



## Psychiatric disorders and symptoms severity in patients with adenotonsillar hypertrophy before and after adenotonsillectomy<sup>☆</sup>



Erkan Soylu<sup>a,\*</sup>, Nusret Soylu<sup>b</sup>, Yavuz Selim Yıldırım<sup>c</sup>,  
Öner Sakallıoğlu<sup>d</sup>, Cahit Polat<sup>d</sup>, İsmail Orhan<sup>a</sup>

<sup>a</sup> Department of Otolaryngology, Head and Neck Surgery, Medipol University Hospital, İstanbul, Turkey

<sup>b</sup> Department of Child and Adolescent Psychiatry, Gaziantep Pediatrics Hospital, Gaziantep, Turkey

<sup>c</sup> Department of Otolaryngology, Head and Neck Surgery, Bezmialem Vakıf University Hospital, İstanbul, Turkey

<sup>d</sup> Department of Otolaryngology, Head and Neck Surgery, Elazığ Training and Research Hospital, Elazığ, Turkey

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### ABSTRACT

**Objective:** The objective of this study was to compare the frequency of psychiatric disorders and the severity of psychiatric symptoms in patients with adenotonsillar hypertrophy with a healthy control group and investigate the potential improvement after adenotonsillectomy.

**Materials and methods:** The study group consisted of 40 patients with adenotonsillar hypertrophy and a control group consisted of 35 healthy volunteers without adenotonsillar hypertrophy. A routine ear nose throat (ENT) examination, flexible nasopharyngoscopy and tympanometry were carried out. The same procedures were applied to the control group. The parents of all the participants were required to fill out the Early Childhood Inventory-4 form, the Strengths and Difficulties Questionnaire and a personal information form. At postoperative month six, the patients were re-examined, and their parents were required to fill out the same forms.

**Results:** Attention deficit hyperactivity disorders and sleep disorders determined with the Early Childhood Inventory-4 were more common in the patients with adenotonsillar hypertrophy than in the control group. There was a significant decrease in the rates of both types of disorders at postoperative month six. The total psychiatric symptom severity was higher in the patients with adenotonsillar hypertrophy and the following were more frequent: cases of attention deficit hyperactivity disorder, oppositional defiant disorder, symptom severity of anxiety disorders and sleep disorders determined with the Early Childhood Inventory-4, as well as emotional problems, attention deficit hyperactivity disorder problems, behavioural problems and peer problems determined with the Strengths and Difficulties Questionnaire parent-report form. There was a statistically significant decrease in all the other symptoms at postoperative month six, except for the severity of oppositional defiant disorder symptoms determined with the Early Childhood Inventory-4 and behavioural problems determined with the Strengths and Difficulties Questionnaire parent-report form. There were no differences in the severity of psychiatric disorders or symptoms between the adenotonsillar hypertrophy group and the control group at postoperative month six.

**Conclusion:** Adenotonsillar hypertrophy is associated with psychiatric disorders and symptoms. Adenotonsillectomy ameliorated the symptoms and the severity of these disorders in most cases.

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## 1. Introduction

From the 1950s until the 1980s, the primary and the most frequent indication for adenoidectomy and adenotonsillectomy

were recurrent infections [1]. Following the emergence of antibiotics, upper respiratory tract obstruction and sleep disordered breathing (SDB) became more common indications for adenoidectomy and adenotonsillectomy [2,3]. SDB includes all sleep pathologies, from simple snoring to sleep apnea syndrome. Sleep problems due to respiratory tract obstructions in patients with adenotonsillar hypertrophy are included in the definition of SDB. Paediatric SDB may be the result of various factors, but the most frequent cause is adenotonsillar hypertrophy [4]. The abnormal growth of adenoids and tonsil tissues can lead to

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\* Corresponding author. Tel.: +90 505 658 77 62; fax: +90 212 460 70 70.

E-mail address: [erkansoylu23@gmail.com](mailto:erkansoylu23@gmail.com) (E. Soylu).

shortness of the upper respiratory tract. Therefore can lead to snoring, mouth breathing, frequent waking during sleep and sleep apnea in untreated advanced cases [5].

Patients with SDB do not sleep efficiently enough to rest, therefore, they may experience neurocognitive disorders, behavioural disturbances and a decline in quality of life scores [6–9]. Researches has shown that both externalising symptoms, such as impulsivity, hyperactivity, aggression, oppositional behaviour, conduct problems and somatisation, frequently occur in children with SBD [10–13], in addition to internalising symptoms, such as anxiety, depression and social withdrawal [14–16]. In our previous study, psychiatric morbidity was significantly higher in patients with adenotonsillar hypertrophy compared to a healthy control group [17].

Studies have demonstrated that adenotonsillar hypertrophy adversely affected the performance of children in school and in intelligence tests and that adenotonsillectomy improved their performance [18–20]. They have also shown that neurocognitive and behavioural impairment seen in children with adenotonsillar hypertrophy improved after adenotonsillectomy [13,21]. The existence of studies reporting a postoperative decrease in psychiatric symptoms, which were determined during the preoperative period, has caused us to plan this study. To the best of our knowledge, this study is the first study to investigate preoperative and postoperative psychiatric disorders and symptoms in preschool children with adenotonsillar hypertrophy.

## 2. Materials and methods

### 2.1. Participants

Forty children aged three to five years who presented to the Elazığ Research and Training Hospital between January 2012 and August 2012 with an indication of adenotonsillectomy or adenoidectomy were included in the study. These patients experienced mouth breathing, snoring and frequent waking from sleep, and various levels of adenotonsillar hypertrophy were detected in a physical examination. The control group consisted of 35 patients and siblings with similar demographic characteristics who presented to the ear, nose, throat (ENT) clinic but did not have complaints of recurrent tonsillitis, snoring and oral respiration and in whom adenotonsillar hypertrophy was not determined in a fiberendoscopic evaluation. Individuals with ear problems, allergic rhinitis, chronic inflammatory diseases, obesity, acute infection, craniofacial anomalies, recurrent tonsillitis without obstructive complaints, type B tympanogram in a tympanometry analysis and an inability to comply with flexible fibreoptic endoscopy were excluded from both study arms.

We completed our first study with 48 adenotonsillar hypertrophy patients and 40 control patients who presented between January 2012 and June 2012 [17]. After planning the second study and receiving the approval of the ethics committee, the cases who had been included in the first study were re-examined. Eight of 48 patients in the adenotonsillar hypertrophy group and six of 40 patients in the control group were excluded from the study because they were six-years-old at postoperative month six. The rest of the patients were contacted again in postoperative month six, informed about the study and included in the second study. Thirty-one of 40 patients in the adenotonsillar hypertrophy group and 27 of 34 patients in the control group completed the second study. Due to the possibility of failing to reach all the cases in postoperative month six, new cases were included between June 2012 and August 2012. During this period, 12 new cases were added to the adenotonsillar hypertrophy group, and 10 new cases were added to the control group. Among these new cases, nine in the adenotonsillar hypertrophy group and eight in the control

group completed the postoperative month six study. In total 40 patients in the adenotonsillar hypertrophy group and 35 patients in the control group completed the study.

### 2.2. Procedure

A routine ENT examination, fibreoptic nasopharyngoscopy and tympanometry were performed in both groups during the preoperative period. The Brodsky scale [22] and fiberendoscopic findings [23] were used to categorise the tonsils and the size of the adenoids, respectively. Following the evaluation, the patients with an indication of adenoidectomy or adenotonsillectomy were informed about the study. In order to determine frequency of psychiatric disorders and severity of psychiatric symptoms, the patients' caregivers or their parents were asked to fill out a demographic information form, the Early Childhood Inventory-4 (ECI-4) parent form and the Strengths and Difficulties Questionnaire (SDQ) parent-report form. Of the study group, 16 underwent adenoidectomy and 24 underwent adenotonsillectomy under endotracheal general anaesthesia. The cold dissection technique was used. There were no intraoperative or postoperative complications. After discharge, the patients were followed up periodically until the sixth postoperative month. At postoperative month six, the parents filled out the same forms as in the preoperative period, and the patients underwent a general examination. The same process was repeated with the control group six months after the first assessment. The study group showed no recurrence of adenoids or tonsils. All the scales obtained were assessed by a child psychiatrist who had no information about the condition of the groups.

### 2.3. Forms and scales used in the study

#### 2.3.1. Demographic information form

This form was developed by the investigators and was used to obtain sociodemographic characteristics of cases, parents and family.

#### 2.3.2. Early Childhood Inventory-4

ECI-4, developed by Sprafkin and Gadow, is a scale designed to evaluate the behavioural, emotional and cognitive symptoms of children between the ages of three and five years according to DSM-IV diagnostic criteria [24,25]. Schizophrenia, which rarely occurs between the ages of three and five years, is not investigated in the ECI-4. However, diagnoses of eating, sleep and attachment disorders, which occur more frequently during these ages, are included. The ECI-4 is composed of 108 items, which are rated as 'never', 'sometimes', 'often' and 'nearly always'. Sprafkin and Gadow graded the ECI-4 in two different ways—symptom score points and symptom severity points. In the symptoms scoring, 'never' and 'sometimes' are scored as 0 and 'often' and 'almost always' as 1. The scores obtained for each disorder in the ECI-4 are added. If the overall score is equal to or higher than the number of symptoms required for a DSM-IV diagnosis, the symptom criteria score for that disorder is evaluated as 'yes'. In scoring the severity of symptoms, 'never' is scored as 0, 'sometimes' as 1, 'often' as 2 and 'almost always' as 3. The scores obtained from the questions are added to obtain the severity score of a particular disorder [24,25]. The reliability/validity of the scale has been tested in Turkey in children between the ages of three and five years [26]. There are two different forms of the scale, one of which is completed by the parents and the other by a teacher. In this study, the parent form was used.

#### 2.3.3. Strengths and Difficulties Questionnaire

The SDQ was developed by Goodman in 1997 [27–29], and the reliability/validity of the scale has also been tested in Turkey [30].

The reliability and validity study of the parent form was carried out with 250 parents with children aged between four and 18 years. There are 25 questions on the scale, which is subdivided into five parts. There are five questions each on hyperactivity-inattention problems, conduct problems, emotional problems, peer problems and prosocial behaviour. The first four subgroups question difficulties, and the last group, prosocial behaviour, questions strengths. Each subgroup can be scored by itself. In addition, the sum of the first four groups yields an overall difficulty score.

#### 2.4. Statistical analysis

The SPSS 16.0 software program was used in the statistical assessment of the study. The student's *t*-test was used to evaluate continuous variables between the two independent groups. The dependent *t*-test was used to in the dependent groups. The chi-square test was used for comparisons of variables with a categorical value in the independent groups. The McNemar test was used in the dependent groups.

### 3. Results

The adenotonsillar hypertrophy group included 40 patients (17 girls, 23 boys) with an age range of 3.17–5.50 ( $4.46 \pm 0.76$ ), and the control group included 35 patients (14 girls, 21 boys) with an age range of 3.25–5.42 ( $4.35 \pm 0.75$ ). There was no statistically significant difference between the groups in terms of age and sex ( $p > 0.05$ ). Table 1 illustrates the sociodemographic characteristics of both groups. No statistically significant difference was found between the two groups with respect to sociodemographic characteristics ( $p > 0.05$ ).

According to the results of flexible fiberoptic endoscopy of the adenotonsillar hypertrophy group, the adenoid was classified as

second degree in 25% of the patients ( $n = 10$ ), third degree in 52.5% ( $n = 21$ ) and fourth degree in 22.5% ( $n = 9$ ). Additionally, 60.0% ( $n = 24$ ) had tonsillar hypertrophy. Tonsillar hypertrophy was evaluated according to the classification of Brodsky [26]. There were 24 cases of tonsillar hypertrophy: 33.3% ( $n = 8$ ) had grade 2, 50.0% ( $n = 12$ ) had grade 3, and 16.7% ( $n = 4$ ) had grade 4 hypertrophy.

#### 3.1. Preoperative comparison of cases with adenotonsillar hypertrophy with the control group

Comparing the cases in relation to the diagnoses of psychiatric disorders determined with the ECI-4, 80.0% ( $n = 32$ ) of the adenotonsillar hypertrophy group and 48.6% ( $n = 17$ ) of the control group were diagnosed with at least one psychiatric disorder. The difference between the groups was statistically significant ( $p = 0.008$ ). Table 2 illustrates the diagnoses of psychiatric disorders based on the ECI-4 data. As seen in the table, attention deficit hyperactivity disorder (ADHD) ( $p = 0.021$ ) and sleep disorders ( $p = 0.018$ ) were more common in the adenotonsillar hypertrophy group ( $p < 0.05$ ).

Evaluation of the severities of the symptoms of the children that were obtained by summing the psychiatric symptom scores calculated with the ECI-4 showed that the scores for ADHD ( $p = 0.041$ ), oppositional defiant disorder (ODD) ( $p = 0.035$ ), anxiety disorders ( $p = 0.019$ ), sleep disorders ( $p = 0.014$ ) and total symptom severities were higher in the adenotonsillar hypertrophy group ( $p < 0.05$ ). Comparison of the subsymptoms of ADHD showed that the severity of attention deficits ( $p = 0.022$ ) was greater in the adenotonsillar hypertrophy group. There was no statistically significant difference between the hyperactivity ( $p = 0.133$ ) and the impulsivity ( $p = 0.350$ ) scores of the two groups ( $p < 0.05$ ). With respect to the scores of the SDQ parent-report form, the scores for behavioural problems ( $p = 0.050$ ), ADHD problems ( $p = 0.030$ ) and problems regarding peer relations ( $p = 0.040$ ) were higher in the adenotonsillar hypertrophy group. The total problem score ( $p = 0.015$ ) was also higher in the adenotonsillar hypertrophy group ( $p < 0.05$ ). Table 3 illustrates the comparison between the psychiatric symptom severity scores of the groups obtained from the ECI-4 and the scores obtained from the SDQ parent-report form.

#### 3.2. Comparison of the ECI-4 and SDQ parent-report form scores of the adenotonsillar hypertrophy cases in the preoperative period and at postoperative month six

The results showed that 80.0% ( $n = 32$ ) of adenotonsillar hypertrophy cases were diagnosed with at least one psychiatric disorder on the ECI-4 before the adenotonsillectomy. This rate fell to 47.5% ( $n = 19$ ) after the adenotonsillectomy. The difference was statistically significant ( $p = 0.004$ ). Table 2 illustrates the diagnosis of psychiatric disorder of the cases based on the ECI-4 scale. As seen in the table, the rate of eating disorders ( $p = 0.008$ ) and sleep disorders ( $p = 0.013$ ) showed a statistically significant decrease during the postoperative period. This decrease was at the limit value for ADHD ( $p = 0.070$ ).

The evaluation of the symptom severities obtained from summing the psychiatric symptom scores calculated with the ECI-4 before and after the operation revealed that ADHD ( $p = 0.007$ ), anxiety disorders ( $p = 0.002$ ), eating disorders ( $p = 0.001$ ), sleep disorders ( $p = 0.001$ ) and total symptom severities ( $p = 0.004$ ) showed a statistically significant decrease six months after the adenotonsillectomy. The analysis of the subsymptoms of ADHD showed that although the symptom severity of attention deficits ( $p = 0.004$ ) significantly decreased after the adenotonsillectomy, there was no statistically significant decrease in the symptom severity scores of

**Table 1**  
Sociodemographic patient features.

	Study		Control	
	<i>n</i>	%	<i>n</i>	%
Sex				
Girl	17	42.5	14	40
Boy	23	57.5	21	60
Nursery school or day nursery				
No	25	62.5	22	62.9
Nursery school	11	27.5	8	22.8
Day nursery	4	10.0	5	14.3
Lives with				
Both parents	38	95.0	33	94.2
Mother	2	5.0	1	2.9
Father	0	0.0	1	2.9
Mother's education level				
Not literate	2	5.0	1	2.8
Graduated primary school	18	45.0	11	31.4
Graduated high school	14	35.0	15	42.9
Graduated university	6	15.0	8	22.9
Father's education level				
Not literate	0	0.0	0	0.0
Graduated primary school	14	35.0	9	25.7
Graduated high school	18	45.0	15	37.5
Graduated university	8	20.0	11	31.4
Family type				
Core family	36	87.5	29	82.9
Extended family	2	6.2	4	11.4
Divided family	1	4.2	2	5.7
One parent deceased	1	2.1	0	0.0
Family's socioeconomic status				
Low	16	40.0	12	34.3
Moderate	17	42.5	14	40.0
High	7	17.5	9	25.7

**Table 2**  
Diagnoses of psychiatric disorders determined by ECI-4.

	Before adenotonsillectomy study group	Control	$p^*$	Before adenotonsillectomy study group	After adenotonsillectomy study group	$p^{**}$	After adenotonsillectomy study group	After six months control group	$p^*$
	n (%)	n (%)		n (%)	n (%)		n (%)	n (%)	
ADHD	12 (30.0)	3 (8.6)	0.021	12 (30.0)	6 (15.0)	0.070	6 (15.0)	3 (8.6)	0.393
ODD	7 (17.5)	2 (5.7)	0.117	7 (17.5)	8 (20.0)	>0.05	8 (20.0)	2 (5.7)	0.069
Behavioural disorders	3 (7.5)	1 (2.9)	0.618 <sup>*</sup>	3 (7.5)	1(2.5)	0.500	1(2.5)	1 (2.9)	0.719 <sup>*</sup>
Emotional disorders	2 (5.0)	2 (5.7)	>0.05 <sup>*</sup>	2 (5.0)	0 (0.0)	0.500	0 (0.0)	1 (2.9)	0.467 <sup>*</sup>
Anxiety disorders	11 (27.5)	6 (17.1)	0.285	11 (27.5)	10 (25.0)	>0.05	10 (25.0)	5 (14.3)	0.247
Eating disorders	13 (32.5)	5 (14.3)	0.065	13 (32.5)	5 (12.5)	0.008	5 (12.5)	6 (17.1)	0.571
Tic disorders	3 (7.5)	2 (5.7)	0.757	3 (7.5)	1 (2.5)	0.500	1 (2.5)	2 (5.7)	0.449 <sup>*</sup>
Sleep disorders	17 (42.5)	6(17.1)	0.018	17 (42.5)	7 (17.5)	0.013	7 (17.5)	7 (20.0)	0.782
Enuresis and encopresis	8 (20.0)	5 (14.3)	0.514	8 (20.0)	7 (17.5)	>0.05	7 (17.5)	5 (14.3)	0.705
Attachment disorders	11 (27.5)	5 (14.3)	0.163	11 (27.5)	5 (12.5)	0.070	5 (12.5)	6 (17.1)	0.571
PDD	0 (0.0)	0 (0.0)	–	0 (0.0)	0 (0.0)	–	0 (0.0)	0 (0.0)	–
Diagnosis psychiatric disorder	32 (80.0)	17(48.6)	0.004	32 (75.0)	19 (47.5)	0.004	19 (47.5)	18 (51.4)	0.734

ADHD = Attention deficit hyperactivity disorder ODD = Oppositional defiant disorder, PDD = Pervasive developmental disorders.

<sup>\*</sup>  $p$ , chi-square test  $p$  value.

<sup>\*\*</sup>  $p$ , McNemar test  $p$  value.

hyperactivity ( $p = 0.626$ ) and impulsivity ( $p = 0.327$ ). The evaluation of the scores from the SDQ parent-report form demonstrated that emotional problems ( $p = 0.050$ ), ADHD problems ( $p = 0.030$ ), problems regarding peer relations ( $p = 0.040$ ) and the total problem score ( $p = 0.015$ ) showed a statistically significant decrease after the adenotonsillectomy ( $p < 0.05$ ). Table 4 shows a comparison of the psychiatric symptom severity scores obtained from the ECI-4 and those obtained from the SDQ parent-report form in the preoperative period and at postoperative month six for the adenotonsillar hypertrophy cases.

### 3.3. Comparison between the adenotonsillar hypertrophy cases and the control group six months after the adenotonsillectomy

Table 2 presents a comparison of the psychiatric disorder rates determined with the ECI-4 six months after the adenotonsillectomy.

**Table 3**

Preoperative comparison of the ECI-4 scores and the SDQ parent-report form scores of the adenotonsillar hypertrophy group and the control group.

		Before adenotonsillectomy study group	Control	$t$	$p^*$
		OP $\pm$ SS	OP $\pm$ SS		
ECI-4	ADHD	19.70 $\pm$ 8.64	15.26 $\pm$ 8.83	2.20	0.031
	Attention deficit	9.20 $\pm$ 3.83	6.80 $\pm$ 4.89	2.38	0.020
	Hyperactivity	6.10 $\pm$ 3.65	4.80 $\pm$ 3.81	1.52	0.136
	Impulsivity	4.40 $\pm$ 2.77	3.66 $\pm$ 2.33	1.25	0.216
	ODD	7.70 $\pm$ 5.51	5.42 $\pm$ 3.69	2.06	0.042
	Behavioural disorders	5.07 $\pm$ 6.06	4.81 $\pm$ 6.78	0.18	0.861
	Emotional disorders	5.02 $\pm$ 3.01	4.65 $\pm$ 2.66	0.56	0.580
	Anxiety disorders	25.02 $\pm$ 10.67	18.97 $\pm$ 11.39	2.37	0.020
	Eating disorders	1.80 $\pm$ 1.71	1.62 $\pm$ 1.53	0.45	0.651
	Tic disorders	0.58 $\pm$ 0.81	0.71 $\pm$ 1.45	0.52	0.603
	Sleep disorders	3.22 $\pm$ 2.12	2.02 $\pm$ 1.87	2.58	0.012
	Enuresis and encopresis	1.17 $\pm$ 1.36	1.17 $\pm$ 1.58	0.01	0.992
	Attachment disorders	1.55 $\pm$ 1.48	1.26 $\pm$ 1.22	0.92	0.358
	Pervasive developmental disorder	5.20 $\pm$ 3.93	4.09 $\pm$ 4.33	1.16	0.247
Total symptom severity	76.05 $\pm$ 33.10	60.01 $\pm$ 31.85	2.13	0.037	
SDQ PARENT FORM	Emotional problems	2.60 $\pm$ 1.85	1.97 $\pm$ 1.74	1.51	0.136
	Behavioural problems	2.23 $\pm$ 1.73	1.45 $\pm$ 1.46	2.06	0.043
	ADHD problems	4.77 $\pm$ 2.36	3.45 $\pm$ 2.06	2.55	0.013
	Peer problems	2.95 $\pm$ 1.66	2.20 $\pm$ 1.47	2.05	0.043
	Prosocial behaviour	7.00 $\pm$ 2.21	7.54 $\pm$ 1.84	1.15	0.255
	Total problem points	12.55 $\pm$ 5.24	9.17 $\pm$ 4.50	2.97	0.004

ADHD, attention deficit hyperactivity disorder; ODD, oppositional defiant disorder.

<sup>\*</sup>  $p$ , student's  $t$ -test  $p$  value.

There was no statistically significant difference in the psychiatric disorder rates between the two groups ( $p > 0.05$ ). Table 5 shows a comparison of the symptom severity scores obtained with the ECI-4 and the scores obtained with the SDQ parent-report form. It can be seen that there is no significant difference between the groups with respect to the psychiatric symptoms scores on the ECI-4 and problem areas identified on the SDQ parent-report form ( $p > 0.05$ ).

## 4. Discussion

In this study, we compared the rate of psychiatric disorders and the severity of psychiatric symptoms of patients with adenotonsillar hypertrophy with a healthy control group. To determine whether the psychiatric morbidity decreased after the adenotonsillectomy, we re-evaluated both groups six months after the surgery.

**Table 4**

Comparison of the ECI-4 scores and the SDQ parent-report form scores of the adenotonsillar hypertrophy group six months after the adenotonsillectomy.

		Before adenotonsillectomy study group	After adenotonsillectomy study group	<i>t</i>	<i>p</i> <sup>*</sup>
		OP ± SS	OP ± SS		
ECI-4	ADHD	19.70 ± 8.64	17.18 ± 8.74	2.84	0.007 <sup>*</sup>
	Attention deficit	9.20 ± 3.83	7.17 ± 5.12	3.08	0.004 <sup>*</sup>
	Hyperactivity	6.10 ± 3.65	5.87 ± 3.75	0.49	0.626
	Impulsivity	4.40 ± 2.77	4.12 ± 2.54	0.99	0.327
	ODD	7.70 ± 5.51	6.60 ± 4.87	1.21	0.233
	Behavioural disorders	5.07 ± 6.06	4.27 ± 5.59	0.89	0.378
	Emotional disorders	5.02 ± 3.01	4.35 ± 2.44	1.45	0.155
	Anxiety disorders	25.02 ± 10.67	20.52 ± 11.87	3.38	0.002 <sup>*</sup>
	Eating disorders	1.80 ± 1.71	1.07 ± 1.23	3.76	0.001 <sup>*</sup>
	Tic disorders	0.58 ± 0.81	0.67 ± 0.79	-0.64	0.523
	Sleep disorders	3.22 ± 2.12	2.18 ± 1.85	3.79	0.001 <sup>*</sup>
	Enuresis and encopresis	1.17 ± 1.36	1.27 ± 1.66	-0.53	0.599
	Attachment disorders	1.55 ± 1.48	1.42 ± 1.20	0.45	0.653
	Pervasive developmental disorder	5.20 ± 3.93	5.15 ± 5.30	0.08	0.939
Total symptom severity	76.05 ± 33.10	64.70 ± 32.42	3.03	0.004 <sup>*</sup>	
SDQ PARENT FORM	Emotional problems	2.60 ± 1.85	1.87 ± 1.80	2.18	0.035
	Behavioural problems	2.23 ± 1.73	2.15 ± 2.05	0.24	0.813
	ADHD problems	4.77 ± 2.36	3.87 ± 2.21	2.76	0.009 <sup>*</sup>
	Peer problems	2.95 ± 1.66	2.30 ± 2.01	2.35	0.024 <sup>*</sup>
	Prosocial behaviour	7.00 ± 2.21	7.52 ± 3.74	-1.31	0.199
	Total problem points	12.55 ± 5.24	10.10 ± 4.62	3.14	0.003 <sup>*</sup>

ADHD, attention deficit hyperactivity disorder; ODD, oppositional defiant disorder.

<sup>\*</sup> *p*, dependent *t*-test *p* value.

Several studies have shown that the incidence of psychiatric disorders and symptoms severity were reported at a higher rate by caregivers in patients with adenotonsillar hypertrophy [14,15,31,32]. In our previous study and the current study also demonstrated that the incidence of psychiatric disorders and symptoms severity were higher in patients with adenotonsillar hypertrophy than in the healthy control group [17]. The existence of studies reporting high psychiatric morbidity in cases with SDB in the literature has impelled researchers to investigate whether the psychiatric morbidity would decrease after adenotonsillectomy. A number of studies reported that psychiatric symptoms, which were common before adenotonsillectomy in patients with SDB,

decreased after adenotonsillectomy [33–35]. In the current study, 80% of patients in the adenotonsillar hypertrophy group had at least one psychiatric disorder according to the ECI-4 before undergoing adenotonsillectomy. After the surgery, this rate decreased to 47.5%, which was almost the same as that of the control group. In addition, the overall psychiatric symptom severity determined with the ECI-4 and the overall problems determined with the SDQ parent-report form significantly decreased after the adenotonsillectomy.

The majority of studies of patients with SDB in the literature have investigated attention, hyperactivity, executive functions and school performance. Most of these studies reported a deterioration

**Table 5**

Comparison of the ECI-4 scores and the SDQ parent-report form scores of the adenotonsillar hypertrophy group and the control group six months after the adenotonsillectomy.

		After adenotonsillectomy study group	After six months control group	<i>t</i>	<i>p</i> <sup>*</sup>
		OP ± SS	OP ± SS		
ECI-4	ADHD	17.18 ± 8.74	15.37 ± 8.17	0.92	0.361
	Attention deficit	7.17 ± 5.12	6.91 ± 4.36	0.23	0.815
	Hyperactivity	5.87 ± 3.75	4.97 ± 3.77	1.04	0.302
	Impulsivity	4.12 ± 2.54	3.49 ± 2.17	1.16	0.249
	ODD	6.60 ± 4.87	5.66 ± 3.80	0.92	0.358
	Behavioural disorders	4.27 ± 5.59	4.24 ± 5.04	0.03	0.979
	Emotional disorders	4.35 ± 2.44	4.49 ± 2.72	-0.23	0.820
	Anxiety disorders	20.52 ± 11.87	19.26 ± 11.15	0.47	0.686
	Eating disorders	1.07 ± 1.23	1.54 ± 1.54	-1.46	0.148
	Tic disorders	0.67 ± 0.79	0.63 ± 1.31	0.19	0.851
	Sleep disorders	2.18 ± 1.85	2.03 ± 1.87	0.34	0.785
	Enuresis and encopresis	1.27 ± 1.66	1.20 ± 1.57	0.20	0.843
	Attachment disorders	1.42 ± 1.20	1.40 ± 1.26	0.09	0.930
	Pervasive developmental disorder	5.15 ± 5.30	4.08 ± 4.33	0.94	0.349
Total symptom severity	64.70 ± 32.42	59.90 ± 29.00	0.67	0.504	
SDQ PARENT FORM	Emotional problems	1.87 ± 1.80	2.09 ± 1.80	-0.51	0.615
	Behavioural problems	2.15 ± 2.05	1.54 ± 1.48	1.45	0.152
	ADHD problems	3.87 ± 2.21	3.54 ± 2.00	0.68	0.500
	Peer problems	2.30 ± 2.01	2.31 ± 1.59	-0.03	0.973
	Prosocial behaviour	7.52 ± 3.74	7.43 ± 1.80	0.14	0.890
	Total problem points	10.10 ± 4.62	9.49 ± 4.53	0.673	0.503

ADHD, attention deficit hyperactivity disorder; ODD, oppositional defiant disorder.

<sup>\*</sup> *p*, student's *t*-test *p* value.

in these areas in patients with SDB [7,21,36–38]. In two studies on preschool children with SDB, the rates of attention deficit and hyperactivity symptoms were higher compared to a control group [11,12]. Similarly, in our study, the adenotonsillar hypertrophy group showed a higher incidence of ADHD diagnoses and an increased severity of symptoms of attention deficits on the ECI-4. Problems regarding ADHD determined with the SDQ parent-report form were also greater in this group. A number of previous studies reported an improvement in attention, hyperactivity and executive functions in cases with SDB after adenotonsillectomy [39–41]. There are also studies reporting that these children are diagnosed with ADHD at a lower rate after the adenotonsillectomy [12,42]. Similarly, in our study, the diagnosis of ADHD and the symptom severity of attention deficit determined with the ECI-4 and the problems regarding ADHD determined with the SDQ decreased after the adenotonsillectomy, with the incidence of the disorders and the severity of the symptoms falling to those of the control group. In a study of 66 school-aged children with ADHD and mild obstructive sleep apnea (OSA) by Huang et al. [43] 27 cases received methylphenidate, 25 underwent adenotonsillectomy, and 14 were assigned to a wait-and-see protocol. They found that the total ADHD scores of the group that underwent adenotonsillectomy improved compared to both the methylphenidate group and the untreated cases. As a result of the comparison that was made in the same study in terms of the sub symptoms of ADHD, while no difference was determined between the groups in terms of hyperactivity symptoms, the sub symptoms of attention deficit showed a greater rate of recovery in the group that was applied with adenotonsillectomy, compared to the other two groups. Another study evaluated 35 children aged 5–12 years with adenotonsillar hypertrophy and ADHD and found that the symptoms of both attention deficit and hyperactivity improved after the adenotonsillectomy [44]. Based on our findings, it appears that adenotonsillar hypertrophy has a greater effect on functions relating to attention from subsymptom of ADHD because improvements after adenotonsillectomy are generally observed in this area. Adenotonsillectomy may be a more effective and cause-oriented treatment for these cases compared to tailored medical treatments. Adenotonsillectomy may be even more relevant for preschool children due to limitations regarding the use of psychopharmacotherapy in this age group.

Our study shows that the improvement was not same level in all of psychiatric symptoms in patient with adenotonsillar hypertrophy, after the adenotonsillectomy. The severity of symptoms of anxiety, sleep disorders and eating disorders determined with the ECI-4 and emotional problems and peer problems determined with the SDQ parent-report form decreased significantly after the adenotonsillectomy. However, the severity of the symptoms of ODD determined with the ECI-4 and behavioural problems determined with the SDQ parent-report form did not show the same level of improvement. Nevertheless, in terms of ODD and behavioural problems, the difference between the adenotonsillar hypertrophy and the control group was statistically insignificant six months after the adenotonsillectomy. Some studies have reported that behavioural problems have been resolved following adenotonsillectomy in patients with SDB [32,45]. A retrospective cohort study of children with obstructive sleep apnea syndrome (OSAS) who did or did not undergo adenotonsillectomy concluded that adenotonsillectomy improved sleep, breathing and quality of life but not behaviour [46]. Based on our results, we postulate that multiple behavioural problems in patients with adenotonsillar hypertrophy might be more permanent compared to other psychiatric symptoms or that a longer period is required to resolve these problems.

In our patients, the adenotonsillectomy indication was based on the anamnesis taken from the parents, the physical examination

and the evaluation that was performed with flexible fiberoptic nasopharyngoscopy. Although the American Academy of Paediatrics [47] has recommended that indications for adenotonsillectomy due to SDB should be based on the objective sleep test, less than 10% of adenotonsillectomies performed in North America are confirmed with polysomnography (PSG) [48]. Some studies have shown that behavioural problems and neurocognitive disorders are associated with OSA(–) adenotonsillar hypertrophy and therefore simple snoring is not benign [6,49,50]. Besides, in studies that were conducted with the patient groups with and without apnea that was applied with adenotonsillectomy, it was determined that neurobehavioural problems were also distinctively higher in the group without apnea in the preoperative period and these symptoms more recovered in the group of without apnea than the group of with apnea after the adenotonsillectomy [42]. A number of studies have found that neurobehavioural problems are not well correlated with severity of OSA and that recovery after adenotonsillectomy is not well correlated with the severity of OSA [51–54]. Giordani et al. assessed 78 patients with adenotonsillar hypertrophy and 27 healthy controls, dividing the patients in the adenotonsillar hypertrophy group into two separate groups labelled OSA(–) and OSA(+) [21]. At the start of the study, the cognitive performance of the patients with both OSA(–) and OSA(+) was lower and behavioural problems were more distinctive compared to the control group. These behavioural problems showed a significant decrease in both groups after the adenotonsillectomy [21]. The important point here is that patients with mild SDB who did not have objective findings also displayed neurocognitive and behavioural problems and availed of adenotonsillectomy. In the current study, the significant highness of preoperative psychiatric disorders and symptoms in patients who were decided with surgery indication as a result of the parent anamnesis and physical examination and similar levels of these symptoms and disorders with those of the control group in the postoperative month six, support the aforementioned data. Because previous studies reported that more than half of patients with an indication of adenotonsillectomy based on anamnesis and a physical examination had OSA(–) (31–54%) [55–57]. Our patient group consisted of preschool children aged three to five years. PSG is an expensive, time-consuming and difficult measurement for these children. Some studies have suggested that PSG may overlook mild SDBs accompanied by neurocognitive and behavioural disorders in patients in this age group who might avail of adenotonsillectomy [49,58]. There is confusion regarding which patients with normal PSG should be operated and on which objective measurements this necessity will be based. Our results and the available literature data show that more objective measurement techniques are needed to determine which patients with adenotonsillar hypertrophy may avail of adenotonsillectomy.

The current study showed that psychiatric disorders and symptoms in preschool children with adenotonsillar hypertrophy considerably improved following adenotonsillectomy. Children with adenotonsillar hypertrophy whose parents report mouth breathing and snoring during sleep should be evaluated carefully to ensure that necessary treatment is applied at an early stage.

A limitation of this study was that face-to-face psychiatric interviews were not carried out with the patients. Our study contributes to the literature by shedding light on the frequency of psychiatric morbidity in preschool children with adenotonsillar hypertrophy and the therapeutic effect of adenotonsillectomy on the psychiatric morbidity.

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