Feasibility of the Korean version of the Bipolar Depression Rating Scale in Adolescents with Early-Onset Bipolar Disorder

Da-Young Lee1, Eun-Kyung Won2, Jung-Won Choi3, Hye Ji Min3, Jayoun Kim4, Kyooseob Ha5, Yunglyul Lee6, Jae Seung Chang5, and Yeni Kim7

1Department of Psychiatry, Seoul National Hospital, Seoul, Republic of Korea
2Department of Child Psychiatry, National Center for Child and Adolescent Psychiatry, Seoul National Hospital, Seoul, Republic of Korea
3Department of Adolescent Psychiatry, National Center for Child and Adolescent Psychiatry, Seoul National Hospital, Seoul, Republic of Korea
4Biomedical Research Institute, Seoul National University Bundang Hospital, Seongnam, Republic of Korea
5Department of Psychiatry, Seoul National University Bundang Hospital, Seongnam, Republic of Korea
6National Center for Child and Adolescent Psychiatry, Seoul National Hospital, Seoul, Republic of Korea

Objective This study explores the feasibility and psychometric properties of the Korean version of the Bipolar Depression Rating Scale (BDRS) in adolescents with Early-onset bipolar disorders.

Methods Fifty-three participants (aged 13–18) with early-onset bipolar disorders (40 depressed and 18 euthymic, 5 patients were assessed at depressed state and reassessed after remission) were recruited. All participants were assessed using the BDRS, the Hamilton Depression Rating Scale (HAM-D), the Montgomery-Asperg Depression Rating Scale (MADRS), the Young Mania Rating Scale (YMRS), and the Modified Overt Aggression scale (MOAS).

Results BDRS exhibited good internal validity and significant correlations with the HAM-D and the MADRS. In item to scale correlations, all items on the BDRS were significantly correlated with the BDRS total scores except for ‘increased motor drive’ and ‘increased speech’, ‘depressed mood’ and ‘worthlessness’ showed the highest mean scores and endorsement rates. BDRS score of the depressed group was significantly higher compared with the euthymic group. Three factors (i.e., psychosomatic, mood, and mixed) were identified in the principal component analysis and hierarchical cluster analysis of the BDRS.

Conclusion In this study, we report that the Korean version of BDRS is a feasible and reliable tool for the assessment of depression in adolescents with Early-onset bipolar disorders.

Key Words Adolescence, Bipolar disorder, Depression, Early-onset, Rating scale.

INTRODUCTION

Early-onset bipolar disorders are characterised by a severe and repeated course accompanied by mixed episodes, psychosis, and suicidal thoughts and behaviours. The initial presentation often appears as a depressive episode, which leads to the misdiagnosis of unipolar depression; children who were diagnosed with unipolar depression prior to puberty have high risks of bipolar spectrum disorders, more than half of unipolar depressed patients are estimated to change diagnosis within the next 20 years.

There are prominent irritabilities without elated mood in the bipolar depression of adolescents, and irritability is also a common symptom in both mania and depression phase. A mixed episode is often prominent in children and adolescent bipolar depression, which has been related to an increased possibility of suicidal attempts. Moreover, depressive or mixed episodes are more likely to recur compared with a manic episode in children and adolescents. A study which reported the clinical characteristics of Korean early-onset Bipolar disorder patients, reported more psychotics symptoms and co-morbid psychiatric disorder compared to bipolar disorder patients who had onset after 19 years of age, however there was no difference in suicidal attempt rate, rapid cycling pattern, and report of familial loading of bipolar illness. Due to lack of appropriate rating tools and confusion with natural
tumultuousness of adolescence, there is difficulty in the diagnosis of bipolar depression in adolescents. The delayed diagnosis of bipolar depression as unipolar depression results in the under-treatment of depressive symptoms in young individuals, which undermines development in environmental and neurobiological aspects.\textsuperscript{13} Therefore, the proper and early diagnosis and treatment are crucial for adolescents to avoid long-term adverse outcomes.

Bipolar depression is phenotypically different from unipolar depression and rating scales originally designed for unipolar depression scales do not fully capture the documented psycho-pathological differences.\textsuperscript{14} Depression rating scales, such as the 17-item Hamilton Depression Rating Scale (HAM-D),\textsuperscript{15} the Inventory of Depression Symptomatology (IDS)\textsuperscript{16} and the Montgomery-Asperg Depression Rating Scale (MADRS),\textsuperscript{17} fail to assess key elements of the severity or treatment response in bipolar disorder.\textsuperscript{18} Berk et al.\textsuperscript{19} previously developed the Bipolar Depression Rating Scale (BDRS), which is a specialised tool for measuring bipolar depression that includes atypical features and mixed states. BDRS arguably better captures symptoms in bipolar depression especially depressive mixed states than traditional unipolar depression rating scales.\textsuperscript{19} Validation of BDRS in adolescents is particularly timely in the context of recent changes in DSM-5 which have expanded the definition of mixed episode to include subthreshold manic features and mixed states. BDRS arguably better captures symptoms in bipolar depression especially depressive mixed states than traditional unipolar depression rating scales.\textsuperscript{19} Moreover, there are limited tools specialised for depression in children and adolescents, including the Children’s Depression Inventory (CDI), Children’s Depression Rating Scale (CDRS) and the Centre for Epidemiological Studies Depression Scale for Children (CES-DC). However, these tools also evaluate patients based on unipolar depression. Furthermore, there are studies that have failed to show significant differences between the depressed and non-depressed groups using these conventional tools based on unipolar depression,\textsuperscript{19,20} which have raised questions as to the validity of these tools in the assessment of depressive symptoms in adolescents with depression. However, the BDRS was developed and standardized for adults, not for adolescents. In the present study, we explored the feasibility and psychometric properties of the Korean version of the BDRS in adolescent patients with Early-onset bipolar disorders.

METHODS

Participants

Forty depressed patients, aged 13–18 years, with a diagnosis of bipolar disorder were enrolled in this study and the comparison group included 13 euthymic bipolar disorder patients. Of the 40 depressed patients, 5 patients transitioned to the euthymic state after treatment; these patients were included in both the depressed and euthymic groups, which resulted in 40 depressive patients and 18 euthymic patients. The subjects were recruited from the outpatient clinics and inpatient wards of one national centre for child and adolescent psychiatry. To minimize the inter-rater differences in patient assessment, one board-certified psychiatrist conducted the structured interviews using the K-SADS-PL, and conducted the HAM-D, the MADRS, the Young Mania Rating Scale (YMRS), the Modified Overt Aggression Scale (MOAS) and the Korean version of BDRS. The HAM-D and the MADRS assessed depression symptoms, the YMRS assessed mania symptoms, and MOAS rated aggression. Treating psychiatrists carefully reassessed the diagnosis and the mood symptom assessment afterwards to correlate with clinical profile of the patients.

The patients were diagnosed using Kiddie Schedule for Affective Disorders and Schizophrenia Present and Lifetime (K-SADS-PL), which is a semi-structured diagnostic interview, considered as a gold standard for diagnosis of affective disorder in children and adolescents. Mean score on the HAM-D of depressed and euthymic group was 17.6±7.6 and 3.6±3.1, MADRS was 26.8±11.1 and 4.9±3.6, respectively. Patients with severely impaired cognitive function, substance abuse, unstable medical problem, and current history of organic brain disease (e.g., seizure) were excluded from participating in the study. All research procedures were approved by the Institutional Review Board (IRB) of Seoul National Hospital, and all participants provided informed consent for the study. All study procedures were in accordance with the latest version of the Helsinki declaration.

Instruments

Bipolar Depression Rating Scale

The standardization of the Korean version of the BDRS (K-BDRS) was performed by Chang et al.\textsuperscript{21} for adults patients, which suggests that the K-BDRS has an advantage in evaluating bipolar depression. The BDRS is a semi-structured observation tool used to evaluate bipolar depression. It is particularly sensitive to the evaluation of atypical and mixed symptoms. Composed of 20 items, each item is evaluated on a 4-point scale (0, 1, 2, and 3 represent no, mild, moderate, and severe symptoms, respectively), and the total score range is 0–60. If the obtained score is higher, then the severity of depression can be considered higher. Items 1 to 15 evaluate the core symptoms of depression. The sleep and appetite categories (items 2 and 3) are divided into increase and decrease characteristics, thereby evaluating hypersomnia and overeating, which are common in bipolar depression. Items 16 to 20 (i.e., irritability, lability, increased motor drive, increased speech, and agitation)
evaluate mixed symptoms, which are common features in bipolar disorder.\textsuperscript{17}

Hamilton Depression Rating Scale
The 17 item HAM-D\textsuperscript{13} was originally developed to assess the effectiveness of antidepressant treatment and is often used in studies of adolescents, and previous study has shown that the test–retest reliability at 1 week was good \((r=0.9)\) in a study of a small number of adolescents.\textsuperscript{22} Internal consistency was also good in a sample of depressed and nondepressed high school students \((\alpha=0.91)\).\textsuperscript{22} Each item on the questionnaire is scored on a 3 or 5 point scale, depending on the item with higher scores indicating more depression. Generally, a score of 0–6 is evaluated as normal, 7–17 is mild depression, 18–24 is moderate depression and higher than 24 is severe depression.\textsuperscript{24} Korean Version of HAM-D was standardized with good internal consistency \((\text{Cronbach’s alpha coefficient}=0.76)\) and inter-rater reliability.\textsuperscript{25}

Montgomery-Asperg Depression Rating Scale
The MADRS\textsuperscript{26} is 10 item scale, which assesses apparent sadness, reported sadness, inner tension, reduced sleep, reduced appetite, concentration difficulties, lassitude, inability to feel, pessimistic thoughts, suicidal thoughts.\textsuperscript{26} Items are scored on a 6-point scale. Scores range from 0 to 60, with higher scores indicating more depression. Previous studies showed that when the adolescents with major depression were compared to adults with major depression rated by MADRS, depressions among adolescents and adults had similar symptomatology.\textsuperscript{27} A score of 10 or below indicates normal and a score greater than 35 indicates severe depression.\textsuperscript{27}\textsuperscript{28,29} Korean version of MADRS was standardized with good internal consistency \((\text{Cronbach’s alpha coefficient}=0.79)\).\textsuperscript{30}

Young Mania Rating Scale
The YMRS\textsuperscript{31} is an 11-item scale, which assesses the intensity of manic symptoms based on a clinical interview with the patient and takes into account the subjective comments of the patients and the clinician’s own observation. Out of 11 items, 4 items are scored on 8 point scale, 7 items are scored on 4 point scale, with higher scores indicate more mania symptom. Korean version of YMRS was standardized with acceptable internal consistency \((\text{Cronbach’s alpha coefficient}=0.73)\).\textsuperscript{32} Previous studies have been conducted to validate its use with children and adolescents, which have also shown satisfactory psychometric properties.\textsuperscript{33–35}

Modified Overt Aggression Scale
The MOAS was developed to assess four types of aggressive behavior: verbal aggression, aggression against property, auto aggression, physical aggression over the past week. Items are scored on a 5-point scale and higher scores indicating more aggression.\textsuperscript{36,37}

Statistical analysis
Statistical analysis was performed with SPSS 19.0 for windows (SPSS Inc., Chicago, IL, USA). Frequency analysis and descriptive statistics were used in the demographic analysis and partial correlation coefficient; data were controlled for age and gender in the correlation coefficient between the total score and items. Cronbach’s alpha coefficient and the item to total score correlation were used to confirm the internal consistency of the BDRS. Pearson correlations between the BDRS, HAM-D, MADRS, YMRS and MOAS were examined to verify scale validity. To investigate internal structure of BDRS, principal component analysis with a varimax rotation and hierarchical cluster analysis was conducted. All analysis were conducted in depressed group. Chi-square and fisher’s exact test were performed to compare demographic characteristics between depressed and euthymic groups. In order evaluate discriminative validity, ANCOVA adjusted for demographic characteristics were conducted to compare depressive and euthymic groups.

RESULTS

Participant characteristics
In the depressed group, there were 23 males and 17 females, with a mean age of 15.7±1.6 years (Table 1). The mean onset age was 12.3±3.0 years. In terms of diagnoses, there were 25 bipolar I disorder \((62.5\%)\) patients, 10 bipolar II disorder \((25.0\%)\) patients, and 5 bipolar disorder NOS \((12.5\%)\) patients. Categorised by treatment patterns, there were 9 outpatients \((22.5\%)\), 29 closed ward patients \((72.5\%)\), and 2 day-hospital patients \((5.0\%)\). There were 10 males and 8 females in the euthymic group, with an average age of 14.9±1.6 years; the average onset age was 12.2±2.4 years. In the euthymic comparison group, there were 12 bipolar I disorder \((66.7\%)\) patients, 5 bipolar II disorder \((27.8\%)\) patients, and 1 bipolar disorder NOS \((5.6\%)\) patients. There were 7 outpatients \((38.9\%)\), 9 closed ward inpatients \((50.0\%)\), and 2 day hospital patients \((11.1\%)\). When depressed and euthymic groups were compared, there were no significant differences in age, gender, onset age, and diagnoses.

Internal consistency of BDRS in depressed group
Cronbach’s alpha coefficient was 0.843 in depressed group, which indicates a high internal consistency of the BDRS. Cronbach’s alpha values were re-calculated for the BDRS scale by systematically removing each of the items for the depressed
Bipolar Depression Rating Scale (BDRS) was used to assess bipolar depression in adolescents. For item to total BDRS score correlation, all items except items 18 (increased motor activity) and 19 (increased speech) showed high correlation in depressed group. The results show that internal consistency of the scale is stable and that no single item disproportionately disturbed the homogeneity of the scale.

### Discriminative validity and inter-correlation among instruments

The average BDRS score of the depressed group was 28.8 ± 10.3, while the HAM-D average was 17.6 ± 7.6 and the MADRS average was 26.8 ± 11.1. The average scores of the YMRS and MOAS were 9.4 ± 7.4 and 5.3 ± 7.5, respectively. For all of the scales, the depressed group showed significantly higher score compared to the euthymic groups (Table 2). There was positive correlation coefficient was between the BDRS and HAM-D and also between BDRS and MADRS (r=0.774, p<0.01 for HAM-D; r=0.812, p<0.01 for MADRS) in depressed and euthymic group. There were no significant correlations between the BDRS total score and the YMRS or MOAS (Table 2). For item to total MOAS score correlation, two items ‘irritability’ and ‘lability’ showed high correlation (Table 3).

### Table 1. Demographic characteristics of the study populations

| Case | Depressed group | Euthymic group | All participants | p |
|------|-----------------|----------------|-----------------|---|
| N=40 | N=18 | N=58 |
| Sex (N, %) | | | | 0.890 |
| Male | 23 (57.5) | 10 (55.6) | 33 (56.9) |
| Female | 17 (42.5) | 8 (44.4) | 25 (43.1) |
| Age (mean±SD) | 15.7±1.6 | 14.9±1.6 | 15.5±1.6 |
| Age onset (mean±SD) | 12.3±3.0 | 12.2±2.4 | 12.3±2.8 |
| First manifestation (N, %) | | | | 0.084 |
| Depression | 33 (82.5) | 10 (55.6) | 43 (74.1) |
| Mixed | 6 (15.0) | 6 (33.3) | 12 (20.7) |
| Mania | 1 (2.5) | 2 (11.1) | 3 (5.2) |
| Diagnosis (N, %) | | | | 0.830 |
| Bipolar I | 25 (62.5) | 12 (66.7) | 37 (63.8) |
| Bipolar II | 10 (25.0) | 5 (27.8) | 15 (25.9) |
| Bipolar NOS | 5 (12.5) | 1 (5.6) | 6 (10.3) |
| Treatment (N, %) | | | | 0.228 |
| OPD | 9 (22.5) | 7 (38.9) | 16 (27.6) |
| Closed ward | 29 (72.5) | 9 (50.0) | 38 (65.5) |
| Open ward | 2 (5.0) | 2 (11.1) | 4 (6.9) |

SD: standard deviation, OPD: outpatient department, Bipolar I: Bipolar I disorder, Bipolar II: Bipolar II disorder, Bipolar NOS: Bipolar disorder Not Otherwise Specified

### Table 2. Discriminative validity among depressed and euthymic group and correlations of HAM-D, MADRS, YMRS and MOAS with BDRS total scores

| Case | Depressed group | Euthymic group | All participants | p |
|------|-----------------|----------------|-----------------|---|
| N=40 | N=18 | N=58 |
| BDRS | Mean±SD | Correlation coefficient with BDRS | Mean±SD | Correlation coefficient with BDRS | Mean±SD | Correlation coefficient with BDRS | p |
| 28.8±10.3 | 1 | 6.5±3.9 | 1 | 21.9±13.6 | 1 | <0.01 |
| HAM-D | 17.6±7.6 | 0.774** | 3.6±3.1 | 0.873** | 13.3±9.3 | 0.897** | <0.01 |
| MADRS | 26.8±11.1 | 0.812** | 4.9±3.6 | 0.676** | 20.0±13.9 | 0.914** | <0.01 |
| YMRS | 9.4±7.4 | -0.027 | 3.2±3.6 | 0.799** | 7.5±7.0 | 0.334* | <0.01 |
| MOAS | 5.3±7.5 | -0.020 | 1.7±3.4 | 0.359 | 4.2±6.7 | 0.195 | <0.05 |

*p<0.05, **p<0.01. BDRS: Bipolar Depression Rating Scale, HAM-D: Hamilton Depression Rating Scale, MADRS: Montgomery-Asperg Depression Rating Scale, YMRS: Young Mania Rating Scale, MOAS: Modified Overt Aggression Scale
Endorsement rates of the items on the BDRS in depressed group

The item 'depressed mood' showed the highest endorsement, followed by 'worthlessness', 'reduced activity', 'reduced social engagement', and 'helplessness' (Table 4). 'Increased motor drive' (7.5%) and 'increased speech' (10%) was least endorsed followed by 'agitation' (27.5%) and psychotic symptom (35%). About half of the patients endorsed 'irritability' (47.5%) and 'lability' (55%), and there were nine depressed patients (21%) who had atypical symptoms of 'hypersomnia', whereas ten (23%) patients exhibited 'hyperphagia'.

Internal structure of BDRS in depressed group

The factor structure of the BDRS was explored using principal component analysis with a varimax rotation. The Kaiser criterion (eigenvalue greater than 1) was applied to determine the number of significant factors. Three factors were extracted from the factor analysis of 20 items in the BDRS with varimax rotation, 'psychosomatic', 'mood', and 'mixed'; the items in each factor are reported in Table 5. When analyzing correlations between scales based on the three factors and the BDRS, HAM-D, MADRS, YMRS, and MOAS totals, 'psychosomatic' and 'mood' factor showed strong positive correlations with the BDRS, HAM-D, and MADRS total scores. While the 'mixed' factor showed correlations with the BDRS, HAM-D, and YMRS total scores (Table 6).

Hierarchical cluster analysis was also performed on 20 items of BDRS (Figure 1). These were divided into three main clusters like principal component analysis, but elements of clusters were somewhat different the clusters of factor analysis. Irritability and lability were included in the mood cluster and agitation was moved from the mixed cluster to the psychosomatic cluster. Only increased motor drive and increased speech remained in the mixed cluster.

DISCUSSION

This study explored the feasibility and psychometric properties of the Korean version of the BDRS in adolescents with Early-onset bipolar disorders. In this research, the BDRS showed good internal consistency, high reliability and validity similar to the results from previous studies performed with adult subjects with bipolar depression, which indicates that the BDRS is also a useful tool for evaluating adolescents with Early-onset bipolar depression. Cronbach's alpha of the BDRS was 0.843, which demonstrated very high internal consistency.
### Table 4. BDRS characteristics, item endorsement rates in adolescents in depressed group

|                              | Mean±SD | Skewness | Kurtosis | Moderate* symptom (%) | High† symptom (%) | Moderate to high symptom (%) |
|------------------------------|---------|----------|----------|-----------------------|-------------------|-----------------------------|
| 1. Depressed mood            | 2.1±0.8 | -0.492   | -0.029   | 50.0                  | 30.0              | 80.0                        |
| 2. Sleep disturbance         | 1.2±1.1 | 0.233    | -1.412   | 32.5                  | 12.5              | 45.0                        |
| 3. Appetite disturbance      | 1.6±1.4 | -0.143   | -1.846   | 20.0                  | 37.5              | 57.5                        |
| 4. Reduced social engagement | 1.7±1.1 | -0.427   | -1.190   | 35.0                  | 30.0              | 65.0                        |
| 5. Reduced energy and activity| 1.8±1.0 | -0.222   | -0.955   | 47.5                  | 22.5              | 70.0                        |
| 6. Reduced motivation        | 1.8±1.0 | -0.222   | -0.955   | 32.5                  | 27.5              | 60.0                        |
| 7. Impaired concentration and memory | 1.4±1.0 | -0.052   | -0.133   | 37.5                  | 12.5              | 50.0                        |
| 8. Anxiety                   | 1.5±0.8 | -0.133   | -0.489   | 42.5                  | 10.0              | 52.5                        |
| 9. Anhedonia                 | 1.4±0.8 | -0.695   | -0.774   | 57.5                  | 2.5               | 60.0                        |
| 10. Affective flattening     | 1.1±1.0 | 0.236    | -1.172   | 32.5                  | 7.5               | 40.0                        |
| 11. Worthlessness            | 2.2±1.1 | -1.088   | -0.143   | 22.5                  | 55.0              | 77.5                        |
| 12. Helplessness and hopelessness | 1.9±1.1 | -0.448   | -1.257   | 22.5                  | 40.0              | 62.5                        |
| 13. Suicidal ideation        | 1.4±1.2 | 0.065    | -1.589   | 25.0                  | 25.0              | 50.0                        |
| 14. Guilty                   | 1.6±1.0 | -0.441   | -0.837   | 47.5                  | 17.5              | 65.0                        |
| 15. Psychotic symptoms       | 1.0±1.2 | 0.659    | -1.215   | 17.5                  | 17.5              | 35.0                        |
| 16. Irritability             | 1.8±1.0 | 0.992    | -1.448   | 12.5                  | 35.0              | 47.5                        |
| 17. Lability                 | 1.7±1.2 | -0.243   | -1.560   | 15.0                  | 40.0              | 55.0                        |
| 18. Increased motor drive    | 0.3±0.7 | 2.703    | 7.193    | 5.0                   | 2.5               | 7.5                         |
| 19. Increased speech         | 0.4±0.8 | 2.281    | 4.546    | 5.0                   | 5.0               | 10.0                        |
| 20. Agitation                | 1.1±0.9 | 0.555    | -0.363   | 20.0                  | 7.5               | 27.5                        |

*score 2, †score 3. SD: standard deviation, BDRS: Bipolar Depression Rating Scale

### Table 5. Exploration of factor structure of BDRS in depressed group

|                              | Psychosomatic | Mood | Mixed |
|------------------------------|---------------|------|-------|
| 1. Depressed mood            | 0.547         |      |       |
| 2. Sleep disturbance         | 0.641         |      |       |
| 3. Appetite disturbance      | 0.508         |      |       |
| 4. Reduced social engagement | 0.756         |      |       |
| 5. Reduced energy and activity| 0.809     |      |       |
| 6. Reduced motivation        | 0.814         |      |       |
| 7. Impaired concentration and memory | 0.624 | 0.441 |       |
| 8. Anxiety                   | 0.527         | 0.514|       |
| 9. Anhedonia                 | 0.627         |      |       |
| 10. Affective flattening     | 0.413         |      |       |
| 11. Worthlessness            | 0.673         | 0.405|       |
| 12. Helplessness and hopelessness | 0.721 |      |       |
| 13. Suicidal ideation        | 0.609         |      |       |
| 14. Guilty                   | 0.677         |      |       |
| 15. Psychotic symptoms       | 0.518         | 0.430|       |
| 16. Irritability             | 0.650         |      |       |
| 17. Lability                 | 0.802         |      |       |
| 18. Increased motor drive    | 0.295         |      |       |
| 19. Increased speech         | 0.224         |      |       |
| 20. Agitation                | 0.760         |      |       |

BDRS: Bipolar Depression Rating Scale
In the factor analysis, there were three factors consistent with the original standardization study of the BDRS, however, there were differences in the components. In the original standardization of the BDRS by Berk et al., the factors were divided into psychological depression (anhedonia, worthlessness, helplessness, and guilt), somatic depression (reduced concentration and activity and disrupted sleep and appetite), and mixed factor (psychotic symptoms, lability, and increased motor drive and speech). However, in this study, sleep and appetite disturbances, reduced social engagement, reduced activity, reduced motivation, impaired concentration, anxiety, anhedonia, affective flattening and psychotic symptoms were considered 'psychosomatic' depression, and the symptoms related to 'psychological' depression, such as depressed mood, worthlessness, helplessness, guilt and suicide ideation composed another factor classified as 'mood.' Mixed factor was composed of irritability, lability, increased motor, increased speech and agitation. But in cluster analysis, only increased motor drive and speech were included in mixed cluster. In Chang et al., cluster analysis showed two cluster structure, the first cluster was depressive symptom cluster which consisted of 12 items and second cluster was mixed symptom cluster which consisted of 8 items including increased motor drive and speech, lability, irritability, agitation, suicidal ideation, appetite disturbance, and psychotic symptoms.

The differences in factor components compared with previous studies that have explored the factors of the BDRS may reflect the differences between adult and adolescent symptomatology in bipolar depression or the differences between the phenomenological manifestations between adult-onset bipolar disorder and early-onset bipolar depression. The results of the present study suggest that irritability, lability and agitation are more general depressive feature of adolescent's bipolar depression. It also correspond with the changes in DSM-5 criteria of bipolar disorder depressive episode with mixed features, where irritability was excluded from mixed symptoms because it appears frequently in depression. The ‘psychosomatic’ depression and ‘mood’ factors had strong correlations with the other depression rating scales, while ‘mixed’ factors showed correlations with the HAM-D and the YMRS. The MOAS showed weak positive correlations with all of the factors but items 'irritability' and 'lability' showed correlation with total MOAS score, suggesting that 'irritability' and 'lability' is associated with aggression in early-onset bipolar depression.

In Korean adults with bipolar depression, the mean HAM-D score was 16.2 (SD=7.0) and the mean MADRS score was 24.5 (SD=8.8), which is similar to the mean HAM-D (17.6±7.6) and the mean MADRS (26.8±11.1) of depressed adolescents in this study. However, the score of YMRS was 5.0 (SD=6.8) for adult Korean bipolar depression patients, whereas the mean YMRS score was slightly higher for adolescents at 9.4

### Table 6. Correlation between subscale scores of the three factors and the BDRS, HAM-D, MADRS, YMRS and MOAS total scores in depressed group

| Subscale         | Psychosomatic | Mood   | Mixed   |
|------------------|---------------|--------|---------|
| BDRS total       | 0.881**       | 0.716**| 0.454** |
| HAM-D            | 0.658**       | 0.613**| 0.325*  |
| MADRS            | 0.757**       | 0.694**| 0.117   |
| YMRS             | -0.058        | -0.277 | 0.421** |
| MOAS             | -0.123        | -0.050 | 0.283   |

*p<0.05, **p<0.01. BDRS: Bipolar Depression Rating Scale, HAM-D: Hamilton Depression Rating Scale, MADRS: Montgomery-Asberg Depression Rating Scale, YMRS: Young Mania Rating Scale, MOAS: Modified Overt Aggression Scale.

### Figure 1. Cluster structure of BDRS. The subjective associations between items are reflected by the horizontal distance. BDRS: Bipolar Depression Rating Scale.
account that most bipolar patients have yet to experience
tinct manic episodes, we cannot rule out the possibility that
with bipolar II disorder or bipolar disorder NOS without dis-
Because considerable number of participants were diagnosed
ings. Second, because of the relative difficulty of diagnosing bi-
ipants were Korean limiting the generalizability of the find-
be helpful in evaluation of behavioral issues in adolescents
behaviour is also common and serious issue in adolescent's
in the assessment of adolescent bipolar depression, which is
BDRS has strength over conventional depression rating scales
erate to severe depression, indicating that it is difficult to prop-
on HAM-D and MADRS although clinically they showed mod-
were also reported as moderate to severe in one quarter of the
patients. These findings are very interesting because it suggest
that atypical and mixed symptoms are frequent in adolescent
bipolar depression, along with the core symptoms that have
been reported in adult onset bipolar depression.42
In this study, some patients were rated as mildly depressive
on HAM-D and MADRS although clinically they showed mod-
ate severe depression, indicating that it is difficult to proper-
evalate adolescents' bipolar depression by conventional
tools based on unipolar depression. So, we can infer that the
BDRS has strength over conventional depression rating scales
in the assessment of adolescent bipolar depression, which is
characterized by prominent irritabilities without elated mood34
and mixed episodes.7 Moreover, impulsivity and delinquent
behaviour is also common and serious issue in adolescent's depression.43,44 As irritability and lability are associated with
these aggressive behaviors, focusing on these symptoms will
be helpful in evaluation of behavioral issues in adolescents
with bipolar depression.

The present study has several limitations. First, all of partic-
pants were Korean limiting the generalizability of the find-
ings. Second, because of the relative difficulty of diagnosing bi-
polar depression at early age, the sample size is relatively small. Because considerable number of participants were diagnosed
with bipolar II disorder or bipolar disorder NOS without dis-
inct manic episodes, we cannot rule out the possibility that
some of the patients may be diagnosed with other psychiatric
conditions when they grow up. However, we should take into
account that most bipolar patients have yet to experience
manic episodes in adolescents.45,46 Also there are limited di-
agnostic tools currently available for adolescent bipolar disor-
der. We performed clinical evaluation and structured diag-
nostic interviews in order to increase the reliability and validity
of bipolar diagnosis in adolescents with bipolar depression.
However, it is necessary to verify our findings in larger cohorts
for future studies. Third, limited availability of age appropri-
depression rating scale in Korean language has made the
use of child specific depression rating scales impossible, there-
fore we used Korean version of HAM-D and MADRS. It is
important that future efforts should be made to standardize
Korean version of children and adolescent specific depres-
sion rating scale. Fourth, the subjects did not include unipo-
lar depression patients as a comparison group. Therefore di-
rect comparison between symptom structures of unipolar
depression and bipolar patient group were not possible.

In conclusion, Korean version of BDRS exhibited good in-
ternal validity and significant correlations with the HAM-D
and MADRS scores in adolescents with Early-onset bipolar
 disorders. All items on the BDRS were significantly correlated
with the BDRS total scores except for increased motor ac-
vity and increased speech. Importantly, in comparisons of
the BDRS scores between the depressed and euthymic groups
diagnosed using K-SADS-PL, the depressed group scored
higher compared with the euthymic group. The BDRS was use-
ful in evaluating the mixed and atypical symptoms, as well as
depressive symptoms of early-onset bipolar depression. In this
explorative study of the BDRS for adolescents with Early-on-
set bipolar disorders, we suggest that the BDRS may be a fea-
sible and reliable tool for the assessment of bipolar depression
in adolescents with early-onset bipolar disorders. Given the
worldwide burden of bipolar disorder across the lifespan and
the controversies about early presentations of this disorder in
non-US populations, validating diagnostic assessments for use
clinically and in research settings is important. This explora-
tion of BDRS in adolescents with bipolar depression will also
enable clinical studies for assessment of the adolescent pa-
tients with unipolar depression in comparison with bipolar
depression so that we may identify the differences between
unipolar and bipolar depression in the future.

Acknowledgments

This research was supported by grant from Seoul National Hospital (Grant
No. 3731-316-210-13) given to Dr. Yeni Kim.

REFERENCES

1. Geller B, Crayon JL, Bolhofner K, Nicksburg MJ, Williams M, Zi-
merman B. Two-year prospective follow-up of children with a prepu-
ental and early adolescent bipolar disorder phenotype. Am J Psychia-
try 2002;159:927-933.
2. Leverich GS, Post RM, Keck PE Jr, Altshuler LL, Frye MA, Kapka RW,
et al. The poor prognosis of childhood-onset bipolar disorder. J Pediat-
2007;150:485-490.
3. Weismann MM, Wolk S, Wickramaratne P, Goldstein RB, Adams P, Greenland S, et al. Children with prepubertal-onset major depressive disorder and anxiety grown up. Arch Gen Psychiatry 1999;56:794-801.

4. Goldberg JE, Harrow M, Whiteside JE. Risk for bipolar illness in patients initially hospitalized for unipolar depression. Am J Psychiatry 2001;158:1265-1270.

5. Youngstrom EA, Birmaher B, Findling RL. Pediatric bipolar disorder: validity, phenomenology, and recommendations for diagnosis. Bipolar Disord 2008;10:194-214.

6. Stringaris A, Zavos H, Leibnhufl E, Maughan B, Eley TC. Adolescent irritability: phenotypic associations and genetic links with depressed mood. Am J Psychiatry 2012;169:47-54.

7. Goldstein TR, Birmaher B, Axelson D, Ryan ND, Strober MA, Gill MK, et al. History of suicide attempts in pediatric bipolar disorder: factors associated with increased risk. Bipolar Disord 2005;7:525-535.

8. Birmaher B, Axelson D, Strober M, Gill MK, Valeri S, Chiappetta L, et al. Clinical course of children and adolescents with bipolar spectrum disorders. Arch Gen Psychiatry 2006;63:175-183.

9. Birmaher B, Axelson D, Goldstein B, Strober M, Gill MK, Hunt J, et al. Four-year longitudinal course of children and adolescents with bipolar spectrum disorders: the Course and Outcome of Bipolar Youth (COBY) study. Am J Psychiatry 2009;166:795-804.

10. Woo YS, Park MH, Seo HJ, Chae JH, Jun TY, Bahk WM. Clinical characteristics of early onset bipolar disorder: a retrospective chart review study. J Korean Neuropsychiatr Assoc 2007;46:469-474.

11. Miklowitz DJ, Cicchetti D. Toward a life span developmental psychopathology perspective on bipolar disorder. Dev Psychopathol 2006;18:935-938.

12. Mitchell PB, Wilhelm K, Parker G, Austin MP, Rutgers P, Malhi GS. The clinical features of bipolar depression: a comparison with matched major depressive disorder patients. J Clin Psychiatry 2001;62:212-216; quiz 217.

13. Hamilton M. A rating scale for depression. J Neurol Neurosurg Psychiatry 1960;23:56-62.

14. Trivedi MH, Rush AJ, Ibrahim HM, Carmody TJ, Biggs MM, Suppes T, et al. The Inventory of Depressive Symptomatology, Clinician Rating (IDS-C) and Self-Report (IDS-SR), and the Quick Inventory of Depressive Symptomatology, Clinician Rating (QIDS-C) and Self-Report (QIDS-SR) in public sector patients with mood disorders: a psychometric evaluation. Psychol Med 2004;34:73-82.

15. Montgomery SA, Asberg M. A new depression scale designed to be sensitive to change. Br J Psychiatry 1979;134:382-389.

16. Sarzo S, Madre M, Fernandez-Cocquerea P, Valenti M, Guokolea JM, Pomarol-Clotet E, et al. Transcultural adaption and validation of the Spanish version of the Bipolar Depression Rating Scale (BDRS-S). J Affect Disord 2014;172:110-115.

17. Berk M, Malhi GS, Cahill C, Carman AC, Hadzi-Pavlovic D, Hawkins MT, et al. The Bipolar Depression Rating Scale (BDRS): its development, validation and utility. Bipolar Disord 2007;9:571-579.

18. Zimmerman M, Chelminski I, Young D, Dahymple K, Martinez JH. A clinically useful self-report measure of the DSM-5 spectrum features specifier of major depressive disorder. J Affect Disord 2014;168:357-362.

19. Faulstich ME, Carey MP, Ruggiero L, Enany P, Gresham F. Assessment of depression in childhood and adolescence: an evaluation of the Center for Epidemiological Studies Depression Scale for Children (CES-DC). Am J Psychiatry 1986;143:1024-1027.

20. Saylor CF, Finch AJ Jr, Sapiro A, Bennett B. The children's depression inventory: a systematic evaluation of psychometric properties. J Consult Clin Psychol 1984;52:955-967.

21. Chang JS, Ahn YM, Yu HY, Park HJ, Lee KY, Kim SH, et al. Exploring clinical characteristics of bipolar depression: internal structure of the bipolar depression rating scale. Aust N Z J Psychiatry 2009;43:830-837.

22. Kutcher SF, Marton P. Utility of the Beck Depression Inventory with psychiatrically disturbed adolescent outpatients. Can J Psychiatry 1989;34:107-109.

23. Greenfield SJ, Kutcher S. Diagnosis and measurement of adolescent depression: a review of commonly utilized instruments. J Child Adolesc Psychopharmacol 2001;11:341-376.

24. Alshuler LL, Post RM, Fedio P. Assessment of Affective Variables in Clinical Trials. In: Brouwers P, Mohr E, Editors. Handbook of Clinical Trials: The Neurobehavioral Approach. Amsterdam, MA: Swets & Zeitlinger, 1991, p.141-164.

25. Yi J, Bae S, Ahn Y, Park D, Noh K, Shin H. Validation and reliability of the Korean version of the Hamilton Depression Rating Scale. J Korean Neuropsychiatr Assoc 2005;44:456-465.

26. Williams JB, Kobak KA. Development and reliability of a structured interview guide for the Montgomery-Asberg Depression Rating Scale (SIGMA). Br J Psychiatry 2008;192:52-58.

27. Kristjansdottir J, Olsson GI, Sundelin C, Naessens T. Could SF-36 be used as a screening instrument for depression in a Swedish youth population? Scand J Caring Sci 2011;25:262-268.

28. Hawley C, Gale T, Sivakumar T, Hertfordshire Neuroscience Research group. Defining remission by cut off score on the MADRS: selecting the optimal value. J Affect Disord 2002;72:177-184.

29. Cusin C, Yang H, Young A, Fava M. Rating Scales for Depression. In: Baer L, Blatt MA, Editors. Handbook of Clinical Rating Scales and Assessment in Psychiatry and Mental Health. New York: Humana Press, 2009, p.7-35.

30. Ahn Y, Lee K, Yi J, Kang M, Kim D, Kim J. A validation study of the Korean version of the Montgomery-Asberg Depression Rating Scale. J Korean Neuropsychiatr Assoc 2005;44:466-476.

31. Young RC, Biggs JT, Ziegler VE, Meyer DA. A rating scale for mania: reliability, validity and sensitivity. Br J Psychiatry 1978;133:429-435.

32. Jung H, Cho H, Joo Y, Shin H, Yi J, Hwang S. A validation study of the Korean version of the Young Mania Rating Scale. J Korean Neuropsychiatr Assoc 2003;42:263-269.

33. Fristad MA, Wellar EB, Wellar RA. The Mania Rating Scale: can it be used in children? A preliminary report. J Am Acad Child Adolesc Psychiatry 1992;31:252-257.

34. Fristad MA, Wellar RA, Wellar EB. The Mania Rating Scale (MRS): further reliability and validity studies with children. Ann Clin Psychiatry 1995;7:127-132.

35. Youngstrom EA, Danielson CK, Findling RL, Gracious BL, Calabrese JR. Factor structure of the Young Mania Rating Scale for use with youths ages 5 to 17 years. J Clin Child Adolesc Psychol 2002;31:567-572.

36. Yudofsky SC, Silver JM, Jackson W, Endicott J, Williams D. The Overt Aggression Scale for the objective rating of verbal and physical aggression. Am J Psychiatry 1986;143:35-39.

37. Knoedler DW. The Modified Overt Aggression Scale. Am J Psychiatry 1989;146:1081-1082.

38. Shahani A, Akbari M, Dadashzadeh M. Reliability and validity of the Bipolar Depression Rating Scale on an Iranian sample. Arch Iran Med 2010;13:217-222.

39. Galvao F, Sportiche S, Lambert J, Amiez E, Dehbridge JR. Factor structure of the Young Mania Rating Scale for use with youths ages 5 to 17 years. J Clin Child Adolesc Psychol 2002;31:567-572.

40. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders (DSM-5) (Fifth Ed). Washington, DC: American Psychiatric Pub; 2013.

41. Bhatia SK, Bhatia SC. Childhood and adolescent depression. Am Fam Physician 2007;75:73-80.

42. Berk M, Malhi GS, Mitchell PB, Cahill CM, Carman AC, Hadzi-Pavlovic D, et al. Scale matters: the need for a Bipolar Depression Rating Scale (BDRS). Acta Psychiatr Scand Suppl 2004;(422):39-45.

43. Halfors DD, Waller MW, Ford CA, Halpern CT, Broidish PH, Iriniri B. Adolescent depression and suicide risk: association with sex and drug behavior. Am J Prev Med 2004;27:224-231.

44. Kandel DB, Ravees VH, Davies M. Suicidal ideation in adolescence:
Bipolar Depression Rating Scale in Adolescents

depression, substance use, and other risk factors. J Youth Adolesc 1991; 20:289-309.

45. Lewinsohn PM, Klein DN, Seeley JR. Bipolar disorders in a community sample of older adolescents: prevalence, phenomenology, comorbidity, and course. J Am Acad Child Adolesc Psychiatry 1995;34:454-463.

46. Geller B, Luby J. Child and adolescent bipolar disorder: a review of the past 10 years. J Am Acad Child Adolesc Psychiatry 1997;36:1168-1176.