



## **Psychiatric Comorbidities among Children with Attention Deficit Hyperactivity Disorders**

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### **Authors' contributions**

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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### **ABSTRACT**

**Background and Purpose:** Attention Deficit Hyperactivity Disorder (ADHD) is the most common neurodevelopmental disorder in children. The purpose of this study is to explore the rate of psychiatric comorbidities among children with ADHD and investigating the impact of comorbidities on function of children.

**Subjects and Methods:** Sixty-four children of both genders who fulfilled DSM-5 criteria for ADHD were included. All subjects were subjected to IQ assessment, Kiddie Schedule for Affective Disorders and Schizophrenia (K-SADS), Conners Rating Scale, and Child Behavior Check List (CBCL).

**Results:** Combined subtype was the commonest (50%) followed by hyperactive-impulsive (31.25%), then inattentive (18.75%). Psychiatric comorbid disorder among pediatric cases with ADHD was ODD (31.25%), followed by nocturnal enuresis (23.44%), conduct disorders (18.75%), motor tic disorders (15.63%), anxiety disorders (12.50%), depressive disorders (10.94%), substance abuse disorders (9.38%), autism spectrum disorders (7.81%), vocal tic disorders (1.56%). There was a statistically significant difference between gender and conduct disorder and SUDs ( $P < 0.05$ ). There was no significant difference in the distribution of comorbidities among subtypes except for conduct disorder ( $P < 0.05$ ). There was a significant difference between

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comorbidities and severity of ADHD, according to the Conners scale ( $P < 0.05$ ). There was a significant difference between comorbidities number and different CBCL parameters ( $P < 0.05$ ). There was a significant negative correlation between the number of comorbidities and total competence and positive correlation with the total problem ( $P < 0.05$ ).

**Conclusions:** The presence of comorbid disorders among pediatric cases with ADHD is the rule rather than the exception. Oppositional defiant disorder, followed by nocturnal enuresis, are the most common comorbid diseases. Comorbidities number is negatively correlated with total competence and positively correlated with the total problem.

*Keywords: ADHD; ODD; SUD; BPD; ASD; NE.*

## 1. INTRODUCTION

The most common neurodevelopmental disease in pediatrics is Attention Deficit Hyperactivity Disorder (ADHD) [1]. The ratio of boys to girls is from 3-10:1 [2]. ADHD is a long-lasting disease characterized by developmentally inappropriate and impairing patterns of inattention, hyperactivity, and impulsivity [3]. Clinical presentation of ADHD may vary according to age and stage of development [4].

Among pediatrics and adolescents with ADHD, there are many associated psychiatric diseases. The rule (not the exception) is overlapping psychiatric diseases, as shown by many studies [5]. Approximately two-thirds of individuals have at least one co-existing developmental or psychiatric condition [6] with higher incidence (67%–87%) with ADHD pediatrics [7]. According to the subtypes of ADHD, age groups, and sex, the rate of comorbid diseases varies [8].

Comorbid diseases affect the occurrence and severity of symptoms, long-term prognosis, and clinical outcome in ADHD cases [9]. Compared to their non- ADHD peers, adolescents with ADHD have more academic achievement disturbances, grade retention and other school problems, delinquency, social competence, parent-child communication, and parental aggravation despite adequate intellectual abilities [10].

The work aimed to explore the rate of psychiatric comorbidities among pediatrics with ADHD. We also aimed at investigating the potential impact of psychiatric comorbidities on the function of pediatrics with ADHD.

## 2. SUBJECTS AND METHODS

The current retrospective cross-sectional, descriptive study was carried out at Tanta University Hospitals, Neuropsychiatry Department from March 2018 to March 2019.

Pediatrics with ADHD aging under 18 years were recruited from those attending the outpatient

clinic of the child and adolescent psychiatry unit of the Neuropsychiatry Department at Tanta Psychiatry, Neurology, and Neurosurgery Center, a part of Tanta University Hospitals, Tanta, Al-Gharbia Governorate, Egypt. The child and adolescent's psychiatry clinic is twice weekly every Monday and Thursday. Both genders were included. Pediatrics fulfilled the DSM-5 criteria for ADHD. Patients with intellectual disability (IQ less than 70) and other medical disorders were excluded. This study included 64 pediatric cases who fulfilled DSM-5 criteria for ADHD. They were 41 males and 23 females; their mean age was  $11.23 \pm 3.27$  year (Range was 6 to 17 years).

Arabic version of Stanford-Binet test 5<sup>th</sup> edition was used to assess intelligence. The Arabic version of Kiddie Schedule for Affective Disorders and Schizophrenia (K-SADS) for diagnosis of any comorbid psychiatric disorders. Arabic version of Conner's Scale for ADHD (Parent and teacher edition) to assess the severity of ADHD. Arabic version of the Child Behavior Check List (CBCL).

### 2.1 Statistical Analysis

All data were statistically analyzed on SPSS (version 20). Descriptive statistics were obtained as means and SD. For quantitative data, the range, mean, and standard deviation were calculated. Also, Chi-square, Linear Correlation Coefficient, and Analysis of variance [ANOVA] tests were used. Correlation between two continuous data was done using Pearson's correlation ( $r$ ). Significance was adopted at  $p < 0.05$  for the interpretation of the results of tests of significance. Logistic regression procedure produces all predictions, residuals, influence statistics, and goodness-of-fit tests using data at the individual case level.

## 3. RESULTS

As illustrated in this Table 1, this study included 64 Pediatric cases diagnosed with ADHD. The

age of the studied peditrics ranged from 6 – 17 years with their mean age  $\pm$ SD (11.23  $\pm$ 3.27) years; out of them, 34/64 (53.12%) were  $\geq$ 12 years, and 30/64 (46.88%) were < 12 years, 41/64 (64.06%) were males, and 23/64 (35.94%) were females, 37/64(57.81%) from urban areas and 27/64 (42.19%) were from rural areas.

Regarding IQ assessment according to Stanford–Binet Intelligence Scale 5<sup>th</sup> edition, the studied sample of peditrics in Table 2 were distributed as follows: 14.06% of the peditric cases presented by dull IQ, 48.44% had average IQ, 18.75% with borderline IQ and 18.75% with a superior level of IQ. IQ assessment of the studied peditric cases ranged 74-115 with their mean 94.7 $\pm$ 12.02, and their median was 95.

Data presented in Table 1 half of the studied peditric cases in this study were combined subtype (32/64,50.00%) followed by hyperactive impulsive subtype (20/64, 31.25%) and inattentive subtype was the least (12/64, 18.75%).

Table 3 showed that moderate severity was the most prevalent degree of severity according to Conner’s Rating Scale in both teacher and parent edition, which constituted 48.44%, 43.75% respectively followed by mild degree according to teacher edition then marked degree. While according to parent edition, moderate severity is followed by marked severity, while a mild degree of severity comes in the last.

Data presented in Table 4: As regarding the number of comorbidities distributed among the sample of peditric cases, they were distributed as follows: 37.5% of peditric cases had one comorbid disorder, 25% had two comorbid disorders, 14.06% had three comorbid disorder. Only 23.44% of the peditric cases were presented by ADHD alone without any comorbid psychiatric disorders. According to data presented in Table 5: there was a statistically significant difference between ADHD subtypes and the number of comorbidities (P-value = 0.047\*) as the combined subtype showed more number of comorbid psychiatric disorders.

**Table 1. Sociodemographic characteristics of ADHD sample (total number 64 children)**

		N	%
Age (years)	Range	6	- 17
	Mean $\pm$ SD	11.23	$\pm$ 3.27
	Median	12	
Age groups	$\geq$ 12 years	34	53.12
	<12 years	30	46.88
Gender	Male	41	64.06
	Female	23	35.94
Residence	Urban	37	57.81
	Rural	27	42.19
Distribution of clinical subtypes of ADHD	Predominantly inattentive	12	18.75
	Predominantly hyperactive /impulsive	20	31.25
	Combined	32	50.00

**Table 2. IQ\* assessment of children according to the Stanford–Binet Intelligence Scale (5th edition)**

		N	%
IQ (categories)	Dull	9	14.06
	Borderline	12	18.75
	Average	31	48.44
	High average	12	18.75
IQ (Descriptive)	Range	74	- 115
	Mean $\pm$ SD	94.7	$\pm$ 12.02
	Median	95	

**Table 3. Distribution of severity of ADHD (teacher and parent edition) according to conner’s rating scale in relation to clinical subtypes of ADHD**

		Subtype						Chi-Square	
		Inattentive (n = 12)		Hyperactive/ impulsive (n = 20)		Combined (n= 32)		X <sup>2</sup>	P-value
		N	%	N	%	N	%		
Severity of ADHD (Teacher edition)	Mild	4	33.3	5	25	10	31.2	11.6	0.020*
	Moderate	8	66.7	13	65	10	31.2		
	Marked	0	0.00	2	10	12	37.5		
Severity of ADHD (parent edition)	Mild	5	41.7	4	20	5	15.7	9.66	0.046*
	Moderate	6	50	11	55	11	34.3		
	Marked	1	8.33	5	25	16	50		

**Table 4. Number and distribution of psychiatric comorbidities among children according to K-SADS\***

<b>Comorbid psychiatric disorder</b>	<b>N</b>	<b>%</b>
Number of comorbidities	No	15
	One	24
	Two	16
	Three	9
<b>Distribution of psychiatric comorbidities</b>		
Depressive disorders	7	10.94
Bipolar disorder	0	0.00
Psychotic disorders	0	0.00
Nocturnal enuresis	15	23.44
Anxiety disorders	8	12.50
Conduct disorders	12	18.75
Oppositional defiant disorders	20	31.25
Substance use disorders	6	9.38
Eating disorders	0	0.00
Tic disorders (Motor)	9	14.06
Tic disorders (Vocal)	1	1.56
Autism spectrum disorders	5	7.81
PTSD*	0	0.00

As shown in Table 5: there was a statistically significant difference between both genders as regard ADHD severity according to Conner's Rating scale (Teacher edition) (P-value = 0.005\*) as males were presented as markedly atypical in severity while females were more affected by mildly and moderately atypical in severity. On the other hand, there was no statistically significant difference between gender and severity of ADHD, according to the parent edition of Conner's Rating scale.

The distribution of psychiatric comorbidities in the studied pediatric cases according to KSADS (with the possibility of the presence of more than one comorbidity in each child) as follows: oppositional defiant disorder was the most comorbid psychiatric disorder among studied pediatric cases which constitute 31.25% of pediatric cases followed by nocturnal enuresis (23.44%), 18.75% had conduct disorders, 15.63% had motor tic disorders, 12.50% had anxiety disorders, 9.38% had substance use disorders, 10.94% had depressive disorders, 7.81% had Autism spectrum disorders, vocal tic disorders represent 1.56%. Bipolar disorder, psychotic, eating disorders and PTSD were not found among the studied pediatric cases Table 4.

There was no significant difference in the distribution of comorbidities among ADHD subtypes except for the conduct disorder which was common among pediatric cases with combined subtype (P-value =0.033\*). There was no significant difference in the distribution of comorbidities among ADHD subtypes except for the conduct disorder which was common among pediatric cases with combined subtype (P-value =0.033) Table 6.

There was a statistically significant difference between the number of comorbidities and different CBCL parameters (Activities, social, school, total competencies, and total problem) (P-value <0.005) as an increasing number of comorbidities was associated with poorer competencies and more problems.

There was a statistically significant negative correlation between the number of comorbidities and the total competence parameter of CBCL (P-value <0.05) as total competence is inversely proportional to the number of comorbidities.

There was a statistically significant positive correlation between the number of comorbidities and the total problem parameter of CBCL (P-value <0.05) as the total problem is directly proportional to the number of comorbidities.

**Table 5. Relationship between the number of comorbidities and clinical subtypes of ADHD**

		Subtype						Chi-Square	
		Inattentive		Hyperactive/ impulsive		Combined		X2	P-value
		N	%	N	%	N	%		
Number of comorbidities	No	5	41.7	4	20	6	18.75	12.77	0.047*
	One	4	33.3	11	55	9	28.13		
	Two	2	16.7	5	25	9	28.13		
	Three	1	8.3	0	0.00	8	25.00		

**Table 6. Relation between the number of comorbidities and parameters of CBCL\***

		Number of comorbidities										ANOVA			
		No	One		Two		Three				F	P-value			
Activities	Range	20	-	50	23	-	45	20	-	40	20	-	28	5.802	0.001*
	Mean ±SD	32.5	±	9.1	30.5	±	6.1	25.1	±	4.9	24	±	2.5		
Social competence	Range	22	-	50	20	-	42	20	-	42	22	-	28	4.644	0.006*
	Mean ±SD	33.1	±	9.8	29	±	5.3	25.5	±	4.8	25.3	±	2.2		
School competence	Range	21	-	56	20	-	45	20	-	45	20	-	28	4.716	0.005*
	Mean ±SD	34.7	±	11.4	30.5	±	7.0	26.4	±	5.8	24.3	±	2.7		
Total competence	Range	21	-	52	22	-	40	21	-	42	21	-	28	4.986	0.004*
	Mean ±SD	33.1	±	9.99	29.9	±	5.8	25.6	±	4.9	24.4	±	2.3		
Total problem	Range	54	-	72	58	-	75	60	-	77	65	-	75	8.701	<0.001*

#### 4. DISCUSSION

In pediatrics, the most common neurodevelopmental disorder is ADHD [11]. The worldwide prevalence rates of ADHD suggest that its prevalence in pediatric cases is around 4 to 7.1% and 2.5 to 5% in adulthood [12,13].

Regarding demographic characteristics of our pediatric cases, the current study found that age of the studied pediatric cases ranged from 6 to 17 years in the form of 34/64 (53.13%) child aged more than 12 years and 30 (46.88%) aged less than 12 years, and the mean age of the cases was  $11.234 \pm 3.265$  years. This finding was in agreement with the result of Visser et al., 2014 who found that the prevalence was 6.6% in pediatric cases aged 4 to 10 years and 11.2% in adolescents aged 11 to 14 years [14]. Our finding is inconsistent with De la Barra et al., 2013 who estimated the prevalence of ADHD is more common among pediatric cases (4-11 years of age) than among adolescents (ages 12–18) as it is a developmental disorder and may persist throughout the life span. This difference might be related to the different age groups of the subjects in the study, or the diagnosis of ADHD in young pediatrics is a real challenge as the core symptoms are common daily behaviors of most preschoolers [15].

In this study, ADHD was higher in boys ( $n = 41$ , 64.06%) than girls ( $n=23$ , 35.94%). This was in line with El Hamrawy et al., 2017 as well as Bishry et al. 2008, they found that ADHD was higher in male than female pediatrics (2.5 and 5.6 times, respectively). This may be due to the lower rates of comorbid disruptive behavior in female and less overt manifestations of inattentive type of ADHD in girls, or gender differences obviously are culture-dependent [8,16]. On the contrary to the previous finding, In India, Joshi and Angolkar (2018) reported that the prevalence of ADHD among girls was higher than boys (3.8% and 1.9%), respectively. This may be due to the more number of females in the study than males (80 vs 76). Also, the sample included urban areas only [17].

Our study found a higher proportion of urban resident pediatric cases ( $n=37$ , 57.81%) than rural resident pediatric cases ( $n = 27$ , 42.19%). This finding is in harmony with the work of Shakir & Sulaiman, 2016, who showed a higher proportion of ADHD among urban residents than rural resident pediatric cases [18]. On the other hand, our study is inconsistent with Ahmed et al.,

2018 who found that there is a significant association between the prevalence of ADHD with low socio-economic status and rural areas. This could be explained by a large sample of pediatric cases from the urban areas and to some extent higher educational levels of parents or caregivers in urban areas than in rural areas [19].

Pediatric cases with ADHD may have a broad range of cognitive abilities. In our study, we measured intelligence quotient (IQ) in pediatric cases by Stanford Binet test (5th edition), and we found that the range of IQ was 74 -115 with their mean  $94.656 \pm 12.024$ . Also, in our study IQ was distributed as follows: ADHD among pediatric cases with normal IQ was 48.44%, 14.06% of pediatric cases were dull, 18.75% were borderline IQ, and 18.75% of them had high average IQ, which was going with the work of Jepsen et al., 2009 who found that ADHD is common among pediatric cases with average IQ [20]. This is inconsistent with Voigt et al., 2006 and Frazier et al., 2004 who found that ADHD is more likely to be present in the context of developmental delay at the level of borderline-to-mild intellectual disability [21,22]. In contrast, Leroux & Levitt-Perlman (2000) had reported that ADHD is more common among pediatric cases with a high IQ as gifted pediatric cases with a lot of energy can be seen as having ADHD. This controversy could be explained as the association between IQ, and attention deficits are generally modest, with the mean influence on IQ probably amounting to 2 to 5 IQ points [23].

Another important finding was that the most commonly observed subtype was the combined subtype, which constituted 50.00% of the studied sample, followed by the hyperactive/impulsive subtype which represent 31.25%, and lastly inattentive subtype (18.75%). This finding is consistent with a study done in Fayoum by Aboul-ata & Amin, 2015, and another one done in Menoufia by El-nemr et al., 2015 who reported that combined subtype is the most commonly observed subtype among pediatric cases with ADHD. This may be because combining information across informants significantly increased the rate of combined type [24,25]. In contrast to our finding, Cerrillo-urbina et al., 2018 found that the inattentive type is the most frequently seen subtype. This may be due to different methods and sampling in this study [26].

Assessment of severity of ADHD by Conners' Rating scale (parent and teacher edition)

revealed that a moderate degree of severity is present in most pediatric cases followed by a marked degree in parent edition and by the mild degree in teacher edition. This is consistent with Danielson et al.,2018 who found that moderate and severe forms are more common than mild forms. This is may be accounted to that parents seek medical advice when the condition is severe [27]. While it is inconsistent with Ramy et al., 2018 who found that about 83.9% were mild 10.3% of cases were severe, 5.7% were moderate in severity. This may be due to including small number of moderate and severe cases (only 14 students), and interviewing the students in school setting with limited available time [28].

The present study revealed that there was a significant relationship between ADHD subtypes and severity as those with combined subtype were more likely to have more severe forms of the disease. On the other hand, pediatric cases with inattentive subtype had less severe degrees (33.33% mildly atypical), none of the pediatric cases scored average or slightly atypical on the severity test. It is consistent with Danielson et al., 2018; Ramy et al., 2018 who concluded that the combined subtype presented with more symptoms than other pediatric cases diagnosed with other ADHD subtype and can be explained in that hyperactive pediatric cases tend to be more disruptive at home and school [27,28]. In contrast to Lubke et al.,2007, there were no differences in severity within different subtypes. Diagnostic tools and recruitment criteria may account for this difference.

In the present study, 76.56% of the pediatric cases had comorbid psychiatric disorders using the K-SADS scale. In other words, 23.44% of pediatric cases have ADHD alone with no comorbid psychiatric disorders [29]. These findings are in accordance with the results of Hergüner et al., 2015 who found that found that 73.7% of ADHD pediatric cases had at least one psychiatric comorbidity using K-SADS, whereas Amiri et al., 2013 reported psychiatric comorbidities in 62.5% of ADHD pediatric cases. This is inconsistent with the finding of Prins et al., 2015 who found that ADHD without comorbidity is rare. The high percentage of the presence of comorbid disorders in the present study may be associated with the study method as K-SADS instrument is a comprehensive measure of a variety of pathological conditions from both the past and the present. Also, it can be explained

that in the clinical sitting sever and complicated cases seek medical advice [30-32].

This study showed that there was a statistically significant difference between the number of comorbidities and ADHD subtype (P-value = 0.047), as pediatric cases with two or more comorbidities were mostly of combined subtype, whereas those with only one concomitant psychiatric disorder were of inattentive subtype. This work is in harmony with the finding of Reale et al.,2017 who found that Comorbid psychiatric disorders were more frequent in patients with combined subtype [33]. It is inconsistent with the study of Ghanizadeh,2009 which showed that there is no evidence supporting different ADHD subtypes as distinct clinical entities in terms of comorbidity. Subjects with combined subtype showed higher rates of psychiatric comorbidity and more significant global functional impairment so, pediatric cases with combined subtype are associated with a higher number of comorbidities [34].

This work revealed that the most frequently reported psychiatric comorbid disorder among pediatric cases with ADHD was ODD (31.25%), followed by nocturnal enuresis (23.44%), conduct disorders (18.75 %), motor tic disorders (15.63%), anxiety disorders (12.50%), depressive disorders (10.94%), substance abuse disorders (9.38 %), autism spectrum disorders (7.81%), vocal tic disorders (1.56%).

Accordingly, ODD was the most frequent comorbidity in our stud with a rate of (31.25%), which is in harmony with the work of El Hamrawy et al., 2017, Elia et al. 2008; Yüce et al., 2013; and Amiri et al., 2013 which reported high but various prevalence rate of ODD in ADHD pediatric cases. Our finding was not consistent with Riahi et al., 2015 who found that nocturnal enuresis was the most common comorbid disorder in pediatric cases with ADHD (58.7%). Also, it is inconsistent with Du Paul et al.,2013 who found that the most common comorbid conditions were specific learning disorders. These discrepancies may be a result of the differences in the age of pediatrics or the instruments and diagnostic criteria used to assess comorbid psychiatry disorders [8,31,35-38].

The comorbid rate of the affective disorders was found to below 10.94%, which is consistent with the finding of Byun et al..2006 who found that ADHD with comorbid affective disorders is

estimated as 14.3%. On the other hand, it is inconsistent with Wilens et al.,2002 who stated that there is a high rate of comorbid depressive disorders. An explanation for the lower comorbid rate could be related to the fact that parents tend to pay more attention to hyperactivity, aggression and impulsive behavior than to emotional difficulties in their pediatric cases. Because of this, parents may be less likely to report the emotional symptoms of their pediatric cases [39,40].

In our study, the comorbid affective disorders were depressive disorders; no pediatric cases were diagnosed with bipolar disorder. This finding is in harmony with McClellan & Werry,1997 likely due to the well-known observation that bipolar disorders are rarely diagnosed in school-age children [41].

There was a statistically significant correlation between the number of comorbidities and school, social, total competence, total problem, and activities in children with comorbid disorders. This is in harmony with Cuffe et al.,2015 who revealed that comorbid conditions are associated with poorer outcomes in academic achievement, grade retention and other school problems, delinquency, social competence, parent-child communication, and parental aggravation. Comorbid conduct disorder and ADHD severity in childhood are the most important predictors of adverse outcomes in adulthood among pediatric cases with ADHD [42] as most of the conduct disorders are mostly associated with severe degrees of ADHD [43].

The results of the present study revealed that pediatric cases diagnosed as having ADHD have a significantly higher risk for the development of socially aggressive behavior. The total number of ADHD symptoms as a marker of severity appears to be important, not only in those who meet clinical diagnostic criteria for ADHD but also for increasing severity of aggressive and rule-breaking behaviors, and these results are in accordance with the work done by Thapar et al.,2006 who stated that severity of ADHD is predictors of antisocial behavior in pediatric cases with ADHD [44].

Associations between ADHD and functioning remained significant in adjusted regression models. Logistic regression analysis revealed that the number of comorbidities was significant predictors of the total competence parameter of pediatric cases with ADHD (P-value =0.036).

This finding is in harmony with the work of Klassen et al.,2007 who found that within a sample of clinically referred ADHD pediatric cases with multiple comorbid psychiatric disorders was associated with poorer psychosocial quality of life than having either no or only one comorbid psychiatric disorder [45]. Also, Larson et al.,2011 have concluded that functioning declines in a stepwise fashion as the number of comorbid diagnoses increases [6].

Pediatric cases with ADHD and three or more comorbid disorders exhibited severe deficits in functioning. For pediatric cases with ADHD, the poorer functioning increased in a stepwise fashion with increasing numbers of comorbidities [6] as pediatric cases with three or more comorbid disorders had the highest score of activity restriction, whereas pediatric cases with one or two comorbid disorder had intermediate scores. These results have important implications for the organization and delivery of health care services for pediatric cases with ADHD.

The current study showed that pediatric cases with ADHD had more problems across a wide range of school, social, and family functioning indicators. This finding is in harmony with the work of Larson et al.,2011 who found that pediatric cases with ADHD and comorbid psychiatric disorders had particularly severe functional deficits. Pediatric cases with ADHD have elevated problems in many areas, including academic functioning and strained social and family relationships [46].

## 5. CONCLUSION

The presence of comorbid disorders among pediatric cases with ADHD is the rule rather than the exception. Oppositional defiant disorder, followed by nocturnal enuresis, are the most common comorbid diseases.

## CONSENT AND ETHICAL APPROVAL

The research was approved by the Ethical and Research Committee of Tanta University, Faculty of Medicine. Informed written consent was obtained from the parents or caregivers of all participants in this research after explaining the steps of the study and its aim.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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