

Upper airway obstruction and nocturnal enuresis in children: Why is it important?

Arif Kol¹®, Hüseyin Günizi²®, Şakir Genç³®

¹Department of Urology, Faculty of Medicine, Aydın Adnan Menderes University, Aydın, Türkiye

²Department of Otorhinolaryngology, Faculty of Medicine, Alaaddin Keykubat University, Antalya, Türkiye

³Department of Pediatrics, Faculty of Medicine, Alaaddin Keykubat University, Antalya, Türkiye

Cite this article as: Kol A, Günizi H, Genç Ş. Upper airway obstruction and nocturnal enuresis in children: Why is it important?. Trends in Pediatrics 2024;5(2):33-37.

ABSTRACT

Objectives: Nocturnal enuresis (NE) is a common urological complaint among children. The most common cause of obstructive airway disease in children is enlarged tonsils and adenoids. Although the relationship between the presence of NE and sleep disorders is unclear, some studies show that enuresis improves after airway obstruction is resolved. We aimed to investigate the relationship between upper airway obstruction and NE in children.

Methods: Between September 2020 and June 2021, 66 pediatric patients diagnosed with persistent NE were included in the study. A total of 57 healthy patients were included in the control group. The presence of snoring and apnea, the presence of Attention-Deficit/Hyperactivity Disorder (ADHD)/social adjustment disorder, academic achievement, and family members' history of NE were asked through questionnaires filled out by the families. An upper airway examination was done with a flexible nasopharyngoscope.

Results: The mean ages of the study patients and healthy controls were 8.32 ± 2.1 and 8.18 ± 2.3 years. The female/male ratio was (25/41) and (33/24), respectively. Of the case group, 62.1% were male, and 78.8% were under nine years old. The frequency of snoring/apnea in children with enuresis was 27.3%, while it was 19.3% in the control group ($p=0.299$). It was found that more enuresis developed in children with high BMI ($p=0.044$). Family history was higher in the NE group than in the control group, but it was not statistically significant ($p=0.173$).

Conclusion: Nocturnal enuresis is commonly associated with obstructive sleep apnea. Upper airway obstruction, obesity, and male gender are important risk factors for NE.

Keywords: Adenoid Vegetation, Children, Nocturnal Enuresis, Tonsillar Hypertrophy, Upper Airway Obstruction.

INTRODUCTION

Nocturnal enuresis (NE) is a common urological complaint among children.¹ According to the definition of The International Children's Continence Society, enuresis (synonymous with intermittent nocturnal incontinence) refers to discrete episodes of urinary incontinence during sleep in children ≥ 5 years of age.² Its prevalence is about 5-10%.^{1,3} Several aetiologies have been researched for nocturnal enuresis, but its pathogenesis

is still unclear.⁴ Reduced functional bladder capacity, detrusor overactivity, nocturnal polyuria, release, and immaturity of the sleep mechanism have been implicated.⁵ Enuresis is seen in patients without bladder dysfunction, and lower urinary tract complaints are defined as monosymptomatic nocturnal enuresis. This disease is described in children older than five years.^{1,3}

Sleep problems in childhood with enuresis have been studied for a long time. The relationship between the presence of enuresis



Correspondence: Hüseyin Günizi E-mail: drgunizi@gmail.com

Received: 21.02.2024 Accepted: 01.04.2024

© 2024 The authors. Published by Aydın Pediatric Society. This is an open access article distributed under the [Creative Commons Attribution License \(CC BY\)](https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

and sleep disorders is not clear. There are some hypotheses about the association of nocturnal enuresis with obstructive airway disease because it may resolve after corrective operation for the disease. The most common cause of obstructive airway disease (OAD) in children is enlarged tonsils and adenoids that block the airway and obstruct breathing during sleep.⁶

Studies are showing that self-esteem is impaired in children with nocturnal enuresis. Low self-esteem is a risk factor for psychiatric disorders and social adjustment problems. Therefore, when treated appropriately, later psychological disorders can be prevented. In addition, studies emphasize that it is important to start treatment early in these children.⁷ Also, studies show that children affected by enuresis tend to have a worse sleep quality when compared to unaffected children.⁸ These data show that enuresis is associated with an increased risk for learning disabilities, intellectual disability, and worse school performance.⁹

We aimed to investigate the relationship between upper airway obstruction and enuresis and its possible risk factors in children.

METHODS

A total of 66 patients (41 males, 25 females) with the diagnosis of persistent enuresis who attended the outpatient clinics of the pediatric department of Alanya Alaaddin Keykubat University Medical Faculty Hospital between September 2020 and June 2021 were included in the study. Ethical approval was obtained from the Alanya Alaaddin Keykubat University prior to the study. Written informed consent was obtained from all children's parents. Cases with complaints such as daytime urinary incontinence, sudden urgency to go to the toilet/incontinence before reaching the toilet, intermittent urination, straining while urinating, persistent constipation, secondary enuresis, mental retardation, and chronic disease were not included in the study. The control group included 57 healthy patients (24 males, 33 females) with no enuresis symptoms. The presence of snoring and apnea, the presence of ADHD (Attention-Deficit/Hyperactivity Disorder)/social adjustment disorder, academic achievement, and family members' own history of enuresis were asked through questionnaires filled out by the families. The survey questions were developed by reviewing the relevant literature on the subject. The questions were reorganized in accordance with the purpose of the study.^{10,11} Then, an upper airway examination was performed with a flexible nasopharyngoscope in each group. Tonsil hypertrophy and adenoid vegetation were classified from 0 to 4 according to the tonsil to oropharynx and adenoid to nasopharynx ratio 1; 25%, 2; 25–50%, 3; 50–75%, or 4; 75–100%.¹² The Body Mass Index (BMI) percentage was calculated by measuring the height/weight of the children in the outpatient

clinic, and they were divided into three groups, namely normal weight (5th-84th percentile), overweight (85th-94th percentile), and obesity (≥ 95 th percentile), according to their BMI.¹³

All analyses were performed using the IBM SPSS Statistics Version 22.0 statistical software package (IBM Corp. Released 2011. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corporation). Categorical variables were expressed as numbers and percentages, whereas continuous variables were summarized as mean and standard deviation. The differences between the categorical variables were compared with the chi-square test, and the differences between the groups were compared with the Mann-Whitney U test. It was accepted as the statistical significance level ($p < 0.05$).

RESULTS

Sixty-six patients diagnosed with enuresis in the pediatric age group and 57 healthy control groups were examined prospectively. The mean ages of the study patients and healthy controls were 8.32 ± 2.1 and 8.18 ± 2.3 years. The demographic characteristics of the groups are presented in Table 1. Of the enuresis group, 62.1% were male, and 78.8% were under nine years old. While the frequency of snoring/apnea in children with enuresis was 27.3%, it was 19.3% in the control group, and the difference was not statistically significant ($p=0.299$). Family history was higher in the enuresis group than in the control group but was not statistically significant ($p=0.173$).

When the patients were classified according to their BMI values, the percentages of normal weight, overweight and obese patients in the control group were 87.7% (50), 8.8% (5) and 3.5% (2), respectively, while in the enuresis group they were 69.7% (46), 16.7% (11) and 13.6% (9), respectively. Our BMI results of sick children supported that more enuresis was observed in overweight and obese children, and it was statistically significant ($p=0.044$). Although family history was present in 18.2% of children with enuresis, it was not statistically significant. ($p=0.231$). When we evaluated the presence of ADHD and social adjustment disorder, we found no difference between enuresis (10.6%) and the control group (10.5%) ($p=0.989$). While low academic achievement was 22.7% in enuretic children, it was 12.3% in the control group. However, this difference was not statistically significant—($p=0.132$) (Table 1).

DISCUSSION

Nocturnal enuresis is one of the common problems encountered in childhood. At the same time, it causes psychosocial problems and a decrease in academic achievement, and with this aspect, it becomes a source of serious emotional distress and anxiety for

Table 1. Demographic characters of control and case group and comparison of results between groups

	Case Group (n=66)	Control Group (n=57)	p
Age (year) (Mean±SD)	8.32±1.57	8.18±1.56	0.547
Gender female/male(%)	25(37,9%) / 41(62,1%)	33(57,9%) / 24(42,1%)	0.027
Familial history of nocturnal enuresis (%)	18.2	10.5	0.231
Academic Achievement (%)	87.7	77.3	0.132
ADHD (%)	10.5	10.6	0.989
Snoring/Apnea (%)	19.3	27.3	0.299
Tonsillar Hypertrophy (%)	35.6	54.5	0.479
Adenoid Vegetation(%)	22.8	37.0	0.019
Septum Deviation (%)	24.6	18.2	0.388
Allergic Rhinitis (%)	12.3	16.7	0.493

ADHD: Attention-Deficit/Hyperactivity Disorder.

families.¹⁰ It is known that patients with enuresis in childhood are at risk for polyuria in adulthood.¹⁴ Similarly, childhood enuresis plays a predictive role in anxiety and depression in adults at older ages.¹⁵ In this respect, treatment of nocturnal enuresis and the underlying risk factors are important.

The incidence of NE in the population is not known exactly. While its prevalence was found to be 12.6% in studies in Turkey, it was reported that it was most commonly observed in the 5-12 age group.¹⁶ The prevalence of enuresis tends to decrease with age. Literature data indicate that enuresis nocturna is detected more frequently in boys.¹⁷ In our study, the mean age of children with nocturnal enuresis was 8.3 years. Of these, 62.1% were male, and most (78.8%) were under nine years old. Our findings support that nocturnal enuresis is observed more frequently at early age periods and in boys. In this regard, it was found to be compatible with general literature information.¹⁸

It is known that having a family history of enuresis increases the risk.¹⁹ If one of the parents has a history of enuresis, the risk of developing enuresis in the child is 43%, while the risk of developing enuresis in the child is 77% if both parents have a history of enuresis.²⁰ Several loci on chromosomes 12,13 and 22 have been identified in some studies.¹⁹ This positive correlation suggested that genetic factors may play a role in enuresis.²¹ In our study, although we found a family history in 18.2% of the children with enuresis, we did not find a link to the probability of developing enuresis in children ($p=0.231$). However, we think that parents may not be able to answer this question correctly due to social concerns, which may have affected the results.

Although a relationship has been shown between nocturnal enuresis and obesity, this issue is still unclear.²² Overweight and obese children are generally thought to be fed an unhealthy diet, and because of this diet, the functional development of the bladder is prevented.²³ In a study, it was reported that while enuresis was observed in 9% of normal children, this rate reached 30% in obese children.²⁴ In their study, Ma et al. reported that there is a link between obesity and enuresis and that there is a low response to treatment in overweight and obese children.²⁵ Our results supported that more enuresis was observed in overweight and obese children ($p=0.044$).

NE is a disease that affects patients' social lives and academic achievement. A study found that the academic achievement of children with enuresis was significantly lower than that of healthy children.²⁶ In psychological analysis tests performed in children with enuresis, it was thought that incomplete intellectual maturation and an underlying ADHD might cause low academic achievement.²⁷ In a study, it has been reported that children with enuresis have more anxiety and feel depressed.²⁸ In a large study of 331 children, the presence of enuresis was statistically significantly increased in those with ADHD compared to normal children.¹⁷ These data suggest that enuresis has an impact on academic achievement. On the other hand, some literature data also states no significant difference in academic achievement in children with primary enuresis compared to healthy children.¹⁹ When we evaluated the presence of ADHD in our study, we did not detect any difference between enuresis and the control group ($p=0.989$). However, in terms of academic achievement, we showed that children with enuresis had a lower success rate (22.7%) than the control group (12.3%) ($p=0.132$). These findings were also similar to the literature.⁹

It is known that nocturnal enuresis may accompany diseases such as constipation, obstructive sleep apnea (OSA), urinary tract infection, and bladder dysfunction.²² The coexistence of sleep disorder and enuresis has been revealed in previous studies.²⁹ Both bladder filling and detrusor contractions are strong stimuli for awakening. However, the fact that impending voiding does not trigger awakening in children with enuresis suggests that this is a sleep-related problem. It is thought to be related to the incomplete development of the brain in children and the immaturity of the sleep center in the hypothalamus.³⁰ In addition, it was thought that increased urinary output due to increased brain natriuretic peptide (BNP) secretion in children with OSAS may be among the other causes of enuresis development.³¹ Snoring and enuresis are thought to be two entities that are seriously related to each other.²⁹ Although our data showed that the frequency of snoring/apnea increased in children with enuresis (27.3%), these findings were not statistically significant ($p=0.299$).

Adenotonsillar hypertrophy (ATH) is the most common cause of OSA in the pediatric age group and also the most common cause of upper airway obstruction associated with enuresis. Upper airway obstruction is usually not the primary cause of enuresis, but it leads to enuresis in children.⁸ The hypothesis about the link between the two conditions is that persistent arousal stimuli from the airways lead to paradoxically raised arousal thresholds in order to preserve sleep. As a result, it is thought that the child, whose bladder is full, cannot interrupt his sleep and develops enuresis. In a study, a significant relationship was found between septal deviation, adenoid hypertrophy, and enuresis, but they did not find a significant relationship between the presence of allergic rhinitis and tonsillar hypertrophy.³² Therefore, correcting sleep disorders and indirectly correcting NE is the expected response in children with ATH. Another study showed that enuresis improved in 40% of children with enuresis with ATH and septal deviation after necessary surgery.⁶ These data suggest that pathologies causing upper respiratory tract obstruction may be involved in the etiology of enuresis.

The relationship between the presence of allergy and enuresis has not been fully elucidated. Abdolohi-Fakhim et al. stated that they did not find a relationship between enuresis and allergy.³³ However, data show that allergic rhinitis causes sleep disturbance, affects sleep quality, and poses a risk in terms of nocturnal enuresis and obstructive sleep apnea.³⁴ In our study, 16.7% of children with enuresis had accompanying allergic rhinitis. However, there was no statistical significance compared to the control group ($p=0.493$).

Again, adenoid hypertrophy was significantly higher in children with enuresis (47%) ($p=0.019$). Especially in children with enuresis, severe adenoid vegetation was detected at a higher rate. However, this situation was not statistically significant ($p=0.269$). When evaluated in terms of tonsillar hypertrophy, there was no statistically significant difference between tonsillar hypertrophy and enuresis, although enuresis was observed more in children with severe tonsillar growth (22.7%). These results seem similar to the literature.^{6,32}

There are two main limitations to our work. First, we used a questionnaire instead of the polysomnography test to detect sleep disorders. The other limitation is that children with ATH were not questioned whether there was a correction operation or not. Therefore, questioning only for symptoms and lack of follow-up of patients partially weakened the power of our study.

CONCLUSION

Nocturnal enuresis is commonly associated with obstructive sleep apnea. Upper airway obstruction, obesity, and male gender are important risk factors for NE. The low academic achievement of children with NE is a striking phenomenon. In addition, we think that the evaluation of children presenting with enuresis in terms of upper respiratory tract obstruction is important as a step of treatment.

Ethical approval

This study has been approved by the Alanya Alaaddin Keykubat University Faculty of Medicine Clinical Research Ethics Committee (approval date 14.08.2020, number 2020/22-21). Written informed consent was obtained from the participants.

Author contribution

Surgical and Medical Practices: HG, ŞG; Concept: AK, HG; Design: AK, HG, ŞG; Data Collection or Processing: HG, ŞG; Analysis or Interpretation: AK, HG; Literature Search: AK, HG; Writing: AK, HG, ŞG. All authors reviewed the results and approved the final version of the article.

Source of funding

The authors declare the study received no funding.

Conflict of interest

The authors declare that there is no conflict of interest.

REFERENCES

1. Läckgren G, Hjälmsås K, van Gool J, et al. Nocturnal enuresis: a suggestion for a European treatment strategy. *Acta Paediatr.* 1999;88:679-90. [\[Crossref\]](#)
2. Nevés T, von Gontard A, Hoebeke P, et al. The standardization of terminology of lower urinary tract function in children and adolescents: report from the Standardisation Committee of the International Children's Continence Society. *J Urol.* 2006;176:314-24. [\[Crossref\]](#)
3. Akyol I, Ates F, Soydan H, Senkul T, Karademir K, Baykal K. An overlooked issue in children presenting with enuresis: constipation. *J Pediatr Urol.* 2010;6(Suppl 1):S66. [\[Crossref\]](#)
4. Robson WL. Clinical practice. Evaluation and management of enuresis. *N Engl J Med.* 2009;360:1429-36. [\[Crossref\]](#)
5. Ryu DS, Lee HW, Kwak KW, Park KH, Baek M. Role of Urodynamic Study in Nocturnal Enuresis: Urodynamic Findings and Treatment Outcome Correlation in Children with Pharmacotherapy-resistant Monosymptomatic Nocturnal Enuresis or Severe Non-monosymptomatic Nocturnal Enuresis. *Low Urin Tract Symptoms.* 2014;6:88-93. [\[Crossref\]](#)
6. Aydil U, Işeri E, Kizil Y, Bodur S, Ceylan A, Uslu S. Obstructive upper airway problems and primary enuresis nocturna relationship in pediatric patients: reciprocal study. *J Otolaryngol Head Neck Surg.* 2008;37:235-9.
7. Häggglöf B, Andrén O, Bergström E, Marklund L, Wendelius M. Self-esteem in children with nocturnal enuresis and urinary incontinence: improvement of self-esteem after treatment. *Eur Urol.* 1998;33(Suppl 3):16-9. [\[Crossref\]](#)
8. Esposito M, Gallai B, Parisi L, et al. Primary nocturnal enuresis as a risk factor for sleep disorders: an observational questionnaire-based multicenter study. *Neuropsychiatr Dis Treat.* 2013;9:437-43. [\[Crossref\]](#)
9. de Sena Oliveira AC, Athanasio BDS, Mrad FCC, et al. Attention deficit and hyperactivity disorder and nocturnal enuresis co-occurrence in the pediatric population: a systematic review and meta-analysis. *Pediatr Nephrol.* 2021;36:3547-59. [\[Crossref\]](#)
10. Hashem M, Morteza A, Mohammad K, Ahmad-Ali N. Prevalence of nocturnal enuresis in school aged children: the role of personal and parents related socio-economic and educational factors. *Iran J Pediatr.* 2013;23:59-64.
11. Gaonkar N, Takalhar S. Reliability of Nocturnal Enuresis Questionnaire in 6-15 Years Typically Developing School Children. *International Journal of Health Sciences and Research.* 2016;6:172-7.
12. Lu X, Zhang J, Xiao S. Correlation between Brodsky Tonsil Scale and Tonsil Volume in Adult Patients. *Biomed Res Int.* 2018;2018:6434872. [\[Crossref\]](#)
13. Preece M, Cole T, Fry T. Body mass index standards for children. 1990 data will remain available. *BMJ.* 1999;319:122. [\[Crossref\]](#)
14. Fitzgerald MP, Thom DH, Wassel-Fyr C, et al. Childhood urinary symptoms predict adult overactive bladder symptoms. *J Urol.* 2006;175:989-93. [\[Crossref\]](#)
15. Kuh D, Cardozo L, Hardy R. Urinary incontinence in middle aged women: childhood enuresis and other lifetime risk factors in a British prospective cohort. *J Epidemiol Community Health.* 1999;53:453-8. [\[Crossref\]](#)
16. Bozlu M, Cayan S, Doruk E, Canpolat B, Akbay E. The epidemiology of nocturnal and diurnal enuresis in childhood and adolescence. *Turk J Urol.* 2002;28:70-5.
17. Khazaie H, Eghbali F, Amirian H, Moradi MR, Ghadami MR. Risk Factors of Nocturnal Enuresis in Children with Attention Deficit Hyperactivity Disorder. *Shanghai Arch Psychiatry.* 2018;30:20-26. [\[Crossref\]](#)
18. Chan IHY, Wong KKY. Common urological problems in children: primary nocturnal enuresis. *Hong Kong Med J.* 2019;25:305-11. [\[Crossref\]](#)
19. Choudhary B, Patil R, Bhatt GC, et al. Association of Sleep Disordered Breathing with Mono-Symptomatic Nocturnal Enuresis: A Study among School Children of Central India. *PLoS One.* 2016;11:e0155808. [\[Crossref\]](#)
20. Bakwin H. The genetics of enuresis. In: Kolvin I, MacKeith RC, Meadow SRC, editors. *Bladder Control and Enuresis.* London: Heineman; 1996:73-7.
21. von Gontard A, Heron J, Joinson C. Family history of nocturnal enuresis and urinary incontinence: results from a large epidemiological study. *J Urol.* 2011;185:2303-6. [\[Crossref\]](#)
22. Prince E, Heys M. Nocturnal enuresis: an update on management. *Drug Ther Bull.* 2020;58:25-9. [\[Crossref\]](#)
23. Barone JG, Hanson C, DaJusta DG, Gioia K, England SJ, Schneider D. Nocturnal enuresis and overweight are associated with obstructive sleep apnea. *Pediatrics.* 2009;124:e53-9. [\[Crossref\]](#)
24. Weintraub Y, Singer S, Alexander D, et al. Enuresis-an unattended comorbidity of childhood obesity. *Int J Obes (Lond).* 2013;37:75-8. [\[Crossref\]](#)
25. Ma Y, Shen Y, Liu X. Association between enuresis and obesity in children with primary monosymptomatic nocturnal enuresis. *Int Braz J Urol.* 2019;45:790-7. [\[Crossref\]](#)
26. Chang SS, Ng CF, Wong SN; Hong Kong Childhood Enuresis Study Group. Behavioural problems in children and parenting stress associated with primary nocturnal enuresis in Hong Kong. *Acta Paediatr.* 2002;91:475-9. [\[Crossref\]](#)
27. Görür S, İnandı T, Turhan E, Helli A, Kiper AN. The prevalence and risk factors of enuresis in children aged between 6 and 18 years in Hatay. *Turk J Urol.* 2008;34:42-50.
28. Ciftci H, Savas M, Altunkol A, Oncel H, Yeni E, Verit A. The relations between enuresis in childhood and nocturnal polyuria syndrome in adult life. *Int Neurourol J.* 2012;16:37-40. [\[Crossref\]](#)
29. Alexopoulos EI, Malakasioti G, Varlami V, Miligkos M, Gourgoulisian K, Kaditis AG. Nocturnal enuresis is associated with moderate-to-severe obstructive sleep apnea in children with snoring. *Pediatr Res.* 2014;76:555-9. [\[Crossref\]](#)
30. Nevés T. The role of sleep and arousal in nocturnal enuresis. *Acta Paediatr.* 2003;92:1118-23. [\[Crossref\]](#)
31. Kaditis AG, Alexopoulos EI, Hatzif F, et al. Overnight change in brain natriuretic peptide levels in children with sleep-disordered breathing. *Chest.* 2006;130:1377-84. [\[Crossref\]](#)
32. Karakas HB, Mazlumoglu MR, Simsek E. The role of upper airway obstruction and snoring in the etiology of monosymptomatic nocturnal enuresis in children. *Eur Arch Otorhinolaryngol.* 2017;274:2959-63. [\[Crossref\]](#)
33. Abdolohi-Fakhim S, Talebi A, Naghavi-Behzad M, Piri R, Nazari MS. Effects of adenotonsillar hypertrophy corrective surgery on nocturnal enuresis of children. *Niger Med J.* 2016;57:69-73. [\[Crossref\]](#)
34. Liu J, Zhang X, Zhao Y, Wang Y. The association between allergic rhinitis and sleep: A systematic review and meta-analysis of observational studies. *PLoS One.* 2020;15:e0228533. [\[Crossref\]](#)