Some neuropsychiatric comorbidities of attention deficit hyperactivity disorder
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Objectives
The aim of the study was to find out the possible neurological and psychiatric comorbidities that might be associated with attention deficit hyperactivity disorder (ADHD) and to assess the intelligence quotient (IQ) in the diagnosed patients, and hence improve the accurate diagnosis of ADHD and its management.

Patients and methods
This study is a comparative cross-sectional study (the study group and the control group). Participants were recruited from the Neuropsychiatric and Pediatric Clinics in Benha University Hospital, in addition to some private clinics and centers. The sample size of this study was 74 (divided into two groups, the study and the control groups). Participants were chosen by nonrandom technique; all patients who fulfilled the inclusion criteria and accepted (their parents) to participate were included in the study. All case and control groups were subjected to a semistructured interview, complete neuropsychiatric clinical assessment, psychometric testing using Wechsler Intelligence Scale for Children, Conners Parent Rating Scale-revised, long version, and Revised Behavior Problem Checklist. Electroencephalography was performed for some cases and controls.

Results
The mean age of the ADHD children was 8.78 years old; it was more prevalent among boys. Perinatal problems were significantly prevailing among cases of ADHD. In all, 70.3% had ADHD combined type, 10.8% had ADHD predominantly hyperactive-impulsive, and 18.9% had ADHD predominantly inattentive type. The control group showed higher mean IQ of 105.4 ± 9.6 compared with the ADHD case group who showed mean IQ of 93.8 ± 10.7. There were several significant comorbidities such as delayed language development, delayed developmental milestones, oppositional defiant disorder, conduct disorder, depressive symptoms, sleep disturbance, nocturnal enuresis, and soft neurological signs. Conners scale showed that the ADHD children showed higher mean in all Conners test items than the control group. ADHD children had higher mean along all Revised Behavior Problem Checklist compared with the control group. With respect to correlations, the oppositional defiant disorder was significantly correlated to the combined type ADHD. There was statistical significant difference in the whole sample where children who did not have oppositional defiant disorder had higher IQ (101.5 ± 11.5) than those who did (95 ± 11.1).

Conclusion
ADHD is a disorder that carries several neuropsychiatric comorbidities. Assessment of children with ADHD should address these comorbidities, and management should focus on them to obtain best outcomes for the patients.

Keywords:
attention deficit hyperactivity disorder, comorbidities, neurology, psychiatry

Introduction
Attention deficit hyperactivity disorder (ADHD)-diagnosed individuals are often found to have a number of comorbidities/disorders as well (Barkley, 2006). Kessler et al. (2005) found that adults with ADHD are six times more likely to suffer one or more additional psychiatric disorders in their lifetime than individuals without ADHD. The number is even higher for children drawn from clinics. Around 87% of clinically diagnosed ADHD children may have at least one other disorder and 67% have at least two other disorders (Kadesjö and Gillberg, 2001).

Despite being the most commonly studied and diagnosed psychiatric disorder in children and adolescents, the cause in the majority of cases is unknown. It affects about 6–7% of children when diagnosed by the Diagnostic and statistical manual of mental disorders, 4th ed. (DSM-IV) criteria (Willcutt, 2012) and 1–2% when diagnosed by the ICD-10 criteria (Cowen et al., 2012). The rates are similar between countries and depend mostly on how it is diagnosed (Tsuang et al., 2011). ADHD is diagnosed approximately three times more frequent in boys than in girls (Singh, 2008; Emond et al., 2009). About
30–50% of people diagnosed in childhood continue to have symptoms into adulthood (Bálint et al., 2008) and between 2 and 5% of adults have the condition (Kooij et al., 2010). The condition can be difficult to tell apart from other disorders as well as that of high normal activity (Dulcan and Lake, 2011).

Inclusion criteria
The inclusion criteria for the studied group were age of 5–15 years old either boys or girls (start of school age until the beginning of preparatory school) and ADHD diagnosis according to DSM-IV. The inclusion criteria of the control group were age of 5–15 years old either boys or girls (start of school age until the beginning of preparatory school) and suffering from minor physical conditions such as otitis media, pharyngitis, parasitic infestations, etc.

Exclusion criteria
Exclusion criteria of the studied group were any patient with age below 5 years or above 15 years and suffering from any major physical condition. The exclusion criteria of controls were any patient with age below 5 years or above 15 years, suffering from any major neuropsychiatric disorder, and patients suffering from any major physical condition.

Patients and methods

Technical design
This study is a comparative cross-sectional study (the study group and the control group). Participants were recruited from the Neuropsychiatric and Pediatric Clinics in Benha University Hospital, in addition to some private clinics and centers. The field work (collection of data) started at the beginning of September 2011 and ended at the beginning of June 2012.

The studied group included patients with ADHD, whereas the control group included patients matched for age, sex, and socioeconomic status but suffering from minor illness such as otitis media, pharyngitis, parasitic infestation, etc. The sample size was calculated according to the following equation: $n = z^2 \times pq/d^2$, where $n$ is the minimum sample size, $z$ is 1.96 at 95% confidence interval obtained from standard statistical table of normal distribution, $p$ is the estimated prevalence of ADHD in a given population (3–7%, obtained from previous literature), $q = (1-p)$, and $d$ is the margin of error (0.05).

For calculating the sample size of this study, the mean prevalence of ADHD (5%) from previous literature was taken; thus, the required ‘$n$‘ was found to be 73, to be increased to 74 (as it will be divided into two groups, the study and the control groups).

Participants were chosen by nonrandom technique; all patients who fulfilled the inclusion criteria and accepted (their parents) to participate were included in the study.

Aim of the study
The aim of the study was to find out the possible neurological and psychiatric comorbid disorders that might be associated with ADHD, to assess the intelligence quotient (IQ) in the diagnosed cases, to discuss the suitable recommendations that might improve the accurate diagnosis of ADHD and hence its management, and to discuss the possible correlations between several factors in the study.

Operational design
All procedures were revised and approved by Research Ethics Committee in Benha, Faculty of Medicine. Informed written consent was obtained from the children’s guardians before participation; it included data about aim of the study, study design, site, time, subject, tool, and confidentiality. Parents were informed by the results and recommendations, and it was explained that they could leave the study with no objections. An official permission was obtained to conduct this study.

All the case and control groups were subjected to the following:

A semistructured interview
This was conducted to their caregivers emphasizing the demographic data such as age, sex, residency, type of school, school grades, history of illness, family history including consanguinity between parents, presence of similar condition in family, and other neuropsychiatric disorders in the family, the condition of pregnancy, labor, type of labor, feeding, vaccinations, milestones, detentions, scholastic achievement, social relations, and communication skills, and past history of medical or surgical conditions or trauma, neuropsychiatric symptoms and signs noted by the caregivers, etc.

Complete neuropsychiatric clinical assessment
This was performed by two neuropsychiatrists using the DSM-IV criteria to identify different neuropsychiatric symptoms/disorders.
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Suitable psychometric tests
Tests that help in diagnosis of ADHD and comorbid psychiatric symptoms and disorders were performed including:

2. Conners Parent Rating Scale-revised, long version (Conners, 1997). The Arabic versions of the Conners Parent Rating Scale-revised, long versions; parent forms used in this study were translated and validated through previous research conducted by El-Shaikh (2003) in the Institute of Psychiatry, Ain Shams University.

Electroencephalography was performed for some cases and controls.

Pilot study
A pilot study was conducted for 1 month at the beginning of the actual field work on eight patients to test the questionnaires before their administration, and it was found to be suitable.

Statistical design
The collected data were tabulated and analyzed using the statistical package for the social sciences (SPSS; SPSS Inc., Chicago, Illinois, USA). Categorical data were expressed as number and percentage using the χ² or Z test for analyzing them. Continuous variables were presented as mean and SD using the Student t-test for analyzing them. Other suitable tests of significance were used when indicated according to the situation. The accepted level of significance in the present study was 0.05 (P < 0.05 was considered significant).

Results
The mean age of the patients was 8.78 years with SD of 3.2, whereas the mean age of the control group was 9.41 years with SD of 2.9.

The case group consisted of 28 (75.7%) boys and nine (24.3%) girls, whereas the control group consisted of 23 (62.2%) boys and 14 (37.8%) girls.

A total of 30 (81.1%) patients were right handed compared with 32 (86.5%) control.

Table 1 shows differentiation of the case group according to diagnosis; it was found that 26 of the 37 (70.3%) patients had ADHD combined type, four (10.8%) had ADHD predominantly hyperactive–impulsive, and seven (18.9%) had ADHD predominantly inattentive type.

Results show that 13.5% of the patients had positive family history of consanguinity (three were first degree and two were second degree consanguinity) compared with 8.1% of the control (one was first degree, whereas two were second degree consanguinity). This finding was statistically insignificant (P > 0.05).

In all, 13.5% of the patients had positive family history of psychiatric disorders (anxiety in father, depression in mother, hyperactive father, neurotic parents, and overprotective parents) and 8.1% of the controls had positive family history of psychiatric disorder (neurotic parents, depression in father and mother, and personality disorder in sister). This finding was statistically insignificant.

A total of 13.5% of the patients had perinatal problems (two patients had respiratory problem, one patient had difficult labor, low birth weight, and intrauterine bleeding) compared with 5.4% of control had perinatal problems (low birth weight and difficult labor). This finding was statistically insignificant.

Table 2 shows that the control group showed higher mean IQ of 105.4 ± 9.6 compared with the ADHD case group that showed mean IQ of 93.8 ± 10.7. This finding was highly statistically significant (P < 0.01).

Table 3 shows that 35.1% of the ADHD patients had delayed language development compared with 2.7% of the control. This finding was highly statistically significant (P < 0.01).

A total of 51.4% of the ADHD patients had a comorbid oppositional defiant disorder (ODD) based on the Conners Parent Rating Scale and clinical evaluation compared with 5.4% of the control. This finding was of high statistical significance (P < 0.01).

Table 1 Distribution of subtypes of attention deficit hyperactivity disorder among cases

<table>
<thead>
<tr>
<th>Diagnoses</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combined</td>
<td>26 (70.3)</td>
</tr>
<tr>
<td>Hyperactive–impulsive</td>
<td>4 (10.8)</td>
</tr>
<tr>
<td>Inattentive</td>
<td>7 (18.9)</td>
</tr>
</tbody>
</table>

Table 2 Distribution of intelligence quotient among cases of attention deficit hyperactivity disorder and the control group

<table>
<thead>
<tr>
<th>Variables</th>
<th>Case (mean ± SD)</th>
<th>Control (mean ± SD)</th>
<th>T</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>IQ</td>
<td>93.8 ± 10.7</td>
<td>105.4 ± 9.6</td>
<td>1.8</td>
<td>0.00 HS</td>
</tr>
</tbody>
</table>

HS, highly significant; IQ, intelligence quotient.
A total of 27% of the ADHD patients had comorbid neurological disorder compared with 8.1% of the control. This finding was statistically significant ($P < 0.05$). Regarding ADHD patients, four (10.8%) showed brisk reflexes, two had epilepsy, two had incoordination, one had dyslexia and hearing problem, and another patient had stuttering problem. The control group had two children with brisk reflexes and one child with epilepsy.

Table 4 illustrates that the case group showed higher mean in all Conners rating scales than the control group. The findings regarding hyperactivity, DSM-IV: hyperactive–impulsive, DSM-IV: inattentive, social problem, oppositional, emotional lability, perfectionism, cognitive problem/inattention, Conners ADHD index, DSM-IV total, Conners global index, and Conners global index restlessness–impulsive had high statistical significance ($P < 0.01$).

Psychosomatic finding showed statistical significance ($P < 0.05$), whereas anxious–shy did not show any statistical significance.

Table 5 shows that the case group had higher mean along all Revised Behavior Problem Checklist compared with the control group. The conduct scale, attention problem scale, and motor excess scale finding’s showed high statistical significance, whereas socialized aggression scale and psychotic behavior scale showed statistical significance. The anxiety withdrawal scale showed no statistically significant difference between the case and control groups.

Among comorbidities, there is only one highly statistically significant correlation. Regarding the ADHD type, it is more prevalent among combined type. The ODD was more prevalent among combined type; 65.4% were positive on the ODD based on Conners and clinical evaluation compared with 50% of the hyperactive–impulsive type and none of the inattentive type.

There is a statistical significant difference in the whole sample where children who did not have ODD had higher IQ ($101.5 \pm 11.5$) than those who did ($95 \pm 11.1$). There was no correlation between IQ and CD among patients of ADHD.

### Discussion

#### Demographic data

The mean age for cases was 8.78 years, whereas the mean age for the control group was 9.41 years. There was no statistically significant difference between both groups regarding age. This finding is in accordance with retrospective studies that show that age at onset can occur...
and statistical manual of mental disorders ADHD, attention deficit hyperactivity disorder; DSM-IV, impulsive index restlessness–Hyperactivity 74.3 ± 11.1 47.3 ± 5.1 18.2 0.000 HS
DSM-IV total 71.5 ± 7.2 47.2 ± 5.7 1.03 0.000 HS
Conners ADHD inattention Psychosomatic 57.81 ± 14.3 52.3 ± 7.1 20.3 0.04 S
Perfectionism 56.24 ± 11.1 47.5 ± 5.9 9.06 0.000 HS
Emotional lability 74.6 ± 12.7 49.7 ± 8.2 8.1 0.000 HS
Oppositional 65.1 ± 13.4 51.4 ± 8.9 9.5 0.000 HS
Social problem 64.1 ± 15.7 51.03 ± 6.1 46.5 0.000 HS
Anxious–shy 57.5 ± 11.4 54.2 ± 10.6 0.04 0.19 NS
DSM-IV: inattentive 68.8 ± 11.1 47.8 ± 6.1 0.7 0.000 HS
impulsive
Hyperactivity 72.1 ± 11.6 48.03 ± 4.9 24.6 0.000 HS

In our results, 30 (81.1%) patients were right handed, whereas 32 (86.5%) controls were right handed, and again there was no statistically significant difference between the case and control groups regarding handedness. Studies show a higher prevalence of left handedness (Rommelse et al., 2007) and mixed handedness (Rodriguez et al., 2010). The higher prevalence in our study could be interpreted by the cultural importance of using the right hand and that parents may train their children to use their right hand. Additional research is needed to understand the connections between neural substrates related to atypical cerebral asymmetry, handedness, and mental health problems including ADHD symptoms.

Upon differentiation of the cases of ADHD, it was found that 26 (70.3%) patients were clinically diagnosed as ADHD combined type, four (10.8%) as ADHD predominantly hyperactive–impulsive, and seven (18.9%) as ADHD predominantly inattentive type.

Most of what is known about ADHD subtype prevalence comes from clinic-based samples, which have demonstrated higher rates of ADHD combined type than the other subtypes (Lahey et al., 1994; Faraone et al., 1998). However, international and US regional population-based studies have had mixed results, with some showing a predominance of the inattentive subtype (Wolraich et al., 1996) and others documenting the highest rates of ADHD combined type (Ford et al., 2003).

Table 4 Distribution of Conners Parent Rating Scale-revised, long version, results among cases of attention deficit hyperactivity disorder and the control group

<table>
<thead>
<tr>
<th>Variables</th>
<th>Case (mean ± SD)</th>
<th>Control (mean ± SD)</th>
<th>T</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hyperactivity</td>
<td>72.1 ± 11.6</td>
<td>48.03 ± 4.9</td>
<td>24.6</td>
<td>0.000 HS</td>
</tr>
<tr>
<td>DSM-IV hyperactive–impulsive</td>
<td>70.8 ± 10.5</td>
<td>47.7 ± 6.3</td>
<td>6.9</td>
<td>0.000 HS</td>
</tr>
<tr>
<td>DSM-IV: inattentive</td>
<td>68.8 ± 11.1</td>
<td>47.8 ± 6.1</td>
<td>0.7</td>
<td>0.000 HS</td>
</tr>
<tr>
<td>Anxious–shy</td>
<td>57.5 ± 11.4</td>
<td>54.2 ± 10.6</td>
<td>0.04</td>
<td>0.19 NS</td>
</tr>
<tr>
<td>Social problem</td>
<td>64.1 ± 15.7</td>
<td>51.03 ± 6.1</td>
<td>46.5</td>
<td>0.000 HS</td>
</tr>
<tr>
<td>Oppositional</td>
<td>65.1 ± 13.4</td>
<td>51.4 ± 8.9</td>
<td>9.5</td>
<td>0.000 HS</td>
</tr>
<tr>
<td>Emotional lability</td>
<td>74.6 ± 12.7</td>
<td>49.7 ± 8.2</td>
<td>8.1</td>
<td>0.000 HS</td>
</tr>
<tr>
<td>Perfectionism</td>
<td>56.24 ± 11.1</td>
<td>47.5 ± 5.9</td>
<td>9.06</td>
<td>0.000 HS</td>
</tr>
<tr>
<td>Psychosomatic</td>
<td>57.81 ± 14.3</td>
<td>52.3 ± 7.1</td>
<td>20.3</td>
<td>0.04 S</td>
</tr>
<tr>
<td>Cognitive problem/ inattention</td>
<td>66.8 ± 9.2</td>
<td>47.1 ± 7.6</td>
<td>0.86</td>
<td>0.000 HS</td>
</tr>
<tr>
<td>Conners ADHD index</td>
<td>70.1 ± 6.9</td>
<td>47.4 ± 5.5</td>
<td>1.29</td>
<td>0.000 HS</td>
</tr>
<tr>
<td>DSM-IV total</td>
<td>71.5 ± 7.2</td>
<td>47.2 ± 5.7</td>
<td>1.03</td>
<td>0.000 HS</td>
</tr>
<tr>
<td>Conners global index</td>
<td>74.3 ± 11.1</td>
<td>47.3 ± 5.1</td>
<td>18.2</td>
<td>0.000 HS</td>
</tr>
<tr>
<td>Conners global index</td>
<td>71.6 ± 11.8</td>
<td>49.6 ± 6.6</td>
<td>10.4</td>
<td>0.000 HS</td>
</tr>
</tbody>
</table>

Intelligence quotient
The result of IQ (Wechsler test) showed that there was a high statistically significant difference between patients with ADHD and the control group. The difference was highly significant. This result is in accordance with the literature that found that clinic-referred ADHD children often have lower intelligence than the control group used in these same studies, particularly in verbal intelligence (McGee et al., 1992; Mariani and Barkley, 1997). However, it did not agree with the results of Hinshaw et al. (1987), Sonuga-Barke et al. (1994), and Peterson et al. (2001) who found significant negative association between the degree of ADHD and intelligence.

Perinatal problems
Perinatal problems were found in 13.5% of patients (including two cases of respiratory problem, one case of difficult labor, one case of low birth weight, and one case of intrauterine bleeding) compared with 5.4% of control who had perinatal problems (including one case of low birth weight and one case of difficult labor). The difference regarding the perinatal problems was found to be statistically insignificant yet higher in ADHD.

Table 5 Distribution of Revised Behavior Problem Checklist results among cases of attention deficit hyperactivity disorder and the control group

<table>
<thead>
<tr>
<th>Variables</th>
<th>Case (mean ± SD)</th>
<th>Control (mean ± SD)</th>
<th>T</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conduct scale</td>
<td>18.9 ± 12.3</td>
<td>7 ± 7.1</td>
<td>26.02</td>
<td>0.000 HS</td>
</tr>
<tr>
<td>Socialized aggression scale</td>
<td>10.5 ± 5.9</td>
<td>7.08 ± 6.3</td>
<td>0.5</td>
<td>0.01 S</td>
</tr>
<tr>
<td>Attention problem scale</td>
<td>21.4 ± 5.7</td>
<td>5.54 ± 6</td>
<td>0.07</td>
<td>0.000 HS</td>
</tr>
<tr>
<td>Anxiety withdrawal scale</td>
<td>9.7 ± 5.6</td>
<td>7.51 ± 5.4</td>
<td>0.49</td>
<td>0.09 NS</td>
</tr>
<tr>
<td>Psychotic behavior scale</td>
<td>3.8 ± 2.5</td>
<td>2.5 ± 2.3</td>
<td>0.72</td>
<td>0.03 S</td>
</tr>
<tr>
<td>Motor excess scale</td>
<td>6.9 ± 2.0</td>
<td>2.14 ± 1.6</td>
<td>0.6</td>
<td>0.000 HS</td>
</tr>
</tbody>
</table>

HS, highly significant; S, significant.

or be first noticed or recalled between the ages of 7 and 12, according to a proposal on DSM-V (Kearl, 2010).

In the current study, the case group consisted of 28 (75.7%) boys and nine (24.3%) girls, whereas the control group consisted of 23 (62.2%) boys and 14 (37.8%) girls, and there was no statistically significant difference between the case and control groups regarding gender. It was noted that there is higher prevalence in boys. This quiet agrees with previous studies that found that male children have 2.5 and 5.6 times more chance than female children to be diagnosed as ADHD within epidemiological samples (Breton et al., 1999; DuPaul et al., 1999; Bishry et al., 2008).

In our results, 30 (81.1%) patients were right handed, whereas 32 (86.5%) controls were right handed, and
Case–control epidemiologic studies indicate that pregnancy, labor/delivery, and neonatal complications are more frequent environmental factors in children diagnosed with ADHD compared with healthy controls (Kotimaa et al., 2003). It is believed that such early trauma on the brain during crucial periods of development may have long-lasting effects on cognition and behavior (McGrath et al., 2000), although the relevant mechanisms mediating the effects of these events remain undetermined.

**Developmental problems**

Regarding language development and other developmental milestones, it was found that 35.1% of ADHD patients have delayed language development compared with only 2.7% of the control group. The difference was found to be statistically highly significant.

In addition, 8.1% of the ADHD patients had delayed developmental problems other than language compared with 2.7% of controls. Three cases and one control had delayed walking, whereas one of the cases had delayed teeth eruption as well, however, without statistical significance.

This increase in developmental delay in cases is in accordance with the results of Barkley (2006), who found delayed onset of language development to be up to 35% and who also found delayed motor coordination to be present in up to 52%, which can explain, to some part, delayed walking. This result may also be interpreted by the significant prevalence of soft neurological signs in ADHD as shown in Table 2.

**Results of clinical finding's (from the semistructured interview and clinical examination)**

The clinical assessment of the case and control groups in the study also showed some positive data (Table 3).

A total of 19 (51.4%) patients compared with two (5.4%) controls showed ODD and the difference was statistically highly significant. This result is in accordance with previous studies that found in clinic-referred ADHD children that between 54 and 67% meet criteria for a diagnosis of ODD by 7 years of age or later (Loeber et al., 2000).

Twelve (32.4%) patients compared with two (5.4%) controls had CD and the difference was found to be highly statistically significant, a result that is in accordance with that of Lahey et al. (2000) and Waschbusch (2002), which found that cooccurrence of CD with ADHD is between 20 and 50% in children and 44–50% in adolescents with ADHD.

Moreover, two ADHD (5.4%) patients were found to be smokers (one cigarette smoking and one shisha smoking). The age of these two children was 13 and 15 years and both had CD as well as ODD, whereas none was found smoking in the control group, and the difference between both groups was found to be statistically insignificant. Statistically, it was not significant; yet, if mean age of the study sample was older, this number would have probably been higher, as the mean age of patients was 8.78 years and probably substance use starts at an older age. In some studies, the risk of substance use disorders among ADHD followed to adulthood ranges from 12 to 24% (Gittelman et al., 1985; Mannuzza et al., 1993, 1998; Rasmussen and Gillberg, 2000).

Regarding tics, five (13.5%) patients and one (2.7%) control had tic disorder and the difference was insignificant. Four ADHD patients of the five had motor tics and one patient had vocal tics; the control child had motor tics. In a previous research, it was found that up to 18% of children may develop a motor tic in childhood that declines to a base rate of about 2% by mid-adolescence and less than 1% by adulthood (Peterson et al., 2001). In the literature, a diagnosis of ADHD does not appear to necessarily elevate these risks for a diagnosis of tics or Tourette’s disorder, at least not in childhood or adolescence (Peterson et al., 2001). Among clinic-referred adults diagnosed with ADHD, there may be a slightly greater occurrence of tic disorders (12%) (Spencer et al., 2001).

No cases of Tourette’s disorder were diagnosed in this study. This is in accordance with the literature, as the prevalence of Tourette’s disorder occurs in less than 0.4% of the population (Peterson et al., 2001) and our total sample size (cases plus control) is 74 children only.

Although depressive symptoms were more prevalent among ADHD (16.2%) patients than the control group (5.4%), it was statistically insignificant. This higher prevalence of depressive symptoms is in agreement with previous studies that found that between 15 and 75% of those with ADHD may have a mood disorder, although most studies place the association between 20 and 30% (Barkley, 2006; Barkley et al., 2008; Cuffe et al., 2001).

No bipolar disorder was detected in our study, neither in the case group nor the control group. Symptoms of hypomania/mania in children seem to mimic other symptoms seen because of the ADHD itself; CD, or ODD, such as irritability, hyperactivity, over talkativeness, shifting attention, which makes the diagnosis of bipolar disorder in such patient harder and harder. Interestingly, DSM-V proposes a new title for diagnosis of such patients ‘disruptive mood
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Regarding the sleep pattern among the studied sample, sleep disturbance was found among eight (21.6%) ADHD patients and only two (5.4%) controls, and the difference was statistically significant. Many studies suggested an association between ADHD and sleep disturbances (Ball et al., 1997; Gruber et al., 2000; Barkley, 2006). Stein (1999) evaluated 125 psychiatrically diagnosed children with 83 pediatric outpatient children and found moderate to severe sleep problems in 19% of those with ADHD. Treatment with stimulant medication increased the proportion of ADHD children with sleep problems to 29%, an unexpected finding given the well-known stimulant side effect of increased insomnia (Barkley, 1998).

Enuresis (nocturnal) was present in 11 (29.7%) ADHD patients and four (10.8%) controls, and the difference was found to be statistically significant. Five (13.5%) ADHD patients had primary nocturnal enuresis, whereas six (16.2%) had secondary nocturnal enuresis. In the control group, equal distribution was present (two patients 5.4% in each). This difference could be due to increased comorbid depression in patients and increased brain insult during difficult labor.

Concerning the neurological findings, 10 (27%) ADHD patients had comorbid neurological findings compared with three (8.1%) controls, and the difference was statistically significant. In four (10.8%) cases of ADHD brisk reflexes were found, two (5.4%) ADHD patients had epilepsy, two (5.4%) ADHD patients had incoordination, one (2.7%) ADHD patient had dyslexia and hearing problem, and another case of ADHD (2.7%) had stuttering problem. The control group had three (8.1%) individuals with brisk reflexes. Our results are in accordance with that of Carte et al. (1996), who found that neurological examinations for ‘soft’ signs related to motor coordination and motor overflow movements find ADHD children to demonstrate more such signs as well as generally sluggish gross motor movements than control children, including those with purely learning disabilities.

These results may also be interpreted by the fact that, in children with ADHD, there is a general reduction in brain volume, with a proportionally greater decrease in the volume in the left-sided prefrontal cortex. The brain pathways connecting the prefrontal cortex and the striatum also appear to be involved. This suggests that inattention, hyperactivity, and impulsivity may reflect frontal lobe dysfunction, with additional brain regions such as the cerebellum also being implicated (Krainer and Castellanos, 2006).

Results of Conners Parent Rating Scale
In our study, we found a high statistically significant difference between cases of ADHD and the control group regarding all subscales except for anxious–shy subscale, which was insignificant. These results not only confirmed the diagnosis of ADHD, but also proved some positive significant findings of comorbidities.

Having highly statistically significant social problems agrees with the literature, as interpersonal behaviors of those with ADHD are often characterized as more impulsive, intrusive, excessive, disorganized, engaging, aggressive, intense, and emotional. Hence, they are disruptive of the smoothness of the ongoing stream of social interactions, reciprocity, and cooperation (Whalen and Henker, 1992).

Finding highly statistically significant was found in oppositional scale, which confirms the high prevalence of ODD in children with ADHD and adds more to the social problems. One longitudinal research suggests that severity of early ADHD is actually a contributing factor to risk for later ODD regardless of severity of early ODD (Burns et al., 2001), perhaps due to the problems with poor emotion (anger) regulation in ADHD (Barkley, 2010), and this shows the link between ADHD and oppositional element.

As well having highly statistically significant emotional lability can reflect impulsivity and shows that these children have more mood symptoms. Moreover, this emotional lability can give a picture mimicking bipolar spectrum.

Although perfectionism was found to be highly significant and these children tend to lack organization, being meticulous this perfectionism might be reflecting obsessive symptoms, which need further research.

A statistical significant difference between cases of ADHD and the control group regarding psychosomatic scale was detected, such as headache, epigastric pain, and nonspecific body pain, a result that might be explained by the prevalence of depression among ADHD.

It was observed that there was also no statistically significant difference between cases of ADHD and the control group regarding the anxious–shy scale, a result that might be explained by the fact that hyperactivity of ADHD children is usually overlapping the shyness, and as both anxiety and shyness were included together in this scale, anxiety would have been overlapped by hyperactivity.

Results of Revised Childhood Behavioral Problem Checklist
It was found that cases of ADHD showed a higher mean among all items of Revised Childhood Behavior
Problem Checklist compared with the results of the control group. There was a highly statistically significant difference between ADHD patients and the control group regarding conduct scale, attention problem scale, and motor excess scale (Table 5).

The finding of a highly statistically significant conduct scale was explained before with CD (Table 3).

There was a statistically significant difference between both groups regarding socialized aggression scale and psychotic behavior scale. Both aggressive and psychotic behaviors here could be explained by the presence of hyperactivity, which may be mounting to destructive behavior, together with the relatively low IQ and the inattention and difficulty in learning from experiences.

There was no statistically significant difference regarding anxiety withdrawal scale. The finding concerning anxiety withdrawal could be explained by the ADHD children tending to be interactive and storming, as they are impulsive and hyperactive. Having more prevailing conduct even increases this more and more; hence, they do not tend to be withdrawn, yet their anxiety can appear in other forms.

Some important correlations
In the current study, some important correlations that might throw some light on important relationships between different variables were found. There was a high statistically significant correlation between ODD and the different subtypes of ADHD; 100% of the inattentive type showed ODD (Table 6).

Hence, the prevalence of oppositional behavior among inattentive type could be explained by these children using passive ways of aggressive attitude by being oppositional.

There is statistically significant difference in the whole sample where children who did not have ODD had higher IQ (101.5 ± 11.5) than those who did (95 ± 11.1). There was no correlation between IQ and CD among cases of ADHD.

A positive correlation between IQ and ODD shows that the higher the level of IQ, the less the presence of ODD.

Regarding CD, our finding showed no correlation between the level of IQ and CD. This is in accordance with the literature that found that associations between ratings of conduct problems and intelligence in children are often small or even nonsignificant (Hinshaw et al., 1987; Lynam et al., 1993; Sonuga-Barke et al., 1994).

High intelligence does not preclude conduct problems. High verbal IQ was related to a decrease in CD symptoms over time only for boys in a clinic-referred sample without a parent with antisocial personality disorder (APD) (Lahey et al., 1995). Furthermore, boys with psychopathic characteristics, parental APD, and conduct problems were found to have IQs equivalent to those of controls and higher than those of boys with conduct problems but without psychopathy and parental APD (Christian et al., 1997). Very young girls with conduct problems, compared with those without such problems, tend to have higher scores on measures of intelligence (Sonuga-Barke et al., 1994; Fagot and Leve, 1998).

Conclusion and recommendations
ADHD is a disorder that carries several neuropsychiatric comorbidities. Assessment of children with ADHD should address these comorbidities, and management should focus on them to obtain best outcomes for the patients.

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Conflicts of interest
There are no conflicts of interest.

References


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