Research

Influence of temperaments in Attention Deficit Hyperactivity Disorder symptoms among preschool children

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ABSTRACT

The objective of this study was to evaluate the relationship between attention deficit hyperactive symptoms and temperament and character profiles among preschool-age children. Total 694 preschool age children (mean age=5.7±0.45) were recruited for the study. The preschool Temperament and Character Inventory (psTCI) and DuPaul ADHD rating scale (K-ARS) were applied to evaluate the children. Statistical analysis was done to explore the association between psTCI profiles and ADHD symptom domains. The total ARS score was positively correlated with novelty seeking and harm avoidance. Inattention symptom domain was positively correlated both with novelty seeking and harm avoidance, whereas hyperactive symptom domain was only correlated with novelty seeking. Novelty seeking might be a universal genetic background for ADHD, and the level of harm avoidance could potentially be used to classify subtypes of ADHD.

Keywords

Attention deficit hyperactivity disorder, Development, Preschool children, Psychopathology, Temperaments

Introduction

Attention deficit hyperactivity disorder (ADHD) is a highly prevalent psychiatric disorder among children [1]. The prevalence of ADHD is around 8-12% of all children worldwide [2]. Symptoms can adversely impact academic performance, socialization and self-esteem [3]. ADHD is considered to be a highly heritable but clinically heterogeneous disorder that can be classified into three subtypes: inattentive, hyperactive-impulsive and combined [2,4]. Heritability and the early onset of symptoms before the age of 7 suggest that ADHD may be related to biogenetic temperament [5]. However, it is difficult to differentiate developmentally healthy levels of inattention and hyperactivity from ADHD at early ages. Furthermore, there is no objective

laboratory test to validate clinical impressions [2].

As ADHD can cause significant functional impairments, it is important to detect symptoms and start intervention at an early age [6]. Little data are available regarding ADHD in preschool children, and little is known about the role of temperament in development of ADHD symptoms [7]. Cloninger's biopsychosocial model of personality presented four temperaments and three characters [8]. Temperament can be defined as the automatic associative response to basic emotional stimuli which determine habits and skills, and to be influenced by disparate neuromodulator pathways in brain. It is conceptualized that moderately heritable and stable over time, may have genetic predisposition,

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and each dimensions have unique relationships with neurotransmitters such as dopamine or serotonin. Characters are the concepts about self and relations to others that develop over time as a function of social learning and maturation of interpersonal behavior.

The temperament dimensions consist of Novelty Seeking (NS), Harm Avoidance (HA), Reward Dependence (RD), and Persistence (P). Character dimensions consist of Self-Directedness (SD), Cooperativeness (C), and Self-Transcendence (ST), each of which refers to individual differences in self-concepts, goals, and values [8]. Cloninger's model of the interaction between biogenetic factors and developmental environmental influences can be used to both generate a multidimensional personality structure and to evaluate various behavioral problems, including psychiatric disorders.

Higher NS and lower P have been related to ADHD symptoms in school-age children and adolescents [5,9]. From a developmental perspective, as subject age increases, the environmental influences also strengthen. Therefore younger age of subjects would have chance to show clearer temperament profiles associated with ADHD symptoms. The objective of the present study is to evaluate the relationships between temperaments and characters and ADHD symptoms in preschool age children.

Materials and Methods

■ Study subjects

The subjects were enrolled in a district of Seoul, Republic of Korea where the total registered population was 489,227. Among them we recruited a total of Seven hundred forty preschool children (5.7% of target population 13,000: age range 4 to 6; mean age=5.7±0.45). Detailed psychosocial variables were not included in the questionnaire as the study was performed as a part of community mental health survey. The enrolled preschools were selected by multi-stage cluster sampling. The authors sent an informational letter and an advertisement to participate in the survey. The letter to the parents included the objective of the study, confidentiality notice, benefits of screening. We excluded 46 subjects due to incomplete or missing questionnaires and refusal. Finally Six hundred ninety four preschool children (351 boys, 343 girls) were included in the final analysis. The response rate was 93.8%.

■ Assessments

a) ADHD Rating Scale-IV parent version

Attention deficit-hyperactivity/impulsivity symptoms were assessed by the Korean version of DuPaul's ADHD rating scale (K-ARS), parent version (ARS-IV), which has been standardized in Korean [10]. It has 18 symptom check lists of ADHD based on diagnostic criteria in the 4th edition of the Diagnostic and Statistical Manual-IV (DSM-IV). The internal consistency of K-ARS by age is 0.77-0.89. The internal consistency of this study is 0.88, confirmed by a Cronbach's alpha.

DuPaul stated that the upper 10th percentile of ARS-IV scores could be defined as ADHD when screening community samples [11]. Hence, we selected 74 subjects (ARS-IV>18, 48 boys and 26 girls) to form the ADHD group. Age and sex matched control group was randomly selected within the whole subjects after exclude the ADHD group.

b) Preschool temperament and character inventory (psTCI)

The psTCI was developed by Constantino [12] et al. to measure the seven factors of temperament and character originally introduced by Cloninger. It was modified from the original version of the TCI to be easily understood by parents observing their children. It consists of 74 identical items that are scored by the parents. The psTCI was standardized in Korean [13]. Cronbach alpha values for the K-psTCI scales ranged from 0.62 to 0.78 for the temperament scales and from 0.62 to 0.77 for character scales.

■ Data analysis

Differences in temperaments and characters between the ADHD group and the control group were determined by the independent t-tests. Pearson's correlation was carried out between seven psTCI factors and each ADHD symptom domains. Logistic regression analysis was performed to determine the significant predictor to develop the presence of ADHD. Statistical significance was defined as p<0.05. All statistical analysis was performed using PASW statistics 17.

Results

Boys had significantly higher K-ARS scores (11 ± 7.4 vs. 8.3 ± 6.9, t=4.89, p<0.001), hyperactivity

domain (5.1 ± 4.0 vs. 3.8 ± 3.5, t=4.79, p<0.001), and inattention domain (5.8 ± 4.1 vs. 4.5 ± 4.0, t=4.15, p<0.001) than girls.

ADHD group showed higher scores in novelty seeking (3.2 ± 0.8 vs. 2.4 ± 0.4, t=7.67, p<0.00), and lower score in persistence (3.1 ± 0.8 vs. 3.4 ± 0.4, t=-2.61, p<0.01) and cooperativeness (3.7 ± 0.6 vs. 4.1 ± 0.4, t=4.89, p<0.001) compared with the control group **(Table 1)**.

Overall correlation between psTCI profiles and ADHD symptoms, novelty seeking was positively correlated with total score, inattention and hyperactivity symptoms(r=0.56-0.60, p<0.01). Persistence (r=-0.18--0.25), self-directedness (r=-0.12--0.19) and cooperativeness (r=-0.39--0.41) were negatively correlated with total score, inattention and hyperactivity symptoms. Harm avoidance was positively correlated with inattention domain and total score (r=0.13-0.20), not correlated with hyperactivity **(Table 2)**.

A logistic regression model was used to assess the possible predictors for the presence of ADHD within seven psTCI profiles. ADHD was predicted by novelty seeking (OR=8.27, 95%, CI=4.51-15.16) and cooperativeness (OR=0.25, 95%, CI=0.11-0.55) **(Table 3)**.

Discussion

The objective of this study was to evaluate the relationship between ADHD symptoms and temperament/character profiles in preschool age children. The prediction of ADHD symptoms with novelty seeking was consistent with previous studies in school age children and adolescents [5,9]. A previous study reported that novelty seeking could predict ADHD diagnosis, although causality could not be determined [7]. Increased novelty seeking has been associated with impulsive behavior, extravagant approaches to external cues, increased response to new stimuli [7]. Psychostimulants that effectively treat ADHD have been shown to block the dopamine transporter. Such findings imply that novelty seeking associated with dopamine could be important in the development of ADHD symptoms, regardless of age [3,14]. Also lower persistence would be associated with the specific symptoms of ADHD such as short attention span and easily distracted by stimuli. Cloninger suggested that interactions or combinations of temperaments could construct a comprehensive biogenetic background for any mental illness or personality trait [8]. A previous

Table 1: Comparison of psTCI profiles between ADHD group and the control group.

	ADHD group (n=74) mean ± SD	Control group (n=74) mean ± SD	T (df=146)	P value
Age	5.7 ± 0.5	5.8 ± 0.3	-1.16	0.25
Harm avoidance	2.9 ± 0.7	2.7 ± 0.5	1.85	0.06
Novelty seeking	3.2 ± 0.8	2.4 ± 0.4	7.67	0.00**
Reward dependence	4.2 ± 0.5	4.2 ± 0.4	-0.45	0.65
Persistence	3.1 ± 0.8	3.4 ± 0.4	-2.61	0.01*
Self-directedness	3.4 ± 0.7	3.5 ± 0.4	-1.28	0.20
Cooperativeness	3.7 ± 0.6	4.1 ± 0.4	-4.89	0.00**
Self-transcendence	3.5 ± 0.7	3.4 ± 0.5	0.96	0.33
Inattention K-ARS	12.6 ± 4.7	4.1 ± 2.9	13.06	0.00**
Hyperactivity K-ARS	11.9 ± 3.7	3.2 ± 2.3	17.18	0.00**
Total score K-ARS	24.5 ± 6.4	7.3 ± 4.5	18.82	0.00**

ADHD group, upper 10th percentile of each subset and total K-ARS scores; control group: randomly selected age, sex matched group

* p<0.05;**p<0.01 (0.00=less than 0.001, omitted by 2 digits)

Table 2: Correlation coefficient (r) between psTCI profiles and ADHD symptoms

	K-ARS[a] Inattention	Hyperactivity	Total score
Harm avoidance	0.20**	0.04	0.13**
Novelty seeking	0.60**	0.56**	0.60**
Reward dependence	-0.02	-0.02	-0.02
Persistence	-0.25**	-0.18**	-0.25**
Self-directedness	-0.19**	-0.12**	-0.19**
Cooperativeness	-0.40**	-0.41**	-0.39**
Self-transcendence	0.03	0.04	0.03

Controlling for age and sex, * p<0.05;**p<0.01

a : sum of scores of each domain of K-ARS

Table 3: Logistic regression analysis predicting the presence of ADHD.

	B	SE B	Wald Statistic	P	OR	95% CI Lower	Upper
HA	-0.17	0.25	0.48	0.48	0.84	0.51	1.38
NS	2.11	0.31	46.6	0.00*	8.27	4.51	15.16
RD	0.54	0.39	1.92	0.16	1.72	0.80	3.72
P	-0.58	0.32	3.23	0.72	0.56	0.30	1.05
SD	-0.67	0.39	3.03	0.82	0.51	0.24	1.09
CO	-1.39	0.40	11.9	0.00*	0.25	0.11	0.55
ST	0.39	0.32	1.45	0.23	1.48	0.78	2.82
Constant	-1.37	1.93	0.51	0.48	0.25		

OR: Odds Ratio, R^2 = 0.19 (Cox & Snell), 0.38 (Nagelkerke). -2 Log likelihood=325.9 Model χ^2 (df=7, p=0.00)= 146.06 (0.00=less than 0.001, omitted by 2 digits)

overall percentage correct=89.3%

HA: harm avoidance, NS: novelty seeking, RD: reward dependence, P: persistence, SD: self-directedness, CO: cooperativeness, ST: self-transcendence

Dependent variable: presence of ADHD (upper 10 percentile of K-ARS score)

*p<0.001

study showed that increased novelty seeking and decreased persistence can predict hyperactivity and increased novelty seeking and harm avoidance, decreased persistence can predict the inattention domain of ADHD [9]. The results of temperaments profiles were same as school

age group in this study. Such findings can be explained as follows. Subtypes of ADHD might exist with different combinations of underlying biogenetic components. Barkely suggested that inattention-subtype ADHD subjects might present a different pathophysiology [4]. Previous research with school-age children also showed that only inattention was positively correlated with harm avoidance [9]. Inattentive ADHD shows more passive social relations, slowed cognition, and less comorbidity with disruptive behavior disorders.

We therefore cautiously suggest that hyperactivity/impulsivity and inattention subtypes can be differentiated by the intensity of harm avoidance. Increased novelty seeking and lower persistence in temperaments might universally lead to the development of ADHD symptoms, especially novelty seeking followed by logistic regression of the current study. And strength of the correlations with ADHD symptoms was significantly higher (r=0.5-0.60) in novelty seeking than other psTCI profiles. Then the subgroup with higher harm avoidance might represent distinct inattentiveness in ADHD due their background traits.

In the character dimension, low self-directedness and low cooperativeness were correlated with ADHD symptoms. It was consistent with previous reports in school age children [5,9]. However, when compared to temperament dimensions, character dimensions are much more readily influenced by social experience and could thus be affected by maturation. Hence it should be limited to easily accept the results in this study.

As the prevalence of ADHD in Korea was once reported as 5.9% [15] and it differs from DuPaul's study. Thus the cut-off rate of ADHD – High risk group might be over-estimated. However, the mean score of total ARS-IV of our study was 24.5 ± 6.4 in ADHD group (range 19-47), above suggested cut-off score of ARS-IV (18 for parents and 17 for teachers), it can be regarded to reflect the characteristics of ADHD group properly.

The limitations of this study are as follows. First, the study was performed without diagnostic confirmation using a standardized structured diagnostic interview. Therefore we limited our result to ADHD symptoms not ADHD per se. Second, the authors did not exclude comorbid disorders such as anxiety, depression, cerebral palsy and mental retardation. Third, demographical data such as socioeconomic status and family environments which could be associated with ADHD symptoms were not included in the questionnaire. Therefore the interpretation of the results has a limitation because psychosocial factors were not controlled in the statistical analysis. Final, the study was conducted by self-report questionnaires, cautions needed to interpret the results in the biogenetic perspectives.

Nevertheless, it was the first study to identify the temperaments and characters of ADHD preschool-age children using the psTCI.

Acknowledgement

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