



Nocturnal enuresis among children: prevalence and risk factors

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ABSTRACT

Background: Nocturnal enuresis (NE) is an inappropriate and involuntary wetting during sleep with a peak prevalence of approximately 15–20% in 5-year-old children and older. The aim of this study is to report the prevalence and risk factor of nocturnal enuresis among children in Makkah and Jeddah. **Materials and Method:** A cross-sectional descriptive study was carried out among Saudi children 5 years of age and older, Mecca and Jeddah, Saudi Arabia, from 12 May to 12 July 2020. Data was collected using a pre-designed questionnaire that was distributed online and included questions designed to fulfill the study objectives. **Results:** Out of 363 children, 90.9% were Saudi, 92.8% of children families are with average/high economic level, and the parents had university education. The prevalence of nocturnal enuresis (NE) among the children of the current study was high (63.9%). Nocturnal enuresis is significantly associated with ages (years) $P=0.002$, $OR=1.191$, 95% CI (1.067 - 1.329), residence $P=0.002$, $OR=2.565$, 95% CI (1.409 - 4.672), and child order $P=0.003$, $OR=2.897$, 95% CI (1.419 - 5.912). Siblings with NE in childhood, parents' history of NE in childhood, child snore during sleep, psychological problems, and history of urinary tract infection (UTI) were the most reported significant NE's risk factors. **Conclusion:** The prevalence of nocturnal enuresis (NE) among the children of the current study was high. The prevalence of NE is significantly associated with age, residence, and child order. Therefore, more health education program should be provided to increase parents' awareness of NE symptoms and treatment to reduce NE's occurrence.

Keywords: children, nocturnal enuresis, prevalence, risk factor.

1. INTRODUCTION

Nocturnal enuresis is one of the most common urological disorders in the pediatric population that is presented in the health care centres, commonly referred to as inappropriate and involuntary wetting during sleep with a peak prevalence of approximately 15–

20% in 5-year-old children and older (Firoozi et al., 2006). It happens at least twice a week, in the absence of congenital or acquired defects of the nervous system and without any other lower urinary tract symptoms or a history of bladder dysfunction (Fritz et al., 2004). NE is classified into primary and secondary. Primary enuresis occurs in children over 5 years who have not been dry for at least 6 months, while secondary enuresis occurs after at least 6 months of nocturnal dryness (Graham et al., 2009; Ghotbi et al., 2001; Thurber et al., 2017). Also, if they occur 4 or more times a week, enuretic episodes are considered frequent (Vande Walle et al., 2012). Risk factors of NE include a low educational level of parents, a history of neonatal sepsis, low birth weight, family history, cesarean deliveries (Khazaie et al., 2018), and psychological or psychiatric factors (Van et al., 2015). Researches show that the inheritance of NE is in an autosomal dominant pattern with 90% penetrance (Thurber et al., 2017). However, most cases are primary and it is important to demonstrate the problem and reassure parents by educating them that this condition is self-limiting in most children over time (Walker et al., 2019) especially those who seek early medical consultation (Baird et al., 2014). There are many causes of NE, such as low secretion of antidiuretic hormones at night, low capacity of the bladder, upper airway obstructions, genetic causes, anatomical changes in the urinary tract, or nervous system problems (Yousef et al., 2011). Other factors involve diabetes insipidus, developmental variety, urinary tract infections, and school or home stressful situations (Jamali et al., 2004). In 2020, a study conducted in Saudi Arabia showed that 31.2% of children were reported to have enuresis; a male was representing 58.2% of the target population (Alhifthy et al., 2020). Another study was published in 2018 stated that 29% of the sample did not receive any type of medical intervention as they may get better sooner, and 12% had reduced their fluid intake in addition to waking up them at night repeatedly by their families (Alshahrani et al., 2018). NE affects children and their families in many ways, also who known to have multiple comorbidities increase the importance of recognizing it. Those include neuropsychiatric problems as attention deficit hyperactivity disorder (ADHD), intellectual disability, low self-esteem, and psychological disorders (Von et al., 1999; Ganti et al., 2016).

2. MATERIALS AND METHODS

A cross-sectional study was applied to children aging 5 years and older from 12th of May to 12th of July 2020. After obtaining the Institutional Review Board approval of Umm Al-Qura University, the data was collected by predesigned questionnaire to obtain the socio-demographic data of the participants (age, gender, nationality, place of residence, mode of delivery, neonatal intensive care unit (NICU) admission, child terms at delivery, size of child at birth and birth order of the child), and personal information such as enuresis-related characteristics like time of enuresis (at night only or both day and night), any associated symptoms like dysuria, incomplete emptying, urgency, relation to sleeping, frequency per week and any improvement in decreasing fluid intake before sleeping, in addition, risk factor like a family history of NE in parents or siblings, delayed milestones, motor and learning disabilities, type of delivery, hospital admission after delivery, presence of urinary tract infection, constipation, psychological problems, chronic diseases such as diabetes mellitus, chronic kidney disease, obstructive sleep apnea, anaemia or other underlying medical condition were also included. We included all the children with nocturnal enuresis, basing on the criteria of diagnosis: age is more than 5 years, an occurrence at 2 times/week for ≥ 3 months or causes clinical distress and having either primary enuresis (never achieved continence) or secondary (onset of symptoms after a patient had achieved incontinence), in the specified time frame, we excluded children with neurological diseases, a congenital defect of the urinary tract, age less than 5 years and refusal to participate. The study was done after getting consent from children's parents or guardians.

The total number of sample size was 363. Endpoints are to report the prevalence and risk factors of nocturnal enuresis in children 5 years and older among Mecca and Jeddah population and to evaluate the most common risk factor of nocturnal enuresis. A pilot study was done before the study to ensure the validity of the questionnaire. Data was entered and statistically analyzed on the Statistical Package of Social Science Software program, version 25 (IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp.). Data was presented using mean and standard deviation for quantitative variables and frequency and percentage for qualitative ones. Comparison between groups for qualitative variables was performed using Chi square or Fisher's exact tests while for quantitative variables the comparison was conducted using Mann Whitney test (due to data skewness). Multivariate logistic regression model was conducted to explore the predictors of nocturnal enuresis. P values less than or equal to 0.05 were considered statistically significant.

3. RESULTS

Table 1 represents the demographic data of the participants. The total number of participants was 363 and child ages are ranged between 5 to 16 years with a mean age of (Mean± SD) 7.1±3.3. Almost 90.9% were Saudi; among them 54.5% are resident in Makkah, 26.4% in Jeddah, and 19% live in other cities. Natural vaginal delivery (NVD) is the most relevant (75.2%), while caesarean section (CS) was (24.8%). Mixed of breast and artificial feeding were the most common among children (46.6%).

Approximately 17.6% of children admitted to the nursery after birth and 94.5% were full-term. Almost 85.4% of babies had normal size after birth and more than half of children ordered the 3rd or more. Most children (82.4%) spent one hour or more on front of the TV or smart devices and 92.8% are with average/high financial conditions. In terms of parents' ages, mother aged between 22 to 58 years with a mean of (Mean± SD) 35.2 ± 7 and fathers aged between 24 to 64 years with a mean age of (Mean± SD) 40.7 ± 8.4. Approximately equal numbers of mothers and fathers with university education (69.7% and 70.5%, respectively) and 36.4% of mothers work.

Table 1 Description of demographic data

	Description (n=363)
Child age (years)	
Range	0.5 – 16
Mean ± SD	7.1 ± 3.3
Saudi Nationality	330 (90.9)
Male Gender	
Residence	
Makkah	198 (54.5)
Jeddah	96 (26.4)
Others	69 (19)
Delivery	
NVD	273 (75.2)
CS	90 (24.8)
Child feeding	
Breast feeding	102 (28.1)
Artificial feeding	92 (25.3)
Mixed	169 (46.6)
Child admitted to the nursery after birth	64 (17.6)
Full-term	343 (94.5)
Baby size after birth	
Low	47 (12.9)
Normal	310 (85.4)
High	6 (1.7)
Child order	
1 st	99 (27.3)
2 nd	68 (18.7)
3 rd or more	196 (54)
The time the child spends in front of the TV or smart devices	
< 1 hour	64 (17.6)
1 hour or more	299 (82.4)
The financial condition of a family	
Average / high	337 (92.8)
Low	26 (7.2)
Mother's age	
Range	22 – 58
Mean ± SD	35.2 ± 7
Father's age	
Range	24 – 64
Mean ± SD	40.7 ± 8.4
Mothers of University education	253 (69.7)
Fathers of University education	256 (70.5)
Working Mother	132 (36.4)

Table 2 shows a description of risk factors; Siblings with NE in childhood was the most relevant risk factor (29.5%), followed by Parent's history of NE in childhood (27.3%). Additionally, 22.3% of children snore during sleep, family and psychological problems (17.4%), and 14.3% of children suffering from constipation. Other risk factors were observed among little percentage of children,

such as; History of UTI (9.6%), chronic diseases (9.4%), developmental delay (7.4%), learning difficulties (7.2%), and weak lower urinary tract muscle (5.8%).

Table 2 description of risk factors

	Description (n=363)
Family difficult situation	63 (17.4)
Parent's past history of nocturnal enuresis in childhood	99 (27.3)
Siblings with NE in childhood	107 (29.5)
Child's developmental delay	27 (7.4)
Learning difficulties	26 (7.2)
History of urinary tract infections	35 (9.6)
weak lower urinary tract muscle	21 (5.8)
Child suffers from constipation	52 (14.3)
Psychological problems	63 (17.4)
Child snore during sleep	81 (22.3)
chronic diseases	34 (9.4)

Regarding description of enuresis findings, table 3 showed that 63.9% of children urinate while sleeping and 48.3% had a bed wetting from one to two times per week. The time of bed wetting was reported only at night among 75.4% of children, among them 47.8% reported that the bed wetting occurred at midnight and 41.8% reported it at the end of night. Among 232 children, 77.2% reported a large amount of urine when they wake up and 62.5% increased drinking water before bedtime. Among 232 children, 45.3% urinate a large amount in the morning after waking up despite bedwetting at night. Concerning the bedwetting associated symptoms, 75.4% reported no symptoms, 12.5% reported urgency, frequent urination (6.5%), incomplete bladder evacuation (3.9%), and dysuria (3.4%). Among 232 children, 23.6% experienced dryness at least 6 months or more.

Table 3 Description of enuresis findings

	Description (n=363)
Urination during sleeping	232 (63.9)
Numbers of bedwetting per week (n=232)	
1-2	112 (48.3)
3-4	50 (21.6)
5-6	28 (12.1)
>6	42 (18.1)
The time of bedwetting (n=232)	
At night only	175 (75.4)
Day & night	57 (24.6)
Times of bedwetting during the night (n=232)	
At start	10 (4.3)
At midnight	111 (47.8)
At the end	97 (41.8)
Anytime	14 (6)
Urination of large amount after waking up (n=232)	179 (77.2)
Increasing fluid intake before bedtime(n=232)	145 (62.5)
Urination of large amount in the morning after waking up despite bedwetting at night (n=232)	105 (45.3)
Associated symptoms (n=232)	
urgency	29 (12.5)
Frequent urination	15 (6.5)
Incomplete bladder evacuation	9 (3.9)
Dysuria	8 (3.4)
No symptoms	175 (75.4)
Experience dryness at least 6 months or more (n=232)	23.6%

Table 4 represents the relation of NE with demographics and risk factors (univariate analysis). A significant association was found between NE and most the demographic features, such as; age ($P=0.000$), child order ($P=0.000$), residence ($P=0.023$), admission to the nursery after birth ($P=0.005$), parents' ages ($P=0.010$ and $P=0.020$, respectively), and parents' education ($P=0.021$ and $P=0.002$, respectively). Additionally, a significant association was reported between most risk factors and NE ($P<0.05$). While developmental delay, constipation and chronic diseases did not show any significant association with enuresis ($P>0.05$).

Table 4 Relation of enuresis with demographics and risk factors (univariate analysis)

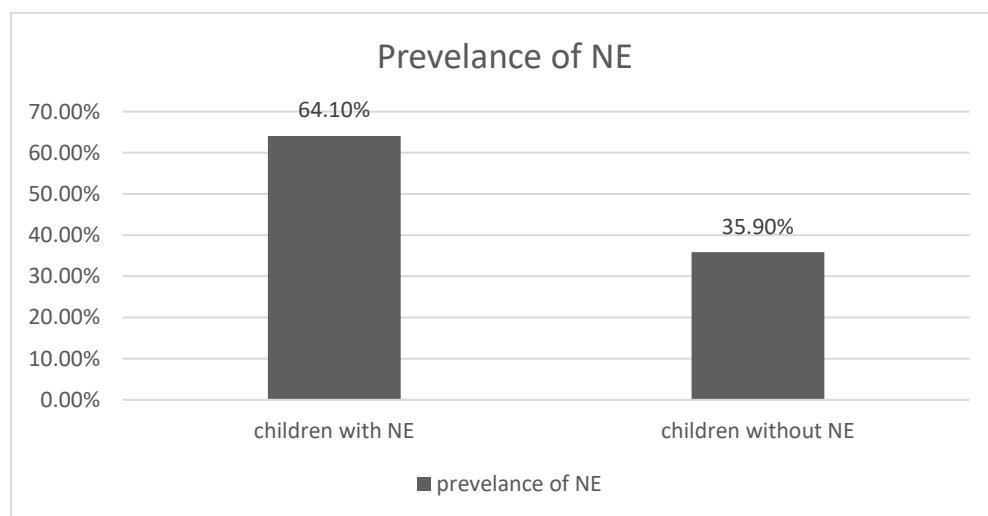
	Nocturnal enuresis		P value
	Yes (n=232)	No (n=131)	
Child age (years)	7.9 ± 3.2	5.6 ± 2.8	0.000
Male Gender	150 (64.7)	76 (58)	0.210
Vaginal Delivery	172 (74.1)	101 (77.1)	0.530
Child feeding			
Breast feeding	60 (25.9)	42 (32.1)	0.421
Artificial feeding	62 (26.7)	30 (22.9)	
Mixed	110 (47.4)	59 (45)	
Admitted to the nursery after birth	31 (13.4)	33 (25.2)	0.005
Full-term	218 (94)	125 (95.4)	0.560
Baby size after birth			
Low	35 (15.1)	12 (9.2)	0.151
Normal	192 (82.8)	118 (90.1)	
High	5 (2.2)	1 (0.8)	
Child order			
1 st	47 (20.3)	52 (39.7)	0.000
2 nd	40 (17.2)	28 (21.4)	
3 rd or more	145 (62.5)	51 (38.9)	
The time the child spends in front of the TV or smart devices			
< 1 hour	38 (16.4)	26 (19.8)	0.405
1 hour or more	194 (83.6)	105 (80.2)	
The financial condition of a family			
Average / high	212 (91.4)	125 (95.4)	0.152
Low	20 (8.6)	6 (4.6)	
Mother's age	35.9 ± 7.2	33.9 ± 6.4	0.010
Father's age	41.4 ± 8.6	39.3 ± 8	0.020
Mothers of University education	80 (34.5)	30 (22.9)	0.021
Fathers of University education	81 (34.9)	26 (19.8)	0.002
Working Mother	84 (36.2)	48 (36.6)	0.934
Family difficult situation	52 (22.4)	11 (8.4)	0.001
Siblings with nocturnal enuresis in childhood	94 (40.5)	13 (9.9)	0.000
Child's developmental delay	21 (9.1)	6 (4.6)	0.119
Learning difficulties	22 (9.5)	4 (3.1)	0.023
History of urinary tract infections	32 (13.8)	3 (2.3)	0.000
Constipation	33 (14.2)	19 (14.5)	0.942
Psychological problems	58 (25)	5 (3.8)	0.000

Snoring during sleep	68 (29.3)	13 (9.9)	0.000
Chronic diseases	26 (11.2)	8 (6.1)	0.109

Table 5 Regression analysis to explore predictors of enuresis (multivariate analysis)

	P value	OR*	95% CI*
Child age (years)	0.002	1.191	(1.067 - 1.329)
Admitted to the nursery after birth	0.301	0.671	(0.315 - 1.43)
Child order (3 rd or more)	0.003	2.897	(1.419 - 5.912)
Mother's age	0.189	0.948	(0.876 - 1.027)
Father's age	0.948	1.002	(0.938 - 1.071)
Mothers of University education	0.865	0.938	(0.45 - 1.957)
Fathers of University education	0.846	1.078	(0.504 - 2.306)
Family problems	0.705	1.193	(0.479 - 2.967)
Parent's past history of nocturnal enuresis in childhood	0.000	9.775	(4.107 - 23.265)
Siblings with nocturnal enuresis in childhood	0.001	3.688	(1.669 - 8.15)
Learning difficulties	0.303	2.009	(0.533 - 7.565)
History of urinary tract infections	0.010	5.831	(1.522 - 22.338)
Psychological problems	0.006	4.779	(1.582 - 14.439)
Child snore during sleep	0.013	2.802	(1.238 - 6.339)

*OR= odds ratio, CI= Confidence Interval

**Figure 1** display that most of sample size have NE.

Regarding multivariate analysis, regression analysis to explore predictors of enuresis, table 5 shows a highly significant association between enuresis and child's ages (years) $P=0.002$, OR=1.191, 95% CI (1.067 - 1.329), residence $P=0.002$, OR=2.565, 95% CI (1.409 - 4.672), and child order $P=0.003$, OR=2.897, 95% CI (1.419 - 5.912). In terms of risk factors, a significant association was reported between enuresis and parents' history of NE in childhood ($P=0.000$, OR=9.775, 95% CI (4.107 - 23.265)), a siblings with NE in childhood ($P=0.001$, OR=3.688, 95% CI (1.669 - 8.15)), history of UTI $P=0.010$, OR=5.831, 95% CI (1.522 - 22.338), psychological problems $P=0.006$, OR=4.779, 95% CI (1.582 - 14.439), and child snore during sleep $P=0.013$, OR=2.802, 95% CI (1.238 - 6.339) (figure 1).

4. DISCUSSION

Nocturnal enuresis (NE) is an undesirable wetting that occurs during sleep after the expected bladder control age. NE negatively impacts children's health that increases the burden among families, so it is considered a major psychosocial problem among children worldwide. Therefore, the present study aimed to assess the prevalence of nocturnal enuresis in children 5 years and older

among Mecca and Jeddah population. Also, evaluate the most common risk factor of nocturnal enuresis. The current study results showed that children aged between 5 to 16 years, NVD was the most common delivery (75.2%), 46.6% had a mixed feeding (breast and artificial), and 85.4% of the studied children had a normal size after birth. Similar previous studies were conducted among children with nearly the same age, Alhifthy et al. (2020) reported that most children aged from 3 to 12 years, Alnajjar (2017) reported the age between 6 to 12 years, Elgohary et al. (2013) reported the age of studied children between 11 to 13 years, and Doganer et al. (2015) reported children age between 6 to 14 years. Huang et al. (2020) reported that natural labour was the most common among children which agreed with our results. Our results showed that 54% of the studied children were the third child or more, while Alhifthy et al. (2020) reported that most children of his study were the first child.

The prevalence of nocturnal enuresis among children of the current study was high (63.9%). These results are in line with a previous study carried out in different Saudi Arabia provinces that reported the prevalence of NE was 63 among children aged between 5 to 7 years, while the prevalence decreased to 4.5% among children aged older than 10 years. Also, our results agreed with another study conducted in Jazan, Saudi Arabia (Sherah et al., 2019) and reported high prevalence of NE (76.4%) among children aged between 5 to 12 years. While these results disagreed with other previous studies; conducted in Saudi Arabia that reported a low prevalence of NE, which was found (15%) among children aged from 6 to 11 years (Kalo et al., 1996). In Turkey, the prevalence of NE was low (13%) (Gür et al., 2004), in India, a low prevalence was reported (7.6%) among children aged from 6 to 10 years (De et al., 2007), in China was 4.6% (Ma et al., 2013), in the UK the prevalence was 18.9% (Redsell et al., 2003). This variation in the prevalence level among children in different studies might be attributed to the diversity in bladder control improvement among different cultures (Chiozza et al., 1998; Bower et al., 1996). Additionally, every study has inclusion criteria of the study sample that might cause variation in the prevalence' ratios. Also, it was reported that by increasing children age, the prevalence level decreased, according to study conducted in turkey 2015, which support our results; hence the mean age of the studied children was 7.1 ± 3.3 and significantly associated with NE prevalence, while there is no significant correlation with gender, which agreed with another study in Taif, Saudi Arabia (Al-Zahrani 2014). The occurrence of NE was associated with the financial condition of the family; our study results reported that most families are with average/high economic level (92.8%), which showed no significant association with NE. It was indicated that families with high income level, increased the use of disposable diaper for prolonged time that delay toilet training and increased the prevalence of NE (Wang et al., 2019). Our results are contrary with other previous studies that reported high prevalence of NE among families with low economic level (Chiozza et al., 1998) and another study reported a negative association between families' income level and NE' prevalence agreed with our results. The majority of children families (54.5%) are residents in Makkah, which is significantly associated with NE prevalence. This might be returned to delaying toilet training in urban areas compared to rural areas that explained the high prevalence of NE and agreed with (Wang et al., 2018). Additionally, mother and fathers' age and educational level did not show any significant association with NE prevalence that agreed with other previous studies (Gunes et al., 2009), while study conducted in Eastern Croatia 2019 reported a close association between parental education level and NE (Jurković et al., 2019).

The present study reported that 48.3% of children had a bedwetting from one to two times per week, which agreed with Alnajjar. Bedwetting time was found only at night among 75.4% and occurred at midnight (47.8%) and at the end of night (41.8%). Most children (62.2%) increased drinking water before bed, 77.2% reported a large amount of urine when they wake-up, and 23.6% of the children had experienced dryness at least 6 months or more. Most children did not show any symptoms associated with bed-wetting. These results agreed with study conducted in Henan province China 2006 (Wen et al., 2006) who reported that sleep disorders and playing video games before bed may increase children's difficulty to wake-up at night, and therefore increased bed-wetting. Additionally, most parents decrease water intake before bedtime to prevent bed-wetting (Mejias et al., 2018).

A significant correlation was found between NE prevalence and most of the risk factors, such as; parents' history of NE in childhood, siblings with NE in childhood, history of UTI, psychological problems, and snoring during sleep, which were the most common risks among children Huang et al. A study conducted in Xi'an 2020 reported that psychological problems are one of the most risk factors induced bed-wetting, which agreed with our results. Other risk factors were reported by a previous study, such as: bladder abnormality, family history, urinary tract infection, sleep disorders, delayed maturation, vasopressin deficiency and stress (De et al., 2007).

5. CONCLUSION

The prevalence of nocturnal enuresis (NE) among the children of the current study was high and it is significantly associated with demographic data (age, residence, and child order). Siblings with NE in childhood, parents' history of NE in childhood, snoring during sleep, psychological problems, and UTI were the most common risk factors of NE among children. Therefore, more health education program should be provided to increase parents' awareness of NE symptoms and treatment to reduce NE's occurrence.

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Author Contributions

All authors contributed to writing the research sections, including introduction, methods, data analysis, result, and discussion.

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Conflict of Interest

The authors declare that there are no conflicts of interests.

Informed Consent

Written informed consent was obtained from all individual participants included in the study at the beginning of the questionnaire.

Ethical approval for the study

The study was approved by the National Committee of Bio Ethics in Umm Al-Qura University (ethical approval code: HAPO-02-K-012).

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Data and materials availability

All data associated with this study are present in the paper.

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