SZCZEREK, Emilia and PŁÓCINICZAK, Viktoria. Nocturnal Enuresis in Children: A Literature Review of Pathophysiology, Diagnosis, and Management. Quality in Sport. 2025;46:66580. eISSN 2450-3118.
https://doi.org/10.12775/QS.2025.46.66580
https://apcz.umk.pl/QS/article/view/66580

The journal has been awarded 20 points in the parametric evaluation by the Ministry of Higher Education and Science of Poland. This is according to the Annex to the announcement of the Minister of Higher Education and Science dated 05.01.2024, No. 32553. The journal has a Unique Identifier: 201398. Scientific disciplines assigned: Economics and Finance (Field of Social Sciences); Management and Quality Sciences (Field of Social Sciences).
Punkty Ministerialne z 2019 - aktualny rok 20 punktów. Załącznik do komunikatu Ministra Szkolnictwa Wyższego i Nauki z dnia 05.01.2024 Lp. 32553. Posiada Unikatowy Identyfikator Czasopisma: 201398. Przypisane dyscypliny naukowe: Ekonomia i finanse (Dziedzina nauk społecznych); Nauki o zarządzaniu i jakości (Dziedzina nauk społecznych). **© The Authors 2025.**
This article is published with open access under the License Open Journal Systems of Nicolaus Copernicus University in Torun, Poland. Open Access: This article is distributed under the terms of the Creative Commons Attribution Noncommercial License, which permits any noncommercial use, distribution, and reproduction in any medium, provided the original author(s) and source are credited. This is an open access article licensed under the terms of the Creative Commons Attribution Non-commercial Share Alike License (http://creativecommons.org/licenses/by-nc-sa/4.0/), which permits unrestricted, non-commercial use, distribution, and reproduction in any medium, provided the work is properly cited.
The authors declare that there is no conflict of interest regarding the publication of this paper.
Received: 12.11.2025. Revised: 16.11.2025. Accepted: 16.11.2025. Published: 20.11.2025.

Nocturnal Enuresis in Children: A Literature Review of Pathophysiology, Diagnosis, and Management

Szczerek Emilia, ORCID https://orcid.org/0009-0005-5238-8988
Email em.szczerek@gmail.com
Medical University of Łódź, Łódź, Poland

Płóciniczak Viktoria, ORCID https://orcid.org/0009-0007-1299-4515
Email viktoria.plociniczak@gmail.com
Medical University of Łódź, Łódź, Poland

Corresponding author
Szczerek Emilia, em.szczerek@gmail.com

Abstract:

Background: Nocturnal enuresis (NE), or bedwetting, is a highly prevalent chronic condition affecting up to 24% of the pediatric population. Despite its commonality, NE carries a significant psychosocial burden, negatively impacting a child's self-esteem and quality of life. The condition's etiology is complex and multifactorial, involving nocturnal polyuria, reduced bladder capacity, and impaired arousal mechanisms.

Aim: This comprehensive review analyzes the evidence from various studies evaluating the current understanding of pathophysiology, diagnostic classification, and evidence-based management strategies for nocturnal enuresis in children.

Materials and Methods: The review included scientific papers sourced from the PubMed and Google Scholar databases.

Results: The literature review confirms the multifactorial etiology of nocturnal enuresis, including strong genetic predisposition, reduced nocturnal bladder capacity, and an association with upper airway obstruction. Key treatment methods include the enuresis alarm and

desmopressin, with the lyophilisate. Desmopressin is generally safe when fluid restrictions are maintained. NE significantly negatively impacts the child's quality of life and places a psychological burden on caregivers.

Conclusions: Nocturnal enuresis is a common and complex condition with inconsistent diagnostic criteria and a multifactorial etiology. Effective treatment requires a combined approach of non-pharmacological methods (with the enuresis alarm as first-line therapy) and pharmacological methods (led by desmopressin), while second and third-line drugs carry greater risks. Due to the significant negative impact of NE on the quality of life of patients and their families, empathetic care and education are crucial. Further research is necessary to standardize therapeutic protocols and evaluate new interventions, such as vitamin supplementation.

Key words: Nocturnal Enuresis, Nocturnal Polyuria, Desmopressin, Children, Enuresis Alarm Therapy

Introduction:

Nocturnal enuresis (NE) is a condition defined as involuntary bedwetting during sleep which occurs at least twice a week. It can be diagnosed in children aged 5 or older. According to the Standardisation Committee of the International Children's Continence Society NE can be divided into two main subtypes - monosymptomatic and nonmonosymptomatic. The differentiation is based on the occurrence of lower urinary tract symptoms (excluding nocturia) as well as history of bladder dysfunction in the nonmonosymptomatic kind. (Nevéus et al., 2006). Those symptoms may include dysuria, frequent urination, hesitancy, incontinence, low or high daytime voiding volumes (voiding fewer than four or more than seven times per day), straining to void, urgency and weak stream. (Burgers et al., 2013).

Monosymptomatic NE can be further divided into primary and secondary conditions. Patients suffering from secondary monosymptomatic nocturnal enuresis have experienced a minimum a 6 months period with continuous nighttime dryness before the recurrence of bedwetting. Those criteria are not met in primary monosymptomatic NE. (Nevéus et al., 2006).

Research materials and methods

A comprehensive literature review was conducted using the PubMed and Google Scholar databases. The search focused on systematic reviews, meta-analyses, and key clinical trials published on the topic of pediatric nocturnal enuresis. To cover all relevant aspects, the search strategy included keywords such as "nocturnal enuresis," "bedwetting," "nocturnal enuresis pathophysiology,", "desmopressin," and "alarm therapy."

Diagnosis

There is a disparity in the diagnostic criteria of NE. The fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM V) defines the condition as involuntary or involuntary or intentional voiding of urine in bed at least twice a week in children aged more

than 5 years, having ruled out congenital or acquired diseases of the central nervous system. (von Gontard et al., 2013). International Children's Continence Society (ICCS) defines enuresis as incontinence while asleep at a ''socially unacceptable'' age with a frequency of more than 1 episode per month and sets age 5 years as the limit of normal (Austin et al., 2016) According to the ICD-10 classification nocturnal enuresis can be diagnosed in children who experience at least 1 episode of bedwetting per month for more than 3 months maintaining the age criteria of 5 years old or more. (World Health Organization, 1992).

Epidemiology

Reported prevalence of the condition differs depending on the population studied and chosen criteria. A 2023 study by Alamri et al conducted on the Saudi Arabia population (children aged 5-15) reported an overall 24% prevalence of NE. (Alamri et al., 2023). On the other hand an assessment performed by Spanish researchers on groups of children aged 6, 10 and 13 years old found the prevalence to be 2.8% applying the DSM-IV-TR/DSM-5 criteria (n = 51) compared to 3.7% with the DSM-III-TR criteria (n = 67) or 5.0% with the ICCS criteria (n = 92). (Diaz et al., 2021). Regardless of the criteria applied, age of children studied and geographic location studies show greater prevalence of NE in boys compared to girls. The ratio is found to oscillate around 3:1.

Pathophysiology and risk factors of NE

There are a number of factors which are believed to contribute to enuresis such as family history, psychological and behavioral abnormalities, maturation delay, upper airway abnormalities, abnormal secretion of antidiuretic hormone, reduced bladder capacity and detrusor overactivity. Zhu et al. analyzed the risk factors for childhood enuresis using a retrospective survey study involving 146 children aged 6 to 13 years. The study employed logistic regression analysis to identify the independent factors contributing to the condition. The results confirmed that stubborn personality, nocturnal polyuria, sleep-wake disorders, and bladder dysfunction were significant independent risk factors for childhood enuresis (all were statistically significant with $p<0.05$) (Zhu et al., 2024). Neuroimaging findings indicate that NE is also associated with both structural and functional alterations in the brain. (Dang et al., 2021).

Von Gontard et al. collected data from over 8,000 children and their parents in a questionnaire about NE and urinary incontinence. Odds ratios were calculated for parent/child sets. The incidence of NE in children was found to be increased if one or both parents reported suffering from NE themselves. Specifically the odds for severe child NE were 3.63 times higher in maternal NE and 1.85 times higher in paternal NE. The results showed a statistically significant association between parental and child NE. (Von Gontard et al., 2011).

Evidence for reduced bladder capacity during the nighttime comes from studies such as the one conducted by Borg et al in 2018 on a group of 103 aged 5-15. Estimated nocturnal bladder capacity (eNBC) was assessed separately each night as the total nocturnal urine production (NUP) causing a wet night. If NUP during a wet night was less than maximal voided volume (MVV), it was considered to be reduced eNBC during that particular night. During the two week duration of the study 84% of children experienced at least one wet night. Of those, the mean percentage of wet nights with reduced eNBC was 49%(SD±31) and the percentage of nights with NUP greater than estimated bladder capacity was 23% (SD±22). (Borg et al., 2018)

Another study analyzed the role of upper airway obstruction and snoring in the etiology of NE. Among 225 children aged 5-16 participating in the study 112 suffered from MNE, 113 did not. It was found that adenoid score ($p = 0.016$), septal deviation ($p = 0.017$), and snoring ($p = 0.007$) were significantly different between the groups, thus identifying them as possible

etiological factors. (Karakas et al., 2017). Further research by Andreu-Codina et al determined that NE is more prevalent in children with Obstructive Sleep Apnea. Of 298 children aged 2-12 NE was present in 39.2% of children with OSA compared to 28% in the control group ($p = 0.04$) (Andreu-Codina et al., 2024).

A 2025 study by Agar et al. carried out on 150 patients with primary NE raised the role of vitamin supplementation in enhancing the therapy. It was found that vitamin supplementation (25-hydroxyvitamin D (25OHD) and vitamin B12) alone resulted in successful enuresis management in 77.6% of the patients. (Agar et al., 2025).

Treatment of NE

The treatment of NE rests on two main pillars - non-pharmacological and pharmacological. The first includes health education and behavioural interventions while the latter aims to reduce incidence of bedwetting by means of drug therapy. Both strategies should be implemented simultaneously in order to achieve the best results possible.

The terminology commonly used to assess the effects of the treatment is as follows. Non-responders demonstrate <50% reduction in the number of wet nights, partial responders >50% but <90% reduction, responders >90% reduction, and full responders demonstrate a 100% reduction. (Bauer et al., 2007)

Non-pharmacological

Non-pharmacological treatment of NE depends heavily on modifying the patterns in an affected child's behaviour. Consequently, it is crucial to achieve patients' involvement in the treatment. Because of that a reward strategy is commonly suggested to parents and guardians. An example of that is setting a goal such as a 7 consecutive nights without bedwetting after which an agreed upon reward is given by the parents.Having the patient keep record of wet and dry nights should be used simultaneously. This strategy has been proven to gradually reduce the number of episodes of bedwetting. (Franco et al., 2012). Behavioral interventions have low costs and lack side effects. That is why parents who may worry about using medications are prone to agreeing on this line of treatment. (Liao et al., 2024).

The first line non-pharmacological method in treatment of NE is enuresis alarm. It is a device which produces a stimuli, usually a loud noise, when its detector located in bed or child's clothing is activated by urine. After being woken up the child should turn off the alarm and use the bathroom. The principle of such treatment is to train the patient to wake up at the sensation of wetness during sleep. The success rate of this method has been found to be between 50% and 70%. Motivated children and families are more likely to benefit from this line of treatment. (Nevéus et al., 2019). The main issue with this line of treatment is disrupting both child's and guardians sleep which may result in fatigue during the day. Effectiveness of enuresis alarm can be assessed after minimum 6-8 weeks of continuous treatment. (Song et al., 2019).

There are still a number of misconceptions regarding behavioral methods of treatment. One such method which effects when used as the only therapy has been mostly disproven is dry bed training (DBT). In a 2008 systematic review comparing the effects of DBT with no treatment after 8-24 weeks, DBT was found to be no more effective than no treatment at all. The proportion of children failing to achieve 14 consecutive dry nights was 77% with DBT compared to 93% without treatment (RR for failure 0.82 ; 95% CI 0.66 to 1.02) (Glazener et al., 2013). However this method compared with enuresis alarm was proven to be effective. (Kiddoo 2015)

Another crucial non-pharmacological part of the treatment is education. The first step in therapy must be ensuring the children that they are not to be blamed for their condition.

Another important information is that there are strategies proven to be effective in treating NE. Medical professionals should ensure that parents and patients understand and accept the chosen strategy. Health education helps decrease the burden NE has on families by reducing anxiety. Understanding of the condition has been shown to improve the quality of life which is a significant aspect in those who are affected by NE. (Oztorun et al., 2022; Liao et al., 2024).

Pharmacological

The first line drug used in the treatment of NE is desmopressin. It is an analogue of the human antidiuretic hormone (vasopressin). Desmopressin similarly to vasopressin binds to the receptors in the renal tubules. This results in the reuptake of water molecules and sodium ions. Consequently the urine becomes more concentrated, thus decreasing its volume. The antidiuretic effect of desmopressin lasts about 8-12 hours making it the perfect drug to use before bedtime in children suffering from NE (Drug Bank, n.d.).

Desmopressin is administered 60 min before bedtime. Standard dosage is 0.2 - 0.4 mg for the tablets and 120 - 240 ug for the lyophilizate. There are two approaches when starting the therapy. The patient may either be prescribed the full dosage which is later titrated down or a lower dose to be increased after careful monitoring of the effects achieved. After first starting desmopressin its effects may be assessed about 1-2 weeks later. If there is none then it is not justified to continue the treatment. (Neveus et al., 2020). Due to the fact that the drug effect only lasts one night it should be administered every day. On the other hand because of the importance of the psychological component some clinicians suggest another approach, especially later in the therapy. That is using the drug only before "important nights" such as sleepovers away from home. (Wang et al., 2019).

One adverse effect which must be considered and thus proactively prevented is hyponatremia. Because of that when prescribed the drug parents should be informed of the need to reduce fluid intake 1 hour before and 8 hours after administering the drug. Provided those precautions are taken, therapy was proven to produce no significant changes in serum osmolality, urine osmolality, and serum sodium concentration. In a 2016 study by TAŞ et al blood and urine samples were collected from 35 children aged 5-15 before administering desmopressin and on the third and seventh day of the treatment. Blood sodium values were 137.0 ± 1.85 mEq/L before the treatment and 138.0 ± 2.07 mEq/L and 137.0 ± 1.95 mEq/L on the third and seventh days of treatment, respectively. Blood osmolality values were 254.9 ± 20.15 mOsm/kg H2 O at the beginning and 260.5 ± 23.9 mOsm/ kg H2 O and 260.4 ± 24.47 mOsm/kg H2 O on the third and seventh days of the study, respectively. Urine calcium/creatinine values were 0.03 ± 0.01 mg/mg at the beginning, 0.06 ± 0.02 mg/mg on the third day, and 0.04 ± 0.01 mg/mg on the seventh day of the study. There were no significant changes of serum sodium level, serum osmolality, urine osmolality, or urine calcium/creatinine ratio ($p = 0.618$, $p = 0.135$, $p = 0.088$, and $p = 0.423$ respectively). (TAŞ et al., 2016).

Currently there are two formulations of the drug available for use - oral tablets and orally disintegrating lyophilisate tablets (melt). A 2013 study by Juul et al. compared the results of those two formulations. A group of 221 patients aged 5-15 years old was randomized to receive either the tablet form or melt. The results revealed that it was significantly more probable to achieve both partial and full response by administering the melt formulation compared to oral tablets (OR, 2.0; CI, 1.07–3.73; p=0.03). (Juul et al., 2013).

Desmopressin has been found to be a relatively safe and well tolerated drug. A 2014 study by van Herzeele focused on the safety profile of the oral desmopressin tablet in children with primary NE. Among the 744 children aged 5–15 years participating in the study 222 (30%) patients experienced 404 treatment-emergent adverse events (TEAEs). Of those,174/744 (23%) were classified as mild TEAEs, 64/744 (9%) were classified as moderate, 18/744 (2%) were classified as severe TEAEs and only 7/744 (1%) of the patients experienced serious TEAEs.

The most common adverse effects were found to be headache (28/744, 4%), vomiting (22/744, 3%) and nasopharyngitis (21/744, 3%). (van Herzeele et al., 2014). Because of that, desmopressin can be used long term in the treatment of NE.

In children resistant to desmopressin a second line therapy drug which may be used is an anticholinergic medication - oxybutinin. It works by reducing the detrusor muscle activity thus causing the relaxation of the bladder and preventing the urge to void. (Drug Bank, n.d.). Oxybutynin was shown to be effective mainly in patients with NMNE and those nonresponsive to desmopressin therapy. (Yeung et al., 1999). Clinically relevant side effects include constipation, residual urine postvoid and feeling of dryness in the mouth. (Van Arendonk et al., 2006).

Similarly to desmopressin, oxybutynin is administered 1 hour before bedtime. It can be used either alone or additionally to desmopressin. The dosage ranges between 2,5 - 5mg. Effects of the therapy may be assessed after 1-2 months. In cases of not full response it should be decided individually whether to increase the dose of oxybutynin or add desmopressin if it was not a part of the therapy prior. In case any of the adverse side effects occur the child should be seen by a medical professional. The decision may be made to temporarily discontinue the drug in order to address such problems. Reintroduction of oxybutynin often leads to achieving a satisfying response. (Neveus et al., 2020).

In cases when the first and second line of therapy proves ineffective the third choice drug is the tricyclic antidepressant imipramine. It is unclear how imipramine reduces the number of dry nights. Authors contribute its beneficial effect to a number of mechanisms such as noradrenergic, serotoninergic and anticholinergic activity, as well as the action on urine production and arousal mechanisms. (Hunsballe et al 1997; Gepertz et al., 2004).

Safety of imipramine is inferior to previously mentioned drugs used in the treatment of NE. The most dangerous adverse effect being cardiotoxicity. Consequently before starting a patient on imipramine an EKG should be obtained in order to measure the QT interval. Children with prolonged QT interval., history of heart palpitations, syncope and sudden cardiac death in the family cannot be prescribed the drug. (Varley, 2000). Imipramine is given 1 hour before bedtime, in the dose of 25-50 mg, effects may be assessed after 1 month of continuous use of the drug. (Neveus et al., 2020)

Impact of NE on mental health

Nocturnal enuresis is known to negatively affect the psychological aspects of the patient's well-being. This includes adverse effects on a child's self esteem, interpersonal relations and school performance. Evidence from various surveys prove bedwetting to be the third most disruptive factor for children with NE, following divorce and parental conflict (Tai et al., 2021; Huang et al., 2022)

There have been studies clearly indicating negative correlation of NE with the health-related quality of life (HRQoL). The negative impact is more pronounced in adolescents, particularly attending high school. (Aygun et al., 2025).

Since the condition occurs primarily in children who require a level of external care in everyday activities, the effects of the conditions on their guardians cannot be omitted. The main concern for parents or guardians seems to be increased burden of household work (in the form of more frequent need to wash the bedsheets). Other problems arising from their child's condition include sleepovers outside of home, embarrassment and even occasional anger towards the child. A survey of Thai children and their parents found that "most parents or guardians reported being slightly (29.8 %), not at all (27.5 %), or moderately (23.8 %) affected by primary NE." (Sirimongkolchaiyakul et al., 2025). As females are more frequently the primary guardians they seem to be the ones being affected by the situation.

The adverse effect of NE on the mental health of both patients and parents is clearly indicated in the results of studies using questionnaires such as Beck Depression Inventory (BDI) and Child Depression Inventory (CDI). A 2020 study which included otherwise healthy individuals (particularly excluding those with a diagnosed mental condition) compared patients suffering from NE with control groups. Results among the mothers revealed a mean BDI score of 13.77 indicating mild depressive symptomatology compared to the control group which showed a number within a normal range. In regards to the children the mean CDI score was not indicative for depression. However the value was significantly higher than in the control group (9.48 compared to 7.80 p=0.031). (Yaradilmiş et al., 2020).

Conclusions

Nocturnal enuresis (NE) is a common yet complex pediatric condition, defined by a persistence of involuntary nocturnal voiding in children over the age of five. Despite its high prevalence both medical professionals and parents still lack knowledge on the condition. This highlights the importance of education on the subject.

The diagnostic criteria of NE vary across major classifications like the DSM-V, ICCS, and ICD-10. This review confirms the condition's heterogeneous nature, highlighting its multifactorial etiology which often involves a combination of genetic predisposition (strong parental association), reduced nocturnal bladder capacity, and related conditions such as upper airway obstruction and sleep-wake disorders. The recognition of those pathophysiological mechanisms is crucial for tailoring effective intervention strategies.

Successful treatment of NE relies on a two parts approach. It combines non-pharmacological and pharmacological strategies. Behavioral interventions, centered on health education, motivational support, and particularly the use of the enuresis alarm, stand as the first-line non-pharmacological methods. The first line treatment in pharmacological therapy is desmopressin. That is because of its ability to reduce nocturnal urine output, offering high efficacy with a manageable safety profile. It is however important to remind the patients and their guardians of the necessary precautions in the form of strict fluid restriction. Second-line drugs, such as oxybutynin (for nonmonosymptomatic NE) and imipramine, are to be administered in refractory cases, acknowledging the cardiotoxicity risks associated with the latter.

The condition causes a substantial negative impact on a child's self-esteem and health-related quality of life (HRQoL). In addition to that it imposes a psychological burden on primary caregivers. Those factors enhance the necessity for empathetic, holistic care. Moving forward, continued research into specific risk factors—such as the role of vitamin supplementation—and further efforts to standardize diagnostic and treatment protocols are essential to optimize outcomes for affected children and their families.

Disclosure

Author's contributions

Conceptualization:ES;
Methodology:ES;
Software:ES;Check:VP;
Formal analysis:ES
Investigation:ES,VP
Resources:ES,VP
Data curation:ES,VP; Writing-rough preparation:ES
Writing-review and editing:ES,VP
Supervision:ES

All authors have read and agreed with the published version of the manuscript.

Funding The research received no external funding

Institutional Review Board Statement Not applicable

Informed Consent Statement Not applicable.

Data Availability Statement Not applicable.

Acknowledgements Not applicable.

Conflicts of Interest The authors declare no conflict of interest.

References:

1. Nevéus, T., von Gontard, A., Hoebeke, P., Hjälmås, K., Bauer, S., Bower, W., Jørgensen, T. M., Rittig, S., Walle, J. V., Yeung, C. K., & Djurhuus, J. C. (2006). 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. *The Journal of urology*, *176*(1), 314–324. https://doi.org/10.1016/S0022-5347(06)00305-3
2. Burgers, R. E., Mugie, S. M., Chase, J., Cooper, C. S., von Gontard, A., Rittig, C. S., Homsy, Y., Bauer, S. B., & Benninga, M. A. (2013). Management of functional constipation in children with lower urinary tract symptoms: report from the Standardization Committee of the International Children's Continence Society. *The Journal of urology*, *190*(1), 29–36. https://doi.org/10.1016/j.juro.2013.01.001
3. von Gontard A. (2013). The impact of DSM-5 and guidelines for assessment and treatment of elimination disorders. *European child & adolescent psychiatry*, *22 Suppl 1*, S61–S67. https://doi.org/10.1007/s00787-012-0363-9
4. Austin, P. F., Bauer, S. B., Bower, W., Chase, J., Franco, I., Hoebeke, P., Rittig, S., Walle, J. V., von Gontard, A., Wright, A., Yang, S. S., & Nevéus, T. (2016). The standardization of terminology of lower urinary tract function in children and adolescents: Update report from the standardization committee of the International Children's Continence Society. *Neurourology and urodynamics*, *35*(4), 471–481. https://doi.org/10.1002/nau.22751
5. World Health Organization. The ICD-10 classification of mental and behavioural disorders: clinical descriptions and diagnostic guidelines. Vol. 1. World Health Organization, 1992.
6. Alamri, A., Singh, V. P., Alshyarba, M. H., Abdullah, A., Ogran, M., Alsuayri, A., Al-Amri, A., Ashraf, T. H., Alyami, F., & Alshahrani, M. S. (2024). Prevalence of nocturnal enuresis among children of Aseer region in Saudi Arabia. *Urology annals*, *16*(1), 81–86. https://doi.org/10.4103/ua.ua_90_23

7. Taborga Díaz, E., Martínez Suárez, V., Alcántara-Canabal, L., Suárez Castañón, C., & Cebrián Muíños, C. (2021). Assessment of nocturnal enuresis diagnostic criteria. *Anales de pediatria*, *95*(2), 101–107. https://doi.org/10.1016/j.anpede.2020.08.005
8. Li, D., Zhu, Z., Zhang, Y., Zhang, Y., & Chao, M. (2024). Logistic regression analysis of risk factors influencing childhood enuresis: a comprehensive survey study. *American journal of translational research*, *16*(7), 3157–3163. https://doi.org/10.62347/TQIR5298
9. Dang, J., & Tang, Z. (2021). Pathogenesis and brain functional imaging in nocturnal enuresis: A review. *Experimental biology and medicine (Maywood, N.J.)*, *246*(13), 1483–1490. https://doi.org/10.1177/1535370221997363
10. von Gontard, A., Heron, J., & Joinson, C. (2011). Family history of nocturnal enuresis and urinary incontinence: results from a large epidemiological study. *The Journal of urology*, *185*(6), 2303–2306. https://doi.org/10.1016/j.juro.2011.02.040
11. Borg, B., Kamperis, K., Olsen, L. H., & Rittig, S. (2018). Evidence of reduced bladder capacity during nighttime in children with monosymptomatic nocturnal enuresis. *Journal of pediatric urology*, *14*(2), 160.e1–160.e6. https://doi.org/10.1016/j.jpurol.2017.09.021
12. Karakas, H. B., Mazlumoglu, M. R., & Simsek, E. (2017). The role of upper airway obstruction and snoring in the etiology of monosymptomatic nocturnal enuresis in children. *European archives of oto-rhino-laryngology : official journal of the European Federation of Oto-Rhino-Laryngological Societies (EUFOS) : affiliated with the German Society for Oto-Rhino-Laryngology - Head and Neck Surgery*, *274*(7), 2959–2963. https://doi.org/10.1007/s00405-017-4558-z
13. Andreu-Codina, M., Nikolic-Jovanovic, D., Esteller, E., Clusellas, N., Artés, M., Moyano, J., & Puigdollers, A. (2024). The Relationship between Nocturnal Enuresis and Obstructive Sleep Apnea in Children. *Children (Basel, Switzerland)*, *11*(9), 1148. https://doi.org/10.3390/children11091148
14. Agar, B. E., Gurgoze, M. K., & Kara, A. (2025). A Novel Approach to the Management of Children with Primary Nocturnal Enuresis. *Children (Basel, Switzerland)*, *12*(9), 1128. https://doi.org/10.3390/children12091128
15. Bauer, S. B., Nevéus, T., von Gontard, A., Hoebeke, P., Bower, W., Jorgensen, T. M., Rittig, S., Walle, J. V., Yeung, C. K., & Djurhuus, J. C. (2007). Standardizing terminology in pediatric urology. *Journal of pediatric urology*, *3*(2), 163. https://doi.org/10.1016/j.jpurol.2006.10.002
16. Franco, I., von Gontard, A., & De Gennaro, M. (2013). Evaluation and treatment of non-monosymptomatic nocturnal enuresis: A standardization document from the International Children's Continence Society. *Journal of Pediatric Urology, 9*(2), 234-243. https://doi.org/10.1016/j.jpurol.2012.10.026
17. Liao, J., Zhu, L., Xie, D., Wang, X., & Zhou, P. (2024). Improving the quality of life of children and parents with nocturnal enuresis: the role of health education. *Frontiers in pediatrics*, *12*, 1464465. https://doi.org/10.3389/fped.2024.1464465
18. Song, P., Huang, C., Wang, Y., Wang, Q., Zhu, W., Yue, Y., Wang, W., Feng, J., He, X., Cui, L., Wan, T., & Wen, J. (2019). Comparison of desmopressin, alarm, desmopressin plus alarm, and desmopressin plus anticholinergic agents in the management of paediatric monosymptomatic nocturnal enuresis: a network meta-analysis. *BJU international*, *123*(3), 388–400. https://doi.org/10.1111/bju.14539

19. Glazener, C. M., Evans, J. H., & Peto, R. E. (2004). Complex behavioural and educational interventions for nocturnal enuresis in children. *The Cochrane database of systematic reviews*, *2004*(1), CD004668. https://doi.org/10.1002/14651858.CD004668
20. Kiddoo D. (2015). Nocturnal enuresis: non-pharmacological treatments. *BMJ clinical evidence*, *2015*, 0305.
21. Yılmaz Oztorun, Z., Gordeles Beser, N., Oztorun, K., & Baysan Arabacı, L. (2022). Evaluating the Social Anxiety Depression Levels and Accompanying Psychosocial Problems in Children Diagnosed with Enuresis. *Cureus*, *14*(8), e28351. https://doi.org/10.7759/cureus.28351
22. The Governors of the University of Alberta. DrugBank Online. Desmopressin (DB00035). https://go.drugbank.com/drugs/DB00035. Accessed November 12, 2025
23. Nevéus, T., Fonseca, E., Franco, I., Kawauchi, A., Kovacevic, L., Nieuwhof-Leppink, A., Raes, A., Tekgül, S., Yang, S. S., & Rittig, S. (2020). Management and treatment of nocturnal enuresis-an updated standardization document from the International Children's Continence Society. *Journal of pediatric urology*, *16*(1), 10–19. https://doi.org/10.1016/j.jpurol.2019.12.020
24. Wang, T. M., Yang, S. S., Tsai, J. D., Yu, M. C., Chiou, Y. H., Chen, K. L., Cheng, H. L., Lin, J., Chen, H. W., Kuo, H. C., & Chen, S. C. (2019). Management of nocturnal enuresis in Taiwan: Consensus statements of the Taiwan enuresis expert committee. *Journal of the Formosan Medical Association = Taiwan yi zhi*, *118*(6), 965–972. https://doi.org/10.1016/j.jfma.2018.04.014
25. Taş, N., Kandur, Y., Fidan, K., & Söylemezoğlu, O. (2017). The effect of antidiuretic hormone on urine and serum electrolyte levelsin children with primary monosymptomatic nocturnal enuresis. *Turkish journal of medical sciences*, *47*(5), 1328–1332. https://doi.org/10.3906/sag-1610-72
26. Juul, K. V., Van Herzeele, C., De Bruyne, P., Goble, S., Walle, J. V., & Nørgaard, J. P. (2013). Desmopressin melt improves response and compliance compared with tablet in treatment of primary monosymptomatic nocturnal enuresis. *European journal of pediatrics*, *172*(9), 1235–1242. https://doi.org/10.1007/s00431-013-1992-9
27. Van Herzeele, C., De Bruyne, P., Evans, J., Eggert, P., Lottmann, H., Norgaard, J. P., & Vande Walle, J. (2014). Safety profile of desmopressin tablet for enuresis in a prospective study. *Advances in therapy*, *31*(12), 1306–1316. https://doi.org/10.1007/s12325-014-0173-1
28. The Governors of the University of Alberta. DrugBank Online. Oxybutynin (DB01062). https://go.drugbank.com/drugs/DB01062. Accessed November 12, 2025
29. Yeung, C. K., Chiu, H. N., & Sit, F. K. (1999). Bladder dysfunction in children with refractory monosymptomatic primary nocturnal enuresis. *The Journal of urology*, *162*(3 Pt 2), 1049–1055. https://doi.org/10.1016/S0022-5347(01)68062-5
30. Van Arendonk, K. J., Austin, J. C., Boyt, M. A., & Cooper, C. S. (2006). Frequency of wetting is predictive of response to anticholinergic treatment in children with overactive bladder. *Urology*, *67*(5), 1049–1054. https://doi.org/10.1016/j.urology.2005.11.060
31. Gepertz, S., & Nevéus, T. (2004). Imipramine for therapy resistant enuresis: a retrospective evaluation. *The Journal of urology*, *171*(6 Pt 2), 2607–2610. https://doi.org/10.1097/01.ju.0000110613.51078.93

32. Hunsballe, J. M., Rittig, S., Pedersen, E. B., Olesen, O. V., & Djurhuus, J. C. (1997). Single dose imipramine reduces nocturnal urine output in patients with nocturnal enuresis and nocturnal polyuria. *The Journal of urology*, *158*(3 Pt 1), 830–836. https://doi.org/10.1097/00005392-199709000-00038
33. Varley C. K. (2000). Sudden death of a child treated with imipramine. Case study. *Journal of child and adolescent psychopharmacology*, *10*(4), 321–325. https://doi.org/10.1089/cap.2000.10.321
34. Huang, W. J., Liang, Y. Y., Yang, Q., & Ma, X. (2022). Nocturnal enuresis in children: Parents' perspectives. *Nursing open*, *9*(5), 2335–2341. https://doi.org/10.1002/nop2.1243
35. Tai, T. T., Tai, B. T., Chang, Y. J., & Huang, K. H. (2021). The Importance of Understanding Parental Perception When Treating Primary Nocturnal Enuresis: A Topic Review and an Institutional Experience. *Research and reports in urology*, *13*, 679–690. https://doi.org/10.2147/RRU.S323926
36. Aygun, E., Aygun, S. T., Turkmenoglu, Y., Irdem, A., & Dursun, H. (2025). Impact of Nocturnal Enuresis on Health-Related Quality of Life in Children. *Sisli Etfal Hastanesi tip bulteni*, *59*(1), 89–97. https://doi.org/10.14744/SEMB.2024.02679
37. Sirimongkolchaiyakul, O., Sutheparank, C., & Amornchaicharoensuk, Y. (2025). Effect of nocturnal enuresis on school-age children and their families in Thailand: A cross-sectional study. *Pediatrics and neonatology*, *66*(6), 561–565. https://doi.org/10.1016/j.pedneo.2024.12.004
38. Yaradilmiş, R. M., Büyükkaragöz, B., Yilmaz, A. Ç., & Tayfur, A. Ç. (2020). Severity of self-reported depressive symptomatology and relevant factors in children with primary monosymptomatic nocturnal enuresis and their mothers. *Pediatric nephrology (Berlin, Germany)*, *35*(7), 1277–1285. https://doi.org/10.1007/s00467-020-04512-8