Accuracy of Brief and Full Forms of the Child Mania Rating Scale

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David B. Henry and Mani N. Pavuluri

University of Illinois at Chicago

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Eric Youngstrom

University of North Carolina at Chapel Hill

▼

Boris Birmaher

University of Pittsburgh

This study assesses the sensitivity of full and brief forms of a parent-rated mania scale to variations in diagnoses. Parents of a sample of 150 subjects either diagnosed with bipolar disorder (BD) or attention deficit hyperactivity disorder (ADHD), or healthy controls (HC), completed the full Child Mania Rating Scale and other measures. We used single-parameter item-response theory models to produce a brief parent mania rating scale from the full version. The 10-item, brief Child Mania Rating Scale—Parent (CMRS-P) version correlated .93 with 11 items from the full CMRS-P that were not used in constructing the brief version, and showed accuracy comparable to the full scale in differentiating BD from ADHD, and in discriminating among bipolar subtypes. © 2008 Wiley Periodicals, Inc. J Clin Psychol 64: 368–381, 2008.

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Pediatric bipolar disorder (PBD) is a serious illness that can lead to high suicide rates, school failure, aggression, and high-risk behaviors such as sexual promiscuity

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and substance abuse (Pavuluri, Henry, Naylor, Carbray, & Janicak, 2005). It is characterized by high rates of recurrence despite initial recovery (Birmaher & Axelson, 2006; Carlson & Kelly, 1998; Geller, Craney et al., 2001; Geller, Zimerman et al.,2001). Given the importance of BD as a public health concern, early recognition, accurate identification, and sensitive measurement of symptom variation are necessary steps in prevention and intervention.

There is a growing consensus on the existence and description of the symptoms of pediatric BD (Kowatch, Youngstrom, Danielyan, & Findling, 2005). Prevalence estimates vary (Kowatch et al., 2005), but there have been no community studies that permit estimation of the prevalence of pediatric BD. One community study of older adolescents estimated 1% prevalence of BD with an additional 5.7% having experienced at least one episode of abnormally elevated mood that did not meet BD criteria (Lewinsohn, Klein, & Seeley, 1995). One retrospective study of 500 adults with BD found that half reported onset in childhood or adolescence (Lish, Dime-Meenan, Whybrow, Price, & Hirschfeld, 1994). Another retrospective survey of young adults estimated the lifetime prevalence of serious mood dysregulation (including several BD symptoms) in children and adolescents at 3.3% (Brotman et al., 2006), but there also is evidence for international variation in rates of diagnosis (Geller, Zimerman et al., 2001).

In children, mania may be confused with attention deficit hyperactivity disorder (ADHD) because these two disorders share several common features, such as hyperactivity, impulsivity, and distractibility (Geller, Zimerman et al., 2001; Wozniak et al., 1995). Such confusion is problematic for screening because instruments that are unable to differentiate pediatric mania from severe inattention, hyperactivity, and impulsivity will result in many false positives. Thus, instruments to screen for pediatric BD must have high specificity for ruling out mania as well as high sensitivity for detecting it (Dienes, Chang, Blasey, Adleman, & Steiner, 2002; Fristad, Weller, & Weller, 1992).

The most widely used measure of mania symptoms is the Washington University in St. Louis Kiddie Schedule for Affective Disorders and Schizophrenia, mania section (WASH-U-KSADS Mania Module; Geller, Zimerman et al., 2001). This measure requires administration by clinically experienced raters, seriously limiting its usefulness in screening or in evaluating the effects of interventions. Recently, Pavuluri and colleagues (Pavuluri, Henry, Devineni, Carbray, & Birmaher, 2006) established a 21-item parent-rating scale for pediatric mania that exhibited excellent psychometric properties and accuracy in differentiating pediatric mania from ADHD. A study of the psychometric properties of the Child Mania Rating Scale—Parent version (Pavuluri et al., 2006) found that the measure had excellent internal consistency reliability, strong correlations (.78–.83) with clinician-administered interview measures for diagnosing pediatric mania, and areas under the curve (AUCs) in excess of .90 for differentiating BD from ADHD and from healthy controls (HC).

This study reports the development and evaluation of a brief version of the CMRS-P. Creating a brief assessment for pediatric mania is important for at least two reasons. First, a brief instrument would be useful in screening and epidemiological studies, where instruments sensitive to specific diagnoses may be preferable to a single omnibus problem checklist (Biederman, 1998). Second, brief, sensitive instruments can reduce the assessment burden on families of children with BD, increasing the likelihood that parents will complete

the measures (cf. Stroud, McKnight, & Jensen, 2004), allowing more frequent assessment, and resulting in more complete data from repeated assessments used to evaluate acute response and maintenance of therapeutic gains.

Other brief screening instruments for mania exist, but none combine coverage of the content domain and sensitivity to variation in presentation. Tillman and Geller (2005) analyzed the sensitivity and specificity of items on the Conners Brief Parent-Rating Scale in order to devise a combination of items that could be used to differentiate prepubertal and adolescent BD from ADHD. They found that a weighted combination of two items ("Cries often and easily" and "Mood changes quickly and drastically") had adequate sensitivity and specificity for this purpose, but cautioned that this measure may not generalize to other populations, possibly due to its limited coverage of the symptoms of BD. Another brief screening instrument is the Mood Disorders Questionnaire (MDQ; Lish et al., 1994). The MDQ uses a binary (yes–no) response format to assess seven symptoms of BD. It was originally validated on adults and has been validated recently for adolescent parent reports (Wagner et al., 2006). The study found parent reports to be superior to adolescent self-reports. However, the usefulness of this instrument with preadolescents is unknown. Also, the binary response format limits the potential sensitivity of the MDQ to variations in severity of presentation that might be important in differentiating within the BD diagnosis and in assessing treatment progress.

Instruments that have high sensitivity and specificity for differentiating clinical from normal populations may not be sensitive to variation among those individuals diagnosed with pediatric BD. Bipolar I disorder is distinguished from Bipolar II disorder in part by hypomanic episodes that are less severe than manic episodes, and Bipolar—Not Otherwise Specified (BD-NOS) is distinguished from Bipolar types I and II by less severe symptoms that may have shorter duration. It is desirable that a brief mania measure be able to detect differences among these subclassifications and differences in symptoms. The purpose of this study was to develop a brief, unidimensional version of the CMRS-P and evaluate its psychometric properties and accuracy for differentiating BD from ADHD and among different BD subtypes.

A few years ago, Smith and colleagues (Smith, McCarthy, & Anderson, 2000) presented criteria for evaluating brief forms of measures. These include showing time and resource savings, demonstrating equivalent content coverage and dimensionality, estimating overlapping variance between full and brief versions, and validating the brief form and assessing classification accuracy. We followed these recommendations in designing and conducting this study.

Methods

Subjects

The characteristics of the sample have been described in detail elsewhere (Pavuluri et al., 2006). Subjects were included in this sample if they were: between 5 and 17 years of age, inclusive; had been diagnosed with ADHD, BD I or II, or BD-NOS; or were healthy controls (HC) with no psychiatric symptoms, based on the WASH-U-KSADS (Geller, Zimerman et al., 2001) interview. Potential participants were excluded if they: suffered from head injury, epilepsy, a pervasive development disorder (PDD), or mental retardation; had significant medical illness; or were taking any medications or substances that could alter their moods. Patients currently under treatment were excluded as the purpose of the study was to screen for subjects at the intake phase, regardless of the severity of their disorders.

Subjects with BD were recruited from among the community, pediatricians, child psychiatrists, the Child and Adolescent Bipolar Foundation (CABF), and our mood disorders clinic. Potential participants with ADHD were recruited from the general psychiatric clinic population. HC were recruited from the community via institutional review board (IRB)-approved advertising flyers and networking. All told, 156 potential participants were assigned to be interviewed by one of three clinicians (a child psychiatrist, a post-MA psychologist, and a doctoral-level psychiatric nurse). Interviewing clinicians were randomly assigned to the subjects, and were blinded to their screening diagnoses. Structured diagnostic interviews using the WASH-U-KSADS were conducted to confirm the clinical diagnosis from the screening visit. Six subjects were excluded due to primary diagnosis of pervasive developmental disorder ($n = 3$), medication for posttraumatic stress disorder ($n = 1$), aging-out at 18th birthday ($n = 1$), and father's withdrawal of consent during a custody battle ($n = 1$).

The final sample consisted of 150 subjects (BD = 50; ADHD = 50; HC = 50). Table 1 reports the sample characteristics by diagnosis, and by subcategory within the sample diagnosed with BD. Table 1 also reports F-tests and chi-square tests of differences between samples. The BD, ADHD, and HC samples were not found to differ on any demographic variable. Approximately half of the BD sample (48%) had a comorbid diagnosis of ADHD. As can be seen in Table 1, the proportion with comorbid ADHD differed among BD subcategories, $\chi^2(2, N = 50) = 6.7, p < .05$.

Measures

Child Mania Rating Scale. The Child Mania Rating Scale—Parent Version (CMRS-P; Pavuluri et al., 2006) is a mania rating scale designed to be completed by parents. It includes 21 items reflecting the characteristics of a manic episode according to the *Diagnostic and Statistical Manual of Mental Disorders*, fourth edition (DSM-IV; American Psychiatric Association, 1994). Each item is answered on a four-point Likert-type scale anchored by 0 (never/rare), 1 (sometimes), 2 (often), and 3 (very often). The entire scale is designed to be completed in 10–15 minutes. The CMRS-P items reflect symptom criteria A and B of the manic episode in DSM-IV. The scale includes age-specific items. Each item is considered to be a problem only if it is causing trouble, is beyond what is normal for the child's age, and has been troublesome during the month preceding completion of the measure. The items are written at a third-grade reading level and the complete measure has an internal consistency reliability of .96. Validity evidence comes from correlations with clinician-rated scales and sensitivity and specificity for differentiating pediatric mania from other disorders and no disorder (Pavuluri et al., 2006).

Washington University Kiddie Schedule for Affective Disorders and Schizophrenia (WASH-U-KSADS), mania section. The mania section of the WASH-U-KSADS is a semistructured diagnostic interview used to diagnose mania. Symptoms are rated on a continuous severity scale by interviewing parents and children (Geller, Zimerman et al., 2001). The WASH-U-KSADS includes specific questions about onset and offset of symptoms, ADHD assessment, and criteria for diagnosis of manic behavior or thinking. The WASH-U KSADS has demonstrated 100% interrater reliability (Geller, Zimerman et al., 2001). In this study, diagnostic interviews were randomly assigned to interviewers, who were blinded to the child's psychiatric diagnoses. Interviewers had at least 6 months of training prior to conducting the interviews. Interrater reliability among the research interviewers at

Table 1
Sample Characteristics

Variable	BD I	BD II	BD NOS	ADHD	HC	Significance Test
N	34	8	8	50	50	
Mean age (SD)	10.49 (3.53)	10.67 (1.36)	9.66 (3.24)	9.88 (1.88)	10.56 (0.41)	$F(2, 147) < 1$, NS
Female, N (%)	12 (35.3%)	4 (50.0%)	2 (25.0%)	19 (38.0%)	27 (54.0%)	$\chi^2(2, N = 147) = 4.4$, NS
Ethnicity						$\chi^2(6, N = 147) = 7.6$, NS
African- American, N (%)	8 (23.5%)	2 (25.0%)	3 (37.5%)	12 (24.0%)	11 (22.0%)	
Hispanic, N (%)	0 (0.0%)	0 (0.0%)	1 (12.5%)	6 (12%)	8 (16.0%)	
White, N (%)	24 (70.6%)	6 (75.0%)	4 (50.0%)	29 (58%)	31 (62.0%)	
Other, N (%)	1 (2.9%)	0 (0.0%)	0 (0.0%)	1 (2%)	0 (0.0%)	
Mean SES (SD)[a]	1.69 (0.99)	1.63 (0.92)	1.50 (0.76)	1.92 (0.92)	4.23 (1.17)	$F(2, 143) = 1.29$, NS
ADHD, N (%)	17 (53.1%)	2 (25%)	7 (87.5%)	50 (100%)	0 (0%)	$\chi^2(2, N = 150) = 100.1$, $p < .01$

Significance tests compare all BD versus ADHD versus HC. NS, not statistically significant.
[a]SES was calculated using a revised Hollingshead scale.

the end of training was .98–1.0 by Cohen's kappa (Cohen, 1960) for diagnosis and rapid cycling, respectively, on the WASH-U-KSADS. Individual item reliabilities on the WASH-U-KSADS ranged from .92 to .96 by Cohen's kappa.

Procedure

The IRB at the University of Illinois at Chicago approved this protocol. All parents gave informed consent and children under 17 years of age gave written or verbal assent, as required depending upon the age of the child. For adolescents older than 16 years of age, at least one parent and the adolescent gave written consent.

The research staff ($n = 6$) who administered the demographic and parent/self-report measures were different from those who conducted the diagnostic interviews ($n = 4$). The CMRS-P was administered prior to conducting the diagnostic interview to minimize bias and fatigue effects.

Data Analysis

Item response theory (IRT; Lord, 1980) provides a method for choosing a set of items that can assess the entire range of mania severity while remaining sensitive to variations within that range. Basically, item-response theory assigns each item a position on a theoretical scale representing a latent trait. In this study, we used a single-parameter item-response (IRT) model (Rasch, 1960) to select items for the brief version of the CMRS-P. Once the brief version was created, we tested it and the full CMRS-P for their sensitivity and specificity for differentiating children with Bipolar I disorder from the less severe bipolar subtypes. We also evaluated the measures for detecting the presence of eight categories of the DSM-IV (American Psychiatric Association, 1994) mania symptoms, including overall mood disturbance and seven categories of symptoms that co-occur with mood disturbance in a manic episode.

The first requirement of IRT models is unidimensionality, which refers to a scale measuring a single underlying construct, and only the construct it is intended to measure. Assessing unidimensionality and the fit of each item to the scale are particularly important for assessing pediatric mania because of the high probability of comorbidity with ADHD, which has led some investigators to assert that pediatric mania is merely a severe form of ADHD (Lewinsohn et al., 1995). As noted earlier, this study aimed to assess the unidimensionality of the brief CMRS-P items.

We used Rasch analysis through the WINSTEPS and FACETS software packages (Linacre, 2004, 2006) to choose items for inclusion in the brief CMRS-P. We entered data from the 150 cases noted previously into a Rasch analysis with items and the 4-point rating scale as facets. Rasch analysis models an individual's probability of a particular response to each item as a function of that individual's level of the latent trait being measured. It estimates only the intercept or difficulty or level of each item, assuming that each item is equally representative of the latent trait being measured.

In selecting items for a short form, we looked for items at equal intervals along a theoretical scale of mania severity (the latent trait in this analysis). When multiple items were found at a scale position, we retained only a single item. This procedure resulted in a scale containing fewer items but represented all degrees of mania severity, and is similar to other applications of Rasch analysis for creating short forms of measures (Cole, Rabin, Smith, & Kaufman, 2004). In the results that follow, all *p*-values are based on two-tailed tests with $\alpha = 0.05$.

Results

Sample Description and Mania Presentation

The sample for this study consisted of equal numbers of subjects diagnosed with BD (Types I, II, and NOS; $n = 50$) or ADHD ($n = 50$), and 50 without impairment (HC). The sample was equally divided by gender, age, socioeconomic status, and ethnicity.

Because of the wide age range of the sample, we correlated the 21 mania symptoms assessed with the WASH-U-KSADS mania module with age. Of the 21 correlations, only the correlation between age and hallucinations ($r = -.37$, $p < .01$) was significant, suggesting, possibly, that hallucinations tended to occur or are identified to a lesser extent among older children. It is also notable that 1 significant correlation out of 21 is exactly the number that would be expected by chance. There was no indication that the presentation of mania differed substantially by age of the child.

Although 8 subjects with BD-NOS were included for the purpose of reducing the number of items for the brief CMRS, the ROC analyses differentiating between BD, ADHD, and HC were conducted both with and without these subjects in the sample, in order to provide for tests with clearly defined diagnostic subgroups. We believe that testing the measure using both narrow and broad definitions of BD would be helpful in evaluating its usefulness for screening (Leibenluft, Charney, Towbin, Bhangoo, & Pine, 2003).

IRT Analysis

Dimensionality. We evaluated the unidimensionality assumption (Cunningham, Wild, Bondy, & Lin, 2001) on the full and brief CMRS-P using principal components analyses of residuals. These analyses estimated the variance accounted for by a single dimension and produced contrasts between successive components in an unrotated solution, quantifying the unexplained variance accounted for by each contrast. The degree to which other components represented scalable dimensions beyond the main dimension was evaluated by examining the eigenvalues and proportions of variance attributable to each contrast. On the full CMRS-P, a single dimension accounted for 91.8% of the variance. The largest contrast accounted for 1.1% of the variance. On the brief CMRS-P, 91.2% of the variance was accounted for by a single dimension, with the largest contrast accounting for 1.8% of the variance. These results clearly suggest that both the brief and full CMRS-P scales were unidimensional.

Item fit. We assessed the fit of each item to a unidimensional scale using a standardized index of outlier-sensitive fit (OUTFIT; Crouch, Gresham, & Wright, 1985). Desirable values of OUTFIT are within a range of ± 2.0. Table 2 shows the items, the position of each item on a scale representing the dimension of manic symptoms, and standardized OUTFIT values for each item. Items included in the brief CMRS-P are starred. As can be seen, all but two items on the CMRS-P had acceptable OUTFIT values according to the standards noted previously (Table 2).

To create a brief CMRS-P, we selected items that allowed us to cover the entire range of severe mania symptoms and were separated by relatively equal intervals. In Table 2, the items included in the brief CMRS-P are starred. Figure 1 maps the item positions on the theoretical dimension against the degree of misfit (cf. Cunningham et al., 2001). The unshaded area in the center of the graph marks the area within which the items fit the unidimensional measurement model. The histogram to the left shows the distribution of the WASH-U-KSADS mania module scores for

Table 2
CMRS-P Items, Location on the Mania Dimension, Estimated Discrimination, and Fit Statistics.

Item No.	Item	Location	Standard Error	Estimated Discrim.	OUTFIT
6[a]	Too much energy	−.81	.10		−.80
7	Talks too much or too loud	−.77	.10	.96	1.60
11	Trouble staying on track	−.67	.10	1.03	−.10
2[a]	Irritable, cranky, or mad for hours or days at a time	−.66	.10	.99	−1.40
16[a]	Rage attacks or intense and prolonged temper tantrums	−.44	.10	1.17	−.80
9[a]	Talks too fast, jumps from topic to topic	−.34	.10	.91	.70
18	Experiences rapid mood swings	−.34	.10	1.24	−.70
17	Cracks jokes or puns more than usual, laughs loud or acts silly	−.28	.10	.95	.00
1[a]	Feeling super happy for hours or days at a time	−.28	.10	.93	−.70
8[a]	Racing thoughts	−.18	.10	1.41	−.40
12	Unusually productive	−.11	.10	.99	.20
10	Rushes around nonstop	−.09	.10	1.36	1.10
3	Thinks that he or she can be anything or do anything	.02	.11		.40
15	Does foolish things	.22	.11	1.03	.10
5[a,b]	Needs less sleep than usual	.23	.11	.45	1.70
14	Talks to strangers inappropriately	.36	.12	.96	-.20
19	Suspicious or strange thoughts	.47	.12	1.23	−1.10
13[a,b]	Sexually inappropriate behavior	.62	.13	1.00	−.30
4[a,b]	Believes he or she has unrealistic abilities	.73	.14	1.04	.50
20[a,b]	Hears voices	.97	.16	1.13	−1.20
21	Sees things	1.32	.20	1.11	−.30

Location measures of higher magnitude indicate more severe mania. OUTFIT = standard normal deviate outlier sensitive fit. This should be treated as a *t*-test of the fit of the item to the model. Values with an absolute value > 2.0 degrade the model.
[a]Items included in the short form of the CMRS.
[b]These items are believed to strongly differentiate BD and ADHD.

the sample. Note that the items selected for the brief version cover the part of the distribution representing more severe mania symptoms. Note also that the items selected for the brief version exhibit the same extent of coverage as the full version, and that the brief version items show relatively consistent spacing across the content domain.

Reliability and Correlation with the Full Scale

The internal consistency of the brief CMRS-P by Cronbach's α was .91 based on the total sample. The α reliability coefficients within the diagnostic subsamples were .82 for the BD ($N = 50$) sample, .78 for the HC ($N = 50$) sample, and .80 for the ADHD ($N = 50$) sample. The average corrected item-total correlation was .66. The retest reliability of the brief CMRS-P was .97 at 1 week.

We assessed the correlation of the brief and full scales in two ways: (1) by correlating the sum of the brief version item scores with the full-scale scores; and (2) by correlating the sum of the brief version item scores with the sum of the remaining
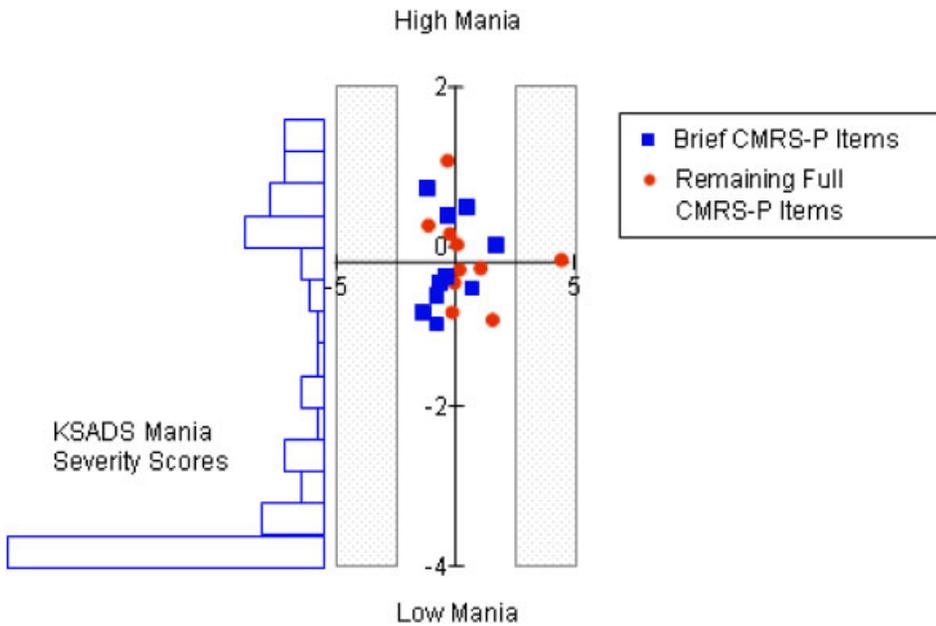
Figure 1. CMRS-P items plotted on the theoretical dimension of pediatric mania (Y-axis) against item fit (X-axis) with histogram of full-scale WASH-U-KSADS Mania Module severity scores. Square symbols indicate items selected for the Brief CMRS-P. The shaded areas at the sides represent areas of misfit of the measurement model.

items after the brief version items were removed from the full scale. The first method overestimates the population correlation because the brief version items contribute to both measures, and the second method underestimates the population correlation because the brief version items are not included (Smith et al., 2000). The correlation between the brief and full versions was .98, and the correlation between the brief version and the items not used in the brief version was .93.

Discrimination of BD, ADHD, and HC

Table 3 reports the means, standard deviations, and minima and maxima for each item by sample (BD, ADHD, and HC) and Table 4 shows the AUC, sensitivity, and specificity of the short and long forms for differentiating between BD, ADHD and HC. Analysis of the receiver operating characteristics (ROC) curves using logistic regression and Youden's (Youden, 1950) criterion provided optimal cut scores for using the brief CMRS-P to screen for BD. From this analysis, we were able to evaluate the extent to which the CMRS-P accurately identified true positive and true negative cases (Tosteson & Begg, 1988). Because mania is difficult to differentiate from ADHD symptoms, we selected the cut score for screening that would be optimal for differentiating mania from ADHD. This score had a sensitivity of .84 and specificity of .92 for differentiating mania from ADHD, and sensitivity of .90 and specificity of .96 for differentiating mania from HC.

Differentiation among Bipolar Subtypes

Table 4 also reports the optimal cut scores, AUC, sensitivity, and specificity of the full and brief forms of the CMRS-P for differentiating between Bipolar I and II subtypes, between Bipolar I and others, and between Bipolar I and NOS. The AUCs

Table 3

CMRS-P Item Means, SDs, and Minima and Maxima, by Diagnosis

| | Diagnosis | | | | | | | | | | | |
| | Normal control | | | | BD | | | | ADHD | | | |
	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max
Have period of too much energy	.40	.67	.00	2.00	2.22	.91	.00	3.00	1.45	1.00	.00	3.00
Feel irritable, cranky, or mad for hours	.30	.61	.00	3.00	2.24	.89	.00	3.00	.69	.89	.00	3.00
Have rage attacks, intense and prolonged temper tantrums	.18	.56	.00	3.00	2.20	1.01	.00	3.00	.45	.71	.00	3.00
Talk so fast that he or she jumps from topic to topic	.28	.57	.00	2.00	1.72	1.18	.00	3.00	.65	.93	.00	3.00
Periods of feeling super happy for hours or days at a time, extremely wound-up and excited, such as feeling "on top of the world"	.26	.53	.00	2.00	1.74	1.03	.00	3.00	.59	.76	.00	3.00
Have periods of racing thoughts that his/her mind cannot slow down, and it seems that your child's mouth cannot keep up with his/her mind	.12	.44	.00	2.00	1.86	1.13	.00	3.00	.51	.82	.00	3.00
Need less sleep than usual. yet does not feel tired the next day	.26	.53	.00	2.00	.98	1.06	.00	3.00	.41	.73	.00	3.00
Behave in a sexually inappropriate way	.04	.20	.00	1.00	.86	1.16	.00	3.00	.08	.34	.00	2.00
Believe that he/she has unrealistic abilities or powers that are unusual, and may try to act upon them, which causes trouble	.06	.31	.00	2.00	.70	.93	.00	3.00	.24	.60	.00	2.00
Hear voices that nobody else can hear	.00	.00	.00	.00	.62	.95	.00	3.00	.00	.00	.00	.00

Table 4

Receiver Operating Characteristics of the CMRS-P Short and Long Forms at Their Optimal Cut Scores for Differentiating among Diagnoses and among Subcategories of Bipolar Disorder

| | Brief CMRS-P | | | | Full CMRS-P | | | |
	Cut	AUC	Sensitivity	Specificity	Cut	AUC	Sensitivity	Specificity
All BD vs. ADHD	10	.85	.84	.83	20	.91	.82	.94
All BD vs. HC	10	.96	.92	.82	20	.97	.84	.98
BD I vs. ADHD[a]	10	.87	.86	.82	20	.89	.83	.86
BD I vs. HC[a]	10	.98	.86	.98	20	.98	.83	.98
BD I vs. Other	13	.78	.77	.73	25	.80	.80	.73
BD I vs. BD II	12	.77	.83	.86	23	.79	.87	.86
BD I vs. BD NOS	13	.79	.77	.63	27	.81	.80	.62

[a]Children diagnosed with BD type II and BD NOS were not included in these analyses.

were slightly lower for these purposes, and the optimal cut scores slightly higher than when distinguishing between a bipolar disorder subtype and other disorders or healthy controls.

Discussion

Based on a Rasch analysis, we selected 10 items from the CMRS-P that represent the DSM-IV symptoms of mania. We found that a summated scale using these items correlated strongly with the unused items on the original 21-item CMRS-P. Logistic analysis of the ROC curves found strong sensitivity and specificity for differentiating mania from ADHD and mania from HC. Both the brief and full forms of the CMRS had somewhat lower, but still acceptable accuracy for differentiating among bipolar subtypes and detecting symptoms of BD.

Upon undertaking this study, we speculated that the full-length version of the CMRS-P might be more appealing for research in studies that would benefit from sampling mania symptoms at different levels of severity. However, we found that the brief version was only slightly less effective than the full version in differentiating diagnoses and BD subtypes. This indicates that eliminating items from the full version to form the brief version may not have substantially reduced the ability of the measure to identify different presentations of pediatric mania. Similarly, Geller et al. (2002) found that five DSM-IV mania-specific symptoms discriminated well between BD and ADHD groups: "Elated mood," "Grandiosity," "Flight of ideas/racing thoughts," "Decreased need for sleep," and "Hypersexuality." Using Rasch analysis to define a unidimensional mania scale, this investigation included all of these symptoms except Grandiosity. Unlike the Geller et al. (2002) study, this investigation identified irritable mood and rage attacks as lying on the mania dimension.

It is not known how either the brief or original CMRS-P would perform in assessing change in mania symptoms. Indeed, sensitivity to change is a neglected aspect of treatment outcome measurement (Guyatt, Walter, & Norman, 1987). One might speculate that the long form would be more sensitive to change than the brief form, because of its greater opportunities to tap changing symptoms. However, the brevity of the short form may argue for its use in repeated assessments, as it reduces the potential for assessment fatigue for families without sacrificing much in terms of reliability or validity. The reduced assessment burden may also make the short form more attractive for large-scale studies or repeated administrations over the course of treatment. The issue of sensitivity to change will require future research.

A limitation of this study is the relatively small sample size. Although a larger sample might have been desirable, this sample of 150 subjects is believed to contain youths whose mania levels represent a sizable array of mania symptoms. We recognize, however, that the performance of the items might change when assessing severely ill samples or samples in community mental health centers, hospitals, or residential treatment settings. Further research will be needed to assess transportability of this measure to such samples and with other cultural or language groups.

It is reasonable to believe that the analysis produced accurate estimates of the item locations. Wright and Tennant (Crouch, Gresham, & Wright, 1985) noted that, with a reasonably targeted sample of 50 persons, there is 99% confidence that the estimated item difficulties are within ± 1 logit of their stable values and, with 200 persons, there is 99% confidence the estimated values are within ± 0.5 logit of their

stable values. Thus, we believe that the sample size of 150 in this study is sufficient to produce reasonable estimates of each item's scale position.

As should be the case with any questionnaire of this nature, high scores should not be treated as a diagnosis, but should be regarded as a trigger for careful evaluation. Further assessment should be done by a qualified mental health professional, and should evaluate developmental history, family history, and changes in energy and mood, while ruling out other potential causes (Quinn & Fristad, 2004). At the same time, there is a growing body of evidence that bipolar disorder has a genetic component, and it appears that there can be severe behavior problems in childhood or adolescence that meet strict DSM criteria for bipolar disorder. This evidence also suggests that these cases show similar validity to adult bipolar disorder in terms of family history, comorbidity, associated features, treatment response, and neuroimaging studies (cf. Geller & Luby, 1997; Youngstrom, Birmaher, & Findling, 2008).

Using Rasch scaling, this study has produced a reliable and valid brief form of the CMRS-P that meets the criteria Smith and colleagues (2000) suggested for short-form development. The brief CMRS-P is a unidimensional scale that is highly sensitive and specific for differentiating mania from ADHD, and has high accuracy for detecting variation within presentations of pediatric mania. Fortuitously, the items that most closely approximated the DSM-IV criteria A and B for mania were also the items showing the most favorable properties according to the Rasch model. The brief version appears to retain the desirable characteristics of the longer form, lending itself to easier use in epidemiological applications and assessment of change at multiple time-points.

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