component 1 contributed 33.28%, and Component 2 contributed 17.82% (Table 3). The components in the rotated solution (Promax) exhibited a simple structure with numerous moderate and strong loadings (greater than or equal to 0.4), and most variables had adequate loadings on one component (Table 4). Specifically, Item 5 (“My family is better off without me”) had the highest loading (0.771), while Item 3 (“I do everything wrong”) had the lowest loading (0.403). The first component of the scale best describes EP and the second component describes FP. No variable exceeded a loading of 0.4 on both factors.

Regarding the fit indices of the model and the appropriateness of the factor analysis, the Bartlett's test for factor analysis was 1314 with $df = 357$ and $KMO = 0.909$ ($p < 0.001$) (Table 4).

Inter-Correlations

An additional analysis was conducted to examine the correlations between the total score of the CDI-2:SR and the two empirically derived subscales (EP and FP). As shown in Table 2, all Pearson's r coefficients were positive and statistically significant at the $p < 0.01$ level. The correlation between the total score and EP was $r = 0.802$, and between the total score and FP was $r = 0.805$, indicating that both subscales contribute substantially to the overall depressive symptomatology. The correlation between EP and FP was $r = 0.750$, suggesting that these two domains are strongly related yet conceptually distinct. Cronbach's alpha coefficients demonstrated excellent internal consistency reliability: $\alpha = 0.907$ for the total scale, $\alpha = 0.892$ for EP, and $\alpha = 0.882$ for FP. According to Cohen's (43) guidelines, these

correlations reflect moderate to strong effect sizes, supporting the internal structure of the instrument.

DISCUSSION

The main objective of this study was to assess the internal consistency reliability and factorial validity of the CDI-2:SR, which is a 28-item questionnaire translated into Greek-Cypriot and administered to schoolchildren in Cyprus. The CDI is a widely used tool for detecting childhood depression. However, a meta-analysis examining the scale's structure and content showed differences in both aspects (44). Despite the modifications that have been implemented in the latest version, there is a paucity of data regarding the validity of the structure and content of the CDI-2:SR. Therefore, it is important to investigate whether these differences in structure and content vary across different cultural backgrounds.

Our findings provide initial evidence for the internal consistency and concurrent validity of the Greek-Cypriot CDI-2's full-length form as a measure of depressive symptoms among Greek-speaking Cyprus students.

To evaluate the underlying structure of the Greek-Cypriot version, an EFA was conducted. The results supported a two-factor solution representing EP and FP, which explained 51.1% of the total variance. Although this percentage may appear modest, it is comparable to that reported in other validation studies using similarly aged school-based samples (31, 33, 45). The two-factor configuration aligned conceptually with the structure of the original CDI-2:SR and offered a parsimonious and interpretable model in the current population.

Item-level loadings were also examined to assess the strength and interpretability of the two-factor solution. Most items demonstrated strong and clean loadings (≥ 0.50) on their respective factors, with minimal cross-loadings and no items needing removal. Items reflecting sadness, self-deprecation, and negative affect (e.g., Items 1, 2, 6, 9, 13) consistently loaded on the EP factor, while those reflecting interpersonal difficulties, ineffectiveness, or withdrawal (e.g., Items 5, 11, 14, 20, 25) loaded on the FP factor.

TABLE 2. Correlation between subscales and Cronbach's α .

CDI2	CDI 2 total score	Emotional problems	Functional problems	Cronbach's α
Total score	1.000			0.907 ^a
Emotional problems	0.802 ^a	1.000		0.892 ^a
Functional problems	0.805 ^a	0.750 ^a	1.000	0.882 ^a

^a Statistical significance is at the 0.01 level (2-tailed).

TABLE 3. Total variance explained.

Component	Initial eigenvalue	% of variance	Cumulative %	Rotation sums of squared loadings
1	7.417	32.28	33.38	4.444
2	1.517	17.82	51.10	5.021

TABLE 4. Structure matrix for Factor 1 and Factor 2 from exploratory factor analysis.^a

	Component	
	1	2
Item 27 R	0.707	
Item 9 R	0.701	
Item 18	0.686	
Item 16	0.681	
Item 7 R	0.668	
Item 6 R	0.652	
Item 26 R	0.638	
Item 13	0.628	
Item 10 R	0.557	
Item 24 R	0.549	
Item 8	0.530	
Item 2 R	0.527	
Item 17 R	0.522	
Item 1	0.508	
Item 15 R	0.501	
Item 5		0.771
Item 23 R		0.723
Item 11		0.719
Item 20 R		0.711
Item 19		0.681
Item 12 R		0.666
Item 25		0.633
Item 14 R		0.565
Item 21		0.494
Item 22		0.493
Item 28		0.453
Item 4		0.407
Item 3		0.403
Eigenvalues	7.417	1.517
Percentage of variance	33.28	17.82

^a Extraction method: ML, maximum likelihood. Rotation method: Promax.

The pattern is consistent with the theoretical framework of the original CDI-2, where these items formed part of higher-order domains corresponding to our factors. Importantly, our results did not reveal any items loading on different conceptual factors compared to the original version. For example, Item 3 (“I feel like crying every day”) and Item 14 R (“I do most things well”) loaded as expected under the Emotional and Functional dimensions, respectively.

Compared to the original English version (21), where item loadings for the four subscales ranged between 0.42 and 0.79, our structure was similarly robust, with loadings mostly falling within that range. In contrast, other studies have reported more variation. For example, Anant et al. (33) found that several items originally belonging to different subscales loaded together, prompting a restructuring into four second-order factors. Likewise, Kim et al. (31) reported that some items showed weaker loadings (<0.40) or cross-loaded across emotional and cognitive dimensions. Despite these variations, all studies converged on the broader distinction between emotional

and functional difficulties, reinforcing the validity of the two-factor structure.

Cross-national comparisons of the CDI-2:SR structure reveal both similarities and divergences. In the Singaporean adaptation, Anant et al. (33) identified a two-factor solution (socio-emotional and cognitive-behavioral problems), supported by both EFA and CFA, though the original subscale model showed suboptimal fit. Kim et al. (31) in Korea confirmed a two-factor model via exploratory structural equation modeling, again diverging from the original subscale structure. Cumba-Avilés et al. (30) in Puerto Rico also observed strong correlations between two broad dimensions in a clinical sample, while Cho et al. (23) emphasized the need for further validation in non-clinical contexts due to inconsistencies in subscale patterns.

Across these studies, the consistent emergence of two overarching factors supports the structural validity of a simplified model, especially in younger or school-based populations. This aligns with our findings, suggesting that children may not differentiate nuanced emotional and functional subdimensions, but rather experience depressive symptoms as broad, interrelated difficulties. Such convergence underscores the potential value of a two-factor structure in culturally adapted settings.

The internal consistency reliability of the Greek-Cypriot CDI-2:SR was also found to be strong. The total scale and the two derived factors the EP and the FP, demonstrated high Cronbach’s alpha values ($\alpha = 0.907$, 0.892 , and 0.882 , respectively), which are consistent with or slightly higher than those reported in other validations (23, 31, 33). These values are also comparable to the original English version (21), which reported $\alpha = 0.85$ for EP and $\alpha = 0.83$ for FP.

Moreover, a strong and statistically significant correlation was observed between the two factors ($r = 0.750$), further confirming the internal coherence of the instrument. This finding is remarkably close to the original scale’s correlation between the two dimensions ($r = 0.77$; Kovacs (21)) and aligns with international data (e.g., Cumba-Avilés et al. (30): $r = 0.77$; Anant et al. (33): $r = 0.87$). These results collectively suggest that the Greek-Cypriot version of the CDI-2:SR maintains solid internal structure and reliability while accounting for potential cultural influences in the expression of depressive symptoms.

These findings carry important implications for school-based mental health screening in Cyprus. The clarity and consistency of the two-factor structure suggest that the Greek-Cypriot CDI-2:SR may serve as a reliable and culturally appropriate tool for the early identification of emotional and functional difficulties related to depression. Given the growing emphasis on mental health promotion in educational settings, especially in the post-pandemic context, this validated instrument can help inform healthcare professionals and teachers in referring students for further support or clinical evaluation when needed.

CONCLUSIONS

The findings for exploratory factor analyses provided evidence supporting the utility of the CDI-2:SR as a screening tool for depression. The results indicated that the CDI-2:SR exhibits a factor structure that aligns with the theoretical understanding of depression. This suggests that the factor structure of the CDI-2:SR scale is valid for the Greek Cypriot population. This is particularly relevant when working with diverse populations with cultural, linguistic, and other contextual differences. The items in the inventory effectively measure depressive symptoms and can be used to identify individuals at risk for depression.

The use of the CDI-2:SR Greek Cypriot version as a screening tool can aid in the early identification of depression in children and adolescents, enabling timely intervention and support. However, further investigations and validation studies are required to determine the scale's validity, reliability, and appropriateness for different populations and settings.

Limitations

This study has several limitations that should be acknowledged, along with the steps taken to mitigate them.

First, the use of self-report measures may introduce response bias, as children may under or over report their symptoms due to misunderstanding, social desirability, or attention-seeking behavior. To minimize this effect, we used a well-validated and age-appropriate instrument (CDI-2:SR) and ensured anonymity and confidentiality during data collection. However, future studies incorporating multi-informant data (e.g., from parents or teachers) would provide a more robust assessment.

Second, the study focused on a relatively narrow age range (11–13 years), which may limit the generalizability of the results to younger children or older adolescents. This age group was selected intentionally, as it represents the transition from late childhood to early adolescence, when depressive symptoms often emerge. Nonetheless, future research should examine the psychometric properties of the CDI-2:SR across a wider developmental span.

Third, the sample consisted exclusively of school-children from non-clinical settings. As a result, the findings may not fully generalize to clinical populations, where symptom severity and expression may differ. Future studies should explore the CDI-2:SR in clinical contexts.

Fourth, the validation was performed within the cultural and educational context of public elementary schools in Cyprus. Although this provides valuable data for Greek-Cypriot youth, cultural norms such as emphasis on emotional restraint or stigma around mental health may have influenced symptom reporting. We did not include cultural or qualitative measures to assess these potential effects, and this should be addressed in future cross-cultural studies.

Fifth, although we used a nationally representative random sample of schools, seven schools declined to participate and 200 students did not obtain parental consent. This introduces the possibility of non-response bias, as non-participating students may differ systematically from those included in the final sample. However, anticipating this potential limitation, we initially targeted a much larger population than required to achieve the minimum sample size. Schools were also recruited from multiple districts across Cyprus to enhance geographic and demographic representation.

Lastly, while our EFA-supported two-factor structure aligns with other international school-based validations, it deviates from the original four-subscale model of the CDI-2. This divergence may reflect cultural or developmental variation or methodological constraints. To enhance interpretability, we focused on the more stable higher-order structure (EP and FP), and we have acknowledged this difference in the Discussion.

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The present study was partially funded by the Cyprus University of Technology and CUT Open Access Author Fund.

Many thanks to all the students who joined this study and to the persons who contributed in the collection of the data.

The authors declare no conflicts of interest.

The datasets generated and/or analyzed during the present study are not publicly available because the authors are currently working on them in order to prepare the final version of this manuscript. However, they are available from the corresponding author upon reasonable request.

This study was approved by the Cyprus National Bioethics Committee [Ref. No: 2020/4]. All participants were informed of the purpose of the study and the data collection procedures, and their consent was obtained. Additionally, the study was approved by university research committees. All methods were carried out in accordance with the relevant guidelines and regulations of the aforementioned committees. The participants were informed about the purpose of the study and the data collection procedures prior to providing their consent. All participants agreed to participate and informed consent was obtained from all subjects and/or their legal guardians. Participation in the study was voluntary and anonymous in order to guarantee confidentiality.

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Received February 24, 2025; revised May 5, 2025; accepted May 22, 2025.

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