BJU International (2001), **87**, 678–681

An epidemiological study of nocturnal enuresis in Taiwanese children

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Objective To estimate the prevalence of primary nocturnal enuresis (PNE) in Taiwanese children, and to examine factors associated with PNE and its severity.

Subjects and methods In all, 1683 questionnaires were sent to parents of schoolchildren aged 6–11 years randomly selected from three primary schools in Taipei City, Taiwan. The questionnaire was designed to collect information about the prevalence of and factors associated with PNE.

Results Of the questionnaires distributed, 1176 (70%) were completed. PNE was reported in 92 (8%) of the children; nine (10%) of these children were wet >3 nights per week. Factors associated with PNE included male gender, deep sleep, divorced parents or separated family and a positive family history of enuresis. Of these factors, only those children with deep sleep were more likely to have >3 wet nights per week.

Conclusion The prevalence of and factors associated with PNE in Taiwan are similar to those reported in Western countries, but the percentage of children with severe enuresis is lower than in Sweden, France and Turkey. Deep sleepers are more likely to have severe enuresis.

Keywords prevalence, risk factors, primary nocturnal enuresis

Introduction

Primary nocturnal enuresis (PNE) is a very common clinical problem in children. Although PNE is generally a benign symptom, it causes considerable distress to both parents and child [1]. The prevalence of enuresis has been reported to be 7–14% in Japan, Korea, Turkey and Western countries [1–14]. The prevalence of enuresis in Chinese children in Hong Kong is reportedly lower than in Caucasians [15]. Most studies have consistently found that the risk factors for PNE are male gender, age, a positive family history of PNE, divorced parents and deep sleep [2,6,7,11,12,15]. There are conflicting results about whether low socio-economic status of the family, being a single child and a low birth weight are risk factors for PNE [7,11,12]. Whether the prevalence of PNE in Taiwanese children is also lower than in Caucasians and whether the associated factors differ warrants further investigation; factors associated with the severity of PNE have been rarely addressed and hence we conducted a study to estimate the prevalence of PNE in Taiwanese children. Factors associated with PNE and the severity of PNE were also examined.

Accepted for publication 22 January 2001

Subjects and methods

The subjects of the study were primary school students selected through a multiple-stage sampling procedure. First, three public primary schools were chosen randomly from three different districts of Taipei City, Taiwan. Three classes in each of six grades of the participating schools were then randomly selected and all students aged 6–11 years in the selected classes were invited to participate in the study. In all, 1683 students from 54 classes were included and a questionnaire was sent to their parents. The items of the questionnaire were designed to collect information about age, sex, birth condition, development history, frequency of enuresis, sleeping habit, number of children, the parental relationship, the family history of enuresis and the socio-economic status of the family.

Enuresis was defined as having at least one wet night every 6 months, as defined previously [2]. Primary enuresis was defined as bed-wetting in subjects who have never been dry for an extended period. Secondary enuresis was defined as the onset of wetting after a continuous dry period of >6 months [16]. The frequency of enuresis was divided into five categories. i.e. >5, 4–5, 2–3, 1 and <1 wet nights per week. To evaluate factors associated with the severity of enuresis, the children with PNE were divided into those with enuresis of >3 or $\leqslant 3$ wet nights per week.

The discriminating risk factors between those with enuresis and those without (controls), and the risk factors for the severity of enuresis, were investigated by multiple logistic regression analysis, with $P<0.05$ considered to indicate significant associations.

Results

Of the 1683 questionnaires distributed, 1176 (70%) were completed; of the 1176 children, 12 (1%) had secondary enuresis, nine (1%) had diurnal wetting, one had both diurnal and secondary enuresis, and 92 (8%) had PNE. Of these 92 children with PNE, 61 were boys and 31 were girls;

Table 1 shows the frequency of PNE related to age and sex. There was a trend for a steady decrease in the frequency of PNE with age. The severity of PNE for the five categories of frequency (>5 to <1 wet night per week) was 4%, 6%, 15%, 12% and 63%, respectively; nine (10%) of the 92 children had >3 wet nights per week.

Enuresis was significantly associated with male gender, deep sleep, divorced parents or separated family, and a positive family history of enuresis (Table 2). However, birth weight, delayed development, constipation, drinking or urination habit before sleep, stool incontinence, number of children, and socio-economic status of the family were not significantly associated with PNE. Of the factors associated with the severity of PNE, only deep sleep was associated in children with >3 wet nights per week (Table 3).

Discussion

PNE is common among younger schoolchildren and its frequency decreases with increasing age; 7–14% of children are bedwetters and 1–2% of enuretic children continue to be wet in adulthood [1–14]. However, the prevalence of enuresis varies with geographical area, study population and the criteria used in the studies [3,11,14].

Table 1 The frequency of PNE in relation to age and sex

Age (years)	*Boys* n/*N (%)*	*Girls* n/*N (%)*	*Total* n/*N (%)*
6	21/129 (16)	10/100 (10)	31/299 (14)
7	15/105 (14)	8/85 (9)	23/190 (12)
8	12/99 (12)	6/94 (6)	18/193 (9)
9	6/80 (8)	3/87 (4)	9/167 (5)
10	4/126 (3)	3/93 (3)	7/219 (3)
11	3/85 (3)	1/93 (1)	4/178 (2)
Total	61/624 (10)	31/552 (6)	92/1176 (8)

n, number of enuretic children; N, total number in each age group.

The prevalence of PNE in Taiwanese children in the present study was 8%; this is similar to those in reports from Japan, Korea, Turkey and Western countries [1–14], but higher than that of Chinese children aged 4–12 years in Hong Kong (3.5%) [15]. The difference with the last study possibly arises because nocturnal enuresis was defined as at least one wet night every 3 months in the Hong Kong study, which is more stringent than the present definition.

The present prevalence of 10% for Taiwanese children aged 6–11 years with >3 wet nights per week is lower than those reported in Sweden, France and Turkey [3,4,9,12]. In contrast, Yeung [15] showed that 28% of Chinese children with nocturnal enuresis in Hong Kong had >3 wet nights per week. This difference arose probably because the study population in that series was younger than in the present study. Whether differences in genetic predisposition or cultural background can explain the difference in severity of enuresis between Taiwanese children and other ethnic children needs further investigation.

A wide variety of factors, e.g. gender, age, a positive family history of PNE, divorced parents and deep sleep, have been reported to be associated with PNE in Western countries, Turkey and Hong Kong [2,6,7,11,12,15]. While a low socio-economic status of the family, single children and a low birth weight were also found to be risk factors for PNE in the USA [7], these were not supported by studies from Italy and Turkey [11,12]. The present results also showed that gender, a positive family history, deep sleep and separated or divorced parents are important factors associated with enuresis. Thus the present study does not support the presence of ethnic differences in the common risk factors for PNE. Moreover, a low socio-economic status of the family, single children and a low birth weight were not associated with PNE, consistent with the results of the Italian and Turkish studies [11,12].

From a clinical perspective it is important to identify children at increased risk of more severe enuresis. The present study showed that factors such as delayed development, constipation, drinking habit before sleep, number of children and socio-economic status of the family had no significant association with the severity of PNE. Although male gender, divorced or separated parents and a positive family history were associated with PNE, they were not significantly associated with the severity of PNE; only deep sleep was associated with >3 wet nights per week. Watanabe and Kawauchi [17] showed that the arousal centre was activated to turn deep sleep into light sleep when the bladder was distended. They found that a disturbance in this arousal system may result in sustained deep sleep and hence cause enuresis; the present finding was consistent with

Table 2 Factors associated with PNE in 92 children

		Univariate analysis		*Multivariate analysis*	
Variable	*Enuresis (%)*	*OR* (95% CI)*	P	*OR (95% CI)*	P
Gender					
Girls	5.7				
Boys	10.0	1.8 (1.2–2.9)	0.007	2.4 (1.4–4.0)	<0.001
Family history of enuresis					
Paternal	38.8	11.8 (7.2–10.2)	<0.001	11.8 (6.8–20.3)	<0.001
Maternal	20.6	3.8 (2.3–6.2)	<0.001	4.2 (2.4–7.5)	<0.001
Divorced family	21.0	3.4 (1.7–6.8)	<0.001	3.3 (1.5–7.5)	0.033
Deep sleeper	15.0	3.3 (2.1–5.1)	<0.001	3.4 (2.1–5.7)	<0.001
Single child	12.8	1.8 (1.1–3.3)	0.035	E	
Delayed development	14.8	3.6 (1.3–9.8)	0.009	E	
Constipation	16.7	2.4 (1.1–5.3)	0.023	E	
Birth weight <2.5 kg	13.0	1.9 (0.8–4.2)	0.140	NI	
Stool incontinence	18.8	2.7 (0.8–9.8)	0.110	NI	
Social class					
Low	11.2	1.0			
Medium	8.1	0.7 (0.3–1.4)	0.632		
High	6.9	0.6 (0.3–1.3)	0.124		
Drinking before sleep	9.7	1.4 (0.9–2.1)	0.105	NI	
Urination before sleep	8.0	1.1 (0.3–3.6)	0.875	NI	

*OR, odds ratio; E, eliminated; NI, not included.

their report. Further investigations are warranted to elucidate the relationship between severe enuresis and the arousal/sleep system, and its implications for clinical intervention.

In conclusion, the prevalence of and factors associated with PNE in Taiwanese children are similar to those reported in Japan, Korea, Turkey and Western countries, but the proportion of children with severe enuresis was lower than those in Sweden, France and Turkey. Deep sleep is associated with bedwetting of >3 nights per week.

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Table 3 Factors associated with the severity of PNE in 92 children

	Frequency of severe	*Univariate analysis*		*Multivariate analysis*	
Variable	*enuresis* (%)*	*OR† (95% CI)*	P	*OR (95% CI)*	P
Gender					
Girls	9.7				
Boys	9.8	1.0 (0.2–4.8)	0.981	E	
Family history of enuresis					
Paternal	13.2	1.9 (0.5–7.6)	0.361	E	
Maternal	11.5	1.3 (0.3–5.7)	0.722	E	
Divorced family	11.4	1.6 (1.8–13.3)	0.691	E	
Deep sleeper	15.7	10.4 (1.2–87.3)	0.013	10.4 (1.2–87.2)	0.030
Delayed development	16.7	2.7 (0.5–15.9)	0.252	E	
Constipation	12.5	1.4 (0.1–12.5)	0.787	E	
Single child	11.8	2.0 (0.2–1.7)	0.514	E	
Drinking before sleep	9.7	1.4 (0.9–2.1)	0.105	E	
Social class					
Low	20.0	1			
Medium	20.0	1 (0.2–6.3)	1.000		
High	5.5	0.2 (0.1–1.2)	0.103		

* Nocturnal enuresis >3 wet nights per week; †OR, odds ratio; E, eliminated.

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