

Risk factors for attention deficit hyperactivity disorder in a sample of Egyptian adolescents: a case-control study

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Background

Attention deficit hyperactivity disorder (ADHD) is a commonly diagnosed behavioral disorder of childhood and adolescence that represents a public health problem with long-term adverse effects on academic, vocational and social development.

Objectives

The aim of this study was to assess some putative risk factors that may be associated with ADHD in Egyptian adolescents compared to matched healthy controls.

Methods

925 preparatory school students were randomly selected from private and public schools in Eastern Cairo. We used the Conners-Wells' Adolescent Self report Scale Short form (CASS: S), as a screener for ADHD students. Those scoring >65 were considered potential ADHD cases, and were assessed by the kiddie Schedule for Affective Disorders and Schizophrenia present and lifetime version (K-SADS-PL) for establishing a diagnosis then were further evaluated by: Wechsler Intelligence Scale (WISC) to assess intellectual abilities. School performances prepared by teachers were recorded. Students were asked to complete a Designed Questionnaire fulfilling data including family background. A local scale for social class classification was administered. We finally compared the ADHD group with a matched healthy control group.

Results

9.4% ($N=87$) of the selected sample had ADHD. The diagnosis of ADHD was significantly associated with low socioeconomic state (8.0%), first sib order (42.5%), quarrelsome home atmosphere (21.8%). One third of the ADHD sample was exposed to cold family relations and criticism with a highly significant association ($P<0.001$); a similar percentage was exposed to parental aggression and abuse but displayed significant statistical association $P<0.05$. Students with ADHD were significantly exposed to postnatal complications (23%), and had more joint (20.7%) and chest (26.4%) diseases; their school performance and IQ scores displayed very highly significant lower values than the control group. Risk factors associated with ADHD were family history of psychiatric illness, history of head trauma, first sib order, delayed sphincter control, epilepsy and parental disharmony.

Conclusion

Our findings highlighted important differences between ADHD subjects and healthy students in several aspects as psychosocial adversities and physical health and delineated significant associations between ADHD and some putative risk factors. These findings would serve as a useful guidance tip for early management of ADHD adolescents and their families who display those risk factors.

Keywords:

academic performance, ADHD, adolescent, family adversity, risk factors, socio-demographic

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Introduction

Attention deficit hyperactivity disorder (ADHD) begins in early childhood and persists throughout adolescence and into adulthood in 70% of patients [1]. The disorder occurs in ~3–5% of the childhood population [2], with boys being almost three times more likely to manifest the

disorder than girls [3]. In adolescents, prevalence rates have varied from 2.2 to 9.9% [4]. ADHD children frequently experience difficulties in social relations and in school environments. These difficulties imply problems in adolescence and undesirable outcomes in adulthood, to a much greater extent than those for children without ADHD [5,6].

Although multiple etiologies may lead to ADHD, evidence points toward neurological and genetic factors as the greatest contributors to the disorder. In addition, no credible social–environmental theory or even hypothesis concerning causation in ADHD has been developed. Yet, evidence suggests some role for the social environment in the onset, course, and severity of the disorder [7]. For some individuals, the development of the disorder appears to be heritable; for a few others, environmental factors may contribute to the presenting symptoms of the disorder; and for the rest ADHD is likely to develop from a combination of genetic and environmental factors [8].

The family is an important aspect of an individual's environment and has been linked to the variability in comorbidity, academic performance, and social difficulties for those with ADHD [9]. The psychosocial etiology of ADHD was studied first by Rutter *et al.* [10], who revealed that an aggregate of adversity factors (i.e. severe marital discord, low social class, large family size, paternal criminality, maternal mental disorder, foster care placement), rather than the presence of any single factor, led to psychopathology. Findings from later studies supported their work and stressed upon the importance of adverse family environment as a risk factor for ADHD [11,12].

Increased severity in patients with ADHD has been linked to increased family conflict, reduced family cohesion, low socioeconomic status, nonintact nuclear families, punitive authoritative parenting, and exposure to parental psychopathology (particularly maternal) [11–15]. Other factors such as family dysfunction, poor peer relations, low self-esteem, poor academic achievement, and school failure are also correlated with ADHD persistence and adverse long-term outcomes in community and clinical samples [16]. Information on demographic distribution of ADHD is generally limited. However higher prevalence rates have been associated with lower socioeconomic status and with urban compared with rural residence [17].

St Sauver *et al.* [18] observed an inverse association between parental education levels and risk for ADHD. The effect of the nongenetic (environmental) attributes on ADHD symptoms is highly variable, ranging in some studies from 0 to 6% [7], whereas in others from 9 to 20% [19].

Despite the fact that ADHD is a common and well-studied disorder in children, it is far less studied during adolescence, and research on adolescent ADHD across countries is even lesser. Because of the scarcity of research on ADHD adolescents in Egypt in general and the rarity of research being carried out on community samples rather than clinically referred samples, the researchers of this study decided to explore the presence of ADHD in a community-based school sample; to study the sociodemographic characteristics, familial interactions, academic characteristics, and intellectual sample characteristics of this sample and compare them with those reported in the literature on ADHD adolescents with the hypothesis that ADHD adolescents would have the same characteristics across different cultures; and to assess the role of environmental (nongenetic) risk factors in the persistence and severity of ADHD in a randomly

selected sample of Egyptian ADHD adolescents compared with matched healthy controls. The main research hypotheses were that ADHD adolescents would have more social, familial, and academic adversities than controls, that the adversities would match those reported in the literature worldwide, and that some adversities may be independent risk factors for ADHD. The importance of identifying social and environmental risk factors lies in the fact that identifying them – as a first step – and subsequently developing awareness programs to ameliorate their effect will contribute to improvements in ADHD symptoms and will improve the outcome of the illness in many ADHD adolescents.

Patients and methods

This study was a school-based cross-sectional survey; the sample consisted of male and female preparatory school students. Cairo is divided into five major geographical and administrative zones, from which one was randomly picked namely (Eastern Cairo). Schools were selected from two educational districts (educational districts are administrative authorities responsible for managing educational and student affairs of all schools located in its geographical areas): one represents a relatively higher socioeconomic status (private school), the Heliopolis area (an affluent residential district), and the other a less affluent status (public school), El Mataria area (a poor residential district with slum areas).

All preparatory students of the two schools in each district were screened for ADHD, making the total number of surveyed schools four.

Ethical approval of the research protocol was obtained from the authority of Ain Shams University Postgraduate Affairs office and Ministry of Education before commencement of the study. In addition, the students' parents were informed about the study through a letter and their consent was obtained, along with some essential data about developmental history and family history of psychiatric disorders. The students themselves were also asked to sign a consent form before enrollment in the study.

A total of 1005 male and female students were potentially identified to participate in the study; their age ranged from 12 to 15 years; 80 students dropped out, making the percentage of defaulters 8.6%; hence, our study included 925 students. The reason for dropping out ranged from being absent from school during the period of the study to parents not consenting to contribute to the study. The researchers asked the school authorities to check the school copy of the medical records (all students in the Egyptian educational system are required to fill a medical status sheet identifying all medical problems of the student; they are also required to hand in medical reports of the medical condition and update the information base regularly; these records are kept in the school) of the enrolled students; those who had any motor and sensory disabilities were excluded.

Tools and procedures

The study was carried out in two steps. The first step involved the following:

- (1) Conners-Wells' Adolescent Self-Report Scale: Short Form (CASS:S) [20] to screen the students for ADHD. The CASS:S has been developed to assess self-reports of problematic behaviors. The 27-item CASS:S includes the following subscales: conduct problems (six items), cognitive problems/inattention (six items), hyperactivity (six items), and ADHD Index (12 items). A cutoff score of 65 or more was considered positive screening for ADHD symptoms, as recommended by Conners. We used the Arabic version of the CASS:S, which was translated and back translated into English and subsequently validated by El Missiry *et al.* [21].
- (2) Kiddie Schedule for Affective Disorders and Schizophrenia, present and lifetime version (K-SADS-PL, Kaufman *et al.* [22]). K-SADS-PL is an interviewer-based, semi-structured interview for children aged between 6 and 18 years. Its primary goal is to assess the current and lifetime history of psychiatric disorders and to make categorical diagnosis by directly interviewing children, adolescents, and their parents according to the *Diagnostic and Statistical Manual of Mental Disorders*, 4th ed. criteria. In this study, it was used for the assessment of diagnostic and comorbidity profiles of ADHD adolescents and controls. It contains five diagnostic supplements for affective disorders, psychotic disorders, anxiety disorders, behavioral disorders, and substance abuse and other disorders. The Arabic version of the K-SADS-PL used in this study was translated and validated through a previous research conducted by Ibrahim *et al.* [23].
- (3) Designed Questionnaire: the enrolled students were asked to complete a questionnaire in the yes/no, multiple choice, or closed-ended format to collect information about personal data, family background, and relation. Data on obstetrics, developmental history, previous medical and psychiatric history of the adolescent and his/her family, and school performance were obtained from the students' parents. The questionnaire consisted of 30 questions divided into sections: the personal data section clarified age, number of siblings, parental occupation, and consanguinity. The family background and relation section involved reporting on the subjective experience of family relations (warm, cold, and quarrelsome) and how the students perceived the attitude of their parents and their treatment toward them, including physical abuse on a four-point likert scale (never, occasionally, frequently, and always). Other questions on any obstetrical complication, developmental delays, previous and present medical and psychiatric history of the student, family history of psychiatric problems, and hospital admission were answered by the family.
- (4) Academic achievement of each student during a 3-month period was estimated by school teachers and subsequently recorded by researchers. Teachers were asked to rate the overall performance of the student in the monthly tests and quizzes; the performance of those achieving 50% or lesser was rated as poor; 50–75%, fair; and greater than 75%, good.
- (5) Students' medical files at the school were thoroughly revised by the authors.
- (6) An Egyptian social class classification scale, 'Fahmy and El Sherbini social scale' [24], was administered to assess the social class of a student on the basis of the educational qualification and work of his/her father, educational qualification and work of his/her mother, income, crowding index, health behavior, and life style variables; students with a score of 25–30 are considered to belong to a high social class, those with a score of 20–25 are considered to belong to a middle social class; and those with a score of 15–20 are considered to belong to a low social class. A score of 14 or less is considered to represent very low social classes.

In the second step, students who scored more than 65 on CASS: S were subjected to a diagnostic psychiatric interview by K-SADS-PL (K-SADS-PL was administered by the authors who were blinded to whether the interviewed students were cases or controls and were also blinded to the results of CASS:S to avoid bias; the principal investigator, who was responsible for allocating

Table 1 Sociodemographic data of both groups

	Patients (N=87)	Control (N=87)	Test	P
Mean age $\pm$ SD	13.4 $\pm$ 0.7	13.09 $\pm$ 0.65	0.446	0.65 (NS)
Socioeconomic class [N (%)]				
High and high middle	58 (66.7)	66 (75.9)	$\chi^2=2.4$ d.f.=3	0.049 (Sig.)
Middle	14 (16.1)	9 (10.3)		
Low middle	8 (9.2)	8 (9.2)		
Low and very low	7 (8)	4 (4.6)		
Mean number of sibs	2.5 $\pm$ 1.5	2.2 $\pm$ 1.2	3.125	0.073 (NS)
Sib order [N (%)]				
1st	37 (42.5)	30 (34.5)	$\chi^2=11.48$ d.f.=4	0.02 (Sig.)
2nd	16 (18.4)	33 (37.9)		
3rd	15 (17.2)	15 (17.2)		
4th	13 (14.9)	4 (4.6)		
5th	6 (6.9)	5 (5.7)		
6th	0 (0)	0 (0)		

Sig., significant.

the groups, was not blinded to these data and did not participate in interviewing the children) [23] according to the *Diagnostic and Statistical Manual of Mental Disorders*, 4th ed. criteria, following which the Wechsler Intelligence Scale for Children (WISC), Arabic version [25], was administered by a trained clinical psychologist to assess the intellectual abilities and cognitive functions of the children.

Controls were chosen from among those who scored less than 65 and were matched to patients in terms of age,

Table 2 Clinical profile of the attention deficit hyperactivity disorder group

Variable	N (%)
ADHD subtype (K-SADS-PL)	
Hyperactive impulsive	41 (54.7)
Inattentive type	11 (14.7)
Combined type	23 (30.7)
Comorbidity (K-SADS-PL)	
Yes	74 (85.1)
No	13 (14.9)
Medication status	
Undiscovered	48 (55.2)
Pharmacotherapy	19 (22)
Behavioral therapy	20 (23)

ADHD, attention deficit hyperactivity disorder; K-SADS-PL, Kiddie Schedule for Affective Disorders and Schizophrenia, present and lifetime version.

sex, and type of school. Their number was similar to that of ADHD patients. The controls were subjected to a diagnostic interview by K-SADS-PL (K-SADS-PL was administered by the authors who were blinded to whether the interviewed students were cases or controls and were also blinded to the results of CASS:S to avoid bias; the principal investigator, who was responsible for allocating the groups, was not blinded to these data and did not participate in interviewing the children) to exclude any undetected psychiatric morbidity, following which they were administered the WISC for determination of their intellectual abilities; their school performance was then assessed and recorded by the corresponding teachers on the basis of the same empirical criteria, after which they were compared with the ADHD group.

Statistical analysis

All analyses were carried out using SPSS, version 15 (SPSS Inc., Chicago, Illinois, USA) [26]. The results were tabulated and statistically analyzed using the following tests: Student's *t*-test to test for statistical significance of variance between the means of the two samples and the χ^2 -test to determine the probability of a deviation from the expected event solely on the basis of chance for qualitative data; quantitative data were represented as mean and SD ($1 \pm$ SD) and the *P*-value

Table 3 Family background and atmosphere

	N (%)		Test	P-value
	Patients	Controls		
Family structure				
Both parents existing	78 (89.7)	82 (94.3)	$\chi^2=5.7$ d.f. = 1	0.03 (Sig.)
One parent died	9 (10.3)	5 (5.7)		
Parental separation				
No	74 (85.11)	80 (92)	$\chi^2=2.03$ d.f. = 1	0.154 (NS)
Yes	13 (14.9)	7 (8)		
Parental disharmony				
No	68 (78.2)	79 (90.8)	$\chi^2=5.3$ d.f. = 1	0.02 (Sig.)
Yes	19 (21.8)	8 (9.2)		
Family relation				
Warm	66 (75.9)	83 (95.4)	$\chi^2=4.43$ d.f. = 1	0.03 (Sig)
Cold/criticism/quarrelsome	21 (24.1)	4 (4.5)		
Parental aggression				
No	71 (81.6)	82 (94.3)		
Yes	16 (18.4)	5 (5.7)		
Parental abuse				
No	74 (85.1)	85 (97.7)		
Yes	13 (14.9)	2 (2.3)		
Consanguinity				
No	65 (74.7)	75 (86.2)	$\chi^2=13.9$ d.f. = 3	0.003 (HS)
2nd degree	12 (13.8)	5 (5.7)		
3rd degree	0 (0)	5 (5.7)		
Far relation	10 (11.5)	2 (2.3)		
Family history of psychiatric disorders				
No	69 (79.3)	79 (90.8)	$\chi^2=4.5$ d.f. = 1	0.03 (Sig.)
Yes	18 (20.7)	8 (9.2)		
ADHD in family				
No	73 (83.9)	78 (89.7)	$\chi^2=1.25$ d.f. = 1	0.263 (NS)
Yes	14 (16.1)	9 (10.3)		
Psychiatric treatment				
No	71 (81.6)	81 (93.1)	$\chi^2=5.2$ d.f. = 1	0.02 (Sig.)
Yes	16 (18.4)	6 (6.9)		
Admission to psychiatric hospitals				
No	77 (88.5)	85 (97.7)	$\chi^2=5.7$ d.f. = 1	0.03 (Sig.)
Yes	10 (11.5)	2 (2.3)		

ADHA, attention deficit hyperactivity disorder; HS, highly significant; Sig., significant.

Table 4 Prenatal, postnatal, developmental, and medical history

	<i>N</i> (%)		Test	<i>P</i> -value
	Patients (<i>N</i> =87)	Control (<i>N</i> =87)		
Prenatal problems				
No	62 (71.3)	63 (72.4)	$\chi^2=0.028$ <i>d.f.</i> =1	0.866 (NS)
Yes	25 (28.7)	24 (27.6)		
Post natal problems				
No	67 (77)	80 (92)	$\chi^2=7.40$ <i>d.f.</i> =1	0.006 (HS)
Yes	20 (23)	7 (8)		
Developmental history				
Sphincter control				
No	77 (88.5)	81 (93.1)	$\chi^2=1.1$ <i>d.f.</i> =1	0.294 (NS)
Yes	10 (11.5)	6 (6.9)		
Delayed milestones				
No	76 (87.4)	84 (96.6)	$\chi^2=4.92$ <i>d.f.</i> =1	0.04 (Sig.)
Yes	11 (12.6)	3 (3.4)		
Delayed language				
No	77 (88.5)	72 (82.8)	$\chi^2=1.68$ <i>d.f.</i> =1	0.28 (NS)
Yes	10 (11.5)	15 (17.2)		
Medical history				
Heart problems				
No	83 (95.4)	86 (98.9)	$\chi^2=1.85$ <i>d.f.</i> =1	0.173 (NS)
Yes	4 (4.6)	1 (1.1)		
Chest problems				
No	64 (73.6)	75 (86.2)	$\chi^2=4.32$ <i>d.f.</i> =1	0.03 (Sig.)
Yes	23 (26.4)	12 (13.8)		
Liver diseases				
No	86 (98.9)	87 (100)	$\chi^2=1.006$ <i>d.f.</i> =1	1.00 (NS)
Yes	1 (1.1)	0 (0)		
Joint diseases				
No	69 (79.3)	81 (93.1)	$\chi^2=6.9$ <i>d.f.</i> =1	0.008 (Sig.)
Yes	18 (20.7)	6 (6.9)		
Renal diseases				
No	84 (96.6)	87 (100)	$\chi^2=0.05$ <i>d.f.</i> =1	0.08 (NS)
Yes	3 (3.4)	0 (0)		
Epilepsy				
No	86 (98.9)	86 (98.9)	$\chi^2=0.00$ <i>d.f.</i> =1	1.00 (NS)
Yes	1 (1.1)	1 (1.1)		
Head trauma				
No	71 (81.6)	76 (87.4)	$\chi^2=1.09$ <i>d.f.</i> =1	0.40 (NS)
Yes	16 (18.4)	11 (12.6)		

Sig., significant.

indicated the level of significance. Logistic regression analysis was used for prediction of the probability of occurrence of an event by fitting data to a logistic curve.

Results

This study was conducted on 925 adolescents in the preparatory stage. When screened for ADHD symptomatology, 101 students scored greater than 65 on CASS:S, a screening tool; subsequently, another 101 matched controls who scored less than 65 were selected from the total number of students. All 202 students were blindly interviewed using K-SADS-PL. Of the adolescents who were positive on screening, 87 (86.1%) met the full diagnostic criteria for ADHD, whereas 14 (13.8%) did not; they were considered as subthreshold cases and were excluded. Thus, 87 matched controls were chosen.

There were no statistically significant differences between patients and controls as regards the mean age. ADHD students predominantly belonged to middle and low social classes compared with non-ADHD students, who belonged to the upper middle class. ADHD male students (*N* = 58) markedly outnumbered female ADHD

students (*N* = 29) and were the eldest among their siblings as further elaborated in Table 1.

As regards the clinical profile of the ADHD group, 54.7% suffered from the hyperactive impulsive type, whereas other psychiatric diagnoses were present in 85.1% of the sample; however, 55.2% never sought treatment for the condition, as shown in Table 2.

Family background and atmosphere

Our data revealed that both groups lived in two-parent families. Although the rates of parental separation were not significantly different between patients and controls, the patient group reported significantly higher rates of parental disharmony. In total, 24.1% of the patient group reported their family relations to be cold and quarrelsome compared with only 5.4% of the control group. Consanguineous parents were more significantly prevalent (*P* = 0.003) among ADHD patients than among controls. Moreover, the majority of ADHD patients showed high statistical significance for the presence of a family history of psychiatric disorders, for psychiatric treatment, and for admission to psychiatric hospitals (Table 3).

Table 5 Intellectual abilities and school performance

IQ	Mean $\pm$ SD		Test	P-value
	Patients (N=87)	Controls (N=87)		
Verbal IQ	91.5 $\pm$ 6.6	111.04 $\pm$ 8.9	-6.48	0.000 (VHS)
Performance IQ	94.6 $\pm$ 8.4	106.7 $\pm$ 8.2	-9.54	0.000 (VHS)
Total IQ	96.6 $\pm$ 8.2	109.36 $\pm$ 9.2	-9.59	0.000 (VHS)
Comprehension	11.72 $\pm$ 4.91	18.33 $\pm$ 2	2.46	0.01 (Sig.)
Arithmetic	8.27 $\pm$ 1.53	9.9 $\pm$ 1.66	-6.72	0.000 (VHS)
Similarity	11.50 $\pm$ 2.4	11.20 $\pm$ 2.23	0.844	0.4 (NS)
Digit span	6.057 $\pm$ 2.02	10.79 $\pm$ 2.26	-14.54	0.00 (VHS)
Picture completion	9.29 $\pm$ 1.8	10.63 $\pm$ 1.74	-4.93	0.000 (VHS)
Block design	8.42 $\pm$ 2.28	10.09 $\pm$ 1.56	-5.618	0.000 (VHS)
Coding	7.77 $\pm$ 1.67	10.11 $\pm$ 1.56	-9.59	0.000 (VHS)
School performance [N (%)]			$\chi^2=85.38$ d.f.=2	0.000 (VHS)
Poor	34 (39)	0 (0)		
Fair	38 (43.7)	31 (35.6)		
Good	15 (17.3)	56 (64.4)		

IQ, intelligence quotient; Sig., significance; VHS, very high significance.

Table 6 Risk factors associated with attention deficit hyperactivity disorder

Variables	T	P
History of psychiatric hospital admission of one of the family members	-2.856	0.005
History of head trauma	2.457	0.016
Position among sibs	2.403	0.018
Delayed sphincter control	0.237	0.020
Psychiatric medication of one of the family members	2.287	0.025
Epilepsy	2.289	0.025
Parental disharmony	-1.986	0.05

Test performed: logistic regression.

Perinatal, developmental, and medical history

Table 4 shows that ADHD patients were more exposed to postnatal problems, with very high statistically significant differences between patients and controls. In addition, they showed a statistically significant delay in developmental milestones. ADHD patients tended to have a statistically significantly higher medical morbidity rate than their non-ADHD counterparts. On stratification of the medical disorders encountered in the ADHD group, only chest problems and joint diseases reached statistical significance when compared with controls.

Intellectual abilities and school performance

Strikingly, ADHD patients showed lower scores with a very high statistical significance in the total intellectual quotient (IQ), verbal performance, arithmetic abilities, digit span, picture completion, block design, and coding subtests; that is, almost all IQ subtests, except for the comprehension subtest in which ADHD patients showed lower scores that only reached the point of statistical significance. However, there were nonsignificant differences in scores in the similarities subtest in comparison with controls Table 5. The majority of the ADHD patients had poor scholastic achievement with a very high statistically significant difference between patients and controls.

Putative risk factor analysis

Logistic regression analysis was carried out to explore the risk factors associated with ADHD. All aforementioned

sociodemographic, familial, and academic factors, such as social class, number of siblings, consanguinity, family relation, perinatal events, developmental and medical history, academic and school performance, etc., were tabulated in a regression curve, with all studied factors displaying nonsignificance, except for some factors, which are displayed in Table 6. It was found that the greatest risk is having one family member admitted to a psychiatric hospital, followed by head trauma, position among sibs, delayed control of sphincters, one of the family members being under psychiatric medication, epilepsy, and parental disharmony.

Discussion

The objective of this study was to determine the possible risk factors associated with ADHD in adolescents. Subsequently the obtained data may be helpful to healthcare providers for early intervention in adolescents with those factors.

Our results showed that most of the ADHD students belonged to middle or very low social classes compared with controls. This is consistent with the findings of Kadesjo *et al.* [27], who reported higher prevalence rates of ADHD in association with lower socioeconomic status. This may be explained by the high heritability of ADHD and its negative impact on social, academic, and career outcomes; hence, it is plausible that families with ADHD may cluster within the lower socioeconomic strata; this finding is further confirmed by Froehlich *et al.* [28]. We agree with the explanation of Lee *et al.* [29], who suggested that patients from the high socioeconomic group are more able to limit their symptoms because they work in highly structured educational settings with a relatively small class size (15–25 students per classroom) compared with those belonging to the low socioeconomic strata, who typically attend crowded classes (40–50 students per classroom) in a strife-torn environment.

Results of our study showed a prevalence rate of 13.8% in boys and 5.8% in girls with a ratio of 2:1, showing that

boys had significantly higher rates of ADHD (double) compared with girls. Our results are consistent with those from studies on different community samples that found that the male-to-female ratio ranged from 1:1 to 3:1. These studies include those by Ersan *et al.* [30] and Cuffe *et al.* [31], and the findings are similar to those of Pineda *et al.* [32], who estimated an ADHD prevalence of 19.8% for boys and 12.3% for girls among 330 participants.

In the current study, we found that adolescents with ADHD were more commonly ranked as the first child in the order of birth, and regression analysis showed that being ranked as the first child is considered to be an independent risk factor for ADHD. Our findings are consistent with those of Sami *et al.* [33], who found that 66.7% of ADHD children in the Egyptian community were the first in the order of birth, and those of Barakat [34], who found that 42% of ADHD patients were the eldest among their sibs. We agree with the explanation provided by Pressman *et al.*, [35] that the family reaction to the first child is more pronounced and leading to impairment because of the relative lack of parenting and child rearing experiences.

Clinically, the most common type of ADHD was the hyperactive impulsive type and the least common type was the inattentive type; this is in accordance with several published studies [29,30,32]. In terms of psychiatric comorbidities, we report an associated comorbidity rate of 85.1%; similar findings were previously reported in a Korean study (76.2%) [36] and an American study (80%) [37].

Our data also revealed that parental disharmony was more prevalent among ADHD students compared with controls, reaching the point of statistical significance, and was further confirmed as a risk factor for ADHD. Although parental separation did not reach statistical significance, it was seen in 14.8% of patients versus only 8% of controls, which could reach statistical significance if higher number of participants were recruited. Our results corroborate previous findings of Rashed *et al.* [38], who reported that 75% (three-fourths) of his studied sample who came from divorced families had ADHD, compared with only 19.42% of those who came from nuclear families and 16.33% of those who came from extended families. Counts *et al.* [39] also reported that a child's perception of marital conflict is an independent risk factor for inattention and hyperactivity.

We report that a statistically significant number of ADHD adolescents are exposed to parental abuse (18.4%) or aggression (14.9%); this is in agreement with the findings of Cartwright *et al.* [40], who found higher levels of maternal expressed emotions toward probands with ADHD than toward siblings without ADHD. They also reported a higher rate of maternal critical comments, which was explained by comorbid conduct problems rather than by ADHD. Only lower warmth levels were associated with ADHD itself. However, their work was only limited to maternal effects, whereas we report on combined parental effects. In the current study, the majority of students with ADHD were also exposed to an

inconvenient atmosphere at home, the parent being cold, quarrelsome, or criticizing. Similar findings were reported in Brazilian adolescents. Pheula *et al.* [41] suggested that family adversity, low family cohesion, and low family relation index were associated with an increased risk for ADHD, especially the inattentive type.

We also report that students with ADHD had very high statistical significance as regards parental consanguinity. Our results were consistent with those of different studies that suggested genetic predisposition in individuals with ADHD [8] and were in accordance with the findings of the study on phenotypic subtypes in ADHD in an isolated Dutch population by Croes *et al.* [42], who found that patients of the inattentive subtype were connected to a common ancestor and 81% of those patients were derived from consanguineous marriages.

Our results showed that having a family history of psychiatric disorders, psychiatric treatment, and hospital admission for a psychiatric disorder was significantly represented in the ADHD group compared with their healthy counterparts. The most important independent risk factors were a history of psychiatric medication and/or hospital admission. This is consistent with the findings of many studies reporting a higher prevalence of psychopathology in parents and other relatives of children and adolescents with ADHD [42,43]; higher rates of ADHD, conduct problems, substance abuse, and depression have been particularly observed. Our findings concurred with research by Faraone and Biederman [44], who found that family members of patients with ADHD are at an increased risk for major depressive disorder. Similarly, Ghanizadeh *et al.* [45] found high rates of major depressive disorder among parents of a sample of ADHD patients in Iran.

Postnatal troubles, including low birth weight, have been extensively associated with increased risk for ADHD [46,47]. In the current study, we found that postnatal problems were more prevalent among ADHD students; this finding is consistent with the findings of El Sheikh *et al.* [48], who revealed that 54% of ADHD children were exposed to early-life developmental insult.

We also report a significant association between ADHD and chest diseases and a highly significant association between ADHD and joint diseases. The high prevalence of chest diseases may be explained by the use of medication for the treatment of significant allergies and asthma, such as theophylline, which is increasingly recognized as affecting the attention span and potentially causing the exacerbation of a pre-existing case of ADHD [7]. Another study reporting increased rates of ADHD in patients suffering from asthma supports our data [49]. Occurrence of higher rates of joint diseases is also supported by Barkley [50], who explained the occurrence as being due to frequent accidental injuries, as ADHD patients are more prone to accidents because of their hyperactivity and impulsivity.

Perhaps the most striking finding was that ADHD patients had significantly lower IQs than controls, with

a very highly significant statistical difference in total, verbal, and performance IQs and almost all other subtests, except for the similarities subtest. Our data are consistent with those of Frazier *et al.* [51], who found that patients with ADHD demonstrated lower intellectual ability than participants in non-ADHD comparison groups and reported that their average score is often 7–10 points or about 0.61 SD below the mean score of the comparison group. An explanation for this decline may be impairment in behavioral inhibition and defects in the executive functions seen in children and adolescents with ADHD, which could result in a small negative relationship between ADHD and IQ (intelligence is related to the executive functions of working memory, internalized speech, and eventual development of verbal thought, all of which are deficient in patients with ADHD) [52,53].

Further, we report that students with ADHD had a far poorer scholastic achievement compared with their non-ADHD counterparts. Evidence supporting the results of our study comes from numerous studies that found patients with ADHD to be more likely to show lower performance than their classmates, by as much as 10–30 standard score points, on various standardized achievement tests [29,53–55]. An explanation to the poor academic achievement may be inattentive, impulsive, and restless behavior in the classroom because of the associated decrease in intelligence, comorbid learning disability, and the higher rates of grade retention and expulsion found in adolescents with ADHD [55]. The increased academic demands during school and after school in preparatory grades, because of the complexity of the educational curriculum, and the increased cognitive demands, requiring students to function with more independence at school and at home, are other factors implicated in poor academic achievement [56].

On exploring independent risk factors, we report that the highest risk factor in ADHD patients is having a family member with a history of treatment with psychiatric medication and/or hospital admission for a psychiatric condition, followed by a history of head trauma, the presence of epilepsy, and, to a lesser extent, delayed sphincter control. Our findings are in agreement with those of previous studies on each of those risk factors [43–58]. Yet, none of the aforementioned studies compared the risk factors collectively.

Finally ADHD remains a multifaceted disorder that is a controversial subject in education. Whereas some practitioners see it as a real issue that blights the lives of children and adolescents, who need dedicated help to overcome it, others dismiss it as an excuse for the failures of parents and teachers [59].

Conclusion

Parental psychopathology and disharmony, in addition to a history of head trauma, epilepsy, and delayed sphincter control, were found to be strong risk factors for ADHD. Sociodemographic variables associated with ADHD were

lower socioeconomic status, increased family adversity, reduced family cohesion, abusive and aggressive parents, presence of medical comorbidity, and poor academic achievement. Thus, early recognition of these risk factors and psychosocial adversities through coordinated multi-agency efforts in support of adolescents with ADHD and their families would seem to be an important area for early intervention.

Strengths and limitations

This study is considered one of few researches that investigated ADHD in Egyptian adolescence through a school-based cross-sectional survey including both sexes and different types of preparatory schools. Several limitations should be considered in interpreting its results such as the inability to establish a causal link between ADHD and the examined variables because of the cross-sectional design of the study, the deficiency in deriving detailed information from different sources such as the parents and peers, and, finally, the difficulty in generalization of our findings to all Egyptian adolescents as rural areas were not represented.

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Conflicts of interest

There are no conflicts of interest.

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