Child characteristics associated with comorbidities among children diagnosed with attention-deficit hyperactivity disorder

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Background
More than half of children who are diagnosed with attention-deficit hyperactivity disorder (ADHD) were reported to have one or more comorbid psychiatric disorder. Our aim is to assess different comorbidities in children diagnosed with ADHD and to explore the association between the presence of such comorbidities and the characteristics of both the child and the family.
Patients and methods
The study included 48 children with ADHD who fulfilled the inclusion criteria. The diagnosis of ADHD was made by semistructured clinical interview for both parents and child according to psychiatric sheet of Psychiatry Department of Zagazig University hospitals. Confirmation of diagnosis, severity, and subtype was done by revision and evaluation of child's presentation according to DSM-5 criteria and the Conner's Comprehensive Behavior Rating Scales (parent's version). Mini International Neuropsychiatric Interview for Children and Adolescents (MINI-KID) was used to assess psychiatric comorbidities among children with ADHD.
Results
Approximately 77.1% of children with ADHD had at least one psychiatric comorbidity. Overall, 41.7% of the population of this study had externalizing disorders (disruptive behavior disorders), whereas 52.1% had internalizing disorder, including mood disorders (25%) and anxiety disorders (29.1%). In addition, neurodevelopmental disorders were comorbid in 27.1% of the population sample. Statistically significant differences between different groups of comorbidities regarding academic performance and ADHD subtype and severity were found.
Conclusion
Most children with ADHD have one or more comorbid psychiatric disorders. Children with ADHD and comorbidities are more prone to low academic performance and increased severity of ADHD.

Keywords:
attention-deficit hyperactivity, comorbidity, conner's

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Introduction

Attention-deficit hyperactivity disorder (ADHD) is a disorder with an early onset and a neurodevelopmental nature. Its prevalence ranges between 5.9 and 7.1% worldwide (Willcutt, 2012). ADHD is three times more frequent in boys than in girls (Biederman *et al.*, 2005). The etiology of ADHD is still unclear. Family studies reported that heredity role is about 80–90%, indicating an important genetic role (Kessler *et al.*, 2005). Moreover, environmental factors such as exposure to adverse circumstances during intrauterine or children life have been included in the etiology of ADHD (Plomp *et al.*, 2009). Studies made about gene–environment interactions state that they may play an important role in ADHD (Thapar *et al.*, 2012). Core characteristics of ADHD are pervasive and developmentally inappropriate inattention, hyperactivity, impulsivity, and distractibility (Faraone and Biederman, 1998). Children having ADHD usually have social, academic, and occupational difficulties, and ~30–50% of them have persisting symptoms during adulthood (Kessler *et al.*, 2005). Studies show that comorbid disorders among children with ADHD are very common. Approximately 50–70% of children with ADHD present with an externalizing disorder such as opposition defiant disorder (ODD) or conduct disorder (CD), whereas up to 64% present with an internalizing disorder such as depression and anxiety (Sciberras *et al.*, 2014). Children with ADHD can also

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present with co-occurring internalizing and externalizing comorbidities in up to 22% of cases (Abikoff *et al.*, 2002). Many cross-sectional studies have examined how comorbidities affect the functioning of children with ADHD (Humphreys *et al.*, 2012) and have shown that children with ADHD and externalizing comorbidities are more prone to poorer peer functioning (Mikami and Lorenzi, 2011) and poorer psychosocial quality of life (Limbers *et al.*, 2011). Studies examining the association between internalizing comorbidities and peer functioning of children with ADHD have produced mixed results. Some studies have found that internalizing comorbidities are associated with poorer peer functioning, whereas others have not (Booster *et al.*, 2012). The aim of this study was to assess different comorbidities in children diagnosed with ADHD and to explore the association between the presence of such comorbidities and the characteristics of the child.

Patients and methods

This was a cross-sectional study. It was done at the outpatient clinic of child psychiatry at Helwan Hospital for mental health during the period from October 1, 2018, to March 30, 2019. A total of 48 children from both sexes, in the age group from 6–12 years old with DSM-5 diagnosis of ADHD, were selected by simple random sampling. They were selected after fulfilling the inclusion criteria from the children with ADHD who came with their caregivers to seek psychiatric advice and help from child psychiatry outpatient clinic. Excluded patients were those who refused to participate, those older than 12 years or younger than 6 years, those who had medical problem that could affect their mental health, and those who had below average IQ. Ethical committee approval and written informed consent were obtained. All participants enrolled in the study were subjected to the following psychometric assessments. Phase 1 included the following: (a) a semistructured interview for one of or both parents and the child according to psychiatric sheet of child psychiatry unite of helwan hospital for mental health for collecting detailed psychiatric history of the child and assessment of the child through a detailed interview including physical and mental state examination. (b) Stanford-Binet intelligence scale 5th edition (Roid and Pomplun, 2012) was designed to test intelligence and cognitive abilities, used for ages 2 to 89 years and provides a Full Scale IQ. (c) Conner's Parent Rating Scale-revised L (Conners, 2001): the Arabic version translated by Dr. Abd El-Rakeeb A. Albehery (2011), was used. The national institute of mental health accepted its validity, reliability, and stability. It is a paper and pencil screening questionnaire designed to be completed by parents to assist in determining whether children between the ages of 3 and 17 years might have ADHD. It consists of 80 questions, which should be answered by parents, each followed by four choices: 0 (not at all), 1 (just a little), 2 (pretty much), or 3 (very much). In addition to diagnosis of ADHD, it evaluates the degree of attention deficit, hyperactivity, and impulsivity symptoms. (d) Mini International Neuropsychiatric Interview for Children and Adolescents (MINI-KID) (Sheehan *et al.*, 1998): the MINI-KID is a structured clinical diagnostic interview designed to assess the presence of current DSM-IV and ICD-10 psychiatric disorders in children and adolescents age 6–17 years in a way that is comprehensive and concise. The interview is administered to the child/adolescent together with the parent(s), although it can be administered to adolescents without a parent present. The MINI-KID follows the structure and format of the adult version of the interview (MINI). Like the MINI, the MINI-KID is also organized in diagnostic sections/modules. Using branching tree logic, the instrument asks two to four screening questions for each disorder. Additional symptom questions within each disorder section are only asked if the screen questions are positively endorsed. All questions are in the binary 'yes/no' format. It takes approximately half an hour to administer. Ghanem *et al.* (2000), developed the Arabic version and Awaad *et al.* (2002), validated it. In phase 2, after the clinical assessment, participants were divided into five groups (children with ADHD only, ADHD+internalizing disorder, ADHD +externalizing disorder, ADHD+developmental disorder, and ADHD+2 or more co-occurring comorbidities) for comparison in relation to characteristics of the child.

Statistical analysis

After data collection, data were coded, entered, and analyzed using statistical package for social science was developed by IBM (The International Business Machines Corporation), New York, USA. Qualitative data were presented as frequencies and percentages. Quantitative data were presented as mean, SDs, and median. Qualitative independent variables were compared using χ^2 test, whereas quantitative data of multiple independent groups were compared using analysis of variance test for normally distributed data. Correlation coefficient was used to assess the strength and direction of correlation

between different quantitative variables. *P* value less than or equal to 0.05 was considered statistically significant.

Results

In the present study, 77.1% of children with ADHD had at least one psychiatric comorbidity. Overall, 41.7% of the population of this study had externalizing disorders (disruptive behavior disorders), whereas 52.1% had internalizing disorders, including mood disorders (25%) and anxiety disorders (29.1%). In addition, neurodevelopmental disorders were comorbid in 27.1% of the population sample. The most frequent reported psychiatric comorbidity in children with ADHD was ODD (31.2%), followed by nocturnal enuresis (NE) (29.1%), learning disability (LD) (18.8), major depressive disorder (MDD) (14.6%), generalized anxiety disorder (GAD) (14.6%), CD (12.5%), and post-traumatic stress disorder (PTSD) (12.5%) (Table 1). Regarding the association between presence of comorbidities and characteristics of the child, the results show a statistically significant increase in frequency of superior academic performance among children with ADHD alone and ADHD with externalizing disorder, a statistically significant increase in inattentive ADHD subtype among cases with ADHD+internalizing disorder, a statistically significant increase in hyperactive-impulsive ADHD subtype among cases with ADHD+externalizing disorder, and a statistically significant increase in combined subtype among cases with developmental and cases with co-occurring comorbidities. A statistically significant increase in ADHD severity among cases with co-occurring comorbidities was found as well (Table 2).

Table 1 Comorbidity among the studied group

Variables	*n* (%) (*N*=48)
Comorbidity	
No	**11 (22.9)**
Yes	**37 (77.1)**
Single comorbidity	7 (14.5)
Two or more	30 (62.5)
Type	
Neurodevelopmental	**13 (27.1)**
Learning disabilities	9 (18.8)
Tic disorder	1 (2.1)
Autism spectrum disorders	2 (4.2)
Developmental co-ordination	3 (6.3)
Externalizing disorders	**20 (41.7)**
Disruptive behavior disorder	**20 (41.7)**
Opposition defiant disorder	18 (37.5)
Conduct disorder	6 (12.5)
Internalizing disorders	**25 (52.1)**
Mood	**12 (25)**
Major depressive d.	7 (14.6)
Disruptive mood disregulation	4 (8.3)
Bipolar affective disorder	1 (2.1)
Anxiety	**14 (29.1)**
Generalized anxiety disorder	7 (14.6)
Social anxiety disorder	4 (8.3)
Separation anxiety disorder	3 (6.3)
Phobia	1 (2.1)
Agoraphobia	1 (2.1)
Post-traumatic stress disorder	**6 (12.5)**
Adjustment disorder	**2 (4.2)**
Nocturnal enuresis	**14 (29.1)**

Discussion

Most children with ADHD were reported to have one or more comorbid psychiatric disorders, which in turn could worsen the clinical picture and the quality of life of those children, complicate the diagnosis and management of their problems, and increase the likelihood of adverse long-term outcomes. As a result, accurate assessment of those children to identify the comorbid psychiatric disorders and the factors that may contribute to the development of these disorders over time are important for those children and their families (Flouri *et al.*, 2017). Therefore, the current study was conducted to assess different comorbidities and explore the association between the presence of such comorbidities and the characteristics of both the child and the family in a sample of children diagnosed with ADHD at child psychiatry outpatient clinics at Helwan hospital for mental health, Cairo, Egypt.

The results of the present study show that 41.7% of the population had externalizing disorders (disruptive behavior disorders), whereas 52.1% had internalizing disorder including: mood disorders (25%) and anxiety disorders (29.1%). In addition, neurodevelopmental disorders were comorbid in 27.1% of the population sample. According to the present findings, the most frequent reported psychiatric comorbidity in ADHD children was ODD (31.2%), followed by NE (29.1%), LD (18.8), MDD (14.6%), GAD (14.6%), CD (12.5%), and PTSD (12.5%). This finding was consistent with different studies that had shown a high but various prevalence of ODD in children with ADHD. Comorbid ODD was reported by Elia *et al.* (2009), and Yüce *et al.* (2013), in 40 and 69.4% of children with ADHD, respectively. In addition, Amiri *et al.* (2013), reported enuresis in 17.5% of children with ADHD. Yüce *et al.* (2013), found enuresis in 21.3% of ADHD cases. The current findings are also in accordance with the results of Ambrosini *et al.* (2013),

Table 2 Relation between attention-deficit hyperactivity disorder groups according to comorbidity and child characteristics

Variables child chch	ADHD (*N*=11) [*n* (%)]	ADHD+internalizing (*N*=9) [*n* (%)]	ADHD+externalizing (*N*=5) [*n* (%)]	ADHD +devlopmental (*N*=4) [*n* (%)]	ADHD+co-occurring (*N*=19) [*n* (%)]	χ^2	*P*
Sex							
Female	2 (18.2)	2 (22.2)	0	0	3 (15.8)	5.99	0.20 NS
Male	9 (81.8)	7 (77.8)	5 (100.0)	4 (100.0)	16 (84.2)		
Age group							
6–9	5 (45.5)	5 (55.6)	4 (80.0)	3 (75.0)	16 (84.2)	2.10	0.72 NS
10–12	6 (54.5)	4 (44.4)	1 (20.0)	1 (25.0)	3 (15.8)		
Exposure to disease during pregnancy							
No	7 (63.6)	7 (77.8)	4 (80.0)	3 (75.0)	13 (68.4)	3.91	0.99 NS
Med.	1 (9.1)	1 (11.1)	0 (0.0)	1 (25.0)	2 (10.5)		
Psych.	2 (18.2)	1 (11.1)	1 (20.0)	0 (0.0)	3 (15.8)		
M+P	1 (9.1)	0 (0.0)	0 (0.0)	0 (0.0)	1 (5.3)		
Type of delivery							
Cs	7 (63.6)	2 (22.2)	2 (40.0)	2 (50.0)	8 (42.1)	3.58	0.47 NS
Normal	4 (36.4)	7 (77.8)	3 (60.0)	2 (50.0)	11 (57.9)		
Infant at birth							
Healthy	11 (100.0)	6 (66.7)	4 (80.0)	4 (100.0)	12 (63.2)	11.08	0.94 NS
Cyanotic	0	0	0	0	1 (5.3)		
Incubation	0	1 (11.1)	0	0	1 (5.3)		
Low birth weight	0	1 (11.1)	1 (20.0)	0	3 (15.8)		
Preterm	0	1 (11.1)	0	0	2 (10.6)		
Lactation							
Bottle	0	1 (0.0)	0	2 (50.0)	4 (21.1)	9.41	0.31 NS
Breast	7 (63.6)	7 (63.6)	4 (80.0)	1 (25.0)	11 (57.9)		
Mixed	4 (36.4)	1 (36.4)	1 (20.0)	1 (25.0)	4 (21.1)		
Academic performance							
Average	2 (18.2)	4 (44.4)	1 (20.0)	3 (75.0)	5 (26.3)	22.45	0.004**
Failed	0	2 (22.2)	1 (20.0)	0	11 (57.9)		
Superior	9 (81.8)	3 (33.3)	3 (60.0)	1 (25.0)	3 (15.8)		
Social problems							
Marked	0	1 (11.1)	2 (40.0)	0	7 (36.8)	23.05	0.11 NS
Moderate	1 (9.1)	0	2 (40.0)	0	4 (21.1)		
Mild	4 (36.4)	4 (44.4)	0	1 (25.0)	4 (21.1)		
Slight	4 ((36.4)	1 (11.1)	1 (20.0)	1 (25.0)	3 (15.8)		
Average	2 (18.2)	3 (33.3)	0	2 (50.0)	1 (5.3)		
ADHD subtype							
Combined	6 (54.5)	1 (11.1)	2 (40.0)	2 (50.0)	16 (84.2)	25.26	0.001**
Hyperactive/ impulsive	5 (45.5)	3 (33.3)	3 (60.0)	1 (25.0)	2 (10.5)		
Inattentive	0	5 (55.6)	0	1 (25.0)	1 (5.3)		
Severity							
Mild	4 (36.4)	0	0	1 (25.0)	2 (10.5)	15.56	0.04*
Moderate	7 (63.6)	8 (88.9)	3 (60.0)	2 (50.0)	8 (42.1)		
Severe	0	1 (11.1)	2 (40.0)	1 (25.0)	9 (47.4)		

χ^2, χ^2 test; ADHD, attention-deficit hyperactivity disorder. Nonsignificant (NS, $P>0.05$). *Significant ($P<0.05$).

which showed a comorbid diagnosis of depressive disorder in 18.8% of children with ADHD, and the results of Tsang *et al.* (2015), which were 11.2% for GAD in children with ADHD.

Regarding broad categories of comorbidities, the population sample was divided into five main groups (ADHD only, ADHD+internalizing disorder, ADHD+externalizing disorder, ADHD+developmental disorder, and ADHD+2

or more co-occurring categories) for comparison in relation to different parameters, and statistical significant differences between different groups in academic performance and ADHD subtype and severity were found. Regarding children's academic performance, the current results show a statistically significant increase in the frequency of superior academic performance among children with ADHD alone and ADHD with externalizing disorder and a statistically significant increase in frequency of failure among children with co-occurring comorbidities. This goes in line with Cuffe *et al.* (2015), who found that the odds for ADHD plus internalizing disorder were higher than the ADHD plus externalizing disorder group for poor academic performance. In contrary, Larson *et al.* (2011), reported that comorbidity of CD/ODD with ADHD negatively affects the academic performance outcome. In the context of the current study, this could be explained by the relatively high IQ among the group with ADHD and externalizing disorder which could compensate for their disruptive behavior and in turn improve their academic performance. In addition, the group with ADHD and externalizing disorder is only from high and moderate social classes which provides them with better opportunities for living and learning.

Regarding ADHD subtype in relation to categories of comorbidities, the current results show statistical significant increase in inattentive ADHD subtype among cases with ADHD+internalizing disorder, significant increase in hyperactive-impulsive ADHD subtype among cases with ADHD +externalizing disorder, and significant increase in combined subtype among cases with developmental and cases with co-occurring comorbidities. These results partially go in line with Armstrong *et al.* (2015), who found that children with ADHD and co-occurring co-morbidities were more likely to have the combined subtype (76%) than children in other groups. However, these findings are not in accordance with Amiri *et al.* (2013), and Yüce *et al.* (2013), who reported no relation between CD frequency with ADHD and ADHD subtypes.

Regarding ADHD severity, it was not an unexpected result of the current study to find a statistical significant increase in ADHD severity among cases with co-occurring comorbidities, which goes in line with the result of Armstrong *et al.* (2015), who found the most severe presentation among children with ADHD and co-occurring comorbidities.

Limitation

This is a cross-sectional observational study, so causal factors or directionality of the associations cannot be determined and does not entail a follow-up strategy for patients, so future longitudinal studies need to be done. Moreover, the potential biases that may be introduced by the reliance on self-report data need to be considered. Information on birth, education, and family history was not verified through patient records.

Conclusion

By the end of our study, we came up with the following conclusions: more than half of children with ADHD have one or more comorbid psychiatric disorders. In addition, children with ADHD and comorbidities, especially co-occurring comorbidities, are more prone to low academic performance and increased severity of ADHD.

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Conflicts of interest

There are no conflicts of interest.

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