

## **Cognitive Function and Skills' Performance of Children with Attention Deficit Disorder**

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### **ABSTRACT**

*ADHD is considered as the most common neurobehavioral disorder of childhood. In the present study, the number of boys with ADHD exceeded girls with the male to female ratio of children with ADHD was 1.3:1. Boys are more likely than girls to be referred for evaluation because they exhibit more disruptive behaviors that are more troublesome to adults. The girls in the present study demonstrated more cognitive impairments, particularly in the area of language function and were more likely to experience peer rejection than their male counterparts. In the present study, all studied case with ADHD showed normal thyroid function. Accordingly, thyroid function tests to be not recommended unless there are other signs and symptoms to suggest thyroid dysfunction. The present study showed higher abnormal EEG findings ( 18 cases, 60%) as compared to controls. These different findings suggest that ADHD is a condition often with organic brain changes in the form of EEG abnormality.*

*The present study revealed significant failure of academic achievement in ADHD pupils as compared with normal controls. Whereas 87.5 %, who showed poor scholastic achievement (percentage of those with low grade) had ADHD, while only 14.3 %of those who had excellent level had ADHD (one child out of total seven children). IQ level of ADHD children in the present study showed no significant difference from controls but perceptual reasoning showed a significant difference in ADHD children as compared with controls that might have a negative effect on the scholastic achievement. Therefore deficits in intellectual functioning in ADHD children are best accounted for by the multiple subtests grading and implications of Stanford Binnet rather than a total IQ level. The studied ADHD children in the present study also showed significant poor cognitive skills. Cognitive difficulties would also explain the associated impaired academic performance.*

*ADHD children in the present study showed a significant poor social skills. Social skills defect might be because of frustrations and failures they experience in academic performance which might cause problems in their relationships with their teachers, peers, and families. In conclusion:*

- 1- Assessing the sub-areas and divisions of intellectual functions especially perceptual reasoning together with the functioning level of all developmental skills were suggested. These findings, though are not needed for diagnosis but are essential for full assessment, management and follow up the effects of treatment strategy and interventions*
- 2- Implicating a four dimensional management program including:
  - Medical treatment.*
  - Cognitive training.*
  - Behavioral and social therapy.*
  - Parental guidance and assurance.**

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## INTRODUCTION

Attention-deficit/hyperactivity disorder (ADHD) is recognized as one of the most prevalent chronic health conditions in school-aged children, affecting an estimated 3% to 9%<sup>1,2</sup>. The key features of ADHD include hyperactivity, impulsiveness, and inattention<sup>1,2</sup>. Only when the symptoms are severe enough to impair function, we can assume that a disorder or disease state exists<sup>3</sup>. Research into the neurological bases of ADHD, using technical approaches such as EEG<sup>4</sup>, MRI<sup>5</sup>, SPECT<sup>6</sup> and PET<sup>7</sup> aspires to identify an ADHD template of abnormal brain structure or function. ADHD-specific questionnaires can only help to determine whether children meet diagnostic criteria for the disorder. No satisfactory evaluation has yet been suggested for the effect of ADHD disorder over the actual functional skills of affected children that of importance for scholastic performance and family and social relation. It is also essential for clinicians to measure changes in impairments to determine the effectiveness of treatment and interventions.

### This study aimed to:

- 1- detect the actual functional skills of ADHD children that may be of importance for scholastic achievement, family and social relation.
- 2- introduce a stochastic assessment combining psychometric tests including assessment of the intellectual functions and the neuropsychological profile of children with ADHD
- 3- suggest psychosocial, behavioral and educational strategies that enhance specific positive attitudes & behaviors that may improve educational and social functioning in the child with ADHD

## MATERIALS AND METHODS

### 1) Children with ADHD (target)

The study participants (30 children) were between 6 and 12 years of age, in grade 1-6. They were 16 boys and 14 girls between the ages of 6–12 (mean  $\pm$  SD was  $7.67 \pm 1.56$ ) who clearly met the DSM IV<sup>3</sup>. All patients had combined subtype

of ADHD and were newly diagnosed and had not received another stimulant medication prior to enrollment. Parents were carefully interviewed and asked to rate the severity of the DSM IV inattention symptoms that their children displayed. Children were excluded if they had been previously diagnosed with a psychiatric disorder or mental retardation (I.Q. < 70 as assessed by Stanford Binnet test). In addition, we excluded patients if they had a clinically significant chronic medical condition, including a past history of cardiovascular disease, organic brain disorder, Tourette's syndrome, epilepsy, pervasive developmental disorder, or other major neurological disorders, current abuse or dependence on drugs within 6 months and current treatment with psychotropic medications.

### 2) Control children (for comparisons)

Each target child was paired with a comparison children from the same classroom. The comparison child was identified by the teacher as of average compartment, and the same sex as the target child. Their inclusion criteria included:

- a. Average intelligence (IQ $\geq$ 90) by Stanford Binnet test.<sup>8</sup>
- b. Normal attention: After application of school form of children's attention and adjustment survey<sup>9</sup>.

### Methods

All included children were subjected to the following:

- I. Full medical history and clinical examination with special emphasis on CNS examination. The presence of ADHD behavior in the interview setting can be helpful, but its absence is not diagnostic, given this novel one-to-one setting
- II. Criteria for inclusion:
  - 1- Age: 6-12 years who present with inattention, hyperactivity and impulsivity
  - 2- The child should meet DSM-IV diagnostic criteria in establishing the diagnosis of ADHD.
  - 3- Obtain information about core symptoms, age of onset, duration of symptoms, and

- degree of impairment directly from parents or caregivers.
- 4- Obtain information from classroom teachers directly about core symptoms, duration of symptoms, degree of impairment, and coexisting conditions.
  - 5- Normal vision and hearing abilities
  - 6- Absence of disorders of mood (depression), communication (autism or pervasive developmental disorder), or speech and language, and for physical stigmata of medical syndromes.

III. Psychometric study:

1. Arabic version of Conners rating scale<sup>10</sup>: it is a simple 10 items scale which is graded from zero (not at all), 1 (mild), 2 (moderate), 3 (severe) and a cut off score of 15 confirms the presence of ADHD. Class teachers were also asked to rate the behavior of all the children according to the given scale. The teachers were not aware of the score which is considered to be abnormal.

**N.B.:** According to the DSM-IV criteria<sup>3</sup>, the impairment associated with ADHD must have been present for at least 6 months before the diagnosis can be established.

2. A battery of tests was used with the aim of covering different aspects of intellectual & neuropsychological assessment of the studied cases. The tests used were:

- a- IQ: using Stanford Binnet test version 4 (Arabic version).<sup>10</sup>
- b- Portage Assessment Program (PAP):<sup>11</sup>

There were a number of basic areas of skills' assessment for evaluation, including: total skills, cognitive skill, fine motor skill, gross motor skill, receptive language skill, expressive language skill, social skill and self dependency skill. Data in

this area was scored & recorded in the form of:

- Total developmental age
  - Total rate of performance
  - Specific developmental age of each skill
  - Specific rate of performance of each skill
- c- Adaptive behavior assessment and DSM-IV criteria: for comorbid psychological conditions (excluded from the study 3 cases with dyslexia, one case with Asperger syndrome and one case with childhood bipolar disorder).

IV. Visual acuity and hearing assessment:

- a- Each case was referred to ophthalmologist to be submitted for visual acuity.
- b- All studied cases were assessed by audiologist for hearing assessment including audiometry and tympanometry

V. Thyroid function : T3, T4 and TSH

VI. EEG study using digital EEG machine – GALILO – SIRUS W.R: Including routine awake 10 minutes digital EEG recording

## RESULTS

**Demographic data:**

- a) **Age:** the mean age of children with ADHD in the present study was insignificantly different from that of normal controls children ( $7.67 \pm 1.56$  and  $7.54 \pm 1.23$  respectively)
- b) **Sex:** the male to female ratio in ADHD children was 1.3:1 the difference between numbers of boys and that of girls was statistically not significant as  $X^2 = 3.33$ .

Accordingly, no significant differences were identified between ADHD children randomly assigned to the ADHD group and control group

with regard to basic demographic data including age, and gender.

**Scholastic achievement and ADD (Table1):**

The assessment of school performance included:

- Regular classroom standardized achievement tests
- Teachers reports & grading

The pupil’s grades were rated according to the following subdivisions:

- Excellent = 90% & above
- Very good = 80% to 89%
- Good = 70% to 79%
- Fair = 60 % to 69%
- Poor = below 59%

Table (1) showed that out of the 30 Studied ADHD pupils: 14 (46.7%) had poor level in their scholastic achievement, 7 (23.4%) had fair, 4 (13.3%) had good degree, 4 (13.3%) had very

good degree and only one (3.3%) had excellent. The difference between different levels of scholastic achievement among normal and ADD pupils were statistically significant as  $X^2 = 48.126$  ( $p < 0.05$ ).

Table (2) showed the mean IQ score of ADHD child according to Stanford Binnet intelligence scale for children ( $116.8 \pm 17.2$ ). No statistical comparable value was detected between the total IQ of ADHD children and the normal control children ( $p > 0.005$ ). However there was a statistical significant value between mean perceptual reasoning of ADHD children and controls ( $p < 0.05$ ).

The results of skills’ assessment were shown in table (3). total skills performance, motor (fine and gross), and language (receptive and expressive) skills showed comparable levels with controls ( $p > 0.05$ ). Meanwhile, cognitive, social and self –help skills were significantly lower in ADHD children ( $p < 0.05$ ).

**Table 1.** Scholastic achievement of ADHD studied and normal control pupils\*.

Scholastic achievement	ADHD children		Normal control		Total	
	Number	%	Number	%	Number	%
Poor	14	46.67	2	6.67	16	26.67
Fair	7	23.33	4	13.33	11	18.33
Good	4	13.3	10	33.33	14	23.33
Very good	4	13.3	8	26.67	12	20.00
Excellent	1	3.4	6	20	7	11.67
Total	30	100	30	100	60	100.00

\* significant ( $X^2 = 48.126$ )

**Table 2.** Total IQ and IQ subtests in studied ADHD children and controls.

	IQ	Auditory reasoning	Visual reasoning	Perceptual reasoning	Short memory
ADHD					
Mean	116.8	124.870	109.826	102.783*	104.522
Range	152-90	158-100	152-77	140-30	152-86
SD	17.2	15.711	25.067	23.531	26.292
Control					
Mean	117.2	119.826	113.826	118.173	109.478
Range	148-95	143-105	164-89	162-94	162-88

SD	13.5	9.614	23.415	13.973	15.243
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\* statistically significant ( p<0.05)

**Table 2.** Skills' assessment in studied ADHD children and controls.

	total	cognitive	Fine motor	Gross motor	Receptive language	Expressive language	Self-help	Social
ADHD								
mean	109.4	108.9*	98.2	88.2	105.2	117.7	105*	104.4*
range	144-70	132-64	125-49	138-85	150-72	151-80	170-54	172-55
Control								
mean	148.6	150	144.1	153.6	157.1	149.8	156.9	153.4
range	142-65	140- 68	140-50	130-67	160-67	160-43	161-54	161-55

\* statistically significant ( p<0.05)

## DISCUSSION

Though ADHD is considered as the most common neurobehavioral disorder of childhood, the diagnosis and management of children with ADHD remains a challenge<sup>12,13,14</sup>. Perhaps 30% to 85% of children with ADHD continue to have the disorder in late adolescence and young adulthood<sup>15</sup>. The cardinal symptoms of the ADHD disorder, inappropriate levels of inattentiveness, motor overactivity and impulsivity<sup>16</sup>, may interfere with the child's adjustment in every phase of existence, both through time and across experience<sup>17</sup>. In the present study, the number of boys with ADHD exceeded girls with the male to female ratio of children with ADHD was 1.3 : 1. Several studies have documented greater incidence of the disorder among boys than girls<sup>18</sup>. These findings suggest the likelihood of referral bias and possibility that symptomatology might vary according to the gender, while girls have more inattentive and learning problems<sup>19</sup>, boys show higher tendency towards impulsivity & overactivity. Thus boys with attention problems and hyperactivity are more likely than to be referred for evaluation than girls, because they exhibit more disruptive behaviors that are more troublesome to adults<sup>20</sup>. Compared to the males, females with ADHD were rated as having fewer assets, more problems of concentration, less problems of restlessness, more problems dealing

with anger, less self-confidence, more emotional problems and showing feelings such as anxiety and depression. Arcia and Conner<sup>21</sup> found that there were no differences between males and females at any age on the IQ tests. The girls in the present study demonstrated more cognitive impairments, particularly in the area of language function and were more likely to experience peer rejection than their male counterparts.

In children with thyroid dysfunction, the thyroid status seems related to attention and hyper-active-impulsive systems. Too much thyroid activity can cause agitation and restlessness. Thyroid hormones correlate with symptoms of hyperactivity but not inattention in attention deficit hyperactivity disorder. Accordingly, experts recommend that all children with ADHD be screened for signs of possible thyroid dysfunction.<sup>22</sup> However, thyroid hormone syndrome appears extremely rare in ADHD in most studies<sup>23</sup>. In the present study, all studied case with ADHD showed normal thyroid function. Accordingly, we suggested that thyroid function tests to be not recommended unless there are other signs and symptoms to suggest thyroid dysfunction.<sup>24</sup>

The present study, as other previous studies<sup>25</sup>, showed higher abnormal EEG findings (18 cases, 60%%) as compared to controls. Definite non-controversial, focal epileptiform activity (usually occipital or temporal) was seen in

33.3% of ADHD children (10 cases) and less often generalized epileptiform with bilaterally synchronous spike and waves complexes was seen in 26.7% (8 cases) of ADHD studied children. These different findings suggest that ADHD is a condition often with organic brain changes in the form of EEG abnormality, Though EEG changes are not useful diagnostic tools for clinicians at present, but could contribute to a deficit in attention or a plethora of movements.<sup>26</sup> We suggest further research about effect of antiepileptic drug in ADHD cases with no seizures but with EEG abnormalities (subclinical seizures).

The main problem of school-age ADHD children in most studies was failure and downgrading of their scholastic achievement. The present study revealed significant failure of academic achievement in ADHD pupils as compared with normal controls. Whereas 14 children out of total 16 children, 87.5%, who showed poor scholastic achievement (percentage of those with low grade) had ADHD, only 14.3 %of those who had excellent level had ADHD (one child out of total seven children). IQ level of ADHD children in the present study showed no significant difference from controls but perceptual reasoning showed a significant difference in ADHD children as compared to controls. According to the diagnostic criteria of ADHD that are provided in the Diagnostic and Statistical Manual of Mental Disorders, 3<sup>rd</sup> edition (DSM-III)<sup>27</sup>, a candidate child's IQ must be higher than 50. Two subsequent editions (DSM-III-R)<sup>28</sup> and the current DSM-IV<sup>3</sup> have eliminated the IQ criterion. They state simply that the child's ADHD symptoms must be significantly comparable with other children of the same developmental age. Defective perceptual reasoning, detected in the present study, might have a negative effect on the scholastic achievement. Therefore deficits in intellectual functioning in ADHD children are best accounted for by the multiple subtests grading and implications of Stanford Binnet rather than a total IQ level which showed no significant difference from controls. IQ subtests such as: attention span,

verbal reasoning, perceptual reasoning, visual reasoning and short-term memory, should be used to detect the influence of ADHD on scholastic achievement

The studied ADHD children in the present study also showed significant poor cognitive skills. Specific cognitive tests that require adequate attention performance, reflectivity and problem solving strategies such as matching familiar figures test; and mechanical measurements of activity by means of such instruments as stability cushions, self-winding watches, and actometers were affected by defective attention and over activity in the ADHD children. Cognitive difficulties continue to be poor with related consequences on academic achievement.<sup>29</sup> Accordingly, cognitive deficit would also explain the associated impaired academic performance. In classroom, attention difficulties and impulsivity are evidenced by the child's inability to fulfill classroom tasks and having difficulty in organizing and completing work. Inattentive symptoms may also manifest as appearing not to listen, frequent forgetting, and failure to follow on instructions<sup>1,2</sup>. Their work is sloppy and is performed in an impulsive fashion as blurring out answers in class. Group situations are particularly difficult for the child<sup>30</sup>. Cognitive defect in ADHD children could be explained by the concept of 'the executive function' introduced by Barkley<sup>31</sup>. The executive function is defined as "the ability to maintain an appropriate problem – solving set for attainment of a future goal".

Children with ADHD, included ADHD children in the present study, often have poor social skills, few friends, low self-esteem, and self-control problems, especially with anger management. Social skills defect among ADHD might be because of frustrations and failures they experience in academic performance.<sup>32</sup> Academic impairments in school-age children with ADHD can cause problems in their relationships with their teachers, peers, and families.<sup>32,33</sup> Behaviors such as blurting out answers might alienate children from their teachers. Problems with peers might stem from playing games uncooperatively,

giving instructions that seem bossy, inability to await & take turns and becoming easily frustrated. Uncooperative behavior might also lessen children's participation in team sports because coaches might think these children have attitude problems. Social impairment can also include impulsively making inappropriate comments, lying, and performing more disturbing behaviors such as stealing, destroying property, and being cruel to other people and animals. At home, these children might disrupt family routines and cause their parents a tremendous amount of stress. Their low tolerance for frustration leads to temper tantrums or sulking. In the present study significant differences between the social skills of ADHD children versus that of the normal peers have been detected ( $p < 0.05$ ). Social disconnection may lead to poor self-esteem, social isolation, and attention – seeking or acting-out behaviors and poor interpersonal skills<sup>34</sup>. Self-esteem problems are both primary and secondary in children with ADHD. They do not develop an appropriate self concept and have difficulty relating to their family and peers. The lack of appreciation in scholastic, sporting or social circles further exacerbates the primary problem, so that by adolescence they are at greater risk of being influenced by peer pressure. Being easily led and set up by their peer group, they are consequently more prone to find themselves in trouble. Feelings of inadequacy, anxiety and depression are therefore more common. Accordingly, social skills training might be effective and of importance. Programs developing social skill can be very helpful when combined with parental guidance and assurance including positive psychic and positive behavior reinforcement techniques.

#### Conclusion:

According to the present study, a fully integrated assessment and management programs should be applied for every ADHD child that include the following:

1. Assessing the sub-areas and divisions of intellectual functions especially perceptual reasoning, together with the functioning level

of all developmental skills. These findings, although not needed for diagnosis (depending on DSM-IV criteria for diagnosis), are essential for full assessment, management and the follow-up of the results of treatment strategies and interventions.

2. Implicating a four dimensional management program including:
  - Medical treatment
  - Cognitive training
  - Behavioral & social therapy
  - Parental guidance & assurance

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