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Using the Children's Depression Inventory in Youth with Inflammatory Bowel Disease: Support for a Physical Illness-Related Factor

Rachel D. Thompson, M.A.¹, Anna E. Craig, M.S.², Christine Mrakotsky, Ph.D.³, Athos Bousvaros, M.D.³, David R. DeMaso, M.D.³, and Eva Szigethy, M.D., Ph.D.¹

¹Departments of Psychiatry and Pediatrics, Children's Hospital of Pittsburgh, University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania, U.S.A

²Department of Psychology, University of Pittsburgh, Pittsburgh, Pennsylvania, U.S.A

³Departments of Psychiatry and Pediatrics, Children's Hospital Boston, Harvard Medical School, Boston, Massachusetts, U.S.A

Abstract

The objective of the present investigation was to evaluate the factor structure of the Children's Depression Inventory (CDI) in adolescents with inflammatory bowel disease (IBD) in order to better understand the CDI's psychometric properties in a medically complicated population. An exploratory factor analysis (EFA) was performed on CDI data collected from a clinical sample of 191 youth with IBD, aged 11 to 17 years. EFA with quartimax rotation yielded 3 factors: Mood, Behavioral/Motivational, and Somatic Complaints. Only the Somatic factor (i.e., fatigue, sleep, decreased appetite, worry about aches and pain) showed a significant positive correlation with IBD severity. The CDI holds promise as a brief measure for the assessment of depressive features psychometrically independent of IBD severity and common steroid treatments, as well as of non-gastrointestinal specific somatic complaints in a sample of adolescents with IBD. Continued work in this area of research appears promising in honing the assessment of depressive and somatic symptoms in youths with IBD.

Keywords

depression; physical illness; adolescence; factor analysis; Crohn's disease; ulcerative colitis

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All correspondence and requests for reprints can be directed to Eva Szigethy, M.D., Ph.D.: Children's Hospital of UPMC, 4401 Penn Avenue, 5-FP-Gastro, Pittsburgh, PA 15224; (p) 412-692-8147; (f) 412-692-6913; szigethye@upmc.edu.

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Introduction

Crohn's disease (CD) and ulcerative colitis (UC) are the major types of pediatric inflammatory bowel disease (IBD), which is characterized by recurrent episodes of acute abdominal pain, bloody diarrhea, and is associated with the damage of intestinal tissue [1]. In addition to these physical symptoms, youth with IBD have higher rates of depressive symptoms compared to healthy controls and youth with other physical illnesses [2, 3, 4, 5, 6].

Literature examining the adjustment of youth with chronic medical conditions has suggested that emotional difficulties often arise as a psychological reaction to the diagnosis of their illnesses and related psychosocial stressors [5]. Illness-related attitudes (i.e., low contingency related to control over the disease) have been shown to negatively impact coping style and psychological adjustment in pediatric chronic illnesses, and may be related to the presence of sickness behaviors that align with the anhedonic and vegetative symptoms of depression (Weisz, McCabe, Dennig, 1994; Band & Weisz, 1990). However, there are likely multiple, overlapping pathways involved in predisposing patients with IBD to depressive symptoms, thus symptoms that manifest are difficult to differentiate. Recent work has begun to suggest that the direct physiological effects of IBD may also be contributing to the presence and severity of depressive symptoms reported by this population and may be secondary to IBD-related disturbances in immune processes or treatment with steroids [6]. More specifically, cytokines, inflammatory proteins released by white blood cells in the gastrointestinal tract during IBD-related inflammation, have been positively associated with sickness behaviors (e.g., fatigue, disinterest in activities, malaise, hypersomnia, hypersensitivity to pain) in animals and humans [7, 8]. Such sickness behaviors closely mirror symptoms of depression and often reflect non-gastrointestinal specific somatic complaints that are common secondary symptoms of IBD. Steroid-induced depression, which includes a number of the above symptoms in addition to irritability, has been reported in a number of physically ill populations [9], including youths with IBD [10].

There is ongoing debate in pediatrics about whether items assessing many of these "sickness" symptoms should be removed from depression screening instruments in physically ill populations given the symptom overlap between physical illness and depression, and the potential for psychiatric misdiagnosis. Among theoretical and empirical work in this area, some authors have argued for their elimination [11, 12, 13] while others have recommended they be retained [14, 15]. Because the extant literature shows that such "sickness" symptoms respond to psychiatric treatment regardless of their etiology [15, 16, 17], research focusing on the development of appropriate measurement tools that will facilitate clinicians' and researchers' understanding of depressive and somatic symptom manifestation, and response to treatment, is of considerable importance.

The Children's Depression Inventory (CDI) is a validated and widely used assessment instrument for childhood and adolescent depression. In normative and clinical samples, for the majority of studies, factor analyses of the CDI report five factors that are inter-correlated [18, 19, 20, 21, 22]. As reported by Kovacs, these factors have been identified as (1) Negative Mood, (2) Interpersonal Problems, (3) Ineffectiveness, (4) Anhedonia, and (5)

Negative Self Esteem [22]. Though not all studies have yielded this exact same structure, the derived solutions consistently appear to reflect symptoms that tap into these similar psychosocial-emotional domains.

A review of published studies across community and clinical psychiatric samples shows a discrepant pattern of findings regarding the factor loadings of the somatic items. Notably, Craighead and colleagues' report evidence of a Biological Dysregulation factor in a community sample of adolescents [20]. In this factor solution, evidence of the typical five factors was observed in addition to a sixth biological factor, which strongly loaded items reflective of somatic content (e.g., sleep, appetite, fatigue, and worry about aches and pain). In contrast, these somatic items loaded highly on the Anhedonic factor in the normative community sample [22], and loaded strongly with negative affect and mood difficulties in clinical psychiatric samples [21, 23]. Craighead and colleagues suggested that their findings may have been attributable to developmental age, as the Biological Dysregulation factor was evident only among adolescents and not children in their community sample [20]. This may be reflective of the impact of puberty and the prominence of physical changes that occur during the adolescent developmental life phase. Whereas, the sample used in Kovacs' normative study encompassed a broader age span, non-specific to this developmental issue. The consistent findings across clinical psychiatric samples likely highlight the strong connection between mood disturbance and vegetative symptoms among this patient population.

To date, no studies have examined the component structure of the CDI in a physically ill population. Given the discrepant loadings of the somatic items across community and clinical samples, and the prominence of depressive somatic complaints in those with a chronic medical condition (such as IBD), the generalization of the five-factor structure reported by Kovacs to a physically ill population is in need of further investigation [22]. Such inquiry is necessary in order to gain a better understanding of the CDI's psychometric properties, as well as to determine the clinical and research utility among medical populations.

The present study examined the pattern of depressive symptoms reported by youth with IBD on the CDI. The primary aim was to evaluate the factor structure of the CDI in a sample of adolescents with IBD and to provide instrument reliability estimates within this specific illness population. It was hypothesized that the depressive symptoms that have been implicated in inflammatory activity (e.g., sleep, appetite, fatigue) would emerge as a unique somatic factor among youths with IBD. *Post-hoc* analyses were conducted to examine the associations between the CDI factors, IBD disease activity and concurrent steroid treatment in order to further elucidate the relationship between depressive features, IBD process and common courses of treatment.

Method

Participants

One hundred ninety-three (193) participants were consecutively recruited during routine gastroenterology appointments at a Children's Hospital located in a northeastern major

metropolitan city. Youths between the ages of 11 and 17 (median age = 14) years were enrolled if they had a biopsy-confirmed diagnosis of IBD and were willing to complete the CDI, a self-report measure of depressive symptomatology. This project was part of a larger research effort to screen potential participants for an open trial of cognitive-behavioral therapy [24]. Informed, voluntary written assent and consent were obtained from all participants and their legal guardians, respectively. Participants then completed the CDI in the presence of both a research assistant and the consenting guardian. Medical records were reviewed to verify IBD diagnosis and to obtain demographic information and steroid dosage level (mg/day) (see Table 1). All study procedures were implemented in accordance with the ethical standards for conducting research on human subjects as stipulated by the local Institutional Review Board and with the Helsinki Declaration of 1975 (as revised in 1983). Two study participants did not complete the CDI and were excluded from the main study analyses.

Measures

Depressive Symptoms—Depressive symptoms were measured using the Children's Depression Inventory (CDI) [22]. The CDI is a 27-item self-report questionnaire that assesses the presence of affective, cognitive and behavioral signs of depression over the past two weeks among children and adolescents. Each of the 27 items are rated along a 3-point ordinal scale with a 0, 1, or 2 corresponding to the severity of the depressive symptom, with 2 being the most severe. The CDI has been extensively validated and has shown adequate internal consistency, test-retest reliability, as well as convergent and discriminant validity [22].

IBD Illness Severity—The Pediatric Crohn's Disease Activity Index (PCDAI) [25] and the Clinical Score of Kozarek (CSK) [26] were used to measure the severity of Crohn's disease and ulcerative colitis activity, respectively. Both scales are derived from standard information obtained during routine gastroenterology visits and recorded in the medical chart. Both scales rate a combination of IBD-related signs and symptoms (e.g., abdominal pain, diarrhea, and well-being); however, the PCDAI also incorporates laboratory hematology values. All disease severity scores were coded by a trained rater blind to depressive severity status. Individual scale items were categorically ranked and then all items were summed to yield a total continuous score of disease severity. A categorical rating system based on the continuous total score (0–14 = *inactive*, 15–30 = *mild*, and 31 = *moderate/severe*) was then applied in order to pool the PCDAI and CSK data, providing a single variable reflective of IBD illness severity. A random 20% of both measures were scored independently by an expert coder. Inter-rater reliability was adequate for both the PCDAI (Cohen's $\kappa = 0.85$) and CSK (Cohen's $\kappa = 0.90$). Disagreements on individual items were resolved by clinician consensus. There was 100% agreement on the categorical ratings of disease severity.

Statistical Analysis

An exploratory factor analysis (EFA) was used to examine the factor structure of the CDI, specifically to assess the underlying latent structure of depressive content in physical illness. A principal axis factoring extraction was applied because the data did not follow a normal

distribution. Prior to performing the EFA, the suitability of the data for factor analysis was assessed using the Kaiser-Meyer-Olkin statistic [27, 28] and Bartlett's Test of Sphericity [29]. The number of components to retain was determined by using the Scree plot [30], Kaiser rule (Eigenvalue > 1), and theoretical interpretability. A quartimax rotation was applied in order to facilitate interpretability. Items with factor loadings of .40 or higher were retained on their respective factor. Cronbach's coefficient alpha was calculated for the total measure and each resulting factor in order to examine the instrument's internal consistency [31].

Subsequently, the retained CDI factors served as predictor variables in a *post hoc* multiple regression model examining the relationship between CDI factors and IBD severity. Generalized linear model techniques were used to determine what model would provide optimal fit given the data. The following three goodness-of-fit indices were examined in order to determine appropriate model fit: scaled deviance to degrees of freedom ratio, Pearson chi-square statistic, and Hurvich and Tsai's Criterion (AICC). Steroid dose was entered as a covariate in the regression model to control for potential drug effects. IBD severity information was missing for 9% of cases, thus the association was tested only among participants with complete data available (N = 173).

Results

CDI Factor Structure and Internal Consistency

The Kaiser-Meyer-Olkin value was .84 (exceeding the recommended value of .60) and the Bartlett's Test of Sphericity reached statistical significance [$\chi^2(351) = 1799.49, p < .001$], supporting the factorability of the correlation matrix. The initial EFA revealed the presence of eight factors with Eigenvalues exceeding 1, explaining a cumulative total of 63.91% of the variance in CDI items. However, this factor solution was not readily interpretable and a number of the factors reflected "scree" (i.e., loaded two or less items).

To facilitate identification of a viable CDI factor structure within the IBD population, a quartimax rotation was applied to the model. Subsequently, the CDI appeared to be best explained by a three-factor model that cumulatively accounted for 41.58% of the variance in CDI item scores. The majority of items (26) loaded highly on a single factor, overall showing a clean and interpretable component structure (see Table 2). Because item 17 loaded highly on two factors, it was retained only on the factor reflecting the highest loading. Item 8 did not reach the .40 factor loading standard, and so was not retained. Factor 1, which accounted for 26.61% of the variance, was characterized primarily by mood items. Factor 2 accounted for 8.14% of the variance and loaded items reflective of externalizing behaviors and motivational difficulties (i.e., acting out behavior and school problems). Finally, Factor 3 accounted for 6.83% of the variance and was distinctively characterized, as hypothesized, by somatic complaints (e.g., disrupted sleep, fatigue, appetite, and worry about aches and pain). All factors were found to be significantly correlated with each other and the total CDI score (see Table 3). Additionally, total CDI and factor scores were also significantly correlated with current steroid dose ($ps < .05$), with the exception of the Behavioral/Motivational factor.

Tests of internal consistency revealed that the overall coefficient alpha for all items was robust ($\alpha = .88$). The alpha for the Mood component was similarly satisfactory ($\alpha = .87$). Coefficient alphas for the Behavioral/Motivational component ($\alpha = .71$) and Somatic Complaints component ($\alpha = .69$) were lower, albeit still in a range that is sufficient for use in psychosocial research [31].

Association between CDI Factor Scores and IBD Severity

The associations between the three CDI factor scores and IBD severity ($N = 173$) were examined using a generalized linear model based on an ordinal distribution with cumulative logit link function (see Table 4). These specifications resulted in adequate model fit to the test data [$\chi^2 (252) = 254.34$, deviance/df = 1.01, AICC = 288.79]. Results from the omnibus test showed that the model accounted for a significantly greater amount of the variance in IBD severity than a threshold-only model [$\chi^2 (4) = 41.36$, $p < .001$]. The main effects of the Mood and Behavioral/Motivational factors were not significant ($ps > .15$); therefore a reduced model was examined in order to determine if model fit would be improved by taking out the nonsignificant terms. Results from the reduced model showed an increase in model fit [$\chi^2 (100) = 95.02$, deviance/df = .95, AICC = 149.51]. Omnibus analysis again indicated a significant overall model [$\chi^2 (2) = 37.47$, $p < .001$]. The final model consisted of one covariate, controlling for current steroid dose, and a main effect for the Somatic Complaint factor (see Table 4). Results showed that current steroid dose significantly contributed to the model ($p = .002$), and that the Somatic Complaint factor was the more robust predictor of IBD severity ($p < .001$).

Discussion

The present study is the first investigation, to our knowledge, to examine the factor structure of the CDI in a physically ill cohort. Results from the EFA show the presence of three factors corresponding to the constructs of (1) Mood, (2) Behavioral/Motivational, and (3) Somatic Complaints. Our findings are discrepant with the five-factor structure commonly reported in the literature [22] and suggest that in a medical population of individuals with IBD, somatic complaints appear to load highly together and form a factor separate from mood and behavioral content. This finding aligns with the main study hypothesis and appears attributable to both the prominence of physical-illness related complaints, as well as symptom overlap of depressive features, in a medically complicated cohort. This pattern of results further suggests that categorizing CDI items into greater than three factors is not reflective of actual psychiatric or disease symptom clustering in this patient population. Moreover, findings from *post hoc* analyses show that after controlling for steroid dose, the Somatic Complaints factor remains a robust, positive predictor of IBD severity. Specifically, the depressive symptoms implicated in inflammatory activity (i.e., sleep, appetite, fatigue, and worry about aches and pain), all loaded on the Somatic Complaints factor.

The identification of a Somatic Complaints factor is interesting from several perspectives, as it aligns well with both a depression and disease model of non-gastrointestinal specific somatic complaints within an IBD cohort. First, the Somatic Complaints factor is consistent with symptoms commonly induced by systemic inflammation (i.e., cytokine activation) [7,

32]. Thus, the Somatic Complaints factor may be related, in part, to the autoimmune response observed during an active IBD flare. Second, study findings are consistent with a subset of symptoms commonly induced by exogenous steroids or cytokine (interferon) treatments in various human diseases [10, 33, 34]. In other words, the Somatic Complaints factor observed in this sample might, in part, reflect symptoms in response to common treatments. Alternatively, the Somatic Complaints factor might also reflect purely depressive symptoms, symptoms that are present in the absence of an active IBD flare state and are suggestive of a poor coping response to pain and physical illness. Future studies are needed to examine these hypotheses and to longitudinally test these casual assumptions.

This first evaluation of the CDI's factor structure in a medical cohort of youth with IBD is very promising. The CDI may be a helpful measure for researchers who want to examine different types of depressive content corresponding to internalizing, behavioral, and somatic features of depression. These preliminary findings suggest that the CDI total and factor scores are reliable measures, and have the potential to provide a quick assessment of prototypical depressive and physical-illness related features, while offering low self-report burden. In part, helping to inform the psychiatric assessment of pediatric depression complicated by IBD in the presence (or absence) of disease activity. Study findings specifically suggest that the Behavioral/Motivational component might be most useful in the differential diagnosis of depression, as this component was not associated with either IBD severity or concurrent steroid dosage. As such, it appears to offer a more pure assessment of depressive features independent of disease activity and treatment.

Although the CDI is an excellent screening measure for depression, this is the first study to suggest that it might also hold promise as a brief measure for the assessment of non-gastrointestinal specific somatic complaints. The current findings should be considered in light of the study's limitations, which highlight a need for continued work in this area of research. Because the present investigation was exploratory in nature, an EFA was deemed most appropriate to statistically evaluate the CDI's factor structure. Future research should build upon these findings through use of confirmatory factor analysis (CFA) in a larger sample. Though study findings favored a 3-factor solution over models that extracted more components (e.g., 5- or 8-component solutions), it is recommended that the generalization of the published 5-factor structure [22] be specifically examined against a 3-factor solution via CFA. Additionally, future research might consider examining the convergent validity of this component with objective instruments of somatic symptoms, in addition to determining its' construct validity with an independent clinical assessment of depression. Continued work in this area of research appears promising in honing assessment strategies of mental health and physical illness for youths with IBD.

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Table 1

Demographic and Clinical Characteristics of Study Sample

Variable	
Demographics	
Age	14.2 (1.9)
Male	103 (53%)
Caucasian	164 (85%)
African American	11 (6%)
Hispanic	8 (4%)
Bi-/Multi-Racial	5 (3%)
Not Specified	5 (3%)
IBD Diagnosis	
Crohn's Disease	141 (73%)
Ulcerative Colitis	52 (27%)
IBD Severity ^a	
Inactive	82 (47%)
Mild	52 (30%)
Moderate/Severe	41 (23%)
On Steroids	64 (33%)
Mean dose, mg/day	9.32 (17.1)
CDI Total Score	7.5 (6.7)

Note. Values in the table reflect *M (SD)* or no. (%). IBD: Inflammatory bowel disease; CDI: Children's Depression Inventory.

^aBased on the categorical ranking systems of the Pediatric Crohn's Disease Activity Index and the Clinical Score of Kozarek. Statistics reflect available data (N = 175).

Table 2

Orthogonal Three-Factor Solution for Children's Depression Inventory in Youth with Inflammatory Bowel Disease (N = 191)

Item	Mood	Behavioral/Motivational	Somatic Complaints
loneliness (20)	.73	-.15	.01
crying every day (10)	.67	-.16	.15
sadness (1)	.65	-.09	.09
self-hate (7)	.64	.14	-.03
pessimism (2)	.62	.12	.14
anhedonia, general (4)	.60	.20	.22
looks unattractive (14)	.58	.09	-.08
irritability (11)	.57	.19	.18
negative social comparison (24)	.56	-.01	-.17
suicidal ideation (9)	.53	-.08	-.06
friendless (22)	.51	.23	-.07
anxious worry (6)	.47	.03	.24
indecisiveness (13)	.45	.20	.19
anhedonia, school (21)	.45	.30	-.12
unloved (25)	.42	.19	-.17
social withdrawal (12)	.41	.10	.10
won't follow rules (26)	.09	.57	.17
is bad (5)	.18	.55	-.07
unmotivated, school (15)	.29	.50	.14
school failure (23)	.33	.49	.14
negative self-view (3)	.22	.43	-.03
gets into fights (27)	.24	.43	.05
self-blame (8)	.20	.29	-.07
reduced appetite (18)	.17	.09	.56
tiredness (17)	.43	.06	.55
worry about aches and pains (19)	.27	-.001	.50
sleep problems (16)	.37	.14	.43

Note. Model reflects factor loadings after quartimax rotation, with retained factors reflecting mood, behavioral/motivational issues, and somatic complaints. Factor loadings $\geq .40$ are presented in bold font. Item numbers range from 1–27, and are provided

Table 3

Intercorrelations between CDI Total and Factor Scores

Variable	2	3	4	5
1. Mood	.55***	.53***	.94***	.17*
2. Behavioral/Motivational		.38***	.68***	.01
3. Somatic Complaints			.72***	.19**
4. CDI total score				.18*
5. Steroid dose				-

Note. CDI: Children's Depression Inventory. Correlations reflect Spearman's ρ (2-tailed).

* Correlation is significant at $\alpha < .05$.

** Correlation is significant at $\alpha < .01$.

*** Correlation is significant at $\alpha < .001$.

Table 4

Generalized Linear Model Summary Table Predicting IBD Severity (N = 173).

Effect	b	Std. Error	χ^2	df	p-value
<i>Full Model</i>					
Current Steroid Dosage	0.029	0.009	10.53	1	0.001
Mood	-0.062	0.043	2.08	1	0.15
Behavioral/Motivational	-0.001	0.104	<0.001	1	0.99
Somatic Complaints	0.463	0.105	19.34	1	<.001
<i>Reduced Model</i>					
Current Steroid Dosage	0.028	0.009	9.96	1	0.002
Somatic Complaints	0.367	0.087	17.72	1	<.001

Note. Results based on an ordinal distribution with cumulative logit link function. The mood and behavioral/motivational terms were removed in the reduced model due to non-significant findings in the full model, as well as resulting improvement in model fit.