Identification of risk factors of attention-deficit hyperactivity disorder in Egyptian children

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Objective
The aim was to identify the risk factors of attention-deficit hyperactivity disorder (ADHD) in Egyptian children.

Background
ADHD is the most commonly diagnosed neurodevelopmental disorder that begins during early childhood. Various psychological, social, genetic, and biochemical factors are thought to be involved in the etiopathogenesis of ADHD.

Participants and methods
A prospective, randomized comparative study was conducted on 50 children with the diagnosis of ADHD and 35 healthy children as the control group. All patients were selected from those attending the outpatient neurology clinic and those admitted in the Pediatric Department Menoufia University Hospital in the period from October 2017 to March 2018. Full history taking and clinical examination as well as assessment of possible risk factors were done.

Results
There was a high frequency of ADHD among male children, school aged children living in urban areas, children of low socioeconomic status living with a single parent, large families and in families who have past history of ADHD. ADHD-C is the most predominant type (38%), followed by ADHD-I (34%) and ADHD-HI (28%). ADHD-C and ADHD-HI were found in the men more than women. Also, epilepsy was found in 10% of ADHD.

Conclusion
There are many factors that are associated with increased possibility of developing ADHD such as male gender, school age, living in urban areas, low socioeconomic status, large families, and families who have a past history of ADHD and children living with a single parent. So, parent training programs should focus on encouraging parents'' positive interaction with their children.

Keywords:
attention-deficit hyperactivity disorder, children, Egyptian, risk factors

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Introduction

Attention-deficit hyperactivity disorder (ADHD) is the most commonly diagnosed neurodevelopmental disorder that begins during early childhood. The worldwide prevalence of this disorder is 5–10% in children and adolescents. Men have a higher prevalence rate of the disorder than women. It is characterized by deficits in attention, activity level, and impulse control [1]. Approximately 70% of patients diagnosed with ADHD as a child will continue to have significant symptoms during adolescence and more than half of them will have impairment into adulthood [2]. In Egypt, Dakahlia Governorate, few studies have investigated the epidemiology of ADHD. The reported prevalence of ADHD among children ranged between 6.5 and 7.9% [3].

Currently, various psychological, social, genetic, and biochemical factors are thought to be involved in the etiopathogenesis of ADHD [4]. Although, the pathogenesis of ADHD is still unknown, primary and secondary factors are estimated to be implicated in ADHD pathogenesis. Primary roles are shaped in the cerebral cortex by catecholamine metabolism. Also, the etiology of ADHD is attributed to genetic factors in about 80%. The secondary roles are created by various environmental factors [5].

Some of these factors, which are associated with ADHD, are pregnancy and birth-related risk factors. A large number of studies have shown that maternal exposure to alcohol, tobacco, and cocaine during pregnancy increases the risk of ADHD. On the other hand, some studies have shown that prenatal viral infections are associated with increased risk of ADHD [6]. Various studies have demonstrated that

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preeclampsia, maternal anemia, lower serum level of iron and iodine, and trauma to the abdomen during pregnancy are associated with increased risk of ADHD development [7].

Prematurity, low birth weight, and breech delivery are estimated to be associated with increased risk of ADHD. Postnatal viral infections such as measles, varicella, and rubella increase the risk of developing ADHD [5]. Additionally, several other factors such as breastfeeding, head injury in early childhood and adolescence, encephalitis, convulsion, and endocrine disorder are estimated to be risk factors for the development of ADHD [8]. The aim of this study was to determine the possible risk factors of ADHD in Egyptian children.

Participants and methods

A prospective, randomized comparative study was carried out on 50 children aged 5–11 years (28 men, 22 women) with the diagnosis of ADHD based on the DSM-IV criteria according to the American Psychiatric Association [9] and 35 apparently healthy children (20 men and 15 women) with matched age, sex, and socioeconomic status were taken as the control group. The patients were randomly selected from those attending the outpatient neurology clinic and those admitted in the Pediatric Department Menoufia University Hospital in the period from October 2017 to March 2018.

Ethical consideration

The study was approved by the ethics committee of Menoufia Faculty of Medicine and an informed consent obtained from all participant's guardian before the study was began.

Children with genetic disorders or congenital anomalies, any children with chronic systemic disease, and refusal of parental consent were excluded from the study.

Complete history was taken for all children including age, sex, residence, history of consanguinity, perinatal history, and developmental history. Assessment of risk factors in the family including family size, living with both parents or single parent, and birth order, and family history of ADHD. Maternal risk factors including duration of pregnancy, type of delivery, type of feeding, birth weight, maternal psychological stress, maternal smoking during pregnancy, history of intrauterine hypoxia, infection, fetal post-maturity or prematurity and difficult or traumatic birth were assessed.

Regarding socioeconomic data included education of the father, work and education of mother, crowding index and income. The socioeconomic level of the family was determined based on the scoring system of the Abdel-Gaffer [10], Egyptian Social Class Classification Scale with some modification to be applicable to this study. Score ranged from 11 to 14 of high socioeconomic class, scores 8–10 of middle socioeconomic class, and scores less than 8 of low socioeconomic class [11].

Clinical examination included anthropometric measurements such as, height, weight, and BMI. Mental status (intelligence quotient) below 70% is subnormal, mentality was assessed by Wechsler scale [9]. Neurological examination: cranial nerves affection, muscle tone, muscle power, reflexes, sensory system affection, and special features of systemic illness.

Investigations

Complete blood count was done for all children using Sysmex N1000; Kobe, Hyogo Prefecture, Japan.

Statistical analysis

Results were tabulated and statistically analyzed using a personal computer using MICROSOFT EXCEL 2016 and SPSS v. 21 (SPSS Inc., Chicago, Illinois, USA). Statistical analysis was done using: descriptive, for example, percentage, mean, and SD. Analytical tests included χ^2-test, *t*-test, and Mann–Whitney test. A value of *P* less than 0.05 was considered statistically significant.

Results

This study was carried out on 50 children (28 men, 22 women) with the diagnosis of ADHD; their age ranges from 5 to 11 years with a mean age of 7.83 ± 1.65 years. A total of 35 apparently clinically healthy children (20 men, 15 women) were taken as the control group with their age ranging from 5 to 11 years with a mean age of 7.94 ± 1.71 years. There is male predominance by 56.0% compared with 44.0% of female' patients with ADHD. The prevalence of ADHD in urban areas (52.0%) was higher than in rural areas (48.0%). Also, the study showed low frequency of ADHD in children with highly educated parents while a high frequency of ADHD in patients with low socioeconomic status, although not reached a statistical level. Consanguinity is detected in 30% of the ADHD group compared with 37.1% of the control group. There was no significant statistical difference between ADHD patients and controls regarding demographic data (Table 1).

Table 1 Demographic data of the studied groups

Sociodemographic characteristics	Patients (*n*=50) [*n* (%)]	Controls (*n*=35) [*n* (%)]	Test of significance	*P*
Age (years)				
Mean±SD	7.83±1.65	7.94±1.71	*t*=0.28	0.77
Sex				
Male	28 (56)	20 (57.1)	χ^2=0.01	0.91
Female	22 (44)	25 (42.9)		
Residence				
Rural	24 (48.0)	20 (57.1)	χ^2=0.68	0.50
Urban	26 (52.0)	15 (42.9)		
Educational level of the mother				
Low	12 (24)	12 (34.3)	χ^2=1.07	0.58
Medium	30 (60)	18 (51.4)		
High	8 (16)	5 (14.3)		
Educational level of the father				
Low	8 (16)	9 (25.7)	χ^2=1.25	0.53
Medium	30 (60)	18 (51.4)		
High	12 (24)	8 (22.9)		
Father's occupation				
Working	44 (88)	29 (82.9)	χ^2=0.44	0.50
Not working	6 (12)	6 (17.1)		
Mother's occupation				
Working	26 (52)	21 (60)	χ^2=0.53	0.46
Not working	24 (48)	14 (40)		
Socioeconomic level				
Low (<8)	17 (34)	14 (40)	Fisher's exact test=0.56	0.75
Moderate (8-10)	27 (54)	16 (45.7)		
High (11-14)	6 (12)	5 (14.3)		
Consanguinity				
Yes	15 (30)	13 (37.1)	0.47	0.49
No	35 (70)	22 (62.9)		

Also, there was no significant statistical difference between ADHD patients and controls regarding family and maternal risk factors (Table 2).

There was no significant statistical difference between patients and controls regarding anthropometric measurements (weight and height and BMI) as well as CBC findings (Table 3).

Also, our study shows that ADHD-C is the most predominant type (38%), followed by ADHD-I (34%) and ADHD-HI (28%). ADHD-C and ADHD-HI were found in men more than in women. ADHD types were commonly present in school aged than in preschool aged children. Also, epilepsy was found in 10% of the ADHD patients (Figs. 1 and 2).

Discussion

The study has shown that there is male predominance by 56.0% compared with 44.0% of female' patients with ADHD. This agreed with Nafi [12] who found a gender difference with male to female ratio of 2.9: 1. Also, Farid *et al.* [13] found on a study done in primary school children in Egypt to estimate the prevalence of ADHD with a male:female ratio of 3:1. This can be explained by the fact that boys with ADHD have more 'externalizing' symptoms (running, hitting, and impulsivity), while girls with ADHD have more 'internalizing' symptoms and side effects (depression, anxiety, and low self-esteem).

The prevalence of ADHD in urban areas (52.0%) was higher than in rural areas (48.0%). Similar results were obtained by Bishry *et al.* [14] who found that the prevalence of ADHD in urban area (6.3%) was higher than the prevalence in rural areas (4.4%) in Egypt. This may be explained by different culture and environmental factors between two areas which contributes to the appearance of ADHD symptoms like environmental pollution which may raise the prevalence of ADHD in urban areas. Also, the study showed low frequency of ADHD in parents with high education. Bener *et al.* [15] showed that there was significant statistical difference between the studied group regarding parent's education and high prevalence of ADHD in children of parents with low level of education. This may be explained by the fact that parents with a low level of education had poor knowledge of how to deal with children having ADHD, might be treating children having ADHD violently and aggressively which may reflect negatively on them, and lead to increased symptoms of ADHD. On the other hand, high levels of parents' education,

Table 2 Distribution of the studied children according to family and maternal risk factors

	Patients (*n*=50) [*n* (%)]	Controls (*n*=35) [*n* (%)]	χ^2-test	*P*
Family risk factors				
Family size				
<4	38 (76)	23 (65.7)	1.07	0.30
≥4	12 (24)	12 (34.3)		
Birth order				
First	13 (26)	13 (37.1)	1.20	0.27
Second and more	37 (74)	22 (62.9)		
Living with parents				
Both parents	40 (80)	29 (82.9)	0.11	0.74
Single parent	10 (20)	6 (17.1)		
Maternal risk factors				
Duration of pregnancy				
Full term	46 (92)	32 (91.4)	0.09	0.92
Preterm	4 (8)	3 (8.6)		
Type of delivery				
Vaginal delivery	21 (42)	12 (34.3)	0.51	0.47
Cesarean delivery	29 (58)	23 (65.7)		
Birth weight				
Low	5 (10)	3 (8.6)	0.04	0.82
Normal	45 (90)	32 (91.4)		
Type of feeding				
Breastfeeding	33 (66)	24 (68.6)	0.06	0.80
Bottle feeding	17 (34)	11 (31.4)		

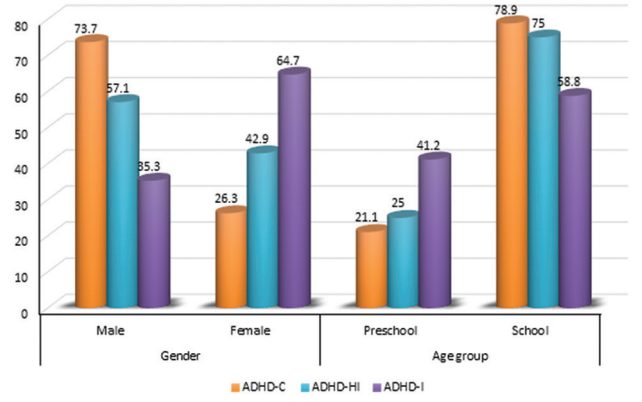
P>0.05, nonsignificant. *P*≤0.05, significant.

Table 3 Comparison between the studied groups regarding anthropometric measurements and complete blood count

	Patients (*n*=50) (mean±SD)	Controls (*n*=35) (mean±SD)	*t*-Test	*P*
Anthropometric measurements				
Weight (kg)	26.96±4.59	27.51±4.11	0.57	0.57**
Height (cm)	119.44±8.39	118.80±4.98	0.34	0.73**
BMI	18.90±2.26	19.48±2.10	1.20	0.23**
Hematological values				
Hb (g/dl)	11.58±0.88	12.27±1.24	1.11	0.07**
HCT%	33.42±0.53	33.5±0.73	1.03	0.30**
MCV (fl)	80.56±4.73	80.74±4.92	0.17	0.86**
RDW%	13.27±0.53	13.22±0.59	0.38	0.70**
RBCs (million/cm^3)	4.25±0.19	4.26±0.18	0.06	0.94**
WBCs (thousands/cm^3)	7.69±0.58	7.82±51	1.08	0.28**
PLT (thousands/cm^3)	278.05±61.71	256.1±25.75	1.05	0.29**

Hb, hemoglobin; HCT, hematocrit; MCV, mean corpuscular volume; PLT, platelet; RBC, red blood cell; RDW, red cell distribution width; WBC, white blood cell. **P>0.05.

Figure 1

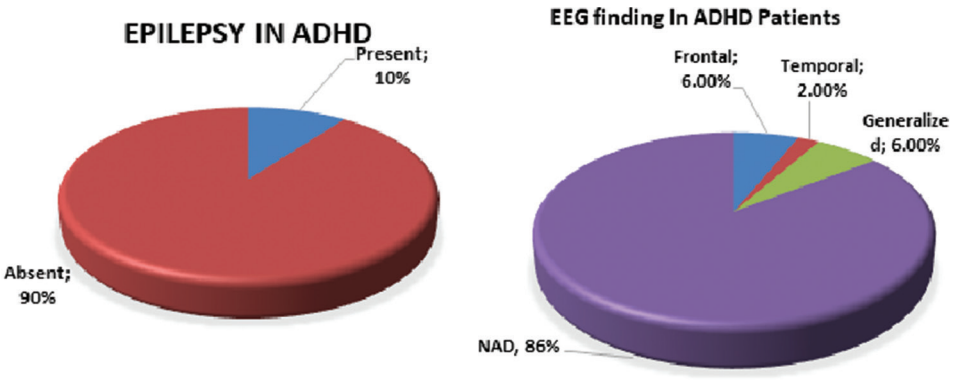


The prevalence of attention-deficit hyperactivity disorder clinical types among children according to gender and age groups.

especially mothers' education, were found to reflect positively on better physical and psychological health of their children [16].

The current study showed a high frequency of ADHD in patients who had low and moderate socioeconomic status. However, socioeconomic status of the family did not show any statistically significant differences among the studied groups. Our findings agree with the results of Akinbami *et al.* [17], although Bener *et al.* [15] found a significant association between low socioeconomic status of the family and ADHD. Out of the 50 children diagnosed with ADHD, 20 (40.0%) were from the lower socioeconomic status, 23 (46.0%) of the middle socioeconomic status, and seven (14%) were from the high socioeconomic status.

Figure 2



Epilepsy and electroencephalogram findings in the attention-deficit hyperactivity disorder group.

The study showed consanguinity is detected in 30% of the ADHD group compared with 37.1% of the control group. This result was in agreement with Bener *et al.* [15] which found that consanguinity was present in 39% of ADHD patients. This suggests that consanguinity may be a risk factor in the development of ADHD. As regards birth weight in our study, no significant statistical difference (P = 0.82) was found between ADHD and control groups. This result comes in agreement with Masana *et al.* [18]. In contrast, Halmøy *et al.* [19] and Pettersson *et al.* [20] reported significant statistically increased risk for ADHD with decreasing weight for gestational age.

The study has shown that there was no significant statistical difference between ADHD and control groups regarding body mass index. This result comes in agreement with Goksugur *et al.* [21] who found no significant statistical difference between the studied groups regarding BMI, and in contrast with Bener *et al.* [15] who found that there was a significant statistical difference between the studied groups regarding BMI.

Also, the study showed that there was no significant statistical difference between ADHD patients and control group regarding hematological values. These results come in agreement with Percinel *et al.* [22] who found that there were no significant statistical differences between the studied groups in terms of hematocrit P = 0.098, hemoglobin P = 0.164, mean corpuscular volume P = 0.055, red blood cells P = 0.811, and red cell distribution width P = 0.565). Also, Konofol *et al.* [23] has shown that hemoglobin and hematocrit levels were within normal ranges in children with ADHD.

In our study, the prevalence of ADHD clinical types among the patient group has shown that 38.0% of ADHD children presented with predominantly ADHD-C type, compared with 28.0% presented with ADHD-HI type and 34.0% presented with ADHD-I type. This agreed with Barkley [1] and Wolraich [2] who stated that more than two-third to three-fourth of people diagnosed with ADHD will be placed in combined type at some time in their childhood or adulthood.

In the current study, epilepsy was found in 10% of the ADHD patients. Our results is in agreement with Davis *et al.* [24] who found an increased incidence of epilepsy in the subsets of ADHD patients. Also, Williams *et al.* [25] found that in children with epilepsy, ADHD has been found to be present in 20–50% of patients. Hemmer *et al.* [26] found epileptic activity in 15.4% of ADHD patients.

ADHD combined presentation has also been associated with more severe seizure disorders Sherman *et al.* [27]. Earlier age of seizure onset has also been found to be associated with greater cognitive deficits, including attention deficit [28]. This could be the result of neuronal damage resulting from frequent seizures or seizures in an immature brain, the effects, or an underlying pathology, or genetic defect, contributing to the etiology for both seizures and cognitive/attention deficits [29].

Normal EEG findings were found in 86% of the ADHD patients while 8% had focal abnormalities (6% frontal and 2% temporal), generalized 2%. This agrees with Clarke *et al.* [30] and Chabot and Serfontein [31] who found that normal EEG findings was the most common in children with ADHD. Williams *et al.* [25] and Hughes *et al.* [32] found focal discharges more than that in our study (23.9 and 61%) and were more commonly on the left side with the vast majority of occipital and temporal regions. Epileptic abnormalities were detected in 21.9% of the cases.

Conclusion

This study identified that there is a possible relationship between the studied risk factors and development

of ADHD such as male gender, school age, living in urban areas, low socioeconomic status, large families, and families who have past history of ADHD, in children living with a single parent.

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Nil.

Conflicts of interest
There are no conflicts of interest.

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