Exploratory Factor Analysis of the Adolescent Version of the General Behavior Inventory in Korean Youth

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Objectives: We examined the factor structure of the Adolescent version of the General Behavior Inventory (A-GBI) for Koreans.
Methods: We retrospectively reviewed the medical records of 220 adolescents (age, 12–18 years) who completed the A-GBI through the Department of Psychiatry at Asan Medical Center, Seoul, Korea, from October 2011 to December 2018. Caregivers of the study participants completed the Parent version of the GBI (P-GBI) 10-item Mania Scale. The adolescents were evaluated based on the A-GBI, Children's Depression Inventory (CDI), and Revised-Children's Manifest Anxiety Scale (RCMAS). Subsequently, an exploratory factor analysis (EFA) using the maximum likelihood method with direct oblimin rotation and correlation analyses with other scales were performed.
Results: The EFA identified a two-factor structure as having the best fit: factor I included depressive symptoms and factor II included hypomanic/biphasic symptoms. Factor I was very strongly correlated with the A-GBI depressive subscale (r=0.990, p<0.001) and strongly correlated with CDI (r=0.764, p<0.001) and RCMAS (r=0.666, p<0.001). Factor II was also very strongly correlated with the A-GBI hypomanic/biphasic subscale (r=0.877, p<0.001) and weakly correlated with CDI (r=0.274, p<0.001) and RCMAS (r=0.332, p<0.001).
Conclusion: The above findings support a two-dimensional model of mood symptoms in Korean youth.

Key Words: Adolescent; Bbipolar disorder; Depression; Factor analysis.

INTRODUCTION

Childhood and adolescent depression is a mood disorder characterized by persistent depressed mood and hopelessness, mood swings, and irritability [1]. The disorder is relatively common with a prevalence rate of approximately 12%, and it is known to have a chronic course with repeated periods of worsening and remission [2]. The rate of depressive disorder in youths is increasing annually in Korea, as it was reported in 2016 that 20.9% of male adolescents and 30.5% of female adolescents in Korea experienced depression [3]. Furthermore, children and adolescents with depressive disorders are more likely to have bipolar disorder, conduct disorder, drug abuse, and relationship problems, and also have increased risk for suicide and self-harm [1].

Compared to bipolar disorder in adulthood, bipolar disorder in childhood and adolescence is associated with shorter episodes, fewer symptom-free periods, higher level of irritability and more frequent mixed episodes, and shows a com-plex cycling pattern between depression and mania [4]. It is reported that bipolar disorder in youths is often accompanied by other psychiatric disorders such as attention-deficit/hyperactivity disorder (ADHD), disruptive behavioral disorder, and anxiety disorder [5]. It is also known that adolescent bipolar disorder causes difficulties in academics and in maintaining relationships with family and friends, and increases the risk for completed suicide [6,7].

As discussed above, mood symptoms in youths pose higher risks for functional deterioration and behavioral problem, as well as other psychiatric comorbidities. Therefore, appropriate evaluation of mood symptoms and early diagnosis of depressive and bipolar disorders in youths are important in risk assessment and intervention. However, the mood symptoms in youths are known to be more difficult to assess than the symptoms manifested by adults. The Beck Depression Inventory (BDI) and Children's Depression Inventory (CDI), which are commonly used for the assessment of mood symptoms, are thought to be limited in evaluating depressive symptoms during childhood and adolescence, a period characterized by mood fluctuation and irritability [8].

Depue et al. [9] proposed a two-dimensional model of mood

symptoms, and developed the General Behavior Inventory (GBI), which consists of depressive subscale and hypomanic/biphasic subscale. The parent version of the GBI (P-GBI) and adolescent version of the GBI (A-GBI), which are modifications of the GBI, evaluate not only depressed mood but also irritability, mood swings, hypomanic symptoms, and behavioral problems, and are effective in screening and assessing depressive and bipolar disorders in youths [10]. In a study that evaluated the diagnostic usefulness and reliability of the Korean version of the A-GBI, the depressive and hypomanic/biphasic subscales showed significant differences between adolescents with bipolar and depressive disorders, and the depressive subscale was correlated with other diagnostic tools for mood disorder [11]. However, the study did not explore the existence of common factors among individual items; furthermore, it did not examine whether the two-dimensional model still holds in Korean youths' A-GBI results.

Accordingly, the present study was conducted to identify common factors among the individual items of the Korean version of the A-GBI and investigate whether the two-dimensional model fits mood symptoms in Korean youths by comparing the latent factors with those of the English version of the A-GBI.

METHODS

Subjects

Study subjects were adolescents aged between 12 and 18 years who were evaluated with the A-GBI at the Department of Pediatric Psychiatry, Asan Medical Center in Seoul between October 12, 2011 and December 31, 2018. Of a total of 392 eligible adolescents, those with the following conditions were excluded from the study: intelligence quotient (IQ) lower than 80 (n=61), diagnosis of autism spectrum disorder (n=6), psychosis (n=29) or organic brain syndrome (n=13), individual A-GBI item scores not available or missing values in 10% or more of the items (n=62), and clinical information not available (n=1). Finally, the data from the remaining 220 subjects were analyzed. Of the 220 subjects, 90 (40.9%) were boys and 130 (59.1%) were girls. The study was approved by the Institutional Review Board at the Asan Medical Center. Requirement for informed consents was waived because it was a retrospective study (IRB No. 2019-0129).

Study design

In this retrospective study, subjects' medical records were reviewed to collect demographic and clinical data including age and sex. The diagnosis and psychiatric comorbidities were confirmed retrospectively based on the reported symptoms in the medical records in accordance with Diagnostic and Statistical Manual of Mental Disorders Fifth Edition. The subjects were classified into the following groups: bipolar disorder, depressive disorder, or non-mood disorder. The bipolar disorder group included subjects diagnosed with bipolar depression, bipolar mania, or bipolar disorder not otherwise specified (BD-NOS), and the depressive disorder group included subjects diagnosed with unipolar depression, dysthymia, or adjustment disorder with depressed mood. Subjects without any mood disorders were assigned to the non-mood disorder group.

Assessment tools

Adolescent and parent versions of General Behavior Inventories

A-GBI is a modification of the GBI [9] for use in the youth [12]. In the present study, the Korean version standardized by Lee et al. [11] was used. A-GBI is a self-administered scale and consists of 46 items in the depressive subscale and 28 in the hypomanic/biphasic subscale, for a total of 76 items. Each item is scored between 0 and 3 points, and the subscales are scored separately; the test score is computed by adding the subscale scores. In this study, individual item scores were submitted to factor analysis, and the subscale scores were used in other analysis. P-GBI was revised by Youngstrom et al. [13], based on GBI; it is composed of 10 items, in which the parent assesses the child's mood symptoms.

Revised Children's Manifest Anxiety Scale

Reynolds and Richmond [14] developed Revised Children's Manifest Anxiety Scale (RCMAS) to assess anxiety in children, by revising existing anxiety assessment tools. In this study, the Korean version of the scale standardized by Choi and Cho [15] is used. The scale has a total of 37 items regarding symptoms of anxiety, each requiring a "yes" or "no" response. The total score is obtained by adding individual item scores. The higher the score, the higher the anxiety level.

Children's Depression Inventory

CDI was revised by Kovacs and Beck [16] from BDI [17], to assess the depression level in children. The Korean version of CDI translated by Cho and Lee [18] is used in this study. The tool consists of 27 items, and the child selects one of the three sentences presented in each item that most closely describes his/her symptoms. Individual items are scored between 0 and 2 points, and the total score is obtained by adding individual item scores. The higher the score, the higher the depression level.

Statistical analyses

Analysis of variance was performed to examine between-group differences in demographic characteristics and the scale scores. Additionally, exploratory factor analysis (EFA) using maximum likelihood and direct oblinin rotation was conducted on A-GBI test results. Factor scores for each factor were computed using the regression method, and correlational analysis with Pearson correlation coefficients was applied to investigate the relationship between factor scores and scores in A-GBI, full scale IQ (FSIQ), RCMAS, CDI and P-GBI. All statistical analyses were performed using SPSS 21.0 (IBM Corp., Armonk, NY, USA), and statistical significance was set at $p < 0.05$.

RESULTS

Demographic characteristics (Table 1)

Of the 220 subjects, 90 (40.9%) were boys and 130 (59.1%) were girls. Twenty-eight subjects were diagnosed with bipolar depression, 4 with bipolar mania, 21 with BD-NOS, 123 with unipolar depression, and 3 with dysthymia. Additionally, 2 were diagnosed with both unipolar depression and dysthymia, and 6 with adjustment disorder with depressed mood. Thirty-three subjects were not diagnosed with any mood disorder. Accordingly, 134 were classified into the depressive disorder group (age 15.4±1.5 year, 59 boys), 53 into the bipolar disorder group (age 15.4±1.7 year, 12 boys), and 33 into the non-mood disorder group (age 14.6±1.8 year, 19 boys). The subjects in the depressive disorder group were significantly older than those in the non-mood disorder group (F=3.55, p=0.030). With respect to sex, the proportion of girls was significantly higher in the bipolar disorder group than in the depressive disorder and non-mood disorder groups (F=11.66, p=0.003). However, age or sex did not show a significant between-group difference after Bonferroni corrections.

Between-group difference was not significant in terms of FSIQ or P-GBI. However, depressive disorder and bipolar disorder groups scored significantly higher than the non-mood disorder group in RCMAS (F=9.67, p<0.001), CDI (F=10.97, p<0.001), and A-GBI depressive subscale (F=15.53, p<0.001). Particularly, A-GBI hypomanic/biphasic subscale score was the highest in the bipolar disorder group, followed by the depressive disorder and non-mood disorder groups, and the score was significantly different among the three groups (F=10.56, p<0.001).

Factor analysis on Adolescent version of the General Behavior Inventory

First, it was confirmed that the A-GBI data were suitable for factor extraction using the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy (KMO value=0.937), and the assumption of the absence of common factors in the 73 items was rejected based on the Bartlett test (χ^2=11011.964, df=2628, p<0.001). Next, EFA with maximum likelihood estimation was

Table 1. Demographic and clinical characteristics of subjects

	Depressive (n=134)	Bipolar (n=53)	Non-mood (n=33)	F or χ^2	p	Post-hoc
Age, years	15.4±1.5	15.4±1.7	14.6±1.8	3.55	0.030	D>N
Gender, boys	59 (44)	12 (22.6)	19 (57.6)	11.66	0.003	N, D>B
Comorbidity						
Anxiety disorders	25 (18.7)	15 (28.3)	17 (51.5)	15.10	0.001	N>B, D
SSD	10 (7.5)	3 (5.7)	6 (18.2)	4.64	0.098	
ADHD	7 (5.2)	3 (5.7)	8 (24.2)	13.34	0.001	N>B, D
Tic disorder	3 (2.2)	2 (3.8)	3 (9.1)	3.55	0.169	
Eating disorder	4 (3.0)	2 (3.8)	4 (12.1)	5.19	0.075	
Conduct disorder/ODD	4 (3.0)	1 (1.9)	4 (12.1)	6.50	0.039	N>B, D
FSIQ	102.0±13.9	98.5±11.9	98.9±12.5	1.59	0.206	
RCMAS	18.2±7.2	19.4±7.6	12.7±6.3	9.67	<0.001	D, B>N
CDI	22.0±8.9	24.4±11.3	14.9±8.0	10.97	<0.001	D, B>N
A-GBI						
Depressive	59.7±31.8	71.5±34.2	32.4±28.3	15.53	<0.001	D, B>N
Hypomanic/biphasic	23.7±14.1	30.8±17.3	15.7±14.9	10.56	<0.001	B>D>N
P-GBI	8.0±6.0	8.6±5.4	6.3±5.1	1.22	0.298	

Data are mean±standard deviation or n (%) values. Multiple comparison corrected significance level: p<0.003. ADHD: attention-deficit/hyperactivity disorder, A-GBI: adolescent version of the General Behavioral Inventory, B: bipolar disorder group, CDI: Children's Depression Inventory, D: depressive disorder group, FSIQ: full scale intelligence quotient, N: non-mood disorder group, ODD: oppositional defiant disorder, P-GBI: parent version of the General Behavioral Inventory, RCMAS: Revised Children's Manifest Anxiety Scale, SSD: somatic symptom disorder

Table 2. Goodness-of-fit indices in the exploratory factor analysis

Factor model	χ^2	df	p	RMSEA
1	4775.826	2555	<0.001	0.120
2	3973.613	2483	<0.001	0.091
3	3668.534	2412	<0.001	0.085
4	3416.968	2342	<0.001	0.080
5	3195.788	2273	<0.001	0.075

RMSEA: root mean square error of approximation

performed to identify an appropriate factor model (Table 2), and a two-factor model was found to have the best fit to the data. An EFA specifying two factors and using an direct obli-nin rotation was performed (Table 3), and items with a factor loading value of 0.4 or lower were removed. Factor I was interpreted as a factor measuring depression level, similar to A-GBI depressive subscale, and Factor II was interpreted as a

Table 3. The two factor solution of the A-GBI

Item	Factor I	Factor II	Depressive*	Hypomanic/ Biphasic†	Questions
63	0.96		+		Have there been periods lasting several days or more when you were so down in the dumps that you thought you might never snap out of it?
72	0.95		+		Have there been periods of time when you felt a persistent sense of gloom?
62	0.92		+		Have you had periods when it seemed that the future was hopeless and things could not improve?
56	0.90		+		Have there been times of several days or more when you really got down on yourself and felt worthless?
23	0.90		+		Have there been times of several days or more when you were so sad that it was quite painful for you, or you felt that you couldn't stand it?
50	0.86		+		Have you had sad and depressed periods lasting several days or more when you also felt much more anxious or tense (jittery, nervous, uptight) than usual (other than related to the menstrual cycle)?
73	0.86		+		Have there been times when you felt that you would be better off dead?
34	0.85		+		Have there been long periods over the last year when you felt sad, depressed, or irritable most of the time?
55	0.83		+		Have there been times when upsetting or bad thoughts kept going through your mind and you couldn't stop them?
16	0.82		+		Have you had long periods in which you felt that you couldn't enjoy life as easily as other people?
45	0.82		+		Over the past year, have there been times of several days or more when you were so down that nothing (not even friends or good news) could cheer you up?
3	0.80		+		Have you become sad, depressed, or irritable for several days or more with out really understanding why?
14	0.79		+		Have you had periods of sadness and depression when almost everything gets on your nerves and makes you irritable or angry (other than related to the menstrual cycle)?
32	0.79		+		Over the past year, have there been times when you looked back over your life and could see only failures or hardships?
68	0.79		+		Have you had long periods when you were down and depressed, interrupted by brief periods when your mood was normal or slightly happy?
47	0.78		+		Have there been times when you hated yourself or felt that you were stupid, ugly, unlovable, or useless?
69	0.77		+		Have there been times of several days or more when you have struggled to control an urge to cry, have had frequent crying spells, or found yourself crying without really understanding why (other than related to the menstrual cycle)?
9	0.75		+		Have there been periods lasting several days or more when you lost almost all interest in people close to you and spent long times by yourself?
49	0.74		+		Have there been times of a day or more when you had no feelings or emotions and seemed cut off from other people?

Table 3. The two factor solution of the A-GBI (continued)

Item	Factor I	Factor II	Depressive*	Hypomanic/ Biphasic†	Questions
20	0.72		+		Have there been periods lasting several days or more when you spent much of your time brooding about unpleasant things that have happened?
41	0.70		+		Have you had periods of several days or more when it was difficult or almost impossible to think and your mind felt sluggish, stagnant, or "dead"?
71	0.70		+		Have you found yourself at times feeling fearful or suspicious of your environment or people around you?
13	0.67		+		Have there been times when you lost almost all interest in the things that you usually like to do (such as hobbies, school, work, entertainment)?
35	0.67			+	Has it seemed that you experience both pleasurable and painful emotions more intensely than other people?
52	0.66		+		Have you had periods of sadness and depression when, for several days or more, it took you over an hour to get to sleep at night, even though you were very tired?
22	0.63			+	Have you had periods of extreme happiness and intense energy lasting several days or more when you also felt much more anxious or tense (jittery, nervous, uptight) than usual (other than related to the menstrual cycle)?
36	0.63		+		Have there been periods of several days or more when you felt guilty and thought you deserved to be punished for something you had or had not done?
18	0.63		+		Have there been times of several days or more when you were so tired and worn out that it was very difficult or even impossible to do your normal everyday activities (not including times of intense exercise, physical illness, or heavy work schedules)?
26	0.61		+		Have you had periods when you were so down that you found it hard to start talking or that talking took too much energy?
1	0.60		+		Have there been periods, over the last year, when it was almost impossible to make small decisions even though this may not be generally true of you?
6	0.59		+		Have people said that you looked sad or lonely?
57	0.59			+	Have there been times when you had blank spells in which your activities were interrupted, and you did not know what was going on around you?
59	0.58		+		Have there been periods of several days or more when you were slowed down and couldn't move as quickly as usual?
40	0.58			+	Have you found that your feelings or energy are generally up or down, but rarely in the middle?
12	0.57		+		Have there been times when your memory or concentration seemed especially poor and you found it difficult, for example, to read or follow a TV program, even though you tried?
19	0.57			+	Has your mood or energy shifted rapidly back and forth from happy to sad or high to low?
28	0.57		+		Have there been periods other than when you were physically ill that you had more than one of the following: (a) headaches or feelings of tightness, pressure, or "wooziness" in your head; (b) dizziness; (c) constipation or diarrhea; (d) aches and pains; (e) nausea, vomiting, or stomach aches; (f) blurred vision; (g) trembling or shaking hands; or (h) feeling too hot or too cold?
2	0.56			+	Have you found your enjoyment in being with people changes -- from times when you enjoy them immensely and want to be with them all the time, to times when you do not want to see them at all?

Table 3. The two factor solution of the A-GBI (continued)

Item	Factor I	Factor II	Depressive*	Hypomanic/ Biphasic†	Questions
39	0.53		+		Have there been times when you were feeling low and depressed, and you also had to struggle very hard to control inner feelings of rage or an urge to smash or destroy things?
10	0.52		+		Have you had periods of several days or more when food seemed rather flavorless and you didn't enjoy eating at all?
33	0.48		+		Have you experienced times of several days or more when you felt as if you were moving in slow motion?
66	0.48			+	Have then been times when you began many new activities with lots of enthusiasm and then found yourself quickly losing interest in them?
29	0.46	0.40	+		Have you experienced periods of several days or more when were feeling down and depressed, and you also were physically restless, unable to sit still, and had to keep moving or jumping from one activity to another?
5	0.46		+		Have there been periods of several days or more when you felt that you needed more sleep, even though you slept longer at night or napped more during the day (not including times of exercise, physical illness, or heavy work schedules)?
37	0.46		+		Have you had times of several days or more when you woke up frequently or had trouble staying asleep during the middle of the night?
70	0.45		+		Have there been times of several days or more when almost all sexual interest was lost?
42	0.44			+	Have there been times when you had a strong urge to do something mischievous, destructive, risky, or shocking?
21	0.44		+		Have there been times when you felt that you were physically cut off from other people or from yourself, or felt as if you were in a dream, or felt that the world looked different or had changed in some way?
8	0.41			+	Have there been periods of several days or more when you could not keep your attention on any one thing for more than a few seconds, and your mind jumped rapidly from one thought to another or to things around you?
25	0.40		+		Have there been times of several days or more when you wake up much too early in the morning and have problems getting back to sleep?
60	0.40		+		Have you experienced weight changes (increases, decreases, or both) of five pounds or more in short periods of time (three weeks or less), not including changes due to physical illness, menstruation, exercise, or dieting?
38		0.63		+	Have you had periods of extreme happiness and high energy lasting several days or more when what you saw, heard, smelled, tasted, or touched seemed vivid or intense?
43		0.60		+	Have there been periods of several days or more when your thinking was so clear and quick that it was much better than most other people's?
64		0.57		+	Have you had times when your thoughts and ideas came so fast that you couldn't get them all out, or they came so quickly others complained that they couldn't keep up with your ideas?
30		0.56		+	Have there been times lasting several days or more when you felt you must have lots of excitement, and you actually did a lot of new or different things?
46		0.53		+	Have there been times of several days or more when you felt that you were a very important person or that your abilities or talents were better than most other people's?
48		0.52		+	Have you found that your thinking changes greatly – that there are periods of several days or more when you think better than most people, and other periods when your mind doesn't work well at all?

Table 3. The two factor solution of the A-GBI (continued)

Item	Factor I	Factor II	Depressive*	Hypomanic/ Biphasic[†]	Questions
31		0.52		+	Have you had periods of extreme happiness and intense energy (clearly more than your usual self) when, for several days or more, it took you over an hour to get to sleep at night?
53		0.50		+	Have you had periods lasting several days or more when you felt depressed or irritable, and then other periods of several days or more when you felt extremely high, elated, and overflowing with energy?
15		0.48		+	Have there been times of several days or more when you did not feel the need for sleep and were able to stay awake and alert for much longer than usual because you were full of energy?
27		0.47		+	Have there been times of several days or more when, although you were feeling unusually happy and intensely energetic (clearly more than your usual self), you also had to struggle very hard to control inner feelings of rage or an urge to smash or destroy things?
54		0.46		+	Have there been periods when, although you were feeling unusually happy and intensely energetic, almost everything got on your nerves and made you irritable or angry (other than related to the menstrual cycle?)
17		0.42		+	Have you had periods of several days or more when you wanted to be with people so much of the time that they asked you to leave them alone for a while?

All loadings ≥0.40 appear in the table. Loadings for items 4, 7, 11, 24, 44, 51, 58, 61, 65, and 67 were all below 0.40. *items included in Depressive subscales in original A-GBI, [†]items included in hypomanic/biphasic subscales in original A-GBI. A-GBI: adolescent version of General Behavioral Inventory

Table 4. Correlations of Factor I and II scores with mood and anxiety scales

	Factor I	Factor II	A-GBI depressive	A-GBI hypomanic/biphasic
Factor I	1	0.477[†]	0.990[†]	0.800[†]
Factor II	0.477[†]	1	0.517[†]	0.877[†]
RCMAS	0.666[†]	0.332[†]	0.664[†]	0.570[†]
CDI	0.764[†]	0.274[†]	0.770[†]	0.550[†]
P-GBI	0.241*	0.255*	0.266[†]	0.322[†]

*$p < 0.01$, [†]$p < 0.001$. A-GBI: adolescent version of General Behavioral Inventory, CDI: Children's Depression Inventory, P-GBI: parent version of General Behavioral Inventory, RCMAS: Revised Children's Manifest Anxiety Scale

factor assessing hypomanic/biphasic symptoms.

Factor I included a total of 51 items, 42 out of 46 items in the A-GBI depressive subscale and 9 out of 28 items in the A-GBI hypomanic/biphasic subscale. Factor II included a total of 13 items, 1 from the depressive subscale and 12 from the hypomanic/biphasic subscale. Items 4, 7, 11, 24, 44, 51, 58, 61, 65, and 67 were excluded because the factor loading value was 0.4 or lower.

To eliminate the influence of comorbidity on the EFA, additional round of analysis was performed on the group of subjects without a comorbidity (n=119) (Supplementary Table 1 in the online-only Data Supplement). The data of this group were best fitted by a two-factor model. Factor I included 44 items and Factor II included 16. Most items showed similar tendencies, except for two. Item 29 was included in both Factor I and II and item 33 in Factor II in the EFA on the entire sample, whereas both items were included in Factor II in the EFA for the group of subjects without a comorbidity.

Analyses of Factor I and II scores

According to the correlation analyses on the factor scores (Table 4), Factor I was very strongly correlated with the A-GBI depressive subscale (r=0.990, p<0.001), and Factor II with the A-GBI hypomanic/biphasic subscale (r=0.877, p<0.001). The correlation analyses which were conducted to examine the relationships between factor scores and other scales showed that Factor I was strongly correlated with RCMAS (r=0.666, p<0.001) and CDI (r=0.764, p<0.001). However, Factor II was weakly correlated with other assessment tools, whereas A-GBI hypomanic/biphasic subscale was moderately correlated with RCMAS (r=0.570, p<0.001) and CDI (r=0.550, p<0.001).

Next, factor scores were compared among the diagnostic groups (Table 5). Factor I score was significantly higher in the depressive disorder and bipolar disorder groups than in the

Table 5. Factor scores according to the diagnosis of the mood disorder

	Depressive (n=134)	Bipolar (n=53)	Non-mood (n=33)	F	p	Post-hoc
Factor I	0.04±0.91	0.39±1.01	-0.78±0.84	15.268	<0.001	D, B>N
Factor II	-0.12±0.87	0.38±1.10	-0.15±0.86	5.580	0.004	B>D, N

Data are mean±standard deviation values. B: bipolar disorder group, D: depressive disorder group, N: non-mood disorder group

non-mood disorder group (F=15.268, p<0.001). Furthermore, Factor II score was significantly higher in the bipolar disorder group than in the depressive disorder and non-mood disorder groups (F=5.580, p=0.004).

DISCUSSION

In the present study, EFA was conducted on the Korean version of A-GBI and two common factors were identified from the individual items. Of the 46 items of the depressive subscale, 42 were included in Factor I and 1 in Factor II, and 9 of 28 items of the hypomanic/biphasic subscale were included in Factor I and 12 in Factor II. Therefore, Factor I and Factor II are thought to show similar trends with A-GBI depressive subscale and A-GBI hypomanic/biphasic subscale, respectively. Additionally, the correlation coefficient of Factor I and the depressive subscale of GBI was 0.990 and that of Factor II and the hypomanic/biphasic subscale of GBI was 0.877, indicating that each of the pairs has a very strong positive correlation. These findings are consistent with a previous finding that two factors, depressive and hypomanic/biphasic, were identified using GBI in youths [19]. The present study demonstrated that the Korean version of A-GBI is constituted of two factors, suggesting a two-dimensional model of mood symptoms in Korean youths.

However, there were discrepancies between the individual items included in Factors I and II of the present study and those of the depressive and hypomaniac/biphasic subscales in the English version of A-GBI. Regarding the English version of A-GBI, items 2, 8, 19, 22, 35, 40, 42, 57, and 66 are in the hypomaniac/biphasic subscale. But in this study, they were included under Factor I, a factor representing depressive mood. These items are related to rapid mood swings, impulsivity, and the increasing level of perceived mood. Also, items 4, 7, 11, 24, 44, 51, 58, 61, 65, and 67 were not included in either factor. These are mainly about euphoric mood or symptoms of seasonal/diurnal mood swings. The discrepancies in the items included in Factors I and II and the depressive and hypomaniac/biphasic subscales may be related to cultural influences. Specifically, mood disorder and relevant symptoms are known to vary among different cultures [20]. The notion of depression has been developed with reference to Western culture and in particular, individuals of Asian culture tend to express more physical symptoms, like insomnia, loss of appetite, and fatigue

[20-22]. The report and interpretation may also differ with respect to manic symptoms [23]. Indeed, previous studies have shown that Koreans more frequently reported symptoms of low energy, concentration difficulty, and poor appetite, and less frequently reported depressed mood and thoughts of death [20,24]. The prevalence of bipolar disorder in youths is reported to vary in different countries, as well [25]. However, it should be determined in a future study whether the aforementioned discrepancies in individual items were due to cultural differences or different sizes of the diagnosis group, as the proportion of those experiencing manic or hypomanic episode was very low in this study (n=4).

A-GBI depressive subscale score was higher in the depressive and bipolar disorder groups compared to the non-mood disorder group, and A-GBI hypomaniac/biphasic subscale score was significantly higher in the bipolar disorder group. These findings are in line with previous studies showing that A-GBI is a useful tool for screening mood disorder in youths [11,12]. Particularly, both hypomaniac/biphasic subscale and Factor II scores were higher in the bipolar disorder group than in the depressive group. The finding suggests that A-GBI is effective in distinguishing bipolar disorder from depressive disorder.

Item 29, which were included in both Factors I and II, and item 33, which was included in Factor I, were classified to Factor II in the EFA conducted only with the subjects without a comorbidity. Mood disorder in childhood and adolescence is well known to co-occur with diverse psychiatric disorders such as anxiety disorder, ADHD, and substance use disorder [26]. Some subjects in the mood disorder groups in this study also had anxiety disorder, somatic symptoms disorder, and ADHD. Hence, the presence or absence of these comorbidities might have influenced the EFA results. Aside from items 29 and 33, however, most of the other items showed similar trends, and the EFA on the subjects only with mood disorder also confirmed that A-GBI consists of two factors.

The study has the following limitations. First, the study sample may have been biased, as the sample was composed of children and adolescents who visited a single university hospital; subjects visiting a tertiary hospital tend to have more severe symptoms. Future study samples should include community youths. Second, the number of subjects having manic symptoms was low. A-GBI is used to assess both depressive and hypomanic/biphasic symptoms simultaneously, but only

4 of the study subjects were experiencing manic symptoms. This number was very low in comparison to 162 subjects manifesting depression. Hence, the EFA results may have been influenced by such a wide variation. Third, the data were collected by performing a retrospective chart review, and the diagnosis was determined on the basis of the recorded diagnosis or other records in the patient charts. Thus, diagnostic accuracy could be lower compared to a structured interview like Kiddie Schedule for Affective Disorders and Schizophrenia-Present and Lifetime. Finally, other assessment tools for bipolar mood symptoms were not administered. The relationship between Factor II and bipolarity could be evaluated more accurately by examining the correlations between Factor II and other assessment tools for bipolar symptoms, but no such tools were available in this study. This limitation is believed to be due to the methodology of retrospective chart reviews. More accurate results are expected if, in the future, assessment tools for bipolar mood symptoms are included in prospectively conducted research.

Nevertheless, the study is of significance in that the structure of mood symptoms in Korean youths was examined by performing EFA on the Korean version of A-GBI, and that the Korean version of the tool is found to be useful in assessing mood disorder in youths.

CONCLUSION

This study was conducted to examine the structure of mood symptoms in Korean youths by conducting EFA on data from Korean youths who self-administered A-GBI. The analysis revealed two mood symptom factors that can be discriminated with the use of the Korean version of A-GBI, a finding in line with a two-dimensional model of the mood symptoms.

Supplementary Materials

Acknowledgments

Conflicts of Interest
The authors have no potential conflicts of interest to disclose.

Author Contributions
Conceptualization: Hyo-Won Kim, Han-Sung Lee. Data curation: Hyo-Won Kim, Han-Sung Lee. Formal analysis: Hyo-Won Kim, Han-Sung Lee. Funding acquisition: Hyo-Won Kim. Investigation: Yejin Kwon, Seung-Hyun Shon, Kee Jeong Park. Writing—original draft: Hyo-Won Kim, Han-Sung Lee. Writing—review & editing: Yejin Kwon, Seung-Hyun Shon, Kee Jeong Park.

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