

Executive Function Impairments in High IQ Children and Adolescents with ADHD

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Abstract

Objective: To demonstrate that high IQ children and adolescents diagnosed with ADHD tend to suffer from executive function (EF) impairments that: a) can be identified with a combination of standardized measures and normed self-report data; and b) occur more frequently in this group than in the general population.

Method: From charts of 117 children and adolescents aged 6 to 17 years with high IQ (> 120) who fully met DSM-IV diagnostic criteria for ADHD, data on 8 normed measures of executive function (EF) were extracted: IQ index scores for working memory and processing speed, a standardized measure of auditory verbal memory, and 5 clusters of the Brown ADD Scale, a normed, age-graded rating scale for ADHD-related executive function impairments in daily life. Significant impairment was computed for each individual relative to age-appropriate norms for each measure and comparisons were made to base-line rates in the general population.

Results: Sixty-two percent of participants were significantly impaired on at least 5 of these 8 markers of EF. Chi-square comparisons of scores from these high IQ participants were significantly different ($p > 0.001$) from standardization norms for each of the 8 EF measures.

Conclusions: High IQ children and adolescents with ADHD, despite their cognitive strengths, tend to suffer from significant impairments of executive functions that can be assessed with these measures; incidence of these impairments is significantly greater than in the general population. These results are fully consistent with data on high IQ adults diagnosed with ADHD.

Introduction

In our clinical practice, often children and adolescents with IQ scores in and above the superior range are brought by their parents for evaluation and treatment of chronic impairments related to symptoms of ADHD. Many of these parents report that they have been told repeatedly by teachers, clinicians and others that their son or daughter was very bright, but doing poorly in school because of chronic problems with inadequate focus, inconsistent effort, insufficient organization, and excessive forgetfulness. When the parents have inquired as to whether these difficulties of their offspring might be due to an attention deficit disorder, many have been told that such problems do not occur among individuals with such high levels of intellectual ability.

Clinically, parents of these very bright students report that their son or daughter has always been able to work very effectively on certain tasks in which they have strong personal interest. Yet these students who demonstrate strong motivation and impressive cognitive strengths on those specific tasks that interest them tend to have much greater difficulty than most of their peers in trying to make themselves do homework, studying, and other important tasks that do not, for them, hold the same intense interest. Many of these students had earned grades in the A range throughout most of their schooling, but had been dropping into the low C to D range over the preceding two years. When provided treatment appropriate for ADHD, these very bright students often show significant improvement in their ability to work effectively while their medication is active.

While there are some data showing that groups of children diagnosed with ADHD tend to have lower full-scale IQ scores than children without ADHD [1], other studies demonstrate that high IQ individuals can suffer from this disorder. Katusic, Voight, Colligan, and colleagues [2] reported data from 331 children in a population-based birth cohort study. They found core symptoms and age of onset of ADHD, rates of comorbid learning and psychiatric disorders, rates of substance abuse, and rates of treatment to be similar across 34 children with high IQ, 276 with normal IQ and 21 with low IQ who fully met diagnostic criteria for ADHD. Thus far the scientific literature has provided little evidence of the nature of the cognitive impairments experienced by persons with high IQ and ADHD and whether those impairments differ significantly from those of others with ADHD or from the general population.

One study by Antshel, Faraone, and colleagues [3] described 49 high IQ children who fully met DSM-IV diagnostic criteria for ADHD and showed a pattern of cognitive, psychiatric and behavioral features typical of children with average IQ diagnosed with ADHD. They found that these very bright children with ADHD tended to have significant difficulty with schoolwork; 22% had repeated a grade at least once, while only 3% of matched controls had ever been retained. These children also had more comorbid psychopathology and were more impaired in multiple domains, relative to similarly bright children without ADHD. Moreover, incidence of ADHD among first degree relatives of these bright children with ADHD was much higher (22.9%) than among such relatives of matched controls (5.6%). Antshel et al [3] concluded that the diagnosis of ADHD can be valid in high IQ children.

In a follow-up study, Antshel and colleagues [4] demonstrated that over a 4.5 year period high IQ children with ADHD, in comparison to high IQ controls without ADHD, continued to have higher rates of mood, anxiety, and disruptive behavior disorders. Participants with ADHD also continued to demonstrate elevated rates of impairment relative to controls across most social, academic and family function domains. The high IQ scores of both groups persisted without significant change over the 4.5 year follow-up period.

While studies by Katusic [2] and Antshel [3, 4] have demonstrated that high IQ children can fully meet diagnostic criteria for ADHD, and Antshel has shown that high IQ students demonstrate significant problems in their schoolwork, those studies did not identify specific cognitive functions underlying academic underachievement of their samples.

Over the past decade there has been increasing recognition that symptoms of ADHD enumerated in the DSM-IV-TR constitute a syndrome of developmental impairments of self-regulation that overlap with the concept of Executive Function [5-10], a term that refers to activities of a variety of brain circuits that prioritize, integrate and regulate other cognitive functions. Miyake, Friedman, et al [11] described EF as general purpose control mechanisms that modulate operations of various cognitive subprocesses and thereby regulate the dynamics of human cognition. These functions develop slowly over the first two decades of life to manage the brain's cognitive functions and provide the mechanism for the multiple aspects of "self-regulation" in daily life [12, 13]. ADHD increasingly is being recognized as essentially developmental impairment of these self-regulatory functions.

EF impairments are not equivalent to overall impairments of cognition measured by standard tests of IQ. Delis and colleagues [14] did a large scale correlational study between measures of EF and measures of IQ using data from 470 normal functioning children and adolescents. Their data demonstrated that IQ and EF skills are divergent cognitive domains and that IQ tests do not provide a sufficient or comprehensive assessment of higher-level executive functions.

This view of IQ and EF as independent of one another is also supported by data from Rommelse, Altink, et al [16] whose large study of children with ADHD vs. controls found that group differences on EF were not explained by group differences on IQ and vice versa.

Most studies of EF impairments, however measured, in those with ADHD have involved participants with a wide range of IQ. They did not address the issue of whether individuals with ADHD and high IQ demonstrate the same problems of EF as do those in the wider range of IQ scores. Most of these other studies, including Antshel, et al [3, 4] did not administer a full IQ test to their subjects; they estimated IQ from just a few key subtests. This method is adequate for estimation of overall cognitive abilities, but it does not provide data necessary for comparing various combinations of subtests useful for assessment of a person's relative strengths and weaknesses in cognitive abilities.

The study reported here used a combination of standardized measures and rating scale data to test the hypothesis that children and adolescents with high IQ diagnosed with ADHD suffer from executive function (EF) impairments that: 1) can be identified with a combination of standardized measures and rating scale data; and 2) tend to occur more commonly in this group than in the general population.

Measures

This study assessed charts of children and adolescents with high IQ who met the DSM-IV diagnostic criteria for ADHD to determine their relative impairment on standardized measures of 3 executive functions: working memory, processing speed, and short-term auditory verbal memory, and on 5 clusters of EF assessed by parental report or self-report on the Brown ADD Scales, normed rating scales for ADHD-related impairments of EF.

Each patient had been evaluated in a two hour clinical interview by a licensed clinical psychologist experienced in assessing ADHD. Diagnosis of ADHD was made according to DSM-IV diagnostic criteria.

For this present study of children and adolescents with both ADHD and high IQ, we asked each subject to listen to each of the two age-appropriate stories of the Children’s Memory Scale [42] or the WMS-III Logical Memory subtest [43] and then scored their immediate recall of each according to scoring guidelines described by Quinlan and Brown [26]. The resulting score was then transformed to an IQ-like score which was then subtracted from that individual’s VCI index score on the Wechsler IQ test. In this way, we corrected for the correlation between overall verbal ability and the person’s recall of the stories.

To obtain a more comprehensive measure of each participant’s EF impairment in multiple activities of daily life, the clinician administered the Brown ADD Scale [33, 34] orally to each parent or patient during the initial evaluation. The 5 clusters of EF assessed include:

- 1) Organizing, prioritizing and activating to work
- 2) Focusing, sustaining and shifting attention to tasks
- 3) Regulating alertness, sustaining effort, and processing speed
- 4) Managing frustration and modulating emotions
- 5) Utilizing working memory and accessing recall

Rather than to merge data from all of these clusters into one total score, we treated each cluster as a separate item. This provided a more detailed profile of each subject’s reported level of EF impairment on each of these five clusters.

Results

All patients in this study were selected because they demonstrated cognitive strengths on verbal and/or perceptual factors of the Wechsler IQ tests that placed them in the top 9% of their age group in the general population. Significant impairment on the Working Memory Index was found in over 74% while severe impairment was found in 40%. Processing Speed Index was significantly impaired in over 80% and was severely impaired in more than 42%.

Over 88% showed significant impairment on their Story Memory Index relative to their high Verbal Comprehension Index on the Wechsler IQ test while over 37% were severely impaired. Analysis of each

patient's scores on the Brown ADD Scale indicated that more than 64% of patients had significant reported impairment on at least 4 of 5 clusters of symptoms on the Brown ADD Scale.

On all 8 measures of EF assessed in this study, the percentage of patients impaired was very significantly greater than percentage impaired in relevant standardization samples for those measures. Even with correction for number of tests, the occurrence of EF disruption was significantly greater in the ADHD samples than in the standardization samples.

Moreover, despite their high IQ, 62% of these very bright children and adolescents showed significant impairment in 5 or more of the 8 markers of EF impairment. These multiple measures converge to indicate that this sample of youths with ADHD and high IQ showed significant impairment on multiple measures of EF, despite high IQ.

Discussion

These data provide evidence that among children and adolescents with high IQ are some who fully meet DSM-IV diagnostic criteria for ADHD. This study cannot provide any estimate of what percentage of persons with high IQ have ADHD, but it clearly demonstrates that having high IQ does not preclude the possibility that one might have ADHD.

We found strong support for the hypothesis that youths with high IQ who meet diagnostic criteria for ADHD tend to have significant weaknesses in working memory, processing speed, and auditory verbal working memory relative to their own cognitive abilities and that they tend to report more impairments in executive functions (EF) than are reported for a comparable age group in the general population. While some of these relative impairments may be within the average range of scores on an absolute scale, they represent significant difficulties for these very bright individuals who tend to have great difficulty in achieving at the academic level generally expected from those with such high overall cognitive abilities. Our analysis of the percentage of individuals with these impairments may be a more useful measure for clinicians than group means because group means tend to submerge individual variabilities.

Clinical interviews [of those] youths [with high IQ and diagnosed with ADHD] and their parents indicated that children and adolescents with high IQ who have ADHD may be at increased risk of having

recognition and treatment of their ADHD symptoms delayed until relatively late in their educational careers because teachers and parents tend to blame the student's disappointing academic performances on boredom or laziness.

Many parents of these high IQ youths reported that situational variability of their offspring's inattention symptoms was the primary reason for their ADHD impairments not being recognized earlier. Like most others with ADHD, these individuals all have a few specific domains in which they have always been able to focus very well, e.g. sports, computer games, artistic or musical pursuits, reading self-selected materials, etc. Parents and teachers tended to assume that these very bright children, could focus on any other tasks equally well, if only they chose to do so [8].

Many parents also reported that their bright offspring with ADHD often demonstrated considerable prowess in performing specific tasks in which they had little positive personal interest, when they experienced considerable fear of immediate negative consequences if they did not complete that particular task by some imminent deadline. Adolescent patients often described this as a character trait, "I'm just a severe procrastinator" or "I always work best under pressure."

Doing well in tasks in which one has strong personal interest, and being unable to begin a task until the very last minute when a harsh deadline immediately looms, are characteristics found in most individuals with ADHD [8], but such traits can be especially problematic for high IQ individuals with ADHD. When these very bright individuals with ADHD often do very well on tasks they enjoy and/or when they are seriously "under the gun," those who know them are especially likely to see their ADHD impairments in other situations as under voluntary control.

The assumption that such self-management can readily be shaped by conscious intentions is being challenged by a number of studies demonstrating that cognitive self-control tends to operate in an extremely rapid, automatized manner, largely under the influence of less conscious emotional and cognitive motivational processes [48-50].

Conclusions

This study demonstrates that individuals with high IQ can fully meet DSM-IV diagnostic criteria for ADHD and that they tend to suffer significant impairments on executive functions measured by three standardized tests and five separate clusters of a normed self-report scale.