



Investigation of voiding dysfunction in a population-based sample of children aged 3 to 9 years

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Abstract

Objective: To describe voiding patterns and related dysfunctions in a population-based sample of children aged 3 to 9 years.

Methods: A cross-sectional population-based survey including 580 children. A probabilistic sample of households in the urban area of Pelotas in southern Brazil was selected following a multiple-stage protocol. Voiding and fecal patterns were investigated using the dysfunction score created by Farhat et al. and modified by the addition of high urinary frequency (more than eight times a day). Boys with scores above eight and girls above five were clinically investigated, as well as a sub-sample of the remaining children.

Results: Nocturia (60.4%), urinary urgency (49.7%) and holding maneuvers (42.1%) were the most frequently reported symptoms. The prevalence of enuresis was 20.1% in boys and 15.1% in girls. The prevalence of urinary dysfunction was 22.8%. Most symptoms were more frequently reported by girls and younger children. Among girls, low socioeconomic level was related to an increased prevalence of enuresis and straining to urinate, while among boys urgency was more common among the poor. Only 10.5% of the parents of the children with voiding dysfunction consulted a doctor because of their problems.

Conclusions: The voiding symptoms studied presented high prevalence rates, and therefore should be investigated in clinical practice, with direct questions about each symptom, aiming to diagnose voiding dysfunction.

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Doctors have a dream: to diagnose, as early as possible, diseases they can't cure (medical aphorism, Oly Lobato).

Introduction

Micturition and fecal habits of children from 3 to 6 years old have been little studied. Prevalence rates of enuresis and diurnal urinary incontinence are generally investigated in samples of schoolchildren and adolescents,¹⁻⁵ with population-based studies being scarce. In the medical literature there are variations in the frequencies of urinary symptoms and their dysfunctions, probably due to differences in symptom definition and data collection methods (type of questionnaire, location of data collection, study population).

The majority of micturition problems occur between toilet training and puberty.⁶ Voiding dysfunction is defined as a micturition pattern that is abnormal for the child's age and is not normally recognized before diurnal urinary

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control is acquired.⁷ Voiding dysfunction includes the loss of the coordinated capacity to collect, store and eliminate urine. The principal symptoms include: nocturnal enuresis, diurnal urinary incontinence, holding maneuvers, urinary urgency and recurrent urinary infections.

In children who are anatomically and neurologically normal, voiding dysfunction is generally caused by a persistently unstable bladder, and is an important risk factor for recurrent infections of the urinary tract and worsening of vesicoureteral reflux, encouraging the appearance of renal scarring and capable, later, of causing kidney damage.²

The objective of this study was to investigate micturition habits and dysfunctions in a population sample of children from 3 to 9 years old living in an urban area in the South of Brazil.

Methodology

This study followed a population-based cross-sectional design, enrolling a probabilistic sample, selected over multiple stages, of children aged 3 to 9 years and resident in the urban area of the city of Pelotas, RS, Brazil.

In order to calculate the sample size, the prevalence of voiding dysfunction was estimated at 8%, with an acceptable error of 2.5 percentage points, which required a sample of 497 children including an extra 10% for losses and refusals. In order to assess the associations between voiding dysfunction and risk factors, the following parameters were employed: confidence level of 95%, power of 80%, exposure prevalence rates varying from 30

to 50%, estimate of 5% voiding dysfunction among those not exposed and a minimum relative risk to be detected of 2.5, with 10% added for losses and refusals and 15% for adjusted analysis. Based on these calculations, the sample required would be 570 people.

The definitions of micturition and fecal symptoms are presented in Table 1. Voiding dysfunction was evaluated using a modified version of the Farhat *et al.*⁸ score (Table 2). This instrument was originally developed and underwent a validation study at a clinic in Canada. The cutoff points are six points for girls and nine for boys. Questions were adapted slightly to make the questionnaire more applicable to the lives of those interviewed. Question five (urinary frequency) was given an extra response category for more than eight urinations per day, which was also considered as a risk factor. For this reason the questionnaire is now referred to as modified Farhat *et al.* score. The original score used the following monthly frequency categories: almost never, less than half the time, half the time and almost always. In order that frequency be better quantified, these categories were specified thus: never, up to two times, three to fourteen times, fifteen times or more.

The remaining variables included in the analysis were: sex, age (split into 3-4, 5-6 and 7-9 years), economic level (*Associação Nacional de Empresas de Pesquisa* – ANEP classification)¹⁰ and age at diurnal and nocturnal sphincter control training (in months).

Data was collected by means of interviews with mothers. Whenever possible the children remained with their mothers during the interview in order to help with any questions to which the mother did not know the answer. In cases of loss

Table 1 - Definitions of micturition and fecal symptoms

Symptom	Definition
Nocturnal enuresis	Bed-wetting after the age of 5, at least once a month.
Monosymptomatic nocturnal enuresis	Bed-wetting during sleep after the age of 5, absence of other diurnal urinary symptoms.
Urinary urgency	Urgent need to urinate.
Diurnal urinary incontinence	Involuntary loss of at least small amounts of urine during the day, at least once at every 2 weeks, in children with sphincter control or after the age of 3.
Increased urinary frequency	Urinate small amounts more than 8 times a day.
Decreased urinary frequency	Urinate less than three times a day.
Nocturia	Need to urinate at night.
Holding maneuvers (abstinence)	Suppressing the desire to urinate using maneuvers as leg crossing, sitting on their ankles and holding the penis.)
Urge-incontinency	Urgency to urinate associated with urine loss.
Dysuria	Painful urination.
Constipation	Interval between bowel movements higher than 72 hours.
Straining to have a bowel movement	Hard stools with blood, use of medicines or glycerin suppositories.

Source: Norgaard *et al.*⁹

Table 2 - Farhat et al. score for voiding dysfunction

During the last month	Almost never	Less than half of the time	Half of the time	Almost always
1. I peed on my clothes during the day	0	1	2	3
2. When I am wet, my underwear gets soaked	0	1	2	3
3. I don't remind voiding everyday		1	2	3
4. I have to strain to void everyday	0	1	2	3
5. I go to the restroom to pee only once or twice a day *	0 (no)	0 (no)	0 (no)	2 (yes)
6. I control pee by holding my penis, sitting on my ankles or moving, dancing	0	1	2	3
7. When I want to go pee I can't wait	0	1	2	3
8. I have to strain to pee	0	1	2	3
9. It is painful when I pee	0	1	2	3
10. To be answered by parents		No (0)		Yes (3)
Has your child already experienced some stress situation as the ones described below? †				

* In the modified Farhat et al. score, question 5 refers to the number of urinations < 3 and > 8 (2 points) and between 3-8 (0 points). The options: almost never, less than half of the time, half of the time and almost always are not applicable.

† Brother or sister birth, school change, moving home, birthday, problems at home (divorce, death) or school, accident, trauma, sexual/physical abuse.

Source: Farhat et al.⁸

or refusal, at least two more attempts to visit were made by the interviewer and a further attempt by the research supervisor. Quality control was performed by the supervisor by means of revisiting 10% of the sample. Thirty-two female interviewers who had graduated high school were selected and trained. A pilot study was performed in a census sector not to be included in the sample in order for the questions to undergo final testing and for the interviewers to receive practical training.

Questionnaires were coded, reviewed and input in duplicate onto the software program Epi-Info 6.04d. Analysis was performed using Stata 8.0 taking into account the effect of the cluster sampling design. Dichotomous exposures were analyzed using the chi-square test to compare prevalence rates and ordinal exposures were analyzed with the linear trend chi-square test. Multivariate analysis was performed using Poisson regression, with P and 95% CI % values calculated using the Wald test.

Children with scores above the cutoffs described above were revisited by the chief investigator as was a simple random sample of the rest of the children. At this revisit a clinical investigation protocol was applied (n = 186) which assessed whether the parents were aware of the child's problem and if they had sought medical treatment for it. As the sub-sample over-represented children with suspected voiding dysfunction, the analyses of this part of the study were weighted in order to represent the general sample.

The study project was approved by the Ethics and Research Committee at the *Universidade Federal de Pelotas* Medical school, and defined as minimum risky. Informed consent was requested for interviews and written authorization was obtained from mothers or guardians for the children enrolled in the substudy.

The main fieldwork took place from October to December 2003 and the substudy from December 2003 to June 2004.

Results

Five hundred and ninety children were identified aged 3 to 9 years. There were 10 (1.5%) refusals, being four boys and six girls. Of the 186 children evaluated clinically by the researcher, there were nine losses (moved city or changed address), one refusal and one exclusion.

Table 3 describes the sample according to demographic and socioeconomic variables. Forty-seven percent of the whole sample were boys and the mean age was 6.1 (SD = 2) years. Around 15% of the families were in economic level E and 39.2% were in level D. Mean maternal schooling in years was 7 (SD = 4). One in every four children had no siblings.

Analyzing the prevalence rates of isolated urinary symptoms (Table 4), it is observed that the most common were nocturia (60.4%), urinary urgency (≥ 3 days per

Table 3 - Sample description (general and stratified by sex) according to demographic and socioeconomic variables

Variable	General %	Male %	Female %
Age (years)			
3-4	27.6	26.5	28.6
5-6	28.6	30.2	27.3
7-9	43.8	43.3	44.1
Economic level			
A	3.8	4.0	3.6
B	12.5	12.9	12.1
C	29.6	31.6	27.8
D	39.2	38.6	39.8
E	14.9	12.9	16.7
Mother's educational level (years)			
0	6.6	5.2	7.8
1-4	22.1	20.2	23.7
5-8	36.9	41.2	33.1
9-11	25.9	23.5	27.9
≥ 12	8.6	9.9	7.5
Number of brothers			
0	24.5	23.2	25.7
1	32.4	36.0	29.2
2-3	30.3	29.0	31.5
≥ 4	12.8	11.8	13.6
Total (n = 580)	100.0	46.9	53.1

month; 30.3%) and holding maneuvers (≥ 3 days per month; 21.2%), with all of these being more frequent among girls, although for nocturia this difference had no statistical significance. The most important symptoms for diagnosing urological diseases (dysuria, effort urinating) presented lower prevalence rates. Enuresis was slightly more frequent among boys, with the difference not being statistically significant. Just 12 children (3.6%) aged more than 5 years exhibited monosymptomatic nocturnal enuresis. Constipation was present in 3.1% of the children, with 8.8% describing effort to evacuate on 15 days or more during the previous month. In the subsample, 15.3% of the children described hardened stools, 2.7% in balls and 2.7% with blood.

According to the original Farhat *et al.* score, the prevalence of voiding dysfunction was 22.8% (10.4% for boys and 33.8% for girls).

Using the modified Farhat *et al.* score, the general prevalence of voiding dysfunction was 24.2%, being 11.2% for boys and 35.8% for girls ($p < 0.001$). When the cutoff for boys was moved to six points (the same as for girls), the prevalence of dysfunction among the boys rose to 30.6%.

Table 5 describes the prevalence rates of the modified Farhat *et al.* score symptoms treated as dichotomous variables, by sex, age and economic level. Girls exhibited

greater frequency of intensity of incontinence, holding maneuvers and urinary urgency, while abnormal urinary frequency was more common among the boys. Younger children exhibited greater prevalence rates and intensities of urinary incontinence, abnormal urinary frequency and urinary urgency. There was a tendency for symptoms to be more frequent among poor children, although just four variables (urinary incontinence, urgency, effort urinating and abnormal urinary frequency) approached statistical significance, with p values of 0.10 or less. Holding maneuvers were an exception, apparently being more common among richer children, although without significance ($p = 0.12$).

Enuresis (Figures 1 and 2), which was investigated only in children over 5, decreased with age ($p = 0.07$), varying from 24.4% among children aged 6, to 10.2% among 9-year-olds and was inversely related to economic level ($p < 0.001$, chi-square for linear trend).

The investigation also permitted sphincter control patterns to be assessed. The age at which diurnal sphincter control was achieved presented a mean of 22.6 months (DP = 11.2) with the mean for nocturnal control being 24.4 months (SD = 14.8). At 12 months, 15.1% of the children had already achieved daytime control, at 18 months 41.7% and at 36 months 97.6%. Nocturnal

Table 4 - Sample description (general and stratified by sex) according to urinary and intestinal symptoms

Variable	General (%)	Male (%)	Female (%)	p†
Enuresis *	17.5	20.1	15.1	0.29
Diurnal incontinency	20.2	18.2	21.9	0.25
Nocturia	60.4	56.8	63.7	0.10
Urinary frequency (times a day)				0.10
< 3	1.4	1.9	1.0	
3-8	89.2	85.9	92.1	
> 8	9.4	12.3	6.9	
Holding maneuvers (days a month)				0.006
0	57.9	64.4	52.1	
1-2	21.0	17.8	23.8	
3-14	10.4	8.5	12.1	
≥15	10.8	9.3	12.1	
Urinary urgency (days a month)				0.01
0	50.3	55.2	45.9	
1-2	19.4	20.4	18.6	
3-14	13.0	9.6	16.0	
≥ 15	17.3	14.8	19.5	
Straining to urinate (days a month)				0.57
0	92.7	93.3	92.2	
1-2	5.6	5.2	5.9	
3-14	0.7	0.7	0.7	
≥ 15	1.0	0.7	1.3	
Dysuria (days a month)				0.17
0	94.0	95.2	93.2	
1-2	5.4	4.8	5.9	
3-14	0.4	0.0	0.7	
≥ 15	0.2	0.0	0.3	
Constipation	3.1	3.3	3.0	0.801
Straining to evacuate (days a month)				0.05
0	55.5	62.1	49.7	
1-2	27.9	22.4	32.8	
3-14	7.8	7.0	8.4	
≥ 15	8.8	8.5	9.1	
Stressful events during the last 30 days	14.0	12.7	0.62	13.3
Total (n = 580)	100.0	46.9	53.1	

* This symptom was assessed only in children under 5 years-old.

† p value of the difference between sexes (Wald test).

control was acquired by 12 months by 10.5%, by 18 months by 28.8% and by 36 months by 89.9%. The following results were weighted to reconstitute the original sample of all of the children. Of these, 40.4% of parents had found urinary training easier, 29.5% considered fecal training was easier and 30.1% judged that there was no difference. Around three out of every four children were trained for feces and urine together and 47.2% were taken out of day and night diapers simultaneously.

Just 18.0% of families reported that pediatricians had given them guidance on sphincter training. The greater part of the mothers (around 55%) said they "did what seemed best", "followed what I already knew" or had "learned earlier in life" and this result was very similar for mothers of children with and without dysfunction. Grandparents provided guidance in 29.2% of cases.

Only 10.5% of the parents of children diagnosed as suffering from dysfunction according to the modified

Table 5 - Prevalence of micturition and fecal habits of the Farhat et al. score in the general sample according to sex, age and economic level

Symptom	Sex			Age				Economic level					Total	
	Male	Female	p	3-4	5-6	7-9	p	A	B	C	D	E		p
Diurnal urinary incontinence	18.2	21.9	0.25	32.1	20.5	12.7	< 0.001	13.6	18.1	18.2	19.2	29.4	0.06	20.1
Intensity of incontinence	19.6	27.7	0.01	37.1	25.9	14.2	< 0.001	22.7	25.0	20.6	22.1	33.7	0.23	23.8
Constipation	3.3	3.0	0.80	1.9	1.8	4.7	0.09	4.6	0.0	2.9	3.5	4.7	0.24	3.1
Strain to void	15.4	17.5	0.49	18.1	17.5	15.0	0.36	13.6	18.1	17.5	15.0	18.6	1.00	16.6
Altered urinary frequency	14.1	8.0	0.03	16.1	9.1	8.7	0.04	9.1	9.7	7.6	9.6	22.4	0.10	10.9
Holding maneuvers	35.6	47.9	0.006	42.7	39.2	43.7	0.75	59.1	50.0	40.9	38.2	43.5	0.12	42.1
Urinary urgency	44.8	54.1	0.03	58.6	48.2	45.3	0.01	50.0	37.5	50.3	49.3	60.0	0.06	49.7
Strain to urinate	6.7	7.8	0.63	7.0	8.4	6.7	0.84	4.6	4.2	5.3	8.0	11.8	0.04	7.3
Dysuria	4.8	6.8	0.36	1.9	9.0	6.3	0.08	4.6	4.2	7.0	4.4	8.2	0.58	5.9
Stressful events	14.0	12.7	0.62	15.6	10.2	13.8	0.69	22.7	9.7	13.4	13.2	12.8	0.82	13.3

* p values calculated with the Wald test for heterogeneity.
 † p values calculated with the Wald test for linear tendency.

Farhat et al. score described reported having sought medical help for the problem.

Discussion

This study has the advantages of being population-based, of investigating a little-studied age group and of using a standardized questionnaire. When reviewing literature, no other Brazilian studies were identified that had investigated urinary habits.

One possible problem with the study is the possibility of a recall bias, with respect of the age at which sphincter control was achieved, but this variable presented a good level of reliability in the quality control interviews, assessed by Bland & Altman analysis.¹¹ The symptoms related with urinary habits were for the month prior to the interview, which should minimize recall bias. Because this was a population-based study the selection bias that can occur when children are selected from pediatric and specialty clinics was eliminated.

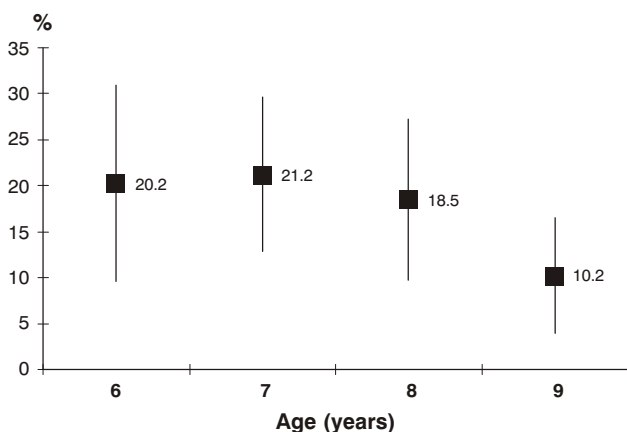


Figure 1 - Prevalence (CI 95%) of enuresis according to age

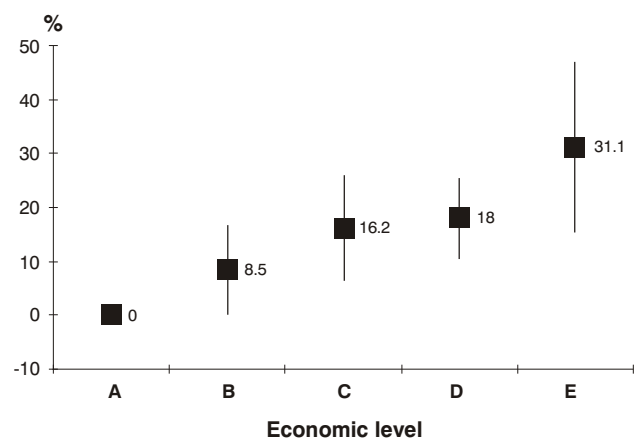


Figure 2 - Prevalence (CI95%) of enuresis according to economic level

Urinary incontinence, holding maneuvers and dysuria were more common among girls and enuresis among boys, as has been described in international studies of schoolchildren from 4 to 7 years in Sweden and Australia.^{2,12}

A high prevalence was observed of urinary symptoms related to bladder hyperactivity (incontinence, holding maneuvers, urinary urgency) which reduced with age, except for holding maneuvers which are honed as the years pass.⁶ Holding maneuvers cause urine reflux via the urethra into the bladder, predisposing towards repeated UTIs and, in children suffering from vesicoureteral reflux, increase bladder pressure, resulting in the vesicoureteral reflux persisting. When urinary urgency is not followed by holding maneuvers, there is no risk of UTI, but there is a possibility of diurnal urinary incontinence.¹³

Voiding dysfunction is a wide term that indicates an abnormal urinary pattern for the age of the child,¹⁴ which is not usually recognized before daytime bladder control, has been achieved.⁷ The literature shows an increase in prevalence rates for voiding dysfunction over recent years.¹⁴⁻¹⁶ However, Bakker¹⁶ questions whether this increase is real, or whether it could be the result of parents' increased knowledge of the existence of treatment for the problem. In the present study it was observed that the great majority of parents did not recognize the symptoms and explained holding maneuvers and urgency as "laziness" or "leaving it till the last minute" because playing. Similar results have been reported in Belgium.¹⁵ The belief that urinary symptoms in children do not need treatment because they tend to disappear spontaneously is incorrect, with the exception of monosymptomatic nocturnal enuresis, which presents a resolution rate of 15% a year.¹ Despite this, it was this symptom that most caused families to seek treatment, in common with other international studies in Sweden.^{17,18} Nocturnal bed wetting is more worrying for parents than presenting diurnal incontinence even if the child needs to change clothes several different times a day.¹⁶ In an evaluation of schoolchildren aged 4 to 6 in Australia,¹² just 16% of all of the children with urinary incontinence received medical care. This symptom can cause self-esteem problems during an important phase of the child's development.¹⁸

The mean age at which sphincter control was achieved was lower than has been observed in other American studies.¹⁹ It was observed that guidance on how to train children out of diapers is not normally supplied by doctors, but passed from parents to children (29.2% guided by grandparents).

In the present study a tendency towards greater symptom prevalence was observed in the lower economic levels, except for holding maneuvers, which had a tendency towards greater prevalence in levels A and B. Just one, Italian, study on enuresis was identified by the literature review, demonstrating an increased prevalence among families of low economic levels, irrespective of the age of the child.²⁰ Our results suggest that poorer children require special attention because of the greater frequency of symptoms.

A positive association between voiding and gastrointestinal disorders has been described in a number of different articles,^{21,22} leading these authors to question the benefits of leaving children to acquire control without training and without the correct orientation as to how a toilet should be used, i.e. allowing a "natural maturation" to occur as has been recommended in recent decades.¹⁶ The present study was unable to assess this association due to the low prevalence of constipation.

A complete history, with special attention to urinary habits will provide orientation with respect of the presence of urinary and intestinal symptoms.²³ Very often such symptoms are concealed by the child and by its parents, who believe that they will resolve spontaneously with time.¹⁶ Many enuretic children transform this symptom into the acceptable act of getting up during the night to urinate (nocturia), which is a common cultural pattern, acceptable to family members (60.4%).^{1,24,25} The questionnaire created by Farhat *et al.* could be used as a guide for the pediatrician to filter children requiring additional investigation by a specialist and prevent the performance of invasive tests, as described by Hellerstein.²⁶ We suggest certain modifications and the inclusion of the enuresis symptom as it is the event that is most important to the children and their families, the one that most often leads to seeking treatment.

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