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Association between Childhood Attention Deficit Hyperactivity Disorder Features and Adulthood Psychological Resilience in Patients with Mood Disorders

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Objectives Psychological resilience plays a significant role in many aspects of mental health. The aim of this study was to find an association between childhood attention deficit hyperactivity disorder (ADHD) features and adulthood psychological resilience in patients with mood disorders.

Methods A total of 213 patients with mood disorders including major depressive disorder or bipolar I, II disorder and 909 healthy controls were included. We assessed childhood ADHD features using the Wender Utah Rating Scale (WURS), adulthood psychological resilience using the Connor-Davidson Resilience Scale (CD-RISC), and current depressive mood using the Beck Depression Inventory (BDI). Pearson's correlation, multiple linear regression and a mediation analyses were performed to examine the relationships between three WURS factor (impulsivity, inattention, and mood instability) scores, the BDI score, and the CD-RISC score.

Results The CD-RISC score was negatively correlated with the WURS childhood inattention factor score and current BDI score in patients with mood disorders. BDI score mediated the influence of the inattention factor score on CD-RISC score among patients with mood disorders. The CD-RISC score was significantly lower in patients with mood disorders than in controls even after controlling for age, WURS scores, and the BDI score.

Conclusions An evaluation of psychological resilience is important for enhancing recovery and quality of life in patients with mood disorders. When assessing psychological resilience, current depression and ADHD features in childhood, particularly inattention, should be considered.

Key Words Psychological resilience · Attention deficit hyperactivity disorder · Bipolar disorder · Major depressive disorder · Mood disorder.

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Introduction

Psychological resilience refers to an individual's psychosocial ability to recover and return to a prior level of adaptation under adversity.[1)] Resilience is a dynamic and complex multidimensional structure consisting of the interaction among neurobiological, social, and personal factors that preserve normal physical and psychological function. Resilience is a protective factor against psychiatric disorders[2)] and varies widely among individuals. Therefore, it is important to identify the various factors that determine psychological resilience. Previous studies have reported that school or parental support, good fear responsiveness, optimism, self-efficacy, adaptive social behavior, and positive peer relationships in childhood are characteristics associated with enduring adversity and recovering to grow positively.[3-6)] Characteristics such as chronic illness, poverty, separation from parents, and exposure to violence negatively affect psychological resilience.[3-6)]

Psychological resilience is important not only in healthy indi-

viduals but also in patients with mental illness. Psychological resilience plays a crucial role during the entire treatment process, particularly recovery from psychiatric symptoms and rehabilitation from later illnesses. Some studies indicate that interventions to bolster psychological resilience help reduce the severity of traumatic stress and depressive symptoms in veterans of Operations Enduring Freedom and Iraqi Freedom with post-traumatic stress disorder (PTSD).[7] Furthermore, psychological resilience moderates the severity of depressive symptoms in subjects exposed to childhood trauma both as a main effect and in an interaction with trauma exposure.[8] In addition, practicing to enhance psychological resilience improves plasticity and the regulation of neural circuits that modulate reward and motivation, fear responses, mood regulation, learning memory, attention, and cognition, thereby improving recovery and adaptation to stress and trauma.[9]

Psychological resilience was initially regarded as a trait. In previous studies that assessed the functioning of children and adolescents whose parents had psychiatric disorders, psychological resilience, such as considerable self-understanding, a deep commitment to relationships, and the ability to think and act separately from their parents, is an individual natural tendency that is an important factor in the primary prevention of mental health disorders.[10] In other respects, psychological resilience is understood as a state. Psychological resilience changes dynamically and is determined by the interaction between an individual's developmental stage and environment that is reintegrated during crisis and confusion.[11-13]

As human traits are based on a genetic predisposition and manifest from childhood, we hypothesized that childhood characteristics would generally influence adulthood psychological resilience. Childhood characteristics were measured using the Wender Utah Rating Scale (WURS), a retrospective subjective scale of childhood attention deficit hyperactivity disorder (ADHD) features. The ADHD features of childhood are traits that may influence adulthood and correlate with adult psychological resilience. Several studies have been conducted on the relationship between childhood ADHD and adulthood psychological difficulties. Children with ADHD often continue to have ADHD symptoms in adulthood, and adults with a history of childhood ADHD have a comparatively high prevalence of other mental disorders, such as conduct disorder or a mood disorder, that develop subsequent to ADHD.[14][15] Hyperactivity seen in childhood is significantly reduced in adults, and surface activity is maintained at a comparatively appropriate level. However, a lack of organizational capacity, academic and work performance problems, excessive emotional reactions, severe emotional instability, and depressive symptoms remain.[16-18] Socioeconomic status and self-esteem are low in adults who have experienced childhood ADHD symptoms, and they suffer from persistent mental health difficulties.[19] In addition, childhood ADHD symptoms are associated with the risk of developing an adult alcohol abuse disorder[20] or a smartphone addiction.[21]

Therefore, we investigated whether childhood ADHD features are associated with adulthood psychological resilience not only in health controls but also in patients with mood disorders. In addition, we investigated whether there is a difference between healthy controls and patients with mood disorders regarding the effects of ADHD features on psychological resilience. Based on our results, we hope to be able to identify more ways to improve psychological resilience in patients with mood disorders and in healthy controls.

Methods

Subjects

This study included 909 healthy controls and 213 patients with mood disorders. Patients with mood disorders included 180 with major depressive disorder, 12 with bipolar disorder type I, and 21 bipolar disorder type II. The patients with mood disorders were enrolled from patients who visited the outpatient clinic of the psychiatric department of Nowon Eulji Medical Center (Seoul, Korea) and who agreed to participate in the study after hearing an explanation of the study. Diagnoses were assigned to each patient according to the criteria in the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition. To reach a consensus on the final diagnosis of each patient, at least two other psychiatrists reviewed the medical records and psychiatric interviews conducted by research nurses. Patients who had a substance use disorder, organic brain syndrome, or any other general medical condition that might have a psychiatric manifestation were excluded. Research nurses enrolled the healthy controls after a brief psychiatric interview. Most of the healthy controls were recruited from among college students, nurses, and fire and public protection officers. The healthy controls were excluded if they reported a history of a psychotic disorder, mood disorder, anxiety disorder, substance use disorder, brain trauma, or intellectual disability. Whether subjects have the diagnosis of ADHD in their childhood and current state was not evaluated in this study. This study was approved by Ethics Committee of Eulji Hospital (Eulji 12-69).

Measurements

To measure childhood ADHD features, we used the WURS, which is a retrospective self-reporting scale that measures ADHD symptoms experienced before the age of 12 years. Each item is

rated on a scale from 0 to 4. We used the short version of the WURS that was translated into Korean. The Korean version consists of 25 items extracted from the original WURS that were determined to be valid and reliable in Western countries.[16] This version has been tested for internal validity.[22] In order to compare childhood ADHD symptoms between patients with mood disorders and healthy controls, cut off score was based on WURS total score of 36 suggested in the previous study.[23]

We used the Connor-Davidson resilience scale (CD-RISC) to measure adulthood psychological resilience. The CD-RISC was developed by Conner and Davidson as a tool to measure successful stress coping abilities.[24] A total of 25 items were scored based on a five-point scale (0–4), and the higher the score, the higher the resilience. The reliability and validity of the Korean version of the CD-RISC has been verified[25][26] and we used this version of the scale. In this study, psychological resilience at the time of the survey was evaluated, and only the total score was used.

We used the Beck Depression Inventory (BDI) to measure current depressive mood. The BDI is a self-administered questionnaire comprising 21 items designed to assess the degree of depressive symptoms.[27] Each scale is evaluated within the range of 0–3 points. The Korean version of the BDI has proven internal validity.[28] Depressive symptoms were evaluated at the time of the survey.

Statistical analyses

A factor analysis was conducted to examine whether the WURS factor score and the total WURS score affected psychological resilience. Our previous studies have shown that the WURS has a three-factor structure [impulsivity (IMP), inattention (INATT), and mood instability (MOOD)].[29] The factor analysis was performed based on the condition that the three factors could be extracted for the study subjects (Table 1). This sample was appropriate for the factor analysis (Kaiser-Meyer-Olkin measure = 0.95; Bartlett's test of sphericity < 0.001). Equamax rotation was

Table 1. WURS items and scores of the three factors used in this study

WURS items	IMP	INATT	MOOD
Temper outbursts, tantrums	0.726	0.119	0.312
Disobedient, rebellious, sassy	0.706	0.186	0.215
Acting without thinking, impulsive	0.682	0.446	0.042
Hot or short tempered, low boiling point	0.637	0.103	0.477
Stubborn, strong willed	0.632	0.016	0.124
Irritable	0.627	0.136	0.527
Angry	0.607	0.090	0.580
Trouble with authorities and school, visits to principal's office	0.573	0.195	0.001
Tendency to be or act irrational	0.567	0.411	0.192
Trouble seeing things from someone else's point of view	0.562	0.402	0.140
Overall a poor student, slow learner	0.087	0.720	0.177
Not achieving up to potential	0.003	0.667	0.327
Trouble with mathematics or numbers	0.038	0.641	0.185
Concentration problems, easily distracted	0.263	0.573	0.107
Tendency to be immature	0.438	0.569	0.188
Loses control of self	0.451	0.565	0.217
Trouble with stick-to-itiveness	0.393	0.532	0.142
Inattentive, daydreaming	0.260	0.511	0.404
Unpopular with other children	0.169	0.486	0.287
Sad or blue, depressed, unhappy	0.221	0.140	0.781
Anxious, worrying	0.104	0.270	0.768
Nervous, fidgety	0.185	0.183	0.752
Low opinion of self	0.020	0.394	0.666
Guilty feeling, regretful	0.077	0.481	0.634
Moody, ups and downs	0.507	0.154	0.552
Initial eigen values	10.136	1.718	2.069
Eigen values after rotation	5.102	4.314	4.507
Percentage of variance	20.408	17.256	18.028

WURS : Wender Utah Rating Scale, IMP : Impulsivity, INATT : Inattention, MOOD : Mood instability

performed to maximize the loading of each variable on one of the extracted factors and to minimize the loading on all other factors. Rotation converged after 18 iterations.

The independent t-test or chi-square test was used to examine the differences in sociodemographic variables and the CD-RISC, WURS, and BDI scores between healthy controls and patients with mood disorders. Pearson's correlation analyses were performed to investigate the correlations between age, the WURS score, the three WURS factor scores, the BDI score, and the CD-RISC score. A multiple linear regression analysis was conducted to examine the association between the CD-RISC score and independent variables, such as age, the three WURS factor scores, and the BDI score. To verify the mediating effect of the BDI score between the three WURS factor scores and CD-RISC score in patients with mood disorders, we conducted a mediation analysis using the Baron and Kenny mediational model.[30] Sobel Test was calculated to test significance of the mediation effect.[31] Analysis of covariance (ANCOVA) was performed to detect significant differences in the CD-RISC score between the healthy controls and patients with mood disorders after controlling for sex, age, the three WURS factor scores, and the BDI score. A p-value < 0.05 was considered significant. These analyses were performed using IBM SPSS Statistics version 20 software (IBM Corp., Armonk, NY, USA).

Results

Comparison of demographic and clinical characteristics between patients with mood disorders and healthy controls

Of the 1122 total subjects, 448 were males and 674 were females. There were 213 patients with mood disorders (45 males and 168 females) and 909 healthy controls (403 males and 506 females). When we set up a total score or 36 or more as a cutoff point for suspicious childhood ADHD, childhood ADHD symptoms were found in 62 (29.1%) patients with mood disorder and 129 (14.2%) healthy controls, respectively. The independent t-test revealed that the CD-RISC score was significantly lower in patients with mood disorders than in healthy controls ($p < 0.001$). The total WURS score and the MOOD ($p < 0.001$) and INATT ($p = 0.003$) scores were significantly higher in patients with mood disorders than in healthy controls. However, the IMP score was higher in healthy controls than in patients with mood disorders ($p = 0.016$). The BDI score was significantly higher in patients

Table 2. Characteristics and comparison of demographic and clinical variables in patients with mood disorders and healthy controls

	Patients (n = 213)	Controls (n = 909)	t	p
Sex				< 0.001*
Male	45 (21.13)	403 (44.33)		
Female	168 (78.87)	506 (55.67)		
Age (years)	49.74 ± 16.24	25.38 ± 6.22	-21.53	< 0.001
CD-RISC	50.85 ± 18.14	63.45 ± 14.91	-9.43	< 0.001
WURS	24.94 ± 18.80	19.47 ± 15.08	3.96	< 0.001
IMP	-0.17 ± 1.17	0.04 ± 0.95	-2.43	0.016
INATT	0.21 ± 1.18	-0.05 ± 0.94	2.96	0.003
MOOD	0.46 ± 1.36	-0.10 ± 0.86	5.74	< 0.001
BDI	25.31 ± 12.46	10.51 ± 6.99	16.74	< 0.001

Values are presented as mean ± standard deviation or n (%) unless otherwise indicated. * : Chi-square test is used ($\chi^2 = 38.75$). CD-RISC : Connor-Davidson Resilience Scale, WURS : Wender Utah Rating Scale, IMP : Impulsivity, INATT : Inattention, MOOD : Mood instability, BDI : Beck Depression Inventory

Table 3. Associations between the CD-RISC score of patients with mood disorders and healthy controls, and age, WURS total score, three WURS factor scores, and BDI score

	Patients		Controls		Total	
	r*	p	r*	p	r*	p
Age	0.356	< 0.001	-0.081	0.014	-0.157	< 0.001
WURS total	-0.204	0.003	-0.233	< 0.001	-0.253	< 0.001
IMP	-0.037	0.588	-0.031	0.357	-0.006	0.843
INATT	-0.217	0.001	-0.170	< 0.001	-0.203	< 0.001
MOOD	-0.094	0.173	-0.235	< 0.001	-0.243	< 0.001
BDI	-0.441	< 0.001	-0.405	< 0.001	-0.494	< 0.001

* : Pearson's correlation coefficient. CD-RISC : Connor-Davidson Resilience Scale, WURS : Wender Utah Rating Scale, BDI : Beck Depression Inventory, IMP : Impulsivity, INATT : Inattention, MOOD : Mood instability

with mood disorders than in healthy controls ($p < 0.001$) (Table 2).

Associations between age, childhood ADHD features, current depressive mood, and psychological resilience

Age, the total WURS score, and the BDI score were significantly correlated with the CD-RISC score in all groups (patients, controls, and total). The INATT score was negatively correlated with the CD-RISC score in all groups, whereas the IMP score was not correlated with the CD-RISC score in any group, and the MOOD score was negatively correlated with the CD-RISC score in the control and total groups (Table 3).

Multiple linear regression analyses of clinical variables and psychological resilience

The three WURS factors were significantly associated with resilience in all subjects. Our multiple linear regression model, which considered the CD-RISC score as the dependent variable, and age, the three WURS factor scores, and the BDI score as independent variables, produced significant regression coefficients for the INATT ($\beta = -0.139$, $p < 0.001$), MOOD ($\beta = -0.072$, $p = 0.010$), and BDI ($\beta = -0.450$, $p < 0.001$) scores (Table 4).

Table 4. Multiple linear regression analysis of the associations between the CD-RISC score for all subjects and age, three WURS factor scores, and BDI score

	B	SE	β	t	p
Age	0.004	0.034	0.003	0.103	0.918
WURS factors					
IMP	0.427	0.430	0.026	0.993	0.321
INATT	-2.286	0.425	-0.139	-5.382	< 0.001
MOOD	-1.179	0.455	-0.072	-2.593	0.010
BDI	-0.725	0.048	-0.450	-15.191	< 0.001

The multiple linear regression model was statistically significant ($R^2 = 0.267$, adjusted $R^2 = 0.264$, $F = 81.501$, $p < 0.001$). CD-RISC : Connor-Davidson Resilience Scale, WURS : Wender Utah Rating Scale, BDI : Beck Depression Inventory, SE : Standard error, IMP : Impulsivity, INATT : Inattention, MOOD : Mood instability

Mediating effect of current depressive mood on the relationship between childhood ADHD features and psychological resilience for patients with mood disorders

In our mediation analysis, a mediation model was employed to characterize the effect of the INATT score (independent variable) on CD-RISC score (dependent variable) using BDI score as a mediator variable. Simple linear regression model which considered the CD-RISC score as a dependent variable and IMP score or MOOD score as an independent variable, the regression efficient was not statistically significant. Thus, these two variables were not included in the mediation analysis. In first regression analysis model, INATT score ($\beta = -0.217$, $p = 0.001$) was a significant predictor of CD-RISC score. Also in second regression analysis model, INATT score ($\beta = 0.159$, $p = 0.020$) was a significant predictor of BDI score. In third regression analysis model, both INATT score ($\beta = -0.151$, $p = 0.016$) and BDI score ($\beta = -0.417$, $p < 0.001$) were significant predictors of CD-RISC score. A Sobel test further confirmed the significance of the mediation effect (CD-RISC score: $z = -2.209$, $p = 0.027$), thus showing that BDI score mediated the influence of the INATT score on CD-RISC score among patients with mood disorders (Table 5).

ANCOVA

The ANCOVA showed that the CD-RISC score was significantly lower in patients with mood disorders than in healthy controls ($p < 0.001$) after controlling for other covariates. The BDI score ($F = 171.017$, $p < 0.001$) and INATT score ($F = 15.548$, $p < 0.001$) were significant covariates for the CD-RISC score in the ANCOVA model. However, age ($F = 0.529$, $p = 0.467$), the IMP score ($F = 1.996$, $p = 0.158$), and MOOD score ($F = 2.615$, $p = 0.106$)

Table 5. Mediating effect of BDI score on the relationship between three WURS factor scores and CD-RISC score for patients with mood disorders

Variable	B	SE	β	t	p	Adjusted R^2	Model p
1st model							
Independent : INATT score	-3.338	1.033	-0.217	-3.231	0.001	0.043	0.001
Dependent : CD-RISC score	-	-	-	-	-	-	-
2nd model							
Independent : INATT score	1.679	0.718	0.159	2.339	0.020	0.021	0.020
Dependent : BDI score	-	-	-	-	-	-	-
3rd model							
Independent : INATT score	-2.319	0.951	-0.151	-2.438	0.016	0.209	< 0.001
Mediator : BDI score	-0.607	0.090	-0.417	-6.737	< 0.001	-	-
Dependent : CD-RISC score	-	-	-	-	-	-	-

The Sobel test showed a significant mediation effect ($Z = -2.209$, $p = 0.027$). BDI : Beck Depression Inventory, WURS : Wender Utah Rating Scale, CD-RISC : Connor-Davidson Resilience Scale, SE : Standard error, INATT : Inattention

were not significant covariates for the CD-RISC score in the model. In addition, in the model, age ($p < 0.001$), the MOOD score ($p = 0.029$), and BDI score ($p = 0.009$) had a significantly different effect on the CD-RISC score in the patient and control groups. However, the IMP score ($p = 0.412$) and INATT score ($p = 0.663$) had no different effect on the CD-RISC score in the patient and control groups (Table 6).

Discussion

We retrospectively assessed the features of ADHD in childhood and determined whether these features correlated with current psychological resilience. In our study, childhood ADHD features measured using the total WURS score were correlated significantly with the CD-RISC score in the patients with mood disorders and in healthy controls. ADHD is a risk factor for lower resilience in adolescence independently of intelligence level, socioeconomic status, depression or anxiety, and age.[32] Moreover, personal resilience is associated with better psychosocial functioning and less anxiety and depression in patients with ADHD.[33]

Among childhood ADHD features, the inattention feature was correlated with psychological resilience, and had the same negative effect on psychological resilience in patients with mood disorders and in healthy controls. A study performed on medical students in China reported that only inattention is negatively correlated with life satisfaction, and that resilience acts as a mediator between inattention and life satisfaction.[34] That study supports our finding that the inattention feature in childhood leads to a lack of complex cognitive ability in a social context, which would make it difficult to cope with psychosocial adversity in adulthood. Compared to hyperactivity, inattention continues to exist and is a dominant feature of ADHD in adulthood.[35][36] It is known that inattention is strongly associated with depression and anxiety.[37] Taken together, these studies suggest that regardless of whether an individual is diagnosed with mood disorders or not, evaluating the inattention trait during childhood and in adults in the present state may be useful for assessing psychological resilience.

Psychological resilience functions as a mediator and moderator between childhood adversity and depression during childhood and adulthood. The association between adverse childhood experiences and depression is stronger in subjects with low resilience than in the subjects with high resilience.[38] In school-attending adolescents in China, resilience acts as a partial mediator and moderator at the same time in the relationship between childhood trauma and depressive symptoms.[39] Another study indicated that the incidence of a mental disorder is not dependent on childhood trauma, but rather on resilience, indicating that resilience plays a protective role against mental disorders.[40] It is expected that mood instability in childhood may affect adulthood psychological resilience. Problems with childhood emotion dysregulation influence social problems in adult life.[41] However, the results were mixed in our study. The childhood mood instability feature (MOOD factor) was correlated with psychological resilience in healthy controls but not in patients with mood disorders. Further research on a possible role of childhood mood instability in psychological resilience is needed.

Not all childhood ADHD features affect psychological resilience. Low levels of resilience are related to high levels of impulsivity.[42][43] However, in our study, the childhood impulsivity feature was not correlated with psychological resilience in either the patients with mood disorders or in healthy controls. Child-

Table 6. Results of analysis of covariance assessing the differences between CD-RISC scores of patients with mood disorders and healthy controls after controlling for age, three WURS factor scores, and BDI score

Source	Sum of squares	df	F	p
Group (patients, control)	10061.505	1	54.003	< 0.001
Age	98.472	1	0.529	0.467
WURS factors				
IMP	371.811	1	1.996	0.158
INATT	2896.742	1	15.548	< 0.001
MOOD	487.206	1	2.615	0.106
BDI	31862.538	1	171.017	< 0.001
Interaction between group and variables				
Group × Age	10565.314	1	56.708	< 0.001
Group × IMP	125.374	1	0.673	0.412
Group × INATT	35.346	1	0.190	0.663
Group × MOOD	887.042	1	4.761	0.029
Group × BDI	1262.106	1112	6.774	0.009

CD-RISC : Connor-Davidson Resilience Scale, WURS : Wender Utah Rating Scale, BDI : Beck Depression Inventory, IMP : Impulsivity, INATT : Inattention, MOOD : Mood instability

hood impulsivity, such as temper outbursts and acting without thinking, may decrease with development. As mentioned previously, hyperactivity and impulsivity symptoms tend to decline with development at a higher rate than inattention symptoms.[35)36)] This developmental characteristic of impulsivity would be one of the reasons behind our lack of a correlation between impulsivity in childhood and psychological resilience in adulthood.

The effect of current depressive mood on psychological resilience was significant. Especially in our analysis, current depressive mood mediated the influence of the inattention feature on psychological resilience among patients with mood disorders. Many studies have investigated the relationship between psychological resilience and mood in various groups of subjects. A recent meta-analysis on geriatric populations reported a significant association between greater resilience and less depressive symptoms.[44)] Another study of people who suffered from a disaster found a significant inverse relationship between psychological resilience and depressive symptoms.[45)] Low resilience along with high negative symptoms and female gender are directly associated with depression severity in patients with schizophrenia,[46)] and resilience is correlated with hopelessness, self-esteem, spirituality, and quality of life in patients with bipolar disorder and schizophrenia.[47)] Significant correlations were observed between the diagnosis of depressive disorder in the past, current BDI score, and psychological resilience in a Korean population.[26)] Our findings were consistent with all of these previous studies. Evaluating the current mood state is important when assessing psychological resilience not only in the general population but also in patients with mental disorders.

Psychological resilience was lower in patients with mood disorders than in healthy controls. Even after controlling for the effects of age, the three WURS factor scores and the BDI score, which differed significantly between patients with mood disorders and healthy controls, psychological resilience remained significantly lower in the patient group. This result is consistent with our previous study of 301 patients with mood disorders and 958 healthy controls that overlapped with this study.[48)] The results also support other previous studies that report that individuals with a mental illness have a significantly lower level of psychological resilience compared to the general population.[24)] Some studies have also shown an association between psychological resilience and quality of life and social functioning in patients with mental disorders. Psychological resilience predicts quality of life in patients with bipolar disorder and schizophrenia.[49)] Resilience is significantly and positively associated with quality of life even after controlling for confounders.[50)] In patients with PTSD, higher resilience is associated with intact social functioning regardless of the severity of the PTSD and depression.[51)]

It should be emphasized that psychological resilience can be improved by pharmacological and non-pharmacological psychiatric treatments. Treating PTSD significantly improves resilience,[52)] and pharmacological treatment combined with cognitive behavioral therapy may increase resilience within 2–3 months in patients with an anxiety disorder.[53)] As psychological resilience is affected by the current state of depressive mood and the individual's childhood ADHD features, mental health professionals should try to improve the patient's current mood as well as manage childhood ADHD features.

Despite the crucial role of psychological resilience in mental health, the underlying biological mechanism or biomarker of psychological resilience is not known. The involvement of the hypothalamo-pituitary axis (HPA) and corticosteroids has been suggested for a long time. The mineralocorticoid receptor is an important stress modulator of stress-induced HPA-axis activity. High mineralocorticoid function may confer resilience to traumatic stress.[54)] Glutamate receptor function and glutamate neurotransmission are other elements associated with stress vulnerability and resilience. Inflammation and microglial activation mediate individual differences in psychological resilience and the risk of stress-related depression.[55)] Our study found that childhood inattention was significantly correlated with adult psychological resilience, indicating that the biological mechanism controlling attention during childhood is involved in psychological resilience.

Our study had the following limitations. First, the characteristics of childhood ADHD were evaluated using the WURS score, which is a retrospective self-survey questionnaire. Thus, recall bias might have occurred. Also using the WURS alone may not be enough to diagnose childhood ADHD. Therefore, WURS scores were used to measure child ADHD features only, and retrospective diagnosis of child ADHD was not attempted. Above all, this study focused on ADHD features such as impulsivity, inattention, and mood instability, which are related to psychological resilience in adulthood, and did not focus on the relationship between adulthood psychological resilience and ADHD diagnosis itself in childhood. Even if symptoms are not severe enough to be diagnosed as ADHD, having childhood ADHD features may affect adult psychological resilience. Second, most of the subjects with mood disorders were diagnosed with major depressive disorder. Relatively few subjects with bipolar disorder were included. Also structural interviews, such as mini-international neuropsychiatric interview, were not conducted on the diagnosis of mood disorders. Third, because the healthy controls were limited to nursing students, nurses, and firefighters, care should be taken when generalizing the results. Fourth, the age range differed between the two groups. Our sample of healthy

controls consisted of younger people than the patient group and did not represent the general population. In this case, a propensity score matching analysis should be considered. However, we did not apply this method because we could lose too much data through data adjustment. Therefore, the bias due to different distribution of age and sex between patient and control groups should be considered in interpretation of this results.

Our study also has some strengths. First, this is the first study to examine the childhood factors influencing adulthood psychological resilience, although only the characteristics of childhood ADHD were investigated. Second, we examined the effects of childhood ADHD features on adulthood by analyzing three factors (impulsivity, inattention, and mood instability). Third, our study found that childhood ADHD features influenced adulthood psychological resilience not only in a normal population but also in patients with mood disorders. As psychological resilience is important for recovery from psychiatric illness and quality of life in a distressed environment even for healthy people, it is meaningful to identify the various factors influencing psychological resilience from childhood to the current state. In this way, we can find methods to improve psychological resilience, which is very important for mental health.

Humans must adapt to variety of environmental stressors. The responses to stress and trauma vary from individual to individual. Psychological resilience is a crucial factor determining the response of humans to the environment under a multidimensional construct.[2)9)] It is important for patients to recover from mood disorders, improve their functioning, and enhance their quality of life. Psychological resilience plays a significant role in recovery and enhancing quality of life. Therefore, assessments of psychological resilience are essential when clinicians evaluate a patient's prognosis or set up a rehabilitation plan. Our study suggests that it is necessary to consider the current mood state and childhood ADHD features when assessing psychological resilience in patients.

Adult psychological resilience in patients with mood disorders was explained by both their current depressive mood state and childhood inattention features. In addition to the degree of depressed mood, information about childhood ADHD features, particularly inattention, is significant when evaluating the psychological resilience of patients.

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Conflicts of interest

The authors have no financial conflicts of interest.

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