



Psychometric properties of the short form of the Children's Depression Inventory (CDI-S) in young people with physical disabilities



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ABSTRACT

Objective: Depression is a significant issue for young people with physical disabilities. Efficient and reliable questionnaires are needed to evaluate and monitor the efficacy of depression treatments in this population. The aim of this study was to evaluate the reliability and validity of the 10-item version of the Children's Depression Inventory (CDI-S) in a sample of young people with physical disabilities.

Methods: A convenience sample of young people with physical disabilities ($N = 97$) was recruited and interviewed. Reliability was evaluated using the Cronbach's α and examining the item-total correlations. Validity was evaluated by computing Pearson correlations between scores on the CDI-S and measures of pain and psychological functioning (anxiety and depression).

Results: The CDS-I items loaded on a single factor. The internal consistency of the scale was good (Cronbach's $\alpha = 0.84$) and the CDI-S showed moderate significant correlations with pain intensity ($r = 0.29$), pain interference ($r = 0.46$) and psychological functioning ($r = -0.57$). Two of the items, however, did not perform well (i.e., item-total correlations < 0.3 , and Cronbach's α improved when they were deleted).

Conclusion: The findings support the reliability and validity of the CDI-S scores for use in young people with physical disabilities. The measure's psychometric properties should be studied in larger samples. In addition, there is a new brief version of the CDI (CDI-S 2) that needs to be evaluated in order to determine which of the two scales is better for assessing depression in young people with physical disabilities.

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1. Introduction

Young people with physical disabilities have nearly a threefold probability to have clinical depression, relative to their healthy counterparts [1]. In addition, they are also at a greater risk of having chronic pain [2], which is known to be related to depression and potentially worsening emotional problems [3,4]. Perhaps in part due to both depression and chronic pain, the health-related quality of life of these individuals has been shown to be greatly impaired [5]. In order for researchers to evaluate the efficacy of treatments that target depression in this particular population as well as for clinicians to be able to evaluate and monitor depression during treatment, it is essential to have a measure of depression that has proven to be valid and reliable for use in young people

with disabilities. Furthermore, due to the high rates of depression in this population, it would be very helpful for clinicians in their screening for depression at medical visits.

The Children's Depression Inventory (CDI) is a widely used questionnaire that has demonstrated robust psychometric properties with a number of populations (e.g., psychiatric and community samples of American and European children and adolescents) [6], including young people with chronic widespread pain [7]. It measures symptoms such as sadness, low self-esteem, crying behavior, and loneliness. There are two versions of the CDI that are available; the original one with 27 items and a brief one that has 10 items (CDI-S) [8,9]. The short version was adapted from the original by deleting the items that had lower inter-item correlations. The CDI-S has been found to be similar to the original version with respect to its specificity and sensitivity to detect depression in hospitalized patients [10]. Furthermore, it has been shown to have a good internal consistency (Cronbach's $\alpha \geq 0.80$) in studies with schoolchildren [11] and adolescents with fibromyalgia

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[12]. To our knowledge, however, no additional validation studies have been completed on the CDI-S, and no study has evaluated the psychometric properties of the CDI-S in samples of young people with physical disabilities. Having the availability of a valid brief version of the CDI (CDI-S) can save time and reduce assessment burden in situations and settings where assessment burden plays a limiting factor, such as in survey research where researchers can be limited in the number of domains they assess due to the length of available measures, or in clinical settings where patients might have multiple co-morbid conditions that require assessment. Knowledge concerning the validity of the CDI-S in a sample of youths with physical disabilities, in particular, would provide additional support for its use in this population. Thus, the use of the CDI-S, if demonstrated to be valid, could ultimately result in better detection and treatment for young people at risk for depression.

The aim of this work was therefore to evaluate the psychometric properties of the short (10-item) version of the CDI (the CDI-S) in a sample of young people with physical disabilities, and chronic pain. Based on the limited research findings that are available, we anticipated that the scores provided with the CDI-S would evidence adequate to excellent reliability and at least adequate criterion validity. Specifically, we hypothesized that [1] the CDI-S would evidence at least adequate internal consistency (Cronbach's $\alpha \geq 0.70$), [2] a CFA would evidence a single factor structure, and [3] its scale's scores would be moderately, negatively and significantly associated (e.g., correlation coefficients of 0.30 or higher) with measures of psychological function (anxiety, depression) in a sample of young people with disabilities. We also hypothesized that the CDI-S would be positively associated with measures of pain interference and pain severity among young people with disabilities who also had chronic pain.

2. Methods

The data used in the current study came from a larger survey study (via in-person or over-the-phone interviews) focusing on pain and quality of life in youths with physical disabilities. Although a number of articles have been published using the same dataset [13–18], the previously published papers focused on topics that are different from the research question pursued in this study.

2.1. Participants

The sample consisted of 97 young people with physical disabilities who live in the Seattle metropolitan area. Inclusion criteria were: [1] having a diagnosis of cerebral palsy, neuromuscular disease, spina bifida, limb deficiency, or spinal cord injury; [2] being between 8 and 20 years old; [3] being able to communicate, with or without augmentative communication devices; [4] having no more than mild cognitive impairment, as determined by a brief screening with the parent, and a passing score on a modified version of the Mini-Mental Status Examination [19]; and [5] being able to communicate in English. Participants were not limited only to children (i.e., 17 years old or younger), because many pediatric treatments centers continue to treat patients that they have a history of treating even after they become 18 years old. Moreover, evidence regarding the psychometric properties of the CDI-S in young people up to 20 years old would provide important evidence regarding its use in longitudinal surveys that seek to understand the time course of depressive symptoms from a very young age into young adulthood.

2.2. Procedures

Participants were recruited using four different strategies: sending letters from clinics at the local children's hospital, word of mouth, public postings, and a local summer camp for youths with muscular dystrophy. Permission to conduct the study was obtained by the Institutional

Review Board at Children's Hospital and Regional Medical Center in Seattle. All participants provided either written informed assent (if they were minors) or consent (if they were adult participants or parents of a minor participant). They completed the questionnaires in one session, answering to an interview conducted either in the participant's home, at the University of Washington Medical Center, at the summer camp, or over the telephone. One of the youth participant's parents was also interviewed (to obtain basic demographic and descriptive data).

2.3. Measures

2.3.1. Demographic variables

Age, sex, ethnicity, and diagnostic group were all obtained from a parent.

2.3.2. Depression

Depression was assessed using the Children's Depression Inventory – Short Form (CDI-S) [8]. This questionnaire was derived from a well-established questionnaire to measure depression in adults, the Beck Depression Inventory [20].

The 10-item CDI-S was designed to be used in children as young as 7 years old, and asks respondents to rate the severity of different symptoms of depression. Each symptom is presented as a series of three phrases, and respondents are asked to select the phrase that best represents how they feel (e.g. "I am sad once in a while"/"I am sad many times"/"I am sad all the time"). Higher scores indicate more depressive symptomatology. No adjustments on the wording of the items were needed during the administration to the older (young adult) participants. The CDI-S has shown excellent psychometric properties, as summarized in the Introduction.

2.3.3. Average pain intensity in the last week

Average pain was assessed using an 11-point numeric rating scale (NRS-11) ranging from 0 ("No pain") to 10 ("Pain as bad as could be") [21]. Scores from NRS-11 have been shown to be valid when used with young people [22], even with children as young as 6 years old [23].

2.3.4. Pain interference

A modified 10-item version of the Brief Pain Inventory (BPI) [24], used and described in a previous study [14] demonstrating excellent reliability and validity with youths, was employed to measure pain interference with function and community participation. This measure was selected on the basis of its easiness in comprehension, administration, and for its established psychometric properties [21]. The original 7-item BPI [24] was modified for the current study in three ways. First, the "walking" item was changed to a "mobility (ability to get around)" item, because not all of the participants in the current study were ambulatory. Second, the "normal work" item was changed to a "school, work, or chores" item, which is more appropriate for subjects of school age. Finally, three items were added to increase the content validity of the scale, so that it assesses additional domains relevant to individuals with disabilities. These included items that ask about pain interference with "self-care (taking care of your daily needs)", "recreational activities" and "social activities" in the last week. Respondents indicated the amount of pain interference with each activity domain on 0–10 numeric rating scales, where 0 means ("Does not interfere") and 10 means ("Interferes completely"). Higher scores indicate higher levels of pain interference. The Cronbach's α for the current sample for the modified BPI interference scale was 0.90, indicating excellent reliability. This questionnaire was only administered to those who reported having pain ($N = 59$).

2.3.5. Psychological function

The Mental Health scale (MH) of the Child Health Questionnaire (CHQ-CF87) [25] was used to assess psychological function. The MH scale is designed to assess anxiety, depression, and positive affect by

measuring the frequency of positive and negative states. It has 16 items that are scored in 5-point Likert scale (from 1 “All the time” to 5 “None of the time”). The MH scale is scored by first computing a raw score for each participant and then transforming raw scores to standardized scores ranging from 0 to 100. Lower scores indicate poorer psychological function (i.e., the child feels depressed or anxious most of the time). It has shown strong reliability and validity with internet, traditional paper-and-pencil, and face-to-face interview administrations [26]. Scores on this scale have been found to be correlated with depression and anxiety, among other chronic conditions [26]. The Cronbach's α for the MH scale in the current sample was 0.88, indicating a good reliability.

2.4. Data analysis

We first computed the means and rates of demographic variables for descriptive purposes. Then we tested the suitability of the data for the planned factor analysis using the Kaiser-Meyer-Olkin test (KMO) [27] and the Bartlett's statistic [28], and examined the skewness and kurtosis of the items. Next, we performed a Confirmatory Factor Analysis (CFA) to evaluate the factor structure of the CDI-S. Because skewness was > 1 for most of the items, the method selected for factor extraction was the Maximum Likelihood Mean Adjusted [29] as this strategy does not require that the items have a normal distribution. We tested a one-factor model solution to confirm that all the items represent the same factor (i.e. depression). Next, we tested the reliability of the CDI-S by computing its internal consistency coefficient (Cronbach's α), item-total correlations and Cronbach's α coefficients of the scale when the items are deleted. Finally, we evaluated the criterion validity of the measure by computing Pearson correlation coefficients between the CDI-S total score and the criterion variables assessing: [1] pain interference; [2] pain intensity; and [3] psychological function. If a questionnaire had any missing response, it was excluded from the analyses. All the analyses were performed using SPSS 23 for Windows [30].

3. Results

3.1. Description of the sample

A total of 102 youth agreed to participate in this study. The sample consisted in 97 (95% of the total) individuals who provided complete data for the measures used in the present analyses. Of these participants, 43 (44%) were females. The mean age of the sample was 14.1 years (SD 3.3), and 59 (61%) of them reported chronic pain (i.e., a bothersome pain that had lasted a minimum of three months). See Table 1 for additional descriptive information about the sample.

Table 1
Demographic information ($N = 97$).

Variable	Percent	N	Mean (SD)	Range
Age, years		97	14.1 (3.3)	8–20
Sex				
Males	66%	54		
Females	44%	43		
Ethnicity/race ^a				
African American	4%	4		
American Indian	1%	1		
Asian	1%	1		
Caucasian	72%	70		
Hispanic/Chicano	5%	5		
Other	1%	1		
Diagnosis ^b				
Limb deficiency	1%	1		
Cerebral palsy	10%	10		
Muscular dystrophy	40%	39		
Spina bifida	37%	36		

^a Ethnicity/race information was missing for 15 (15%) participants.

^b Diagnosis information was missing for 11 (11%) participants.

3.2. Factor structure of the CDI-S

The CDI-S showed good fit indexes for a factor analysis: KMO = 0.803 and Bartlett's statistic = 426.2 ($df = 45$; $p < 0.01$). In addition, the data adjusted well to a one factor model in the CFA, as evidenced by a significant Chi squared (127.94, $p < 0.01$). All item loads on the factor are between 0.50 and 0.87, except from items 3 (0.27) and 9 (0.25).

3.3. Internal consistency of the CDI-S

The CDI-S showed good internal consistency (Cronbach's $\alpha = 0.84$). All values of alpha when one item was deleted are higher than 0.80 (rank: 0.81–0.85), supporting the reliability of the scale. The alpha, however, increased fairly substantially when deleting items 3 (+0.007) and 9 (+0.011); if both items are deleted, Cronbach's α increases by 0.03. Looking into the item-total correlations (see Table 2), the coefficients associated with all of the items range from 0.48 to 0.74, except for items 3 (0.27) and 9 (0.26), being below the recommended cut point of 0.3 for keeping an item in a questionnaire [31]. Item 3 measures the perception of doing things incorrectly (e.g., “I do many things wrong”) and item 9 asks about the respondent's social network (e.g., “I have plenty of friends”).

3.4. Validity

Validity of the CDI-S scores was evidenced by moderate and positive significant correlations with pain intensity (NRS, $N = 58$; $r = 0.29$, $p < 0.05$) and pain interference (BPI, $N = 59$; $r = 0.46$, $p < 0.01$) in those participants with chronic pain. The CDI-S scores also evidenced a strong significant negative association with psychological function (CHQ-MH, $N = 97$; $r = -0.57$, $p < 0.01$).

4. Discussion

The aim of this work was to evaluate the psychometric properties of the short version of the Children's Depression Inventory (CDI-S). The results of this study show that the CDI-S scale has a one-factor structure, good internal consistency and are in line with the original validation studies performed in other populations [8,9]. Moreover, we found that the CDI-S scale scores evidenced criterion validity in a sample of young people with physical disabilities with respect to its association with measures of pain intensity, pain interference and psychological function.

In the current sample, however, a problem with two of the items (items 3 [“...do many things wrong”] and 9 [“...few friends”]) was observed. Our results showed that these two items had weak loadings on the factor, and that if these two items were deleted, the psychometric properties of the questionnaire would improve to some degree (i.e., if both items are deleted, Cronbach's α increased by 0.03 in our sample). It is not entirely clear why these items did not perform well in the current sample. With respect to the “do things wrong” item, it is possible that many young people with disabilities may see themselves as not able to “do things right” because of their disability, rather than because of anything related to depression (e.g., low self-esteem). Similarly, with respect to the “few friends” item, it is possible that the respondents accurately evaluated their limited access to friends, again related more to their disability than to factors related to depression [32]. Thus, in this particular (disabled) population, these items may not adequately reflect depression. However, as this was the first time that the CDI-S items were evaluated in a sample of young people with disabilities, the findings with respect to these items should be considered preliminary. Future research is needed before any decision is made to drop these items from the scale; especially given the other evidence from the current study that scores from the full CDI-S demonstrate more than adequate psychometric properties (i.e., good reliability and validity). If future research with larger samples replicates the current findings

Table 2
Item-total statistics.

Item ^a	Mean	Item-total correlation	Cronbach's alpha if item is deleted
1 "I am sad all the time"	0.14	0.51	0.83
2 "Nothing will ever work out for me"	0.33	0.68	0.81
3 "I do everything wrong"	0.13	0.27	0.85
4 "I hate myself"	0.17	0.74	0.81
5 "I feel like crying every day"	0.13	0.66	0.82
6 "Things bother me all the time"	0.32	0.71	0.81
7 "I look ugly"	0.38	0.54	0.83
8 "I feel alone all the time"	0.20	0.56	0.83
9 "I do not have any friends"	0.36	0.26	0.85
10 "Nobody really loves me"	0.08	0.48	0.83

^a The most severe option of each item has been included to illustrate their content.

with respect to the lack of reliability of items 3 and 9, this would support the removal of these items from the scale. This would also result in a questionnaire that is not only psychometrically robust, but also a measure with even less assessment burden.

Since the data used in the current analyses were collected, a new version of the CDI and its short version (the CDI 2 [33]) was published. The validation samples chosen for the initial testing of CDI 2 included children and adolescents with Major Depressive Disorder, Attention-Deficit/Hyperactive Disorder, Conduct Disorder, Generalized Anxiety Disorder, or Oppositional Defiant Disorder. Similar to the CDI-S, the short version of the CDI 2 (i.e., the CDI-S 2) was developed by selecting specific items from the CDI 2, this time on the basis of those with the largest effect sizes (Cohen's *d*) for distinguishing criterion groups as well as the largest beta weights in a multiple regression analyses conducted for screening for depression [34]. Some of the CDI-S 2 items are the same as those in the original CDI-S (items 1–4 and 8), but seven items have been included in the CDI-S 2 that were not part of the CDI-S (e.g., eating, fatigue, family, fun, school). Moreover, four items (i.e., items 5, 8, 9 and 10) from the original CDI-S were also included in the new long version (CDI 2), but not in the new short version (CDI-S 2). Although there is some overlap in items between the CDI-S and CDI-S 2, the CDI-S 2 has not yet been validated in samples of young people with physical disabilities. Given this, we recommend that when researchers or clinicians want to assess depressive symptoms in these populations, they should consider using the CDI-S, whose scores have demonstrated validity and reliability in the current study.

The current study has a number of limitations that should be considered when interpreting the results. First, and primarily, the sample consisted of young people who were willing to participate in a survey study, and so represented a convenience sample. Thus, we are unable to determine how representative they are of the population of young people with disabilities. In addition, although the sample size is appropriate for most of the analyses performed, it was too low to provide stable results for evaluating the factor structure of the items [35]. Thus, future research in additional samples of young people with disabilities, ideally using larger sample sizes, would be useful to determine the generalizability of our findings, as well as evaluate the structure of the CDI-S items. Also, given that a more recent short-form version of the CDI has been developed, research comparing the psychometric properties of the CDI-S and CDI-S 2 in samples of young people with physical disabilities would provide researchers and clinicians an empirical basis for determining which of these scales would be most useful in their settings. Despite the limitations of this study, the findings show that the scores provided with the CDI-S are both valid and reliable. These findings provide important new psychometric information about the CDI-S supporting that it could be useful for clinicians and researchers alike. The current findings indicate that CDI-S is a valid and time-efficient questionnaire that assesses depressive symptoms in youth with physical disabilities. The CDI-S may prove to be helpful for evaluating and monitoring depressive symptoms during routine medical visits, as these patients are at risk to experience high rates of depression. Furthermore, due to its good psychometric properties and low administration

and scoring burden, it could be of great value for assessing the efficacy of treatments that target depression in this particular population.

Competing interest statement

The authors have no competing interests to report.

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