

## Vocal Fold Nodules and Psychopathology in Children

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### Abstract

**Objective:** To examine the association between vocal fold nodules and DSM-IV defined psychiatric disorders, including depression, anxiety disorders, conduct disorder, oppositional defiant disorder, attention-deficit hyperactivity disorder, and mental disorders, in children referred to Audiology Department of İstanbul University.

**Methods:** Experiment group consists of 24 children (22 males and 2 females) aged from 5 to 12 years referred to audiology center in İstanbul University due to dysphonia. The control group was also composed of 24 children (22 Males and 2 females) randomly selected from a primary school class, age and sex matched to experiment group. The inclusion criteria of these children were the same as for children in experiment group without any report of dysphonia or vocal fold nodules. All children underwent perceptual evaluation of their voice, followed by an acoustic analysis. The subjects from both group were evaluated using K-SADS-PL-T for psychopathology and using Wisc-R for mental development status. The results of experiment group compared to control group.

**Results:** The children with vocal fold nodules showed mostly anxiety disorders (mainly specific phobia) 62,5% (15/24), ADHD 50% (12/24) and elimination disorders (mainly enuresis) 16,6% (3/24).

**Conclusions:** Vocal fold nodules are the most common laryngeal pathology observed in primary schools. In our study we aimed to find out the psychopathologies of children with voice disorders especially with vocal fold nodules. Children with ADHD were perceived to have significantly more hoarseness, breathiness, and straining in their voice. Children with ADHD may abuse their voice and as a result we have a high percentage vocal fold nodules. Also the children suffering from anxiety disorders may abuse their voice by means of crying, shouting and temper tantrums. As a result we can conclude that early detection of vocal disorders and the underlying psychopathology is very important in therapy planning and the prevention of recurrence of vocal fold nodules in children.

**Keywords:** ADHD; Psychopathology; Vocal Fold; Nodule; Voice Disorder

### Introduction

The prevalence of pediatric voice disorders has been estimated as 6 - 9% in children [1]. Vocal fold nodules represent the most common laryngeal cause of voice disorders in children; between 38% and 78% of children evaluated for chronic hoarseness are estimated to have vocal fold nodules [2].

Kiliç, *et al.* found overall prevalence of focal fold nodules in school children as high as 30,2% [3]. It is seen in boys 3 times more than girls.

Vocal fold nodules are small subepithelial tissue benign swellings, pale to pink in color. Vocal fold nodules are associated with chronic phonotrauma. Vocal abuse can be described as yelling, talking in excess, excessive crying, cheering, imitating animal noises, and making

sound effects [2]. These vocal habits characterize hyperkinetic or musculoskeletal dysphonia and are the genesis of vocal nodule development [4]. The appropriate diagnosis and evaluating the underlying psychopathological conditions are very essential for progress in education and psychosocial development of the children. Vocal dysphonia in children may have impact on physical, functional and emotional health.

Psychiatric co-morbidity has recently been identified as an important risk factor for the development of vocal fold nodules in children. In literature it is estimated 14 features of personality of the children treated for vocal nodules [5]. Attention deficit hyperactivity disorder and conduct disorders are the most investigated psychiatric comorbidities in children with vocal fold nodules and social phobia and general anxiety in adults with vocal nodules [2,3,6]. Eggers and co-workers found that childhood dysphonia is related to externalizing disorders (conduct disorders, ADHD, oppositional deviant disorder) [7].

Some studies failed to find direct associations between co-occurring disorders and vocal fold nodules especially they reject the hypothesis that a behavioral disorder may underlie in the development of vocal fold nodules in children [2].

Despite childhood dysphonia has a diverse and multicausal etiology and accepted being related to organic, behavioral or emotional factors, it is still needs to be researched in children [2,8].

The K-SADS-PL is a semi-structured diagnostic interview designed to assess current and past episodes of psychopathology in children and adolescents according to DSM-III-R and DSM-IV criteria. Probes and objective criteria are provided to rate individual symptoms. The primary diagnoses assessed with the K-SADS-PL include: Major Depression, Dysthymia, Mania, Hypomania, Cyclothymia, Bipolar Disorders, Schizoaffective Disorders, Schizophrenia, Schizophreniform Disorder, Brief Reactive Psychosis, Panic Disorder, Agoraphobia, Separation Anxiety Disorder, Avoidant Disorder of Childhood and Adolescence, Simple Phobia, Social Phobia, Overanxious Disorder, Generalized Anxiety, Obsessive Compulsive Disorder, Attention Deficit Hyperactivity Disorder, Conduct Disorder, Oppositional Defiant Disorder, Enuresis, Encopresis, Anorexia Nervosa, Bulimia, Transient Tic Disorder, Tourette's Disorder, Chronic Motor or Vocal Tic Disorder, Alcohol Abuse, Substance Abuse, Post-Traumatic Stress Disorder, and Adjustment Disorders [9]. All K-SADS-PL-T interviews were completed by experienced child psychiatrists involved in the study. The standardized Turkish form of the interview is applied [10].

The aim of this study was to investigate the extent and the clinical relevance of psychiatric comorbidity in children with vocal fold nodules using standardized diagnostic tools, including parental rating to describe emotional and behavioral problems. The following questions are addressed:

- i. Do children with vocal fold nodules have more emotional and behavioral problems than healthy controls?
- ii. Are these emotional and behavioral problems clinically relevant?

### Materials and Methods

The research described in the following was reviewed and approved by the local ethic commission in Cerrahpasa School of Medicine at the İstanbul University with a protocol number and was conducted according to the principles expressed in the Declaration of Helsinki. All subjects were instructed about the study and signed informed consent was obtained from children and parents.

### Participants

During a period of 6 months, 24 children (22 males, 2 females; mean age of  $9,89 \pm 1,84$  years) affected by dysphonia were referred to our speech and language disorders unit. 24 children of 25 children diagnosed with vocal fold nodules were included in the study, and were designated as experiment group.

The inclusion criteria for the recruitment of children into experiment group was as follows: age 5 to 12 years: bilateral vocal fold nodules, history of dysphonia, no previous voice therapy; normal hearing; no history of recurrent inflammation of the upper airway, allergies, and gastroesophageal reflux; and the absence of bronchopulmonary diseases.

The control group, was composed of 24 children (22 Males and 2 females) randomly selected from a primary school, age and sex matched to experiment group. The inclusion criteria of these children were the same as for children in experiment group without of course any report of dysphonia or vocal fold nodules.

	Control Group	Experimental Group
N	24	24
Gender	22 Male	22 Male
	2 Female	2 Female
Age	9,9± 2,0	9,89 ± 1,84

**Table 1:** Descriptive characteristics of subjects.

### Diagnostic assessment of vocal fold nodules

The subjects participating in this study were selected according to a procedure. For this purpose, for all cases, standard Ear, Nose and Throat (ENT) examination, audiometric and impedansmetric test batteries were carried out. Subjects with any hearing problem were discarded.

The children were subjected to videolaryngoscopy conducted by an otolaryngologist, who used the Digital Video Stroboscopy System (Model 9295, KAY PENTAX, Montvale, NJ, USA).

For computerized acoustic vocal assessments, KAYPENTAX CSL 4500 (Computerized Speech Lab, KAY PENTAX, Montvale, NJ, USA) was used. The definitive measurements were preceded by the training of children for understanding the test, and vocal samples were obtained during the sustained emission of vowel/a/. The analyzed vocal parameters were: Average Fundamental Frequency (Fo), Highest Fundamental Frequency (Fhi), Lowest Fundamental Frequency (Flo), Absolute Jitter (Jita), Jitter Percent (Jitt), Relative Average Perturbation (RAP), Pitch Perturbation Quotient (PPQ), Smoothed Pitch Perturbation Quotient (sPPQ), Fundamental Frequency Variation (vFo), Shimmer Percent (Shim), Amplitude Perturbation Quotient (APQ), Smoothed Ampl. Perturbation Quotient(sAPQ), Peak-to-Peak Amplitude Variation (vAm), Noise to Harmonic Ratio (NHR), Voice Turbulence Index(VTI), Soft Phonation Index (SPI), Total Number Detected Pitch Periods (PER).

### Psychological assessment

Psychiatric evaluation of the children done by using the Kiddie Schedule for Affective Disorders and Schizophrenia for school-aged Children- present and Lifetime Version – Turkish Version (K-SADS-PL-T).

The K-SADS-PL is a standardized, DSM-IV based, clinician administered diagnostic interview, designed to provide an overview of current and lifetime psychopathology. The K-SADS-PL-T has demonstrated good reliability and validity [9]. Based on DSM-III-R and DSM-IV criteria, the K-SADS-PL has an initial 82 item screen interview that surveys key symptoms for current and past episodes of twenty different diagnostic areas, some of which screen for multiple disorders [9,10].

**Cognitive testing:** In accordance with best practice in testing intelligence of children, the performance and verbal scales from the Wechsler series were used in this study. The Wechsler Intelligence Scale for Children (WISC) 1974 revision (Turkish Version) uses standardized verbal and non-verbal tasks to assess overall intellectual capacity calculated as the intelligence quotient (IQ), which was the ratio assessed mental age to chronological age times 100. It measures the ways a child responds to a series of different stimuli which represent different skills used in everyday life. The full IQ determined by the WISC-R can be subcategorized into verbal and performance components [11]. The subjects with low IQ score were discarded.

**Statistical Analysis**

Crosstab Pearson Chi- Square test is used to evaluate differences of K-SADS-PL –T test parameters between groups. All analysis was conducted using SPSS (SPSS, Chicago, IL, USA) and a P value < 0,05 was considered significant.

**Results**

As shown in table 2, using the K-SADS-PL-T, 75% (18/24) of the participants had a definite DSM-IV axis \_1 diagnosis, with 29% (7/24) having one present disorder, 25% (6/24), having two disorders, and 2% (2/24) three or more disorders.

	Experiment Group				Control Group			
	Past		Present		Past		Present	
	N	%	N	%	N	%	N	%
Any disorder	19	79,17	18	75	2	8,33	3	12,5
No diagnosis	5	20,83	6	25	22	91,7	21	87,5
Having one disorder	6	25	7	29,17	2	8,33	2	8,33
Having two disorder	6	25	6	25	0	0	1	4,17
Having three disorder	4	16,67	2	8,33	0	0	0	0
Having four disorder	2	8,33	2	8,33	0	0	0	0
Having more than four disorder	1	4,17	1	4,17	0	0	0	0

**Table 2:** The prevalence of diagnoses.

The most prevalent present disorders were anxiety disorders (mainly specific phobia) 62,5% (15/24), ADHD 50% (12/24), and elimination disorder (mainly enuresis 16,6% (3/24). The percentage of diagnoses shown in table 3.

	Experiment Group				Control Group				Pearson Chi-Square Test for Present D.		
	Past		Present		Past		Present		Value	df	Sigma
	N	%	N	%	N	%	N	%			
<b>1- Any disorder</b>	19	79,17	18	75	2	8,33	3	12,5	19,048	1	0,000
<b>2- Any Mood Disorder:</b>	1	4,17	2	8,33	0	0	0	0	2,087	1	0,149
Depressive disorder	1	4,17	2	8,33	0	0	0	0			
Manic disorder	0	0	0	0	0	0	0	0			
<b>3- Any Anxiety disorder</b>	16	66,67	15	62,5	0	0	1	4,17	12,857	2	0,02
Separation anxiety disorder	5	20,83	3	12,5	0	0	1	4,17			
Generalized anxiety disorder	0	0	0	0	0	0	0	0			
Specific phobia / agoraphobia	10	41,67	11	45,83	0	0	0	0			
Social phobia	1	4,17	1	4,17	0	0	0	0			
Posttraumatic stress disorder	0	0	0	0	0	0	0	0			
Panic disorder	0	0	0	0	0	0	0	0			
<b>3- Any elimination disorder</b>	8	33,33	4	16,67	1	4,17	1	4,17	1,424	2	0,491
Enuresis	7	29,17	3	12,5	1	4,17	1	4,17			
Encopresis	1	4,17	1	4,17	0	0	0	0			
<b>4- Any eating disorder</b>	0	0	0	0	0	0	0	0	-	-	-
Anorexia nervosa	0	0	0	0	0	0	0	0			
Bulimia Nervosa	0	0	0	0	0	0	0	0			
<b>5- Any behavioral disorder (ADHD, Conduct disorder, oppositional disorder)</b>	12	50	12	50	0	0	1	4,17	11,141	2	0,004
ADHD	11	45,83	11	45,83	0	0	1	4,17			
Oppositional defiant disorder	1	4,17	1	4,17	0	0	0	0			
Conduct disorder	0	0	0	0	0	0	0	0			
<b>6- Attention Deficit Hyperactivity Disorder (ADHD)</b>	12	50	12	50	0	0	1	4,17	11,141	2	0,004
ADHD	11	45,83	11	45,83	0	0	1	4,17			
Oppositional defiant disorder	1	4,17	1	4,17	0	0	0	0			
Conduct disorder	0	0	0	0	0	0	0	0			
Psychosis	0	0	0	0	0	0	0	0			
<b>7- Any tic disorder</b>	3	12,5	2	8,33	1	4,17	1	4,17	0,356	1	0,551
<b>8- Any obsessive compulsive disorder</b>	3	12,5	3	12,5	0	0	0	0	3,2	1	0,074

**Table 3:** K-SADS-PL Past and Present Definite DSM-IV diagnoses (n = 24).

The differences of K-SADS-PL–T test results between groups were evaluated by using Crosstab Pearson Chi- Square test. Statistical results for present diagnosis can be seen in table 3. As shown from the table; Chi-Square test results were significant for the anxiety disorders and ADHD (p < 0,05).

### Discussion

The aim of this study was to determine the underlying psychopathology of children with vocal fold nodules and to determine the differences between children with vocal nodules and a vocally normal, sex and age matched control group. Recruitment of dysphonic children in the study was performed based on vocal symptoms and after excluding other organic causes of dysphonia (e.g. inflammation of upper airway, allergies, gastroesophageal reflux, bronchopulmonary diseases, and/or hearing impairment).

The key finding of the present study which included 24 children with vocal fold nodules aged 5 - 12 years and the healthy control group is that, the children with vocal fold nodules suffer from more behavioral and emotional problems than healthy controls.

As the underlying psychopathology by children with vocal fold nodules was investigated; it was found that children with vocal fold nodules were mostly affected by ADHD (Pearson Chi-Square value = 11,141 and sigma = 0,004) and anxiety disorders (Pearson Chi-Square value = 12,857 and sigma = 0,02).

Our findings are supported by studies in literature. Eddger, *et al.* compared the temperamental characteristics of children with stuttering, children with developmental disorders and children with vocal fold nodules and found that children with vocal fold nodules showed strong irritation/frustration, sadness; sensitivity /response threshold; fear; discomfort all corresponding to the negative affectivity dimension in behavioral conduct [7]. Roy, *et al.* studied the behavioral characteristics of 26 children with vocal fold nodules and found that the social behavioral characteristics of the children are consistent with vocal use. In the analysis by item, the behaviors crying a lot and nagging a lot also had a significant association with the presence of vocal nodules [5,14].

Excessive crying, anxiety, worry, or nervousness by enduring threatening situations are also strongly related to vocal fold nodule formation. Due to this relationship; we found 62,5% of the experiment group were affected by any anxiety disorder mainly separation disorder and specific phobia.

In another study from Angelillo, *et al.* 83% prevalence of hyperactivity and aggression attitudes was observed in dysphonic children in school and family environments, through clinical neuropsychiatric evaluation [13]. Hamdan, *et al.* concluded that ADHD is a risk factor for childhood dysphonia [15]. Controversially Vicari, *et al.* found no relationship between vocal disorders and ADHD. However, the presence of psychiatric disorder correlates to a greater degree of vocal disorder which supports our findings [6].

In regard of our results, considering the patho-physiology of vocal fold nodules in children, we can correlate the two diagnosis; ADHD and anxiety disorders with the underlying psychopathology. In light of above results, the following recommendations may be considered. Early identification of pediatric voice disorders is advisable because these disorders may progress and may cause lifelong communicative impairments. Early diagnosis and proper intervention by altering the hyper-functional vocal behavior may prevent the occurrence. Voice therapy is the treatment of choice for vocal fold nodules [1,12]. However the vocal fold nodules in children are mostly resistant to therapy and tend to reoccur [12].

We know that multiple domains of quality of life may be impaired in children with vocal fold nodules including their communication skills and vocal performance. The findings of our study emphasize that the childhood vocal fold nodules can be a good sign for the underlying psychopathology, and by early intervention it will be appropriate to use multidisciplinary approach including voice therapy and behavioral changes.

### Conclusions

Children with vocal fold nodules and emotional/behavioral problems of clinical relevance need special psychiatric therapy which focuses on individual psychopathology in addition to voice therapy and other necessary medical interventions.

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