

SECTION II

Epidemiology of Enuresis

Epidemiology of Enuresis: a Survey of the Literature

G. A. DE JONGE

Introduction

The epidemiology of enuresis affords insight into the process of bladder control maturation. It can be maintained that, in a population not exposed to any therapeutic efforts, the relationship between age and the prevalence of enuresis reflects the spontaneous course of enuresis. Opportunities for studying such an untreated population are diminishing fast in the Western world.

All doctors who give advice about special examinations or medical treatment for enuresis have to bear in mind prevalence data for enuresis at various ages. In addition, from the age distribution it is possible to deduce the trend of spontaneous cures at various ages; and this can be used in the evaluation of therapeutic results.

A review of available pertinent publications leads to the observation that comparison of results presents great difficulties. There are substantial differences in methods of investigation: *i.e.* who is interviewed (parent, nursemaid, patient), about whom (selection of the group), by whom (doctor, nurse, aide), on which occasion (school survey, population survey), in which year (peace-time, war-time), in which season, in which way (by questionnaire or personal interview), with which questions (concerning the immediate or more remote past). Moreover, there is considerable variation in how enuresis is defined.

Enuresis Nocturna

Table I presents data from the literature on the prevalence of enuresis nocturna at various ages. When comparing these data, it should be remembered that different authors use different definitions of enuresis nocturna. For example, Hallgren (1956a), Notschaele (1964) and Oppel *et al.* (1968) require a minimum frequency of one wet night per month; Thorne (1944) and Forrester *et al.* (1964) consider one wet night per week a minimum requirement. Martin (1966) does not diagnose enuresis nocturna unless two wet nights occur per week. Levine (1943) gives no definition of enuresis nocturna, and the figures reported by Bieger (1954) concern rejections for military service because of enuresis nocturna. Only Blomfield and Douglas (1956), Oppel *et al.* (1968) and de Jonge (1969) distinguish some categories of gradation.

Groenhart (1943), Levine (1943) and Thorne (1944) made their investigations in war-time, when prevalences may differ from those in peace-time.

Methods of investigation also differ. Groenhart (1943), Blomfield and Douglas (1956), Notschaele (1964), Martin (1966), Oppel *et al.* (1968) and de Jonge (1969) interviewed parents personally, whereas Hallgren (1956a) had them complete a questionnaire form at home. Some investigators interview subjects about the current situation (Groenhart 1943, Levine 1943, Thorne 1944, Blomfield and Douglas 1956,

Blomfield and Douglas (1956)	Great Britain	2/week	2026 ⁶				3-1	2-3 ⁴												
Hallgren (1956 a and b)	Stockholm schools	1/month	925				7-2*	5-5*	4-5*	3-7										
Notschaele (1964)	Ysselmonde (Neth.) schools	1/month	3184				13-0	6-2	6-5	4-9										
Oppel <i>et al.</i> (1968)	Baltimore caucasians	1/month	1877	73	36	30	32	24	18	10	9	7	4							
Oppel <i>et al.</i> (1968)	Baltimore negroes	1/month	2707	70	37	28	30	21	24	22	19	16	9							
Forrester <i>et al.</i> (1964)	Leigh (Eng.) schools	1/week	937				17-3	15-8												
Hawkins (1962)	Mount Gambier South Australia	1/week	±500 ⁶	76	46	31	16	14	20	10	13	7	20	8	20	12				
Martin (1966)	Birmingham schools	2/week	1842																	
de Jonge (1969)	Eindhoven child welfare centres/schools	3/month	4839	98	75	29	18	13	11	7	6	5	8	3	3					
de Jonge (1969)	" "	2 1/month	4839	96	63	21	9	8	5	2	3	2	0	1	2					
<i>Males + Females</i>																				
Bransby <i>et al.</i> (1955)	York schools	sporad.	798				32-4	13-5	18-5	13-4	16-4	4-7	9-1	9-0						
Groenhart (1943)	village N.H. Netherlands	sporad.	1249	98-4	88-1	58-5	45-5	42-1	43-7	31-5	45-7	28-8	26-1	14-8	17-1	14-5	15-6	3-5	12-5	6-6
Klackenberg (1955)	Stockholm child welfare centre	1/month	315	92-1	40	13														0

¹The definitions of enuresis nocturna differ as to the minimum number of wet nights per month or per week.

²n = the number of children examined/questioned.

³Prospective study; the number (n) therefore refers to the number in each age group.

⁴7½ years old.

⁵17-27 years old.

⁶The percentages were estimated in a graph.

⁷Due to correction for prematurity, the effective number is substantially smaller; prospective study (see note 3 above).

⁸Enuresis nocturna prompting rejection for military service.

*Retrospective study; the populations were 7-year-olds (Hallgren) and 18-year-olds (Thorne).

Hallgren 1956a, Notschaele 1964, de Jonge 1969), while in other, retrospective studies the questions sometimes concern the remote past. Hallgren, for example, questioned seven-year-olds about bladder control at four, five and six years. Such investigations probably yield falsely low prevalences, especially for ages four and five. Thorne asked recruits at which age they had achieved bladder control, and on the basis of their answers he gave an age distribution of enuresis nocturna.

Selection always plays a rôle. Comparing Levine's figures (1943) with Bieger's (1954), it should be borne in mind that the former reports on war-time naval volunteers, while the latter discusses peace-time conscripts. This difference makes it less surprising that the prevalences reported by these two authors are so disparate. Thorne (1944) reports that his series of 100 recruits included a number of older men with a physical or mental handicap, so his series is not representative of 18- to 19-year-olds. In school surveys (Hallgren 1956a, Forrester *et al.* 1964, Notschaele 1964, Martin 1966, de Jonge 1969), there is no selection other than that inherent in the school or kindergarten itself. Only Blomfield and Douglas (1956) report on an ideal sample: all children born in Great Britain during the first week of March 1946.

Finally, the statistical reliability of the reported prevalences of enuresis nocturna depends on the number of children in each survey. In Table I, this number (n) is indicated for each group. In prospective studies (Blomfield and Douglas 1956, Oppel *et al.* 1968), as well as in retrospective studies (Thorne 1944, Hallgren 1956a), this number refers to each age group; in the other publications it refers to the total of the various age columns.

Because of all these variables, reports on the prevalence of enuresis at various ages differ substantially in quality.

All the authors note a difference in enuresis prevalence between boys and girls up to the age of 11 years. In a child guidance clinic, Addis (1935) found enuresis nocturna in 189 boys and 125 girls; Weiss (1936) found it in 121 boys and 66 girls (aged 4 to 18), and Schaper (1955) in 62 boys and 38 girls (aged 9 to 11). It is doubtful whether enuresis is more common in boys than in girls over the age of 11 years. Hawkins (1962) found a predominance of girls among 10- to 14-year-olds.

Enuresis prevalence diminishes with increasing age. For a few age groups, this diminution can be calculated theoretically from the prevalence surveys (Table II). From about 6½ to 12 years of age, the mean diminution is 55 per cent (range 26-77 per cent), over a period of about five and a half years. In this period of his or her life, the chance that a child with enuresis nocturna will sleep dry a year later can therefore be estimated as: $\sqrt[5]{0.55} = 13.5$ per cent. This equation is given with reservations, however, because the percentage decreases mentioned in Table II are heterogeneous, due to differences in enuresis definition and other variables.

A few authors have presented data on different degrees of enuresis nocturna. Hallgren (1956 *a* and *b*) gives the following breakdown of 78 children with enuresis nocturna in his school survey: between once a month and once a week 14 per cent; two to six times per week 44 per cent; every night 42 per cent. The corresponding percentages among 278 children examined in his psychiatric clinic were 4 per cent, 12 per cent and 84 per cent (Hallgren 1957); selection is apparent. Groenhart (1943) found a sporadic wet night in 99 out of 229 children with enuresis nocturna; of the remaining

TABLE II
 Diminishing prevalence of enuresis nocturna with increasing age. In each publication, the prevalences of enuresis nocturna at the ages of 4½ years and 6½ years were taken to represent 100 per cent.

Authors	Definition of enuresis nocturna	Percentage decrease in prevalence			
		from 4½ to 7½ years		from 6½ to 12 years	
		Males	Females	Males	Females
Blomfield and Douglas (1956)	sporad.	40	38	—	—
Notschaele (1964)	1/month	67	62	26	54
Oppel <i>et al.</i> (1968) (Caucasian)	1/month	38	69	77	69
Oppel <i>et al.</i> (1968) (Negro)	1/month	18	27	47	63
Thorne (1944)	1/week	—	—	49	—
Blomfield and Douglas (1956)	2/week	3	28	—	—
Martin (1966)	2/week	—	—	50	58
de Jonge (1969)	21/month	74	78	71	60
de Jonge (1969)	3/month	59	59	58	73
de Jonge (1969)	3/month*	55	54	47	71

*after correction for treatment received in the past

130, 24 per cent had wet nights between once per week and once per month, 28 per cent were wet on between two and six nights per week, and 48 per cent were wet every night. Oppel *et al.* give the following breakdown: once a month to less than once a week 31.5 per cent; one to six times per week 54 per cent; every night 14.5 per cent.

Enuresis is described as secondary or acquired when it has not prevailed since birth, and has appeared after a dry interval of a certain duration. Some authors accept a dry interval of six months as the criterion (Martin 1966), but the majority insist on a minimum of twelve months (Gunnarson and Melin 1951, Hallgren 1959, Notschaele 1964, Starfield 1967, de Jonge 1969).

According to Hallgren (1959), secondary enuresis exists in 20 to 25 per cent of all cases of enuresis nocturna after the age of four years. Oppel *et al.* (1968) give a larger percentage, particularly for negroes. Notschaele (1964) reports 19 per cent; de Jonge (1969) gives figures of 22 per cent for boys and 19 per cent for girls (aged six to twelve years). Martin (1966) describes the secondary form as rare in 14- to 15-year-olds, but at this age it is difficult to establish with certainty whether or not enuresis is secondary, because the age of onset is usually between three and eight years. Hallgren (1959) reports the following ages of onset in 41 cases of enuresis nocturna (over the age of four years and with at least one wet night per month): age three years in 14 cases; age four years in 11; age five to six years in 10; age seven to eight years in 5; and age nine to twelve years in 1.

TABLE III
Prevalence of enuresis diurna in boys and girls at various ages, expressed in percentages. Summary of published data.

Author(s)	Population	Sex	Definition ¹	n ²	0	1	2	3	4	5	6	7	8	9	10	11	12	
Groenhart (1943)	village N.H. Netherlands	Male + female	sporad.	238	100	92	51	21										
Groenhart (1943)	village N.H. Netherlands	Male + female	sporad.	1000												3-8		
Hallgren (1956 a and b)	Stockholm schools	Male	1/month	1067					2.7*	1.6*	1.2*	1.0						
Hallgren (1956 a and b)	Stockholm schools	Female	1/month	925					2.5*	2.1*	1.7*	1.3						
Blomfield and Douglas (1956)	Great Britain	Male	?	2268							1.8							
Blomfield and Douglas (1956)	Great Britain	Female	?	2026							4.1							
Oppel <i>et al.</i> (1968)	Baltimore (caucasians and negroes)	Male + female	1/month	859 ³	94	45	16	8	12	8	4	4	3	3	3	2	1	
de Jonge (1969)	Eindhoven, child welfare centres/schools	Male	2 1/2 months	5150		92	48	9	2	2	1	0	1	1	1	0	0	0
de Jonge (1969)	"	Male	3 months	5150		94	57	13	3	4	2	1	1	1	1	0	0	0
de Jonge (1969)	"	Female	2 1/2 months	4839		88	32	4	3	3	2	0	0	0	0	1	0	0
de Jonge (1969)	"	Female	3 months	4839		92	39	8	5	6	3	2	2	1	0	1	1	0

¹The definitions of enuresis diurna differ as to the minimum number of wet days per month.

²n = number of children examined or questioned.

³Due to correction for prematurity, the effective number is substantially smaller; prospective study.

*Retrospective study; the population consisted of 7-year-olds.

Enuresis Diurna

Even less is known of the epidemiology of enuresis diurna (Table III). Only Groenhart (1943) and Oppel *et al.* (1968) gives percentages for very young children, but these are not divided according to sex. Hallgren (1956*a* and *b*) and Oppel *et al.* (1968) insist on a minimum of one wet day per month in their definition; Groenhart is probably less strict, and Blomfield and Douglas (1956) give no definition.

All publications clearly indicate a trend of diminution in the prevalence of enuresis diurna with increasing age. A division according to sex shows that, unlike enuresis nocturna, enuresis diurna is more frequently observed in girls than in boys from the age of about four years onward.

Enuresis diurna tends to be combined with enuresis nocturna. Notschaele (1964) reports enuresis diurna in 25 out of 100 children with enuresis nocturna (aged four to thirteen years), but in only two out of 100 children without enuresis nocturna. In Blomfield and Douglas's (1956) group of six-year-olds with enuresis diurna, 80 per cent of the boys and 60 per cent of the girls were also found to show enuresis nocturna. Hallgren (1956 *a* and *b*) found that, of his enuresis patients aged between four and seven years, 74 per cent showed only enuresis nocturna, 16 per cent showed enuresis nocturna et diurna, and 10 per cent showed only enuresis diurna; there was no significant difference in sex distribution between these three categories. Of a group of 101 out-patients with enuresis diurna, Hallgren (1957) found that 23 per cent had secondary enuresis, of whom a significantly higher proportion were girls than boys. For 22 of these children he quotes the ages of onset: age three years in 6 cases; age four years in 6 cases; age five to six years in 2 cases; age seven to eight years in 7 cases; and older than eight years in 1 case. In those of his children with combined enuresis nocturna and enuresis diurna, there was no significant concordance between the primariness of the former and the secondariness of the latter.

Frequency

Frequency is closely related to both enuresis nocturna and enuresis diurna. It can be defined as a regular frequency of micturition of more than once per hour, either throughout the day or during a part of the day. The prevalence of frequency rapidly diminishes in children between the ages of 1½ and 3½ years, and does so earlier in girls than in boys. From the age of five years, however, boys and girls no longer differ in this respect. A positive association has been established not only between the occurrence of frequency and the occurrence of enuresis diurna, but also between the occurrence of frequency and the occurrence of enuresis nocturna. Fifteen per cent of school children with enuresis nocturna also have diurnal frequency, and of this fifteen per cent significantly more are girls than boys (de Jonge 1969).

Conclusions

Exact comparison and analysis of data is difficult because of varying standards. Some children are dry at night by age one year. Thereafter, the prevalence of bedwetting diminishes with increasing age, and is usually lower in girls than in boys. There are fairly consistent variations in prevalence in different countries. Oppel *et al.* (1968), for children aged four years, cites prevalences of 39 per cent in Australia,

29 per cent in the U.S.A. amongst whites, 12 per cent in England, and 8 per cent in Sweden.

Estimates of the chance that a wet child will sleep dry a year later are calculated for children of six and a half to twelve years as 13.5 per cent.

Addendum. In preparing this paper for the press, I take the opportunity to add three important references. (1) The first is to the Newcastle 1000 family survey. In this population study, 77 per cent of the children were dry at night by the age of three years; 82 per cent were dry at five years, and 89 per cent at eleven years (Miller *et al.* 1960, Miller this volume Chapter 5). (2) The second is to Brazelton (1962) who, using his 'child oriented' system, had 98½ per cent of 1172 children in private paediatric practice in Boston, U.S.A., dry at night by the age of five years. (3) The third is to Young (1964) who reported on various groups of children, including one of 333 children of whom 98½ per cent were dry at age four.

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