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ORIGINAL CONTRIBUTION

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The Children's Depression Inventory and classification of major depressive disorder

Validity and reliability of the Danish version

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Abstract The study examines the validity and reliability of the Danish version of the Children's Depression Inventory (CDI) in a child psychiatric population. Participants were 149 child psychiatric patients aged 8–13 and their parents. After diagnostic interview with the Kiddie-Schedule for Affective Disorders and Schizophrenia, the children completed the CDI. A subgroup of 44 children repeated the CDI after 2 weeks. The psychometric properties of the Danish CDI were similar to those reported for the English version. CDI is moderately correlated with other measures for depressive disorder, but the instrument is not sufficiently reliable or valid to be used as a single diagnostic or screening measure in a child psychiatric population.

Key words psychiatric status rating scales – depressive disorder – child psychiatry – psychometrics

Introduction

Despite increasing support to the existence of DSM-defined depressive disorders in children [4], major depressive disorder (MDD) may remain undiagnosed in epidemiological as well as clinical child and adolescent populations [5, 11, 26]. Thus, well-established and psychometrically sound instruments for assessment of depressive symptoms in children and adolescents are important. Self-report measures, which are quick and easy to administer, may be an attractive alternative to time-consuming diagnostic interviews in screening for MDD. Still, appropriately translated and validated versions of widely used measures of depression such as the Children's Depression Inventory (CDI) [12] are sparse in small linguistic areas such as Denmark.

The CDI [12] is one of the most widely used self-report scales for measuring depression in children [29]. It is usually considered relatively reliable and valid with respect to depressive symptoms [28], with a mean in normal populations around 9, a standard variation around 7, and internal consistency around 0.8 [2, 21, 25]. However, the use of the scale as a diagnostic instrument [6] and its ability to discriminate between child psychiatric patients with and without MDD have been questioned [2, 3, 21].

Research suggests that depression is a dimensional construct rather than categorical, meaning that no underlying groups exist [16, 20]. Ruscio et al. argue from adult studies using the Beck's Depression Inventory that any cut-point based on a scale measuring a dimensional construct will only define arbitrary categorical groups (i. e. with and without MDD) and increase measurement error.

The aims of the study were first to examine the validity and reliability of the Danish version of the CDI in a child psychiatric population compared with a categorical measure. We also discuss the advantages and disadvantages of the CDI as a measure of depressive symp-

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toms in general, and as a mean to generate groups of children with and without MDD specifically.

Methods

Instruments

The CDI was translated from the English original version [13] by the third author (M. T.). An expert board [an experienced child psychologist and a resident in child and adolescent psychiatry (the first author, M.S.)] reviewed the draft, which was subsequently revised according to their comments. Finally, the scale was back-translated and the copyright holders approved the translation. The CDI contains 27 items including questions about depressive symptoms as well as symptoms of anxiety and conduct problems. The child marks one of three statements regarded the most appropriate for the past 2 weeks. For half of the items the most negative statement is first, for the other half the order is reversed.

The Schedule for Affective Disorders and Schizophrenia for Children – Present and Lifetime version (K-SADS-PL) is a widely used and validated semistructured diagnostic interview generating a wide range of child psychiatric diagnoses [8, 9, 24]. It includes a child interview and a parent interview. The final diagnoses are based on the clinician's synthesis of both interviews. For the purpose of validity analysis, we also generated diagnoses based only on the child interview.

Additionally, for the validity analysis, we included the clinical diagnoses which were clinicians' consensus diagnoses based on a multidisciplinary clinical assessment.

Subjects

The sample consisted of 199 first-ever referred 8- to 13-year-old children (mean age 10.6 years), consecutively examined at the Psychiatric Hospital for Children and Adolescents, Risskov, Denmark, in the study period (01.12.01–06.06.03). The sample consisted of 147 boys and 52 girls. Twelve children were inpatients, 187 were outpatients. Fourteen boys and eight girls (of 221 eligible children) were not included due to communication failure. The interviewed and not interviewed children did not differ with regard to gender ($\chi^2 = 1.0, p = 0.31$) or age group (8–11 years vs. 12–13 years) ($\chi^2 = 2.9, p = 0.09$).

Procedure

The children and one or both parents were interviewed with the K-SADS-PL [8] as part of the standard examination procedure.

The child completed the CDI after written consent from parents and children aged 12 years or older and oral consent from children younger than 12 years. Of the original sample, 149 children agreed to complete the CDI. These children did not differ from children who did not complete the CDI with respect to age (Mann-Whitney; $p = 0.14$) or gender ($\chi^2 = 2.1; p = 0.14$). The first author read the instructions and questions aloud to children who were unable to complete the CDI by themselves. Children were informed that their answers would be kept confidential. Children who were able to complete the questionnaire by themselves were asked to complete it again after 2 weeks and submit it by mail. Forty-four children with various diagnoses replied. The parents were asked to remind the child when the 2 weeks were over and assist with mailing, etc., but not to assist the child in answering or to read the answers.

Diagnostic procedures

The interviewer assigned diagnoses according to K-SADS-PL. Diagnoses were assigned if DSM-IV criteria for the diagnosis were met at the time of the interview. If one symptom was lacking for full diagnostic criteria to be met (but core symptoms and age/duration criteria were present), the diagnosis was classified as "probable" according to the K-SADS-PL. If symptoms were in remission (partly or completely) to such a degree that diagnostic criteria were no longer met but short of 2 months of complete remission, the diagnosis was classified as "partly remitted". Based on these diagnoses, the children were assigned to the "depressed group" if they had a diagnosis of certain or probable major depressive disorder (MDD), to the "remitted group" if they had a diagnosis of certain or probable MDD in part remission, and to the "nondepressed group" if they had no episode of MDD within the past 2 months. The diagnosis "probable MDD" was included in the depressed group because this diagnosis is equivalent to the DSM-IV diagnosis "MDD not otherwise specified". The remitted group was formed because it has been suggested that adolescents with remitted depression often have higher levels of depressive symptoms than they had before the depressive episode [15]. Children with brief recurrent depression ($n = 1$), cyclothymia ($n = 1$) and dysthymia ($n = 1$) were not included in any subgroup, but were included in analyses on the entire sample. Comorbid diagnoses were present in all three groups. As expected, separation anxiety disorder (SAD) (Fischer's exact test; $p = 0.01$), generalized anxiety disorder (GAD) (Fischer's exact test; $p = 0.04$) and anorexia nervosa (Fischer's exact test; $p = 0.002$) were significantly more prevalent in the collapsed depressed and remitted groups, whereas attention deficit hyperactivity disorder (ADHD) ($\chi^2 = 8.1; p = 0.004$) was more present in the nondepressed group.

Other comorbid diagnoses were distributed evenly between groups. The interviewer scored the Children's Global Assessment Scale (CGAS) [23] for current function. CGAS is a score of overall function ranging from 1 to 100 (100 being perfect function in all areas).

Reliability of the interview

Interviewer and rater training consisted of a theoretical training course in ICD-10/DSM-IV and K-SADS-PL, live and videotaped interviews with non-referred children, and live interviews with child psychiatric patients, which were videotaped and rated by the second rater. Total agreement on three consecutive videos was the entry criterion for the interviewer and the second rater. The rater re-assessed 20 interviews (of patients with mixed diagnoses), videotaped during the study period, and assigned K-SADS-PL diagnoses. There was agreement on the presence of MDD in five cases and on the absence of MDD in 13 cases. In two cases, the rater assigned a diagnosis of MDD, whereas the interviewer did not. This yields a kappa value of 0.76, which is considered substantial agreement according to Landis and Koch [14].

For other current disorders, Kappa values were almost perfect (0.81–1) for cyclothymia, psychosis, phobia, obsessive compulsive disorder (OCD), encopresis, anorexia, and enuresis, substantial (0.61–0.80) for ADHD, Tourette's syndrome, and oppositional defiant disorder (ODD), and moderate (0.41–0.6) for GAD and SAD. For dysthymia, the kappa value was poor. For adjustment disorder, tics, panic disorder, social phobia and post-traumatic stress disorder (PTSD), kappa values could not be calculated because at least one rater did not assign these disorders.

Statistics

The test-retest repeatability was investigated by using the recommendations in Bland and Altman [1]. We used a nonparametric test (Mann-Whitney) for comparisons of scores between groups (using exact tests for comparisons of small groups). We used Cronbach's alpha for calculation of internal consistency. We used Kendal's tau for measures of association between variables. The diagnostic value was described by sensitivity, specificity, predictive value of positive test, correct classification rate (the number of true positives plus the number of true negatives divided by the total number), and the area under the Receiver's Operating Characteristics (ROC) curve. All statistical calculations were performed with the Statistical Package of Social Sciences [27].

Results

Reliability

The internal consistency at first admission of the CDI (n = 149) was 0.86 (Cronbach's alpha).

The test-retest CDI scores are shown in Fig. 1. There was a small and statistically insignificant difference in the mean scores from test to retest, the average difference being –0.34 (95% Confidence Interval: –1.53 to 0.85). This indicates that there was no average improvement or deterioration of depressive symptoms over the test-retest interval. There was a relatively large random variation between the test and retest scores. There are no standard values for what can be considered a clinically meaningful change in CDI scores, but we suggest that a change of 4 or more will usually be considered a true change by clinicians. We found such a change between the first and second test in 34% of the cases (see Fig. 1).

Validity

We found a significant correlation between the CDI and the sum of depressive items rated positive in the K-SADS-PL interview (Kendal's tau = 0.254; $p < 0.001$). Although statistically significant, the correlation was small (see Fig. 2). In order to analyse whether the CDI correlated with general impairment rather than with depressive symptoms alone, we analysed correlation between

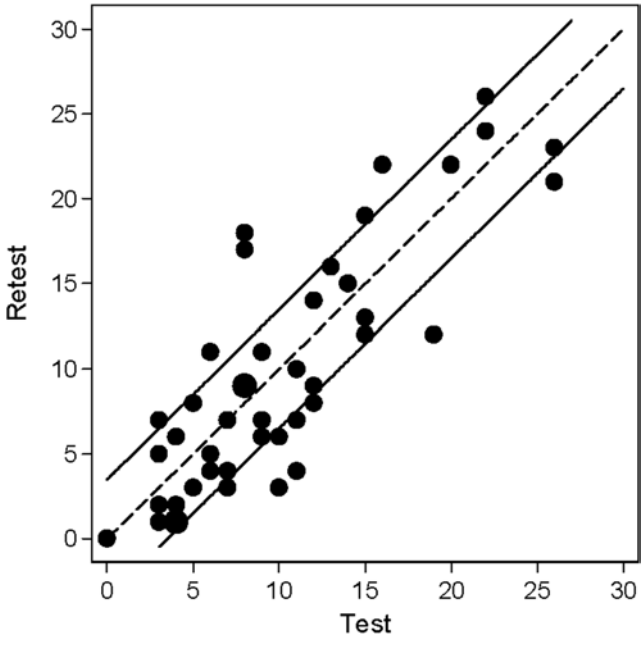

Fig. 1 Test and retest scores. Test and retest CDI scores after a 2 week interval for 44 patients. Dotted line indicates full agreement and full lines indicate agreement within 3 points. Fifteen patients fall outside these limits

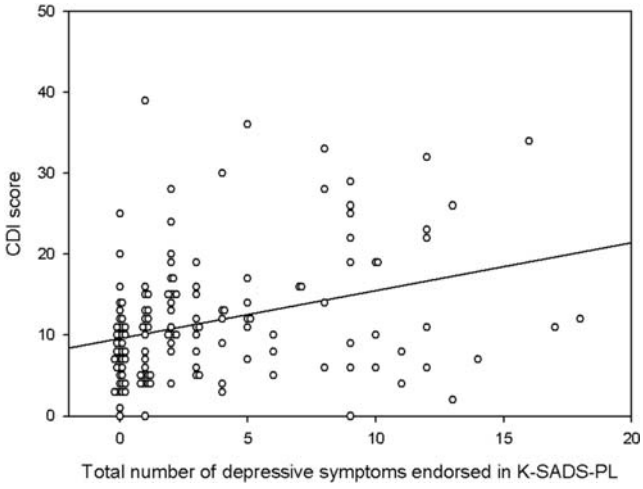

Fig. 2 CDI-score vs. number of depressive symptoms in K-SADS-PL

CDI and CGAS. CDI score did correlate negatively with the CGAS (Kendal's tau = –0.142; $p = 0.015$). A higher score in CGAS indicates better functioning. However, tau was smaller for this comparison than for the comparison with depressive symptoms.

There was no correlation between age and CDI score (Kendal's tau = 0.015; $p = 0.795$). CDI scores among males and females did not differ significantly (Mann-Whitney test, $p = 0.13$).

The mean CDI scores in the three diagnostic groups were: "depressed group" 18.7 (n = 19), "remitted group" 11.7 (n = 13) and "nondepressed group" 10.5 (n = 114). Differences were significant between the depressed and nondepressed groups (Mann-Whitney, $p = 0.002$). When the main groups were broken down by age and gender, the trend persisted in all depressed vs. nondepressed comparisons, but only the comparisons for depressed vs. nondepressed girls in the older age group (exact test, two-tailed; $p = 0.006$) and depressed vs. nondepressed boys in the younger age group (exact test, two-tailed; $p = 0.013$) remained significant.

The ability of CDI to classify children correctly as depressed/nondepressed against K-SADS-PL as the gold standard was moderate. In Table 1, sensitivity, specificity, correct classification rate and positive predictive value are displayed for cut-point 12 (0–12 vs. 13–54), which is the cut-point often recommended for screening in clinical populations, and for cut-point 16, which had the same sensitivity but a better specificity in this sample (see Table 1). For comparison, we repeated calculations by using: (1) K-SADS-PL diagnoses scored only from child information, (2) ICD-10-DCR diagnoses (based on the K-SADS interview plus additional questions), and (3) clinicians' diagnoses (consensus diagnoses according to the ICD-10 diagnostic system). For these analyses, we excluded cases with remitted or partly remitted disorder. Table 1 also contains the area under the ROC-curves.

Performance of specific symptoms

We calculated the difference in mean score between depressed and nondepressed cases for each item in order to analyse whether some items of the CDI correlated better with the K-SADS-PL diagnosis of depression than did other items (Fig. 3). Three items were negatively related to depressed status: worried (which was positively related to anxiety status), tired (positively related to ADHD status), and sees self as bad, although this was not significant. The five items with the greatest mean-difference between the depressed and nondepressed groups were: likes oneself, suicidal thoughts, likes to be with others, appetite, and blames oneself.

Discussion

The internal consistency of the Danish CDI was good and similar to the internal consistency in the English version [2].

In more than one-third of the children, a difference was seen of at least 4 points between the test and the retest 2 weeks later. This difference is probably more

Table 1 Sensitivity and specificity for CDI at cut-point 12 and 16 against different diagnostic methods

	K-SADS-PL DSM-IV diagnoses		Child K-SADS-PL DSM-IV diagnoses		K-SADS-PL based ICD-10 diagnoses		Clinical ICD-10 diagnoses	
CDI cut-point	12	16	12	16	12	16	12	16
Sensitivity	0.63	0.63	0.79	0.71	0.67	0.67	0.67	0.44
Specificity	0.64	0.86	0.66	0.86	0.62	0.80	0.61	0.79
PPT	0.21	0.38	0.21	0.37	0.11	0.19	0.11	0.13
CCR*	0.64	0.83	0.68	0.85	0.62	0.80	0.62	0.77
ROC**	0.72		0.80		0.69		0.66	

* Predictive value of positive test
* *CCR* correct classification rate
** *ROC* Receiver's Operating Curve, number indicates area under curve

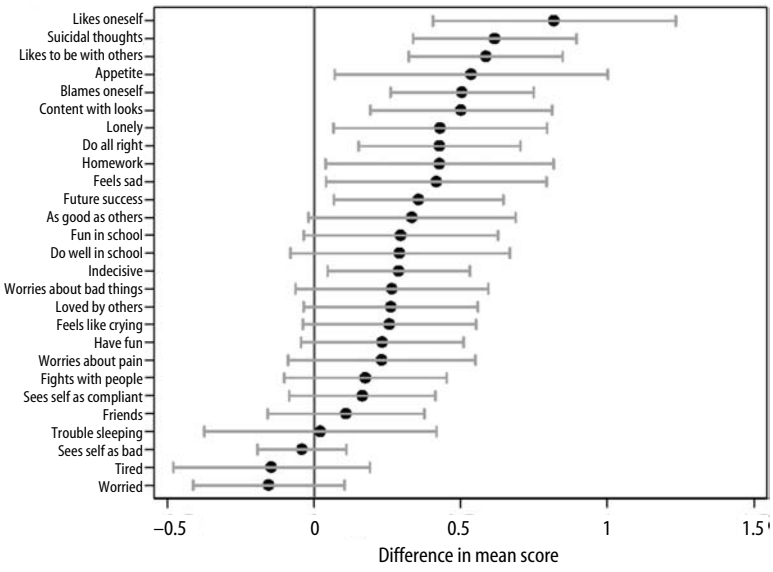

Fig. 3 Difference in mean score between depressed and nondepressed children (lines indicate 95 % confidence intervals)

than what is acceptable for a test used for clinical purposes. These large differences in test-retest scores may reflect differences in test administration: the first test was completed in a clinical setting, and the second test was submitted per mail. Differing settings are, however, often the case in clinical settings, and a test used for screening and monitoring would ideally be insensitive to change in condition. Another explanation of the large differences could be that the children were monitored during a period of child psychiatric assessment. Some families may have benefited from this contact with professionals even before actual treatment was implemented, causing the "true" CDI score to drop. Because the changes in CDI were positive as well as negative with only a slight and nonsignificant negative mean difference, i. e. no improvement in depressive symptoms over the test-retest interval on a group level, this is not likely to be the explanation. Thus, although children's reports on emotional and affective symptoms are somewhat consistent over time, the actual variability in score for the specific child is often too large for the CDI to be used as the only instrument for screening or treatment monitoring.

Even though the correlations were not very great, the CDI scores did correlate significantly in the expected direction with the number of depressive symptoms scored positive in the K-SADS-PL interview, as well as with the more general CGAS. The correlation with depressive symptoms was higher than that with the CGAS indicating that, to some degree, CDI taps depressive symptoms specifically. Mean CDI score was significantly higher in the depressed compared with nondepressed children, as found in some [10, 12, 17, 28], but not all [18, 21, 31], clinical studies with the English version of the CDI [2]. Even though these findings do support the discriminant validity of the CDI, sensitivity and specificity may be more relevant psychometric measures for a screening or diagnostic instrument.

The sensitivity and specificity of the instrument were low in this study. If the recommended cut-point of 12 were used for screening in clinical populations, 37 % of depressed children would slip through the net, whereas the predictive value of positive test would be as low as 0.21 %. The discrepancy between the diagnostic interview and the self-report was partly, but not completely, a question of different informants. Results improved slightly when the diagnosis of major depression was based only on the interview with the child. The sensitivity and specificity were not considerably different when other measures of depressive disorder (ICD-10 criteria or clinical consensus diagnosis) were applied. Because direct interview is still the method considered most sensitive for diagnosis of childhood depressive disorder [30], the results lead to the conclusion that the Danish CDI is not by itself sufficiently valid for screening or diagnostic purposes in clinical populations. On the basis of other studies questioning the discriminative validity of the CDI [18, 21, 31], we believe that this is also true for the English version, although one recent study of a clinical sample did report values of sensitivity and specificity considerably higher than the values found in our study [28]. The children in this study were older (8–18 years) and diagnostic information was based largely on child information, which may be part of the explanation for the better performance of the CDI in this sample. We also suggest that research based on the CDI, as the only diagnostic or outcome measure, must be interpreted with caution. If CDI is used as part of an examination programme, it is essential that information from the parents be added. These recommendations are in line

with the instructions from the author [12, 13], but, in the literature, the CDI is often referred to as a reliable and valid instrument for measuring child depressive symptoms [6, 17]. As indicated by Ruscio et al. [20], the application of cut-points to define groups characterized by presence or absence of a disorder which is likely to be dimensional in nature [16] may not be a valid approach.

Still, the CDI scores in this study do correlate significantly with the number of depressive symptoms, and mean scores are significantly different in depressed and nondepressed populations, indicating that the scale does measure some aspect associated with or involved in childhood depression. Numerous studies have found that CDI scores correlate with other measures of depressive disorder or related constructs such as helplessness and explanatory style [19, 22], and that CDI scores are predictive of future depressive disorder [7]. The fact that some items (seeing him/herself as bad, being tired, and being worried) were scored higher by the nondepressed children than by the depressed children, even though this was nonsignificant, suggests that a revision of the scale might result in a more efficient scale for screening purposes.

Strengths and limitations

Most studies of psychometric properties of the CDI focus on correlation between the CDI and other rating scales of depression, or mean scores in depressed vs. nondepressed samples. In this study, we apply other measures of reliability and validity, which may be more clinically meaningful and directly applicable, namely, the Bland and Altman Plot as a measurement of repeatability and sensitivity/specificity, as well as ROC curves as measurements of validity. The gold standard in this study was the semistructured diagnostic interview, a sensitive method of diagnosing childhood depressive disorder.

The retest was administered only to children with a cognitive ability high enough to complete the test without help. The results of test-retest reliability cannot be generalized to children with a lower level of education or cognitive abilities. Conditions for the test and the retest differed, which means that differences between test and retest scores may indicate high variability in children's emotional state rather than low reliability in the instrument itself. Conclusions are limited to children receiving child and adolescent psychiatric care, and they do not necessarily apply to nonreferred children.

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