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Temperament and Character Profiles Associated with Internalizing and Externalizing Problems in Children with Attention Deficit Hyperactivity Disorder

Na Ri Kang and Young Sook Kwack✉

Department of Psychiatry, Jeju National University School of Medicine, Jeju, Republic of Korea

Objective This study aimed to identify temperament and character profiles associated with internalizing and externalizing problems in children with attention deficit hyperactivity disorder (ADHD).

Methods Children with ADHD (n=114, 8.51±1.87 years) were selected from the Department of Child and Adolescent Psychiatry at Jeju National University Hospital. They were diagnosed by Kiddie-Schedule for Affective Disorders and Schizophrenia-Present and Lifetime Version and evaluated using the Advanced Test of Attention and Korean Wechsler Intelligence Scale for Children-Fourth Edition. Their parents completed the ADHD Rating Scale, Korean-Child Behavioral Checklist, and Junior Temperament and Character Inventory.

Results The participants with both internalizing and externalizing problem had more severe ADHD symptoms and significantly higher novelty seeking, harm avoidance, and self-transcendence, as well as lower self-directedness and cooperativeness than those who had not comorbid problems. Harm avoidance was correlated with their level of internalizing problems regardless of severity of ADHD symptoms. In addition, novelty seeking and sex (male) were being associated with the level of externalizing problems.

Conclusion Differences were observed in the temperament and character profiles of children with ADHD according to their comorbid psychopathology. Results suggested that temperament and character profiles may affect the comorbid psychopathology in children with ADHD regardless of ADHD symptom severity.

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Key Words Temperament, Character, ADHD, Psychopathology.

INTRODUCTION

Attention deficit hyperactivity disorder (ADHD) is characterized by inattentiveness, hyperactivity, and impulsivity, and it is a developmental disorder with a significant impact on the affected individual's life. Moreover, it has heterogeneous characteristics between inattention and hyperactivity/impulsivity. Based on the Diagnostic and Statistical Manual of Mental Disorders, 4th Edition (DSM-IV), ADHD is classified into inattentive, hyperactivity/impulsivity, and combined types.

The prevalence of internalizing and externalizing disorders in children with ADHD has been reported in various studies. The prevalence of externalizing disorders such as conduct disorder and oppositional defiant disorder, is approximately 50%. Moreover, the prevalence of conduct disorder and oppositional defiant disorder in children with ADHD are 20% and 30−45%, respectively. Approximately 10−20% of children with ADHD present with internalizing disorders, such as mood disorders.[1,2] In a recent study, the prevalence of externalizing disorders, such as conduct disorder and oppositional defiant disorder were 9.4 and 5.6 times higher in children with ADHD than in children without ADHD, and those of depressive disorder and anxiety disorder were 4.2 and 3.2 times higher in children with ADHD.[3] The prevalence of comorbid internalizing and externalizing problems in children with ADHD is approximately 13−20%.[4]

In other words, children with ADHD can manifest with various externalizing and internalizing problems, and the effects on the level of development and function vary depending on the pattern of the comorbid psychopathology. When children with ADHD have comorbid internalizing or externalizing problems, they have more problems with peers as

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✉ **Correspondence:** Young Sook Kwack, MD, PhD
Department of Psychiatry, Jeju National University School of Medicine, Aran 13-gil 15, Jeju 63241, Republic of Korea
Tel: +82-64-717-1850, **Fax:** +82-64-717-1849, **E-mail:** yskcpy@jejunu.ac.kr

well as lower quality of life and family functioning than those with ADHD who do not have comorbid internalizing or externalizing problems. Moreover, they are vulnerable to social dysfunction.[5]

The emotional or behavioral problems in children with ADHD are associated with a combination of biological and environmental factors. A recently published twin study showed that internalizing problem of children with ADHD has a heritability rate of 15−29%, and a shared environmental factor rate of 58−77%.[6] In a Korean twin study on identical twins, genetic associations between hyperactivity/inattention and conduct problems have been reported.[7] Temperament is a stable hereditary component that is associated with individual differences in spontaneous reactions to emotional stimuli. Character profiles are correlated with individual differences in goals and values, which are based on learning and the perceptions of self and others.[8] In a study on the relationship between behavioral problem and temperament, 'high emotionality' was a predictor of withdrawn/depressed, attention problems, aggressive behavior, and delinquent behavior, and it was also the strongest temperamental predictor of behavioral problems.[9] Other studies, have reported significant association of high novelty seeking and low harm avoidance with externalizing disorder.[10] In addition, a high level of 'negative affectivity' predicted the internalizing and externalizing problems from infancy to school age.[11]

In recent years, the peaks of the attention problems, aggressive behavior, and anxiety/depressed scales of the Child Behavior checklist (CBCL) have been defined as the Child Behavior checklist- Dysregulation Profile (CBCL-DP), which is a useful index for self-regulatory problems in multiple domains,[12-15] and high heritability and stability across ages.[16,17]

In particular, ADHD children with CBCL-DP are known to have severely impaired social functioning, high incidence of comorbid psychiatric disorders, and high risk of mental problems druing adulthood.[13,18] Among children with ADHD, those with both internalizing and externalizing problems were at risk for social dysfunction and comorbid psychopathology during adulthood. Early recognition of the risk factor and therapeutic intervention for ADHD children with both internalizing and externalizing problems is important. Although the temperament and character profile affect the manifestation of psychopathology in children, few studies on the temperament of children with ADHD who have comorbid internalizing and externalizing problems have been conducted.

Thus, this study aimed to compare the temperament and character profiles of children with ADHD according to the presence of comorbid internalizing or externalizing problems or both. Furthermore, the temperament and character profiles associated with internalizing and externalizing problems were examined via a linear regression analysis.

METHODS

Participants and procedure

In total, 113 children aged 6−12 years who were diagnosed with ADHD were selected from the Department of Child Psychiatry, Jeju National University Hospital, between January 2014 and January 2017. The diagnoses of ADHD and tic disorder were made according to the DSM-IV, and confirmed via parent interviews using the Korean version of the Kiddie-Schedule for Affective Disorder and Schizophrenia-Present and Lifetime Version (K-SADS-PL-K). The following were used to assess the participants: Children's Depression Inventory, State-Trait Anxiety Inventory, and Korean Wechsler Intelligence Scale for Children-Fourth Edition. Advanced Test of Attention was also utilized a trained clinical psychologist. In addition, the participant's parents completed the ADHD Rating Scale, Korean-Child Behavioral Checklist, and Junior Temperament and Character Inventory. The exclusion criteria were as follows: the presence of comorbid disorders, including mental retardation, learning disorder, major depressive disorder, and pervasive developmental disorder, based on the DSM-IV. Current study procedures were approved by the Institutional Review Board of Jeju National University Hospital (IRB No. 2016-05-004).

Assessments

Kiddie-Schedule for Affective Disorders and Schizophrenia-Present and Lifetime Version (K-SADS-PL)

It is a semi-structured interview that evaluates 32 child and adolescent psychiatric disorders based on the DSM-IV. Each question is rated from 0 to 3 and assesses disease severity and current and past history of individuals with psychiatric disorders. In Korea, its validity and reliability were verified by Kim et al., and it is a useful tool for diagnosing major childhood psychiatric disorders including ADHD.[19]

Korean-Child Behavioral Checklist (K-CBCL)

CBCL is a child behavior assessment tool developed by Achenbach and Edelbrock[20] and it is one of the tools most commonly used in clinical settings. In Korea, reliability and validity were reported by standardized.[21] The social competence dimensions consists of social competence, adjustment function and school competence. The dimensions of problem behavior include withdrawn/depressed, somatic complaints, anxious/depressed, social problems, thought problems, attention problems, delinquent behavior, and aggressive behavior. The internalizing problem scale is a sum of the scores for anxious/de-

pressed, somatic complaints, and withdrawn/depressed scales. The externalizing problem scale is sum of the scores for delinquent behavior, and aggressive behavior scales. The T-score is presented according to sex and age group. Thus, it is suitable for evaluating developing children and adolescents. The internal consistency coefficient Cronbach's α ranged from 0.62 to 0.82. In this study, the presence of ADHD with both internalizing and externalizing problems (COM group) was defined as a T score of ≥64 points for the internalizing and externalizing scales, whereas the presence of ADHD with only internalizing problem (INT group) and ADHD with only externalizing problem (EXT group) were defined as a T score of ≥64 points for the internalizing or externalizing scales, respectively, and the ADHD with no problems (NO group) was defined as ADHD without internalizing and externalizing problems.

Junior Temperament and Character Inventory (JTCI)

Luvy et al.[22] developed an instrument that consisted of 108 items for evaluating the temperament and character profiles of children under the age of 14 years. The instrument consists of four temperament items (novelty seeking, harm avoidance, reward dependence, persistence) and three character items (self-directedness, cooperativeness, and self-transcendence). In Korea, Cronbach's α values of the Korean version of the JTCI scales ranged from 0.48 to 0.80 for temperament and from 0.64 to 0.68 for character.[23]

ADHD Rating Scale (ARS)

Of the 18 items, 9 were about inattention symptoms and 9 were about hyperactivity and impulsivity that are in accordance with the DSM-IV diagnostic criteria for ADHD. Parents or teachers assess children's symptoms on a 4-point scale ranging from "not at all" (0 points) to "very often" (3 points). In Korea, reliability was evaluated using the parent version 0.94 and teacher version 0.96.[24]

Korean Wechsler Intelligence Scale for Children-Fourth Edition (K-WISC-IV)

This is an intelligence test that can assess the cognitive abilities of children aged 6−16 years. It consists of 15 subtests. The full scale IQ and verbal comprehension, perceptual reasoning, working memory, and processing speed scores can be obtained. In this study, the full-scale intelligence score was used, and only children who scored ≥70 for total intelligence were included.[25]

Advanced Test of Attention (ATA)

This is a computerized test developed to assess selective attention and impulse inhibition levels in children aged 5−15 years. It measures the omission errors that reflect the inattention and commission errors that reflect impulsivity, the mean time of reaction (response time) that measures the consistency of the concentration of attention and standard deviation of reaction time (response time variability). The T scores of these four variables are calculated.[26]

Statistical analysis

Demographic variables were analyzed via descriptive statistics. JTCI T scores were compared using a one-way analysis of variance (ANOVA) to confirm the difference in groups. A fixed factor multiple analysis of covariance (MANCOVA) was performed with age, gender and severity of ADHD symptom. To control the influence of type 1 errors for multiple comparisons, the Bonferroni post-hoc test was applied. Linear regression analysis was used to analyze the correlates of internalizing and externalizing problems. The collected data were analyzed using SPSS version 18.0 (SPSS Inc., Chicago, IL, USA). A p value of <0.05 was considered statically significant.

RESULTS

Comparison of the demographic characteristics and Advanced Test of Attention and Wechsler Intelligence Scale for Children-Fourth Edition scores between groups

The mean age of 114 children was 8.51(±1.87) years old, of which 103 (90.4%) were boys. No significant difference was observed in the age and sex distribution of each group.

No statistically significant difference was observed among the groups in terms of the depression inventory, State-Trait Anxiety Inventory, full-scale intelligence, and ATA scores. However, the COM group showed a significantly higher score for the ARS that assessed ADHD symptoms (Table 1).

Comparison of the JTCI scores between groups

The COM group showed significantly higher novelty seeking, harm avoidance, and self-transcendence and lower self-directedness and cooperativeness than did the NO group. The INT group showed significantly higher harm avoidance as well as lower novelty seeking and reward dependence than did the NO and COM groups. The EXT group showed significantly higher novelty seeking than did the NO and INT groups. The MANCOVA with age, sex, ATA and ARS for covariate revealed a significant difference between the groups except for persistence and self-transcendence (Table 2).

Correlates of internalizing and externalizing problems

Based on the linear regression analysis of the subscales of JTCI, including age, sex, and severity of symptoms, harm

Table 1. Baseline characteristics of participants

	NO group (N=49)	INT group (N=11)	EXT group (N=26)	COM group (N=28)	F	p value	post-hoc analysis
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)			
CDI	20.82 (20.72)	29.18 (24.46)	28.88 (22.67)	21.79 (22.49)	1.064	0.368	
ARS	20.16 (9.51)	20.60 (12.30)	26.04 (8.34)	29.46 (11.31)	5.716	0.001*	COM>NO
STAI							
State anxiety	30.14 (9.20)	30.11 (6.77)	32.16 (6.06)	32.54 (8.03)	0.602	0.615	
Trait anxiety	29.48 (9.52)	30.89 (9.37)	33.16 (7.90)	33.42 (9.10)	1.328	0.270	
FSIQ	85.65 (13.71)	85.91 (10.48)	84.54 (12.67)	84.11 (14.87)	0.105	0.957	
ATA							
Omission errors, visual	68.98 (21.52)	78.82 (18.71)	64.31 (19.14)	65.54 (24.06)	1.349	0.262	
Commission errors, visual	71.69 (19.39)	73.18 (18.18)	71.88 (21.76)	69.82 (23.18)	0.088	0.966	
RT, visual	59.12 (16.17)	57.18 (16.41)	58.46 (15.16)	55.50 (16.95)	0.317	0.813	
RT variability, visual	64.00 (18.24)	68.82 (19.21)	67.15 (21.43)	65.07 (19.80)	0.270	0.847	
Omission errors, auditory	67.57 (20.22)	61.45 (11.62)	67.65 (17.31)	68.61 (22.33)	0.376	0.770	
Commission errors, auditory	73.96 (21.18)	58.18 (17.25)	64.38 (18.97)	76.50 (22.62)	2.399	0.072	
RT, auditory	43.18 (12.38)	45.27 (9.48)	42.81 (17.93)	44.93 (13.36)	0.179	0.910	
RT variability, auditory	52.57 (11.94)	51.91 (9.95)	47.54 (12.02)	47.39 (11.85)	1.711	0.169	
K-CBCL							
Total problems	57.37 (4.83)	69.64 (5.41)	64.73 (3.68)	77.71 (8.49)	75.472	<0.001	COM>INT, EXT>NO
Internalizing problems	54.76 (6.12)	71.64 (6.47)	56.54 (6.41)	72.07 (8.84)	48.676	<0.001	COM, INT>EXT, NO
Externalizing problems	56.76 (6.22)	61.18 (2.71)	68.62 (4.86)	75.32 (9.95)	47.849	<0.001	COM, EXT>INT, NO
Anxious/depressed	55.06 (5.30)	69.46 (2.46)	58.46 (6.36)	69.39 (13.73)	22.680	<0.001	COM, INT>NO, EXT
Withdrawan/depressed	55.22 (4.83)	72.00 (5.81)	56.65 (6.16)	63.14 (13.35)	16.153	<0.001	INT>COM>NO, EXT
Somatic complaints	55.84 (6.13)	60.73 (6.67)	53.46 (4.12)	63.32 (9.46)	11.684	<0.001	COM>NO, EXT INT>EXT
Social problems	58.55 (5.59)	67.09 (5.61)	63.46 (6.78)	68.68 (8.20)	15.821	<0.001	COM>EXT>NO INT>NO
Thought problems	57.82 (6.84)	66.36 (4.68)	60.65 (7.16)	64.14 (12.92)	4.844	0.003	COM, INT>NO
Attention problems	60.35 (6.80)	67.18 (7.28)	65.31 (6.06)	72.50 (8.65)	17.336	<0.001	COM>EXT>NO INT>NO
Rule breaking behavior	57.31 (5.26)	59.09 (6.77)	65.19 (4.81)	67.18 (6.13)	23.649	<0.001	COM, EXT>INT,NO
Aggressive behavior	56.63 (4.49)	60.36 (3.72)	68.27 (3.17)	71.18 (15.00)	22.987	<0.001	COM, EXT>INT, NO

*p<0.05. CDI: Children's Depression Inventory, ARS: ADHD Rating Scale, STAI, State-trait Anxiety Inventory, FSIQ: Full Scale Intelligence Quotient, ATA: Advanced Test of Attention, RT: response time, K-CBCL: Korean-Child Behavior Checklist

avoidance was associated with a higher internalizing problem score. The externalizing problem score was significantly associated with the score of novelty seeking and sex (male) (Table 3).

DISCUSSION

Significant differences were observed in the JTCI scores of the groups with internalizing and externalizing problems based on CBCL. Considering the possibility that the temperament and ADHD symptoms might affect with each other, we analyses JTCI differences among groups adjusting ATA and ARS. There was a significant difference between the groups when the ADHD rating scale which was reported by parents and ATA, an objective attention test was taken into consideration. This suggests that there is a distinct pattern of temperament according to comorbid psychopathology, regardless of the objective attentional test or subjective assessed the severity of ADHD symptoms.

The INT group showed higher harm avoidance and lower reward dependence than did the NO group. Children with high

Table 2. Comparison of the JTCI scores of the groups

	NO group (N=48)	INT group (N=11)	EXT group (N=26)	COM group (N=28)	F	p value	post-hoc analysis	MANCOVA†		
	Mean (±SD)	Mean (±SD)	Mean (±SD)	Mean (±SD)				F	p value	ηp²
NS	53.98 (±11.28)	52.91 (±9.62)	64.65 (±11.28)	69.57 (±11.97)	14.203	<0.001*	COM> EXT> NO, INT	8.492	<0.001*	0.200
HA	49.18 (±10.11)	62.36 (±8.69)	47.08 (±12.20)	57.50 (±8.83)	9.727	<0.001*	COM, INT> NO, EXT	8.282	<0.001*	0.196
RD	47.88 (±8.64)	37.00 (±9.01)	44.88 (±10.93)	48.96 (±12.23)	4.249	0.007	NO, COM> INT	3.830	0.012*	0.101
P	39.92 (±9.56)	36.91 (±8.62)	39.54 (±11.22)	42.21 (±11.65)	0.758	0.520		2.022	0.116	0.056
SD	40.53 (±13.96)	33.18 (±11.64)	37.46 (±10.35)	29.93 (±12.25)	4.520	0.005*	NO> COM	3.455	0.019*	0.092
CO	43.35 (±12.60)	44.18 (±12.99)	36.15 (±9.29)	31.89 (±13.08)	6.487	<0.001*	NO, INT> COM	3.770	0.013*	0.100
ST	42.37 (±11.81)	46.45 (±7.30)	45.58 (±8.45)	49.93 (±12.55)	2.868	<0.040*	COM> NO	2.214	0.091	0.061

*p<0.05, †comparison of the JTCI scores among the groups including age, sex, ARS, ATA as covariates. JTCI: Junior Temperament and Character Inventory, NO: ADHD children with no problems, INT: ADHD children with internalizing problems, EXT: ADHD children with externalizing problems, COM: ADHD children with comorbid both internalizing and externalizing problems, NS: novelty seeking, HA: harm avoidance, RD: reward dependence, P: persistence, SD: self-directedness, CO: cooperativeness, ST: self-transcendence

Table 3. Factors associated with internalizing problems and externalizing problems in the linear regression analysis

	Internalizing problems†					Externalizing problems‡				
	B	SE	ß	T score	p value	B	SE	ß	T score	p value
Sex	4.592	3.114	0.131	1.474	0.144	5.980	2.782	0.173	2.149	0.034*
Age	-0.041	0.516	-0.007	-0.079	0.937	0.003	0.461	0.000	0.006	0.995
ARS	0.121	0.098	0.122	1.233	0.221	0.165	0.088	0.169	1.878	0.063
NS	0.107	0.122	0.135	0.880	0.381	0.443	0.109	0.565	4.072	<0.001*
HA	0.380	0.098	0.412	3.890	<0.001*	0.024	0.087	0.026	0.274	0.785
RD	-0.021	0.105	-0.020	-0.196	0.845	-0.098	0.094	-0.099	-1.045	0.298
P	0.122	0.100	0.121	1.220	0.225	0.100	0.089	0.101	1.123	0.264
SD	-0.180	0.100	-0.227	-1.799	0.075	-0.049	0.090	-0.063	-0.546	0.586
CO	0.151	0.107	0.186	1.418	0.159	-0.031	0.095	-0.038	-0.321	0.749
ST	0.098	0.106	0.106	0.926	0.357	-0.061	0.095	-0.067	-0.643	0.522

*p<0.05, †R^2=0.382, adjusted R^2=0.319, p<0.001, F=6.066, ‡R^2=0.489, Adjusted R^2=0.438, p<0.001, F=9.570. ARS: ADHD Rating Scale, NS: novelty seeking, HA: harm avoidance, RD: reward dependence, P: persistence, SD: self-directedness, CO: cooperativeness, ST: self-transcendence

harm avoidance are more likely have internalizing problems, even though the severity of ADHD symptoms and other temperament factors are considered. These findings are similar to those reported on children and adolescents with major depressive disorders, which is related to pessimism, uncertainty, shyness, and fatigability.[27,28]

The EXT group had higher novelty seeking than the NO and INT groups. In children with ADHD, those with higher scores for novelty seeking were more likely to experience externalizing problems. This finding is consistent with that of previous studies.[29-31] In addition, some studies have shown that conduct disorder and oppositional defiant disorder that are common comorbidities in children with ADHD with higher novelty seeking and lower cooperativeness. Children with mood and anxiety disorders have high harm avoidance.[32] In a longitudinal study on the association between early maladaptive traits and psychopathology, the temperament of emotional instability/introversion was associated with internalizing problems, and disagreeableness was associated with externalizing problems.[33]

In this study, the COM group was more likely to have high novelty seeking, harm avoidance, and self-transcendence and low self-directedness and cooperativeness than the NO group. In previous studies, the CBCL-DP was defined as a high level of attention problems, aggressive behavior, and anxiety/depression, and in the CBCL subscales, high novelty seeking, harm avoidance, and low reward dependence and persistence were observed, and this temperament and character profile was associated with impaired social functioning and psychopathology. In addition, the CBCL-DP in children with ADHD

experienced more severe ADHD symptoms, which is similar to the results of our study, and they showed a low response rate to ADHD medication.[34]

In other previous studies, disengaged temperament profiles, such as novelty seeking and harm avoidance, were high, and reward dependence and persistence were low and had a push–pull phenomenon in which individuals get attracted and curious in a novel situation and feels sensitive and anxious. However, fewer temperamental resources are available to help them delay gratification, cope with distress, and see difficult situations through to resolution. These temperament and character profile have probably demonstrated impaired self-regulation, and these profiles are an indicator of disordered self-regulation.[32,35] In this study, the temperament and character profiles of the COM group is similar to that of the CBCL-DP, suggesting that children with ADHD who have a temperament pattern of difficulty in self-regulation are likely to experience both internalizing and externalizing problems and more severe ADHD symptoms.

In a study that investigated the association between temperament and the dual process of ADHD, the top-down process involves planning and controlling goal-directed behavior and suppressing unnecessary activation, which is related to cognitive control, conscientiousness, and effortful control trait. Moreover, the bottom–up process is associated with affective reactivity and behavioral activation, which is related to neuroticism and negative emotionality trait.[36] In this study, children with both internalizing and externalizing problems are more vulnerable to the bottom–up process because they have a high level of novelty seeking and harm avoidance. Thus, they easily get anxious while seeking stimuli in their temperament. At the same time, their low self-directedness and cooperativeness in controlling the goal-directed behavior and social activity showed a pattern that could make them vulnerable to the top–down process. If children with ADHD have vulnerable temperament and character profiles to both these dual process mechanism, this temperament profile can affect various clinical symptoms and its severity.

In this study, the comorbid psychopathology in children with ADHD may vary depending on their temperament and character profiles. In particular, children with both internalizing and externalizing problems may experience more severe symptoms and specific pattern of temperament that imply the difficulty of self-regulation.

This study has some limitations. Observing for the long-term interaction of temperament and psychopathology models is challenging. In addition, a relatively low number of participants were included. A control group was not included. We also did not fully take into consideration social and environmental factors, such as parenting and peer relationships, that could affect internalizing and externalizing problems. In addition, despite the significant differences in the internalizing problem and externalizing problem of CBCL reported by the parent, there was no significant difference in the level of depression and anxiety in the self-report scale between the groups. Perhaps the average age of the subject was around 8 years of age, so that it was difficult to accurately recognize and express their feelings and thoughts and CBCL includes more detailed questions about the child's condition throughout the daily life than the self report scale. It is possible that these discrepancy has occurred from these points. So, there is a need for research using structured clinical interview tools to overcome these differences in the future.

The evaluation of accompanying psychopathology was evaluated only based on the CBCL reported by parents without using structured interviewing tools. Despite these limitations, our study showed the effect of temperament and character profiles on the psychopathology of children with ADHD. Thus, in the future, a clinical evaluation of temperament and character profile must be conducted to prevent comorbid diseases in children with ADHD, and the interventions for self-regulation in these children are important.

In conclusion, children with ADHD who have both internalizing and externalizing problems exhibit a distinct pattern of temperament compared with those who do not have problems, which suggests difficulty in self-regulation, and this profile may affect the symptoms and accompanying psychopathology in children with ADHD. In the future, a study on the pattern of temperament and comorbid psychopathology with a larger number of participants must be conducted, and whether there are differences in the pattern of comorbid psychopathology in children with ADHD due to character maturation and the development of brain function should be investigated.

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