Study on executive function of children with high IQ attention deficit hyperactivity disorder

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Abstract: Objective: To explore the executive function of children with attention deficit hyperactivity disorder (ADHD). Method: From May 2016 to May 2017, 48 patients aged 7 to 14 were selected from the Second Affiliated Hospital of Qiqihar Medical University, who met the diagnosis of mental disorders in the United States. ADHD children with high intelligence quotient (total intelligence quotient (> 120) and 48 age-matched normal control children with high intelligence quotient (total intelligence quotient (> 120) met the diagnostic criteria of the fourth edition of the American Mental Disorder Statistics Manual (DSM-IV). The executive function characteristics were assessed by the Parent Version of the Executive Function Behavior Rating Scale (BRIEF). Result: In the high IQ IQHD group, the scores of inhibition, conversion, emotional control, task initiation, working memory, planning, organization, and monitoring, as well as behavior management index, metacognitive index, and total score were higher than those of high IQ. Control group. The differences were statistically significant ($P<0.05$). Conclusion: The executive function of high IQ ADHD children is worse than that of high IQ normal children at all levels, and there are operational deficits.

1. Introduction

Attention deficit hyperactivity disorder (ADHD) is a common behavioral disorder in childhood, mainly characterized by inattention, hyperactivity or impulsivity that is not commensurate with its age [1]. The prevalence rate is 3% to 7%. The core damage of attention deficit hyperactivity disorder is the executive function (EF) defect [2]. Execution function refers to the ability to maintain an appropriate problem-solving state in order to achieve the goal, including attention and suppression, working memory, task management, planning and monitoring [3]. The impaired function of ADHD patients will have a sustained impact on their development, which may eventually develop into inadequate ability to plan, implement, self-reflection, and achieve goals [4]. Relevant studies have also shown that high IQ may be a protective factor for ADHD, and executive dysfunction in high IQ ADHD patients is not easily detected. However, foreign studies have found that the executive function of ADHD patients is still impaired, so attention should be paid to the executive function of ADHD patients with high intelligence quotient [5].

At present, the research on executive function of ADHD patients with high intelligence quotient is insufficient, and the commonly used operational neuropsychological test results can not accurately reflect the actual level of executive function of subjects in daily life, and the research results are also insufficient. The Behavior Rating Inventory of Executive Function (Women) can be used to assess the actual level of behavior in a subject's daily life with good reliability and validity. This study intends to use theRIEF scale to explore the executive function characteristics of high IQ ADHD children in China.

2. Materials and Methods

2.1 Normal information

ADHD children from the Psychiatric Department of the Second Affiliated Hospital of Qiqihar Medical University from May 2016 to May 2017 were selected. High IQ ADHD group inclusion criteria: (1) two children psychiatrists diagnosed as ADHD, and then trained psychiatrists use the Clinical Diagnostic Interview Scale (CDIS) [6] the parents of the children interviewed. Meet the diagnostic criteria for ADHD developed by the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) [7]. (2) China's revised Wessler Intelligence Scale for Children (C-WISC) [8] assessed the total scale intelligence quotient (FIQ) ≥ 120 points. (3) Exclusion criteria: no mental illness, autism, history of severe brain injury and other organic diseases such as nervous system. (4) There was no history of acute or chronic somatic infection in the past two weeks. Forty-eight ADHD patients, aged 7-14 years, with an average age of (9.65 + 1.89) years, were screened by BRIEF. The total intelligence quotient (FIQ) ranged from 120 to 150, with an average of (128.92 + 10.58). All patients had not received formal systemic treatment before being included in this study.

High IQ normal control group: 6 to 15 years old children from 2 ordinary primary and secondary schools near the Second Affiliated Hospital of Qiqihar City, the criteria for inclusion: (1) Exclusion of any mental disorders. (2) There is no history of acute and chronic physical infection in the past two weeks, and there are no other major physical diseases. (3) Completion of the revision of the Wechsler Children's Intelligence Scale in China by FIQ ≥ 120 and the BRIEF test of 89 persons. According to age, FIQ and ADHD group 1:1 pair 48, age 7 to 14 years, mean age (10.23 ± 1.26) years, total IQ (FIQ) 126 ~ 153 points, average (131.07 ± 8.92) points. There were no significant differences in age and IQ between the two groups ($P<0.05$).

This study was approved by the Ethics Committee of the Second Affiliated Hospital of Qiqihar Medical College. All the subjects participated in the study with informed consent and signed by their guardians.

2.2 Research method

2.2.1 Clinical Diagnostic Interview Scale for Children (CDIS) [6]

The clinical semidefinite interview scale compiled by the American Working Group on Children's Disorders was translated and revised by Yang Li and Wang Yufeng. Based on the diagnostic criteria of DSM-IV, the content includes the diagnosis and classification of the main behavioral and emotional disorders in childhood. The psychiatrist and the informed informant of the child make an assessment with good reliability and validity.

2.2.2 China Revises Wechsler Children's Intelligence Scale (C-WISC) [8]

The intelligence level was assessed using the Wechsler Children's Intelligence Scale revised by Gong Yaoxian et al. The scale includes knowledge, classification, arithmetic, vocabulary, comprehension, and numerical breadth. Five sub-tests of operational IQ, including mapping, picture arrangement, block drawing, graphic Patchwork and coding, were conducted. Verbal intelligence quotient (VIQ), operational intelligence quotient (PIQ) and total intelligence quotient (FIQ) were assessed. In this study, FIQ (> 120) was used as the criterion to define high IQ.

2.2.3 Executive Function Behavior Rating Scale (BRIEF) Parent Edition [9]

The scale has good reliability and validity in assessing the actual level of executive function in daily life. The scale consists of 86 items, 2 dimensions and 8 factors, namely, behavioral management index dimension (including inhibition, conversion, affective control) and metacognitive index dimension (including task initiation, working memory, planning, organization and monitoring). The scale is filled out by parents according to the performance of the past 6 months. Each item is scored according to the grade, and the score is 1~3. The higher the score, the

more serious the impaired execution function.

2.3 Statistical analysis

Analysis was performed using SPSS20.O statistical software. The measurement data were normally distributed, expressed as x±s, and the count data were compared by $\chi 2$ test. The comparison between groups was performed by independent sample t test. $P<0.05$ showed that the difference was statistically significant.

3. Result

3.1 Results of Wechsler Intelligence Test in Two Groups of Children

There were no significant differences in verbal intelligence quotient (VIQ), operational intelligence quotient (PIQ) and total intelligence quotient (FIQ) between the two groups ($P > 0.05$). See Table 1.

Table 1. Comparison of IQ and age of high IQ ADHD group and high IQ normal control group (x±s)

	High IQ ADHD group	High IQ control group	t	P
VIQ	130.12±10.01	132.35±9.61	0.408	0.661
PIQ	118.35±9.66	120.46±8.92	0.912	0.436
FIQ	128.92±10.58	131.07±8.92	0.329	0.875
Age	9.65±1.89	10.23±1.26	0.155	1.722

3.2 Comparison of various factors of two group of children's BRIEF

The two dimensions, eight factor scores and total scores of the high IQ IQHD group were significantly higher than those of the high IQ group ($P<0.05$). See Table 2.

Table 2. Comparison of the factors of the BRIEF between the high IQ ADHD group and the high IQ normal control group (x±s)

BRIEF Factor/Dimension	High IQ ADHD group	High IQ control group	t	P
Behavior Management Index	51±9	36±8	6.23	<0.001
Metacognitive Index	103±10	69±13	9.82	<0.001
Inhibition	21±4	14±3	8.14	<0.001
Transformation	13±2	10±2	4.22	<0.001
Control one's emotions	17±4	14±3	5.46	<0.001
Task initiation	16±3	12±4	5.93	<0.001
working memory	22±3	15±3	10.26	<0.001
plan	29±3	18±4	10.09	<0.001
organization	15±4	10±2	7.66	<0.001
Monitor	21±2	16±3	9.49	<0.001
Total score	152±21	106±20	10.17	<0.001

4. Discuss

The executive function is an advanced form of cognitive function that controls and regulates other cognitive processes while completing complex cognitive tasks [10]. In this study, the executive function characteristics of children with high IQ in China were analyzed by using the daily actual performance level of the BRIEF scale. The results of the study showed that the executive function of children with high IQ ADHD was in the two dimensions of behavior management index and metacognitive index, as well as inhibition, transformation, emotional control, task initiation, working memory, planning, organization, and monitoring. Poorer than the high IQ normal control group, there is impaired executive function. In a study of the executive function

characteristics of 117 children with high IQ and ADHD, Brown et al [11] found that more than 64% of children with high IQ ADHD had at least 4 functional impairments. At the same time, Brown's findings on functional impairment in high-intelligence adult ADHD are consistent with the above results. Seidman et al. [12] In the study of executive function of ADHD children, it was found that the executive function of ADHD children was impaired, especially in the inhibition ability, which was significantly impaired compared with the normal control group, which was consistent with the results of this study. Shuai L et al. [13] evaluated the intelligence quotient, attention and executive function of 64 adult ADHD patients with high intelligence quotient. The results showed that ADHD patients with high intelligence quotient were more likely to suffer from impairment of family, occupation and social functions, which affected their quality of life.

Through this study, we found that although children with ADHD have higher IQ, they still perform poorly in the executive function test, especially in the aspects of conversion, task initiation, working memory, which affect their learning, interpersonal and cognitive abilities. This explains that patients with high IQ ADHD have high IQ and adult status, but it is difficult to have a higher social status and lower quality of life [14, 15]. In summary, high IQ ADHD children have executive function defects.

There are still some limitations in this study. The sample size of children with ADHD is small, and there is no further analysis of the difference in executive function of different subtypes and comorbidities of ADHD. In future research, it is necessary to expand the sample and analyze the functional characteristics of children with high IQ ADHD in different dimensions such as different subtypes of ADHD and comorbidity.

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