RESEARCH INTO THE INFLUENCE OF POTTY-TRAINING ON LOWER URINARY TRACT DYSFUNCTIONS

Thesis submitted to obtain the degree of Doctor in Medical Science at the University of Antwerp by

Wilhelmina BAKKER

Prof. Dr. J.J. Wyndaele
Prof. Dr. M. van Sprundel

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To Yvonne, my children and all children with problems

Above the clouds, the sun shines always,
So climb....
### Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>CNS</td>
<td>central nervous system</td>
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<tr>
<td>EMG</td>
<td>electromyography</td>
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<tr>
<td>ICCS</td>
<td>International Children's Continence Society</td>
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<td>ICS</td>
<td>International Continence Society</td>
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<tr>
<td>LUT</td>
<td>Lower urinary Tract</td>
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<td>LUTD</td>
<td>Lower urinary Tract Dysfunctions</td>
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<tr>
<td>MNE</td>
<td>monosymptomatic enuresis nocturna</td>
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<td>NNBSD</td>
<td>non-neuropathic bladder sphincter dysfunction</td>
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<td>PAG</td>
<td>periaqueductal grey</td>
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<td>UTI</td>
<td>urinary tract infection</td>
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<td>PMC</td>
<td>pontine micturition centre</td>
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<td>VUR</td>
<td>vesico-urtereral reflux</td>
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Illustrations are coming from:

- « La maman et le bébé terrible » de Barbro Lindgren et Eva Eriksson. Editions Mijade
- « Les petites vies d'Apolline » de A. Mordéré et Didier Dufresne, Editions Mango Jeunesse
- « Hé, jij daar luister eens even...” Rebecca Verbanck, van ferring en Charco
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Chapter 1

Introduction

Aims
1.1. Development of bladder control

The bladder and bowel are of endodermal and mesodermal origin, originally forming as the invagination of the endodermal surface of the caudal aspect of the foetus, the cloaca. The bladder separates from the hindgut with the formation of the urorectal septum and is first identifiable as a separate structure at 8 weeks of gestation. Mesodermal cells condense around the developing bladder and ultimately become the detrusor musculature. Inductive differentiation of bladder epithelium and smooth muscles occurs with this interaction.

With bladder capacity to supply for storage and expulsion, sphincteric function must develop to provide continence. By 14 to 15 weeks of gestation there is a definite muscularisation of the sphincter, starting at the anterior aspect and progressing posteriorly [Bourdelat et al. 1992, Kokoua et al. 1993], simultaneously the bladder develops a rich innervation for the detrusor musculature.

Further development of the foetal bladder is likely dependent upon function, particularly mechanical stretch, or contraction. The increase in capacity depends both upon the physical size of the bladder as well as its compliance. The latter is the result of visco-elastic properties of the bladder wall (passive compliance) as well as smooth muscle contractility. The net effect is increasing bladder capacity, with increasing voided volumes, which is an important parameter for normal development and a useful indicator for possible lower urinary tract dysfunction (LUTD)[Abrams P et al. 2002]. Absence of function, as in bladder extrophy, is associated with reduced growth and abnormal detrusor development. When mechanical stress is excessive however, abnormal bladder development occurs, as in congenital urethral obstruction. This is characterised by excessive smooth muscle growth, increased amounts of connective tissue and impaired compliance [Peters C et al. 1992].

The function of the lower urinary tract (LUT) is to store and periodically evacuate urine from the bladder. Integration of detrusor-sphincter function is the foundation of continence and normal micturition. It requires perfect co-ordination of smooth muscles of bladder and urethra, and striated muscles of the outflow region and pelvic floor by a complex neural control system. It is generally accepted that the brain plays a crucial role in normal storage and micturition, but in humans little is known about which specific brain areas are involved at each step.
Anatomically the control of the central nervous system (CNS) over the LUT is situated at different levels: cerebral cortex, thalamus, hypothalamus, limbic system, basal ganglia, brain stem with the pontic micturition centre and the periaqueductal grey (PAG), and finally the spinal cord with ascending and descending tracts.

In the peripheral nervous system 3 centres and their nerves are involved:

- the thoraco-lumbar sympathetic n. Hypogastric (D10-L2). They are the principal inhibitory input to the bladder during the filling phase;
- sacral parasympathetic n. Pelvini (S2-S4). They are the principal excitatory input to the bladder during the emptying phase;
- the somatic n. Pudendus, originates in Onuf’s nucleus in the anterior horn of S2-S4 of the spinal cord. They form the pudendal nerves that supply the pelvic floor and the striated urethral and anal sphincter.

All nerves connected to the bladder are able to transport information

- from the organ to the CNS, afferent impulses, which is mainly a sensory function
- from the CNS to the organ, efferent impulses, which is mainly a motor function, and use the same pathways.
An important prerequisite for conscious bladder control is adequate sensory input and correct interpretation of the received information. In healthy spine, afferent activity (information on pressure, pain, temperature, tension) is mediated largely by small myelinated Adelta-fibers that pass through spinal tracts to the brainstem and from there to two pontine micturition centres:

- the lateral L-region is implicated in the maintenance of continence by direct projections to the nucleus of Onuf (Onuf's nucleus in the sacral cord contains motor neurones innervating the pelvic floor, including the anal and urethral sphincters [Sato et al. 1978]), resulting in inhibition of urethral relaxation and of detrusor contraction [Griffiths et al. 1990].
- the median M-region or pontine micturition centre (PMC) is mostly activated if the bladder is filled to such degree that voiding is appropriate. Stimulation of the median region causes a decrease in urethral pressure and silence in the pelvic floor EMG signal, followed by a rise in detrusor pressure [Holstege et al. 1979, 1986].

Despite their role in the control of both micturition and continence, these two pontine centres seem to receive few, if any, direct projections conveying sensory information from the LUT. A rich direct projection does however pass to the mesencephalic PAG [Vanderhorst et al. 1996]. One current model of bladder control holds that during urine storage there is a tonic influence of PAG upon the “continence” neurones of the L-regions. However, when bladder afferent activity indicates a state of bladder fullness and if the situation is appropriate, there is a switch of activity within the pons from the L-region to the M-region. The result is an inhibition of spinal somatic outflow to the urethral sphincter, resulting in relaxation of the striated muscles and activation of sacral spinal parasympathetic fibres to the detrusor causing a contraction resulting in bladder emptying.

Other sensitive bladder receptors have been identified. They seem to be mechanotensive and have unmyelinated C-fibres travelling in the pelvic and pudendal nerves. Electrical stimulation of C-fibres elicits a long latency reflex discharge in efferents of the bladder [Yoshimura N et al. 1997]. These reflexes, known under the name of sacro-spinal reflex, is facilitated by cooling and survives acute spinalization, indicating that it is primary mediated by a segmental reflex pathway [Geirsson G et al. 1999].
The cooling response is physiological in children until about six years and absent in neurologically normal subjects.

The infant bladder has for a long time been accepted to be overactive and to empty automatically at regular intervals through simple spinal reflexes and without any control of higher centres [Bauer et al. 1980, Hjalmas 1988]. Development was believed to be a maturational process, normally functional at the age of 4 years [Doleys and Dolce 1982]. Recently several authors have pointed out spinal micturition pathways influenced by behaviour and/or arousal and dyssynergic voiding patterns with incomplete emptying. They concluded that voiding with incomplete co-ordination between detrusor contraction and sphincter relaxation could be normal [Sillén et al. 1999]. This more complex mechanism has since been confirmed by other urodynamic studies [Gladh et al. 2000].

Mature micturition involves several steps, including

1. filling of the bladder
2. desire to void
3. postponement of the voiding
4. initiation of the voiding by sphincter relaxation, reflex bladder contraction
5. maintenance of the urine flow until the bladder empty
6. bladder refilling

Similar sequences have been discussed for development of bowel control [Largo et al. 1978]. Children’s ability to control their bowel and bladder depends on mastering each step in the cycle. Bowel maturation typically precedes bladder maturation, which is not surprising given the respective complexities of the developmental processes. The
postponement phase of the cycle is the endpoint for what, in Western cultures, is considered bladder/bowel control or toilet training. Postponement is necessary to fulfil two functions: allow micturition/defaecation to occur in a socially acceptable site, and allow adoption of the proper micturition/defaecation position. In this thesis we use “he” indicating the child of both sexes in order to facilitate the reading of this work.

In 1943 Gesell described different steps in the maturation. According to him the development of voluntary control of the bladder is an increasing awareness of the micturition cycle.

- At about 4 weeks he noticed a phase of waking up by the passing of urine and the wetting afterwards. The baby may start crying suddenly during his sleep on the moment of the voidings. This is the first manifestation that the baby is starting to be attentive to signs of bladder activity.
- At 16 weeks the number of voidings decreases and the quantity of urine increases.
- At 28 weeks the diapers are starting to be soaking wet, and the intervals between the voiding will increase.
- At 40 weeks the baby will be dry during about 1 hour, i.e. during the afternoon nap. The mother will place the child immediately after the siesta on a little potty to collect the urine. Some children may even be trained in this way at 28 weeks. The success is rather due to a close control of the mother than to a control of the infant.
- At about 1 year the child might always be dry after the afternoon nap and show some signs of impatience when he is wet. He now can be considered as a good candidate for “dry-drilling”.
- At 15 months the child can sit properly on the potty, and is able to be dry during 2 to 3 hours. He is not able to control the contraction/relaxation of his sphincter, and so to postpone the voiding, but will urinate in the potty if placed there. He is now learning to speak, but is not yet capable to answer the question if he needs to void.
- At 18 months he will be able to delay urination during a short period but will still urinate spontaneously if his urge was not attended shortly enough after it emerged. He might now express his needs.
- At 24 months he will communicate the urge to urinate and will be dry throughout the night if placed on the potty between 10 p.m. and midnight.
He is now able to interrupt the voiding, but still have some difficulties to relax the sphincter and initiate the miction.

- At 36 months he will use the toilet independently.

Thirty years later McKeith et al. presented in 1973 a similar timeline by proposing that children

- At 15 months of age would point to wet clothing, demand to be changed soon after wetting at night, and use the same word for faeces and urine
- Between 18 and 24 months would report soiled diapers and use separate words for faeces and urine
- At 2 years would sometime announce the need to urinate
- Between 2.5 and 3 years they would usually announce their need in time to be taken to the toilet
- From 3 years they would be able to delay urination for some time after urgency developed and thereafter eliminate or evacuate in an appropriate place.

The authors suggested that a 3 year old child would go to the toilet unattended, but would easily be distracted and forget to urinate. He will not always be able to initiate the voiding at any place.

In 1993 Zerin et al. confirmed these findings by cystourethrography in 274 children (214 girls and 60 boys) with anatomically and neurologically “normal” bladders. They observed a very important increase in bladder capacity between 18 months and 4 years. During this period the median bladder capacity tripled from 72 ml in children aged less than 18 months to 226 ml by age 4 years. They also noticed that although the majority of the children were able to prevent micturition by age 4 years, many of them would still not been consistently ready to initiate the voiding spontaneously on all occasions. The children were incapable to voluntarily open the bladder neck and relaxing the external sphincter. When the authors encouraged these children to void, these generally would increase intra-abdominal pressure by straining (with depression of the bladder neck and the pelvic floor). Straining will elicit a reflex contraction of the pelvic floor, with an increased risk for incomplete emptying of the bladder.

Although bowel and bladder symptoms at low age typically are transient in otherwise healthy children, untreated issues can spiral into physical, behavioural and
developmental problems. These will disrupt toilet training, and chronic wetting and soiling may persist well into the school years and often are refractory to empirical medical treatment.

If untreated, transient changes in bowel function associated with constipation can lead to bladder problems. For a variety of reasons the toilet training process itself can be a primary cause of stool-withholding behaviour and constipation: children using regular toilets rather than a potty fell into the pot with dangling legs and are unable to build up sufficient intra-abdominal pressure (because they cannot push against the floor) to eliminate stools [Christophersen 1991]. Additionally the toddler in training may withhold stools as response to excessive parental pressure. Institutionalised day care settings may also lead to constipation and primary encopresis by inadequate information between caregivers and parents: both parties may incorrectly assume that the child defecates only at home or only at the centre [Brazelton et al. 1999]. It is highly significant that a majority of children who do not attain social bowel continence have a history of constipation beginning at toilet training age [Issenman et al. 1999].

1.2. Toilet training

Toilet training sensu stricto seems to have been limited to bowel training as long as children had no underwear. As training instruments, throughout history, examples can be found of special chairs, with a hole in the seat and a potty attached underneath. Prior to the seventeenth century, toilet training is not even mentioned in medical or pedagogical treatises, except for stool. This proves to a certain point that
people did not think too much about it. Blankaart’s treatise on the bringing up of children and on their diseases is very clear on this point: put the child on a potty (close-stool) and wait. There are examples -for instance the future Louis XIII, whose childhood years were dutifully recorded by his physician Jean Hérard- who at the age of 16 months was put on a chair for several hours at a time.

Once the art of disposing the stool where it belongs was mastered, with help from potty chair or chamber pot, the child was considered housebroken, and could start walking around the house, often on a leash, dressed in just a shift or shirt. Outside the house, children could make water whenever and wherever they felt the urge, without drawers, knickers, or pants to worry about. Until the 17th century, the transition from being swaddled as an infant to being housebroken seems to have been a very casual and uncomplicated matter. Water closet did not exist at that time, they are a Victorian contraption which no farmer in his right mind would tolerate inside the walls of his living quarters. Up to the nineteen fifties in rural Europe, toilets and sewer systems were non existent in villages, in contrast with their presence in towns. Rainwater, water from the kitchen, and urine ran together in the gutters of the village street. The urine came from open urinoirs in the yard or “cour” still synonymous with toilet in Belgium. Toddlers and pre-school children, boys and girls alike, were dressed in buttoned-up long shirts over a shift, without underpants underneath. At daytime, they voided outside, squatting over a gutter, or standing up against a wall, a tree, a corner. At night they had a chamber pot under their bed, to be emptied in the morning. For bowel movements, one sat on a wooden box with a hole in the seat, placed over a deep pit, which was emptied for manure periodically. Chinese toddlers to this day wear no underpants, but trousered suits with a slit in the crotch of the pants, to make voiding less of a nuisance.

In the beginning of the 20th century, the prevailing attitude toward toileting was still one of permissiveness: daytime wetting was of no concern to parents as small children had no underwear. In “L’enfant et son médecin” of Albert Ball in 1922, daytime wetting was not even mentioned in the chapter dedicated to urinary incontinence. Night-time wetting, in contrary, was a far more bothersome condition, as small children slept very often with their parents in one bed. Besides anatomical origins as hypospadias, a range of possible causes for this disease was reported: stress, heredity, and thyroid insufficiency. Treatments reached from psychotherapy, via spanking to more aggressive attitudes:

- Psychotherapy: reassuring the child
• Hygienic and physical measures: drink less at the evening, eat less meat, sleep with the pelvis higher, envelop the child in wet cold sheets,...
• Electrotherapy with faradic currents during 10 minutes with two small electrodes placed on the perineum and the pubis
• Pharmacotherapy reaching from belladone to strychnine
• New therapies as lumbar punctions, perineal injections of 40-60 cc serum were considered as simple and non dangerous treatments.

Popular medicine proposed also a big variety of treatments for bedwetting:
• drink infusions with herbs
• rub the legs and the stomach with Hypericum Perforatum (Uyl)
• pilgrimages to f.i. Liefferinge or Tongeren (Saint Ursula)
• eat an egg mixed with red wine before going to sleep
• eat a fried mouse in a pancake
• eat a slice of bread with a lot of salt
• drink boiled milk with onion
• drink every day the urine
• dress the child with a shirt of a dead child
• put some urine of the patient in a coffin and bury it

The attitude towards toilet training -laissez faire-laissez aller- changes dramatically in the mid 1930's: the notion that a child should be taught to control the urge to void or to defecate at all times appears for the first time. The use of very strict and structured schedules were applicated: parents were invited to train their children as early as possible. Toilet training was usually begun before 1 year of age, when children could just sit without support. The early onset and high intensity of potty-training had strong practical reasons, namely the labour-saving effects of avoiding extra laundry [Hindley 1968, Largo and Stutzle 1977]. Parents often used methods that would be considered very coercive by current standards, especially in case bladder and bowel control was not reached at the time parents expected it. Stephens and Silber reported on the risk of parents expecting the training to be completed too early (by punishing the child for wetting accidents), which may in contrary interfere on the normal process of bladder development [Stephens and Silber 1974].
Official instances, as for example the “Commissie inzake Huishoudelijke Voorlichting en Gezinsleiding” in 1946 (The Netherlands) proposed pamphlets with directives how to deal with for instance night-time wetting, reaching from practical advices as how to keep the mattress dry and how to wash the sheets (you can use the same broth several days), to how to react in case of the wet beds. They were very reassuring as to the spontaneous resolution of bedwetting, except the complete feeble minded no adult will regularly wet his bed, and warned against spanking or punishing. A lot of love and comprehension of the mother was prescribed. They insisted heavily on the importance of keeping the disease secret: the bedwetting is between the mother and the child: no one else has anything to do with it, so don’t ever talk about it with your family, friends or neighbours!

From end 1950’s, adherents of child oriented toilet training cautioned against coercive methods and encouraged parents to promote independent toiletting by allowing children to train on their own schedule, and to favour the physiological process of maturation to bladder and bowel control without any intervention of the caregivers. The development was described as a largely maturational process, which is normally functional at the age of 4 years. Practitioners as Ilg and Ames suggested in 1955 that children will train themselves through a natural maturation process if left alone. In the late fifties, Dr Spock supported this point of view in his book on “Baby and Child Care”, which has been a reference in the field of how to take care of your child at that time and long after. According to him, lasting problems with bladder control were only in a very few cases caused by a physical disease. In the big majority night-time wetting and even daytime wetting were caused by psychological stress or bad will of the child. Only emptying difficulties and pain (caused either by an UTI or vaginal infection) found their origin in a physical or functional dysfunction.

Brazelton’s child-oriented approach from 1962 was a compromise between the different theories. He emphasized a gradual learning process, that was gently introduced as the child matures. After the child reached the age of 18 months, a potty-chair on the floor was introduced as the child’s own chair. A verbal association was made between the potty and the parent’s toilet seat. During the 1st week the parents took the child to sit on the potty for a few minutes every day. The child was completely clothed, as the unfamiliar feeling of a cold seat could interfere with further cooperation. When the child sat on the potty, the parent could read a story or give the child a snack to eat. During the 2nd week the child was asked to sit on the potty with his diapers off. No attempt of “catching” stool or urine will be made. Gradually, when
the child got interested in sitting on and eliminating in the potty, he was taken to the potty a second time during the day. If the child was willing, he was taken to the chair several times a day. During the next phase the potty was placed in an appropriate place, and diapers and pants were removed for brief periods of time. The child was encouraged periodically to go alone to the potty. Night training was postponed until the child developed the ability to control bowel and bladder function during the day. When the child expressed an interest in night training, the parent could awaken the child in the early evening and offer him the opportunity to go to the potty. A pot, painted with luminous paint, placed near the bed of the child could be very useful.

A decade later a structured behavioural method was designed by Azrin and Fox's in a one day training program [1974]. According to them three areas needed to be assessed when deciding if the child was ready to begin training: bladder control, physical readiness and instructional readiness.

- **Bladder control**: the child was deemed to have sufficient bladder control if he urinates a good portion at one time (no more dribbling), was capable of staying dry for several hours, and was aware of his need to eliminate (by body signs).
- **Physical readiness**: the child was physically ready if he had enough fine motor co-ordination in his fingers to pick up small objects, was capable of walking easily...
- **Instructional readiness** was assessed by asking the child to carry out 10 simple tasks (touching one's nose, imitating a parent,...). The child was considered “ready” if eight of the 10 requests were carried out correctly.

In this training procedure a doll was used as a symbolic model to accomplish two tasks: the acquisition of the new appropriate toileting behaviours and the inhibition of the already existing inappropriate toileting behaviours such as wetting and soiling.

The first was accomplished by having the child observe the doll toilet appropriately and then receive a reward for its behaviour.
Similarly, the second was accomplished by having the child observe what happened to the doll when it had an accidental wetting: parental disapproval. In addition to having the child observing this procedure, he was also required to participate in helping guide the doll to each step of toileting. Reinforcement for these newly acquired behaviours had to be included in the training program.

Murphy [1975] and Horner and McClellon [1981] include several additional indices of readiness. Adequate muscular and neurological development was considered present if the child had been walking and stooping well for 6 to 12 months. The child should also be capable of sitting still for 10 minutes, and should be able to help in dressing and undressing himself. He should know the meanings of the words used in the training process, “pot”, “wet”, and so forth.

A similar procedure has been described by Doleys and Dolce in 1982: they broke down the total process into a preparatory phase, a training phase and a follow-up phase when the learned skills were practised and refined.

Follow-up surveys, from Klackenberg [1971] and Largo et al. [1996], confirmed that bladder and bowel control are largely maturational processes, which cannot be accelerated by an early onset or high intensity of training. They incited the parents to a still more child oriented approach, with more and more emphasis on readiness rather than on age.

The introduction of disposable nappies and information campaigns in the press were probably the last factors which provoked a profound change in toilet-training during the last 60 years [Schmitt 1987, Largo et al. 1996, Brazelton et al. 1999, Bakker et al. 2000]. Physiological maturational rates have then been accepted to vary greatly between children, and to be dependent upon several factors as sex, race, weight, culture. Oppel et al. [1968] reported that maturation is dependent on a lot of different factors, including child’s birth weight: babies weighing less than 2.5 kg for instance will be slower than normal or above-weight babies in achieving day and night dryness.

The development of a more and more child oriented education during the following years, in which imposing rules to children is prohibited, or at least strongly dissuaded, had also his consequences on toilet training. The achievement of property was no more considered as a development, but as a gift from the child to the mother, and thus in a way as a standard for the quality of the “child-mother” relationship [e.g. Dolto, Prévot]. When the results failed to materialise, it was rather considered due to
psychological than to physiological factors. Parents started to "compete" on the age at which bladder and bowel controls were obtained, in order to receive the label of a "good mother". Cleanliness became a standard of the child's well-being and a potential source of anxiety.

As no, or very contradictory, scientific information on the value and effects of potty training is available at this time, a great deal of sensitivity is required by the parents "to catch" the child when he would be developmentally ready to become dry and clean. The reports on negative effects of training, if started too early, added to the stress of the parents to "catch" the child at the right moment. Ilg and Ames [1962] reported school problems generating more questions from parents who sought help from the Gesell Institute of Child Development.

Recent urodynamic studies have revealed the presence of a more complex mechanism during voiding than has generally been thought; they also showed that the integration of bladder-sphincter co-ordination in infants is not a simple reflex action occurring as the bladder fills. The voiding patterns do not always appear to be coordinated, and often show multiple incomplete voids.

Spinal micturition pathways, involving a complex integration of neural pathways at both peripheral and central levels, are influenced by behaviour and/or arousal. Micturition never occurs during quiet sleep: there is a cortical arousal in response to full bladder even in new-born infants [Wille S 1994, Neveus T] et al. 1999, Wolfish NM 2001].

The "dyssynergic" voiding patterns indicate incomplete co-ordination, which will at a later age be functionally controlled at several levels of the central nervous system. The development of voluntary control therefore represents, according to Yeung et al. [1995] and Gladh et al. [2000], only a modulation of pre-existing reflexes. Yeung suggested in 1995 that voiding with incomplete co-ordination between detrusor contraction and urinary sphincter relaxation could be normal, which could mean that non neuropathic bladder-sphincter dysfunction (NNBSD) is a physiological transition phase in normal bladder maturation. In 2000 Hellström put forward the possibility of an increased risk for development of NNBSD with a prolonged transition period to bladder control and with increase child's age at the start of the training. One year later the same group [Hellström and Sillén 2001] discussed in a paper the possible negative consequences of the postponement of the start of the training. They confirmed the findings of Sillén et al. [1999], who studied the voiding pattern in children with dilating
reflux and noticed a decrease in residual volume and urinary tract infections in both boys and girls once potty-training was completed [Sillén et al. 1999]. Other studies already documented positive consequences of potty-training [Jansson et al. 2000, Sillén and Hanson 2000].

This reiterates the old question: when and how to toilet train? Whether early training also results in early completion is at the centre of a long standing controversy: the use of different endpoints for completion of training increases the confusion. A child can be considered toilet-trained when he no longer needs assistance or supervision of a parental figure or caregiver to use the toilet, and can assume the responsibility of independent toileting. This definition differs from the concept of toilet training as the ability to remain dry or clean through close control of the caregiver. If independent functioning and volitional control are the goals of the training, little influence of training may be expected. In fact, attempts at independence as an endpoint seem likely to frustrate parent and child, or even worse. At the other hand a child may be developed enough to control evacuation and remain accident-free for long periods of time, but may do so only with the assistance of the parents frequently reminding the child to use the toilet or sending the child to the toilet when they think he has the need to eliminate. Earlier training may only be possible, if it focuses on the child's indication of need and the caretaker's awareness of the indication. The concept of remaining dry and clean is of course not sufficient at long term, because it fails to include the concept of independent toileting. We should however not forget that most of the learning processes of the child start through a close control of the parents, and that growing up is synonymous for getting independent and taking over responsibilities.

Smeets et al. [1985] have shown that in placing the responsibility for the training in the hands of the caregiver, early completion of training is possible. They studied toilet-training in 3-6 months old children. They included in their group of target behavioural signals (e.g. grimaces, quieting, etc) and reaching for the potty. In the initial phase of the study they made sure to keep the potty within the child's visual range and also made sure the children looked at, or touched the potty whenever they emitted body signals. In the next phase the children were helped onto the potty after body signals. As their proficiency increased, diapers were taken off and the distance between the child and the potty was gradually increased. All children in the study were trained (accident-free) before they could walk.
These findings were confirmed by de Vries and de Vries [1977] who reported that society’s infant-specific training practices are adaptive to survival and cultural values. The East African Digo believe that infants can learn soon after birth and begin toilet training in the first week of life. To accomplish this, the mother and the child are in constant physical contact for the first 3 months of baby’s life. Whenever the mother senses that the baby is about to void, she places the baby between her knees and use tactile interactions to provoke the voiding. The child is then rewarded with feeding and/or close physical contact. At about 3 to 4 months, young caregivers (5 to 12 year old girls) take over the baby care during the day. If an accident happens, the attendants and not the babies are punished. This means that the responsibility for the training is placed on the parents and caregivers, and not on the child as it is in our Western society today.

In conclusion most children seem to achieve bladder control anyway, but several facts must be considered:

- the success reported with training and behavioural programmes for dysfunctional voiding associated with recurrent UTI and/or daytime wetting. [Hoebeke et al. 1996, De Paepe et al. 1998].
- the better emptying of the bladder in children with congenital dilating vesico-ureteral reflux (VUR) by control of the voiding [Sillen and Hanson 2000, Hellström and Sillen 2001].
- the risk of NNBSD developing during the transition to bladder control [Hellström 2000].

From these fact it becomes clear that actual used training methods should be reconsidered. Up to now it is not clear if potty training might contribute in preventing lower urinary tract dysfunction, or if on the contrary, certain methods might provoke dysfunctional voiding problems at a later age [Bakker et al. 2000].
1.3. Lower urinary tract dysfunctions

1.3.1. Pathophysiology of the LUT

Normal function of the detrusor allows bladder filling with little or no changes in pressure. No involuntary phasic contractions should occur despite provocation. Normal voiding is achieved by a voluntarily initiated continuous detrusor contraction that leads to complete bladder emptying within a normal time span, and in absence of obstruction [Abrams et al. 2002].

Consequently functional pathophysiology can be divided into abnormalities during filling or during emptying phases, though dysfunction can occur during both simultaneously.

Standardisation and definitions are used as approved by the International Children’s Continence Society (ICCS) in 1998, but also adapted to the new terminology 2002 of the ICS (International Continence Society).

1.3.1.1. Dysfunction in the filling phase

- Detrusor overactivity

The first descriptions of non-neurological detrusor dysfunctions in patients with severe disease, date from 1915 [Beer]. He described disharmony between sphincter and detrusor and postulated it was caused by an occult neurological disorder. Further reports on this condition did not appear until 1973, when Hinman and Bauman [1973] described a small group with unco-ordinated micturition, MNE and recurrent UTI without neurological or obstructive disease. It was thought to be a behavioural functional disorder. Its reversal by biofeedback and hypnosis gave an argument in favour of the behavioural nature.

Different terminology has since been used in the pathophysiology of filling: uninhibited bladder, infantile bladder, irritable bladder, spastic bladder, reflex bladder. In the ICS standardisation of the terminology of lower urinary tract dysfunction [1976,1977] the term “detrusor instability”, was adopted as first used by Bates et al. in 1970, was reserved for an involuntary phasic detrusor contraction of any pressure during the filling phase while the patient is trying to inhibit micturition. In patients with relevant neuropathy this was called “detrusor hyperreflexia”.

The ICS standardisation and terminology 2002 has recently introduced the term “overactive bladder” [Abrams et al. 2002]. Detrusor overactivity is defined as a urodynamic observation characterised by involuntarily detrusor contractions during the
filling phase which may be spontaneous or provoked, and can be qualified according to the cause in neurogenic- or idiopathic detrusor overactivity.

In 1980 Bauer et al. defined abnormal voiding patterns, based on urodynamic investigations in a large study of affected children. He grouped the disorders into

1. primarily unstable bladders (small capacity, hypertonic bladders, detrusor hyperreflexia)
2. infrequent voiding associated with large capacity (lazy bladder syndrome).
3. psychological non-neuropathic bladder

Other studies in large populations of children concur [Mayo and Burns 1990, Breugelmans and Wyndaele 1992]. Webster et al. evaluated 60 neurologically normal children with video-urodynamic studies and found 47% to have phasic uninhibited detrusor contractions, recommending all children with voiding symptomatology to be studied [1984]. Weerasinghe et al. [1993] studied the correlation between diagnosis by history-taking and by urodynamic findings in 56 children: only 20% of the normal and 56% of the abnormal results were correctly predicted. This suggests the potential for incorrect treatment without the use of urodynamics. Glazier et al. [1997] retrospectively studied 38 children with UTI and symptoms of bladder-sphincter dysfunction and documented bladder instability in 71%

These data show involuntary detrusor contractions during provocative cystometry, are one of the most common elements of NNBSD. The necessity of urodynamic investigation in NNBSD is however contradicted by Himsl and Hurwitz [1991]. They feel there is little value to the use of urodynamics: diagnosis of urgency or dysfunctional voiding can be made accurately in 80% of the cases with a structured history and physical examination. Micturition charts (Addenda 4), giving information on volume and frequency, are also very helpful. These authors suggest that only in doubtful cases, or with therapeutic failures, both ultrasound imaging of kidneys and bladder as well as full urodynamic studies are indicated.

The exact causes of the development of bladder overactivity are yet unclear. It has been believed that the uninhibited bladder contractions are exclusively a consequence of a retardation of the maturation of the reticulospinal cords and the inhibition centres in the cerebral cortex. In 1989 Goldraich et al. however noticed that the balance between bladder and sphincter is very vulnerable as long as the child has not acquired the ability to suppress the detrusor contractions. Hellström suggested recently that in
the period of transition to bladder control there might be a risk of development of NNBSD [2000].

According to the 2002 terminology **urgency** (formerly overactive syndrome, urge syndrome or urgency syndrome) is defined as the complaint of a sudden compelling desire to pass urine, which is difficult to defer. Urgency may lead to urge-incontinence, which is the complaint of involuntary leakage accompanied by or immediately preceded by urgency. The term “urgency” may only be used if there is no proven infection or other obvious pathology [Abrams P et al. 2002].

Clinically urgency is characterised by frequent needs to void, caused by detrusor contractions during the filling phase of the bladder, causing imperative urge to void at small capacity [van Gool et al. 1989, van Gool and de Jonge 1989]. Symptoms and signs as urge-incontinence and/or frequency and/or inability to postpone the voiding and/or nocturia are suggestive of urodynamically demonstrable detrusor overactivity, but can also be due to other forms of urethro-vesical dysfunction.

The overactive detrusor contractions are countered by pelvic floor contractions to minimise wetting and to postpone imminent voiding. This will “overtrain” the pelvic floor muscles, who will cause functional outlet obstruction due to urethral and pelvic floor overactivity (see dysfunctional voiding). The dysfunctional voiding will, in turn, maintain the filling phase dysfunction of the detrusor [Hoebeke et al. 1996].

If children wet in spite of pelvic floor contractions, they may even add external compression to the urethra, such as sitting on the point of a chair, pushing the heel
against the urethra. [Vincent 1966]. The habit of countering every urge to void inevitably leads to postponement of defaecation (see associated symptoms).

Urge incontinence usually peaks in the afternoon, and may have a nocturnal component, which may or may not wake the child. Night-time wetting in a child with urge is not categorised as enuresis but as incontinence: the wetting at night is caused by the same dysfunction as its daytimes counterpart.

Although wetting is commonly seen, urgency should also be considered in continent children with recurrent UTI and VUR [Koff 1992].

- Abnormal bladder sensation

Normal bladder sensation can be judged by three defined points noted during cystometry and evaluated in relation to bladder volume at that moment. Bladder sensation may be increased (an early desire to void at low volume), reduced (diminished sensation during bladder filling) or absent. Bladder sensation is difficult to evaluate in children, and can only be used in toilet trained cooperative children.

In adults extensive work on bladder sensation has been done [Wyndaele 1991, 1992]. The only work on bladder sensation in children was done by Wyndaele. He selected a group of 35 children presenting MNE but could not find any difference in bladder sensation with a control group of 28 patients [1993].

Conclusion: During the filling phase several dysfunctions can be present: bladder overactivity, sensory problems and incompetent urethral closing mechanism.

- 1.3.1.2. Bladder emptying phase

- Dysfunctional voiding

Overactivity of the pelvic floor and the urethral sphincter used continuously as emergency brake to prevent leakage’s, leads to a hypertonic pelvic floor. The most common problem in these children is their inability to relax the pelvic floor during the mictions, leading to dysfunctional voiding. Different patterns of dysfunctional voiding have been described, all with pelvic floor overactivity during voiding as common denominator. The patterns range from staccato voiding, to fractionated voiding to lazy bladder with incomplete emptying. Although nobody to date has proven that such sequences exists, it does make the pathogenesis of these disorders easy to understand.
Staccato voiding:
If the urethral sphincter no longer relaxes completely during voiding a staccato pattern may be observed. This rhythmic voiding pattern is caused by periodic bursts of pelvic floor activity during voiding, resulting in dips in the urine flow rate coinciding with high detrusor pressure.

![Volume vs. EMG](image1.png)

A flow rate above a certain threshold seems to trigger the pelvic floor muscles into contraction. As soon as this contraction has reduced the flow rate, the pelvic floor relaxes again and the flow rate regains the threshold. Flow time is prolonged and emptying may not be complete, increasing the child's risk for developing UTI [van Gool 1996].

Fractionated voiding:
Is characterised by incomplete and infrequent voiding, with micturition in several separate fractions. Here both the voiding and the filling phase are abnormal.

![Volume vs. EMG](image2.png)

The voluntary, repeated postponement of the voiding can also lead to chronic overactivity of the pelvic floor, with overdistension of the bladder and loss of
perception of bladder filling. Gradually the bladder will decrease its capacity to contract and these children will have incomplete voiding on abdominal pressure. The voiding consists of several detrusor contractions, each with his own flow. Abdominal pressure is often used to shorten the flow time. Wetting in these cases is usually secondary to overflow incontinence [van Gool 1996].

- Detrusor underactivity

Detrusor underactivity, or lazy bladder, is defined as a contraction of reduced strength and/or duration, resulting in prolonged bladder emptying and/or failure to achieve complete bladder emptying. The most extreme form is an acontractile detrusor. This pattern in children was recognised in 1962 by Luca. Straining becomes the driving force to expel urine. Normal bladder sensation is absent and children postpone micturition.

**Conclusion:** During voiding the main dysfunctions encountered are thus related to inadequate sphincter function, the use of straining and inadequate detrusor contraction.

1.3.2. Associated pathologies

The nature of the relationship between NNBSD, UTI and VUR is unclear. Whether NNBSD may give rise to (recurrent) UTI, or, whether a bacterial cystitis may give rise to NNBSD is not clarified until yet [Allen and Bright 1978, Koff et al. 1979, Koff and Murtagh 1983]. Even if at present there seems consensus that the triggering factor most often is immaturity of the co-ordination between detrusor and sphincter, it is probable that the train may start from any of the three stations.

Association between bladder and bowel dysfunction has been described in many reports, but the exact pathophysiology remains unexplained [Neumann et al. 1973, De Paepe et al. 2000]. O’Regan et al. reported in 1986 a resolution of daytime wetting in as many as 89% of the cases after treatment of constipation.

- 1.3.2.1. Recurrent UTI

Recurrent UTI and VUR form a well documented clinical complex in school-age children, especially girls. Children with dysfunctional voiding are more likely to have recurrent UTI as a primary symptom as compared to children with urgency. This is felt
to be secondary to incomplete emptying NNBSD. [van Gool and Tanagho 1977, Koff 1982, van Gool et al. 1992, Chandra 1995, Vega and Pascual 2001]. Bladder-sphincter dysfunction, both neuropathic and non-neuropathic, has been documented extensively as a major factor in causing and perpetuating VUR [van Gool et al. 1984]. The complex causes considerable morbidity, both from infection and incontinence, and has a prevalence that peaks at 8% around the age of 7 years, slowly decreasing to about 2% around adolescence [Hellström 1990].

De Paepe et al. delivered indirect evidence for the casual relationship between NNBSD and recurrent UTI by a prospective study on pelvic floor therapy. They studied the relationship between urge syndrome, dysfunctional voiding and incomplete emptying [1998]. In girls they found the highest risk for development of recurrent UTI in those with a lazy bladder (53%), indicating that residual urine is even a higher risk factor than detrusor instability. No significant differences between urge syndrome and dysfunctional voiding were found, indicating that bladder instability is a higher risk factor than detrusor sphincter disco-ordination.

During unstable contractions urine is pushed into the distal urethra: when the contraction stops the urine returns to the bladder, possibly carrying bacteria from the distal urethra. This traditional concept of “milk-back” of potentially infected urine from the distal urethra seems to be less important than detrusor instability itself [Hoebeke et al. 2001].

- 1.3.2.2. Vesico-ureteral reflux

Reflux is the retrograde flow of urine from the bladder into the ureter. It results in an aliquot of stagnant urine remaining in the urinary tract after the bladder has emptied, and provides a pathway for the ascent of bacteria from the bladder into the kidney, facilitating renal involvement once bacteriuria has been established in the bladder [Aperia A et al. 1976, Jodal U and Winberg J 1987, Hellstrom et al. 1989, Jacobson et al. 1989, Holland et al. 1990, Rushton and Majd M 1992]. VUR is found in 29 to 50% of children with recurrent UTI. About 30% of such patients have evidence of renal parenchym scarring due to pyelonephritis. Although VUR is an important risk factor for renal damage, it can also occur in the absence of reflux [Jacobson et al. 1992, Jacobsson et al. 1999].

Complications of renal scarring are known and well documented. For example in pregnant women following complications have been described [Becker et al. 1986,
Kincaid-Smith and Fairley 1987, Cunningham et al. 1990, Jungers P et al. 1991, Jones and Hayslett 1996:

1. toxemia: 13-79%
2. preterm delivery 30-57
3. foetal growth retardation: 31-43%
4. foetal loss: 9-75%.

Prevalence of renal scars at first referral is already high: van Gool and de Jonge reported in a retrospective study an average of 30% in 93 children [1989], Goldraig et al. [1989] reported in a prospective study an average of 38% in 202 children. Smellie et al. in 1998 reported not only even higher prevalence’s (49% in 309 children), but also the possibility to limit new renal scars to 2-5%, with careful management once the diagnosis has been made.

Important factors provoking renal scarring are young age at first infection and delay of treatment. In young children, infections should be diagnosed pro-actively and treated as soon as possible in order to prevent renal scarring. Scrutinous history taking should reveal any sign or symptom of NNBSD: recurrent UTIs and NNBSD should be treated together not separately [van Gool JD and Tanagho EA 1977, Peters CA et al. 1992].

- 3.2.3. Bowel dysfunction

The anatomical proximity of bladder and bowel, and the identical innervation of the urethra and the anal sphincter, make it tempting to conceptualise that dysfunction can occur in both systems simultaneously.

Constipation most often has a functional cause, but anatomical and neurological origins must be excluded [Loening-Baucke 1991, 1994]. Soiling is defined as the involuntary seepage of loose stool resulting in staining of underwear. Encopresis is the involuntary loss of formed, semi-formed or liquid stool into the child’s underwear in the presence of idiopathic (functional) constipation in a child after the age of 4 years, occurring on a regular basis without any organic cause. The difference between encopresis and soiling is the amount of faeces lost [Loening-Baucke 1991, 1994, 1996].
Functional constipation, with or without soiling represents a common problem in children with urge syndrome. The high pelvic floor tone present in urge syndrome and in dysfunctional voiding, as a result of defence against urine-loss, might contribute to the occurrence of constipation [Dumont 1979, Dohil et al. 1994, Wan et al. 1995, Blethyn et al. 1995, Kalo and Bella 1996, Loening-Baucke 1997, Issenman et al. 1999, De Paepe et al. 2000]. O'Regan described in 1985 the link between constipation, bladder instability and UTI [O'Regan et al. 1985,1986]. These findings were confirmed by Romanczuk and Korczawski in 1993, who revealed a high percentage of LUT-problems in hospitalised children for chronic constipation. Koff et al. proposed in 1998 the concept of “dysfunctional eliminating syndrome”, covering both urinary and bowel dysfunction.

The pathophysiology of functional encopresis and soiling is not clear. Rappaport and Levine proposes in 1986 a developmental model for understanding the evolution and treatment of bowel problems in infancy and childhood. It focuses on anticipatory guidance to maximize parental understanding of the normal variations of bowel function and specific interventions to limit the long-term effects of mild bowel problems.

For a long time it was thought that too early potty training might lead to toileting refusal. This has been contradicted by the findings of Taubman in 1997. He reported significant more toileting refusal in children trained at a later age.

Different hypothesis for development of constipation are emitted:

- The habit to counter every urge to void with voluntary pelvic floor contractions leads to inappropriate postponement of defaecation, leading to constipation and soiling. High tension of the pelvic floor muscles can cause a paradoxal contraction of the pelvic floor, which is defined as the contraction of the puborectalis muscle or/and the anal sphincter during defaecation [Wasserman 1964, Wald et al. 1986, Keren et al. 1988].

- Anal pain due to hard stools or anal injuries may lead to fear of next defaecation and thus to delay of eliminating stool. The overtraining of pelvic floor muscles to withhold stool, causes faecal impaction, pain during the defaecation, leading to a paradoxal contraction of the sphincter and incomplete emptying of the bowel [Loening-Baucke and Younoszai 1982]. This leads to chronic distension, decreased ano-rectal sensibility, more faecal impaction, more pain and finally involuntary stool loss. Indeed, infants and
toddlers with constipation usually have a history of infrequent, hard and painful bowel movements, often accompanied by screaming and stool-holding manoeuvres [Loening-Baucke 1987].

- Chronicle incomplete emptying by the use of an adult toilet to large for small children, who will fell into the pot with dangling legs. The inadapted toilet seat offers insufficient leverage to build up intra-abdominal pressure [Christorphensen 1991].

**Conclusion:** Pathophysiology of constipation in children can probably start from the three different stations at the time.

### 1.4. Therapy

#### 1.4.1. Pharmacotherapy

To date no randomised controlled studies are available where the studied population received standardised pharmacotherapy as only intervention.

- **1.4.1.1. Anticholinergics**

found a 4-fold increase in the resolution of UTI and VUR compared to non-randomised controls.

- 1.4.1.2. Treatment or prophylaxis for UTI


- 1.4.1.3. Treatment of concomitant constipation

Treatment consists of faecal disimpaction with drugs, laxatives to prevent future impaction [Loening-Baucke 1991, 1994].

1.4.2. Cognitive training for bladder and bowel dysfunction

- 1.4.2.1. Treatment for bladder dysfunction

Pelvic floor therapy is used in the rehabilitation of dysfunctional bladder and is a combination of cognitive, behavioural and physical therapy methods. The programs are based on careful evaluation of bladder function. The aim of this training is to normalise the whole voiding pattern and prevent further functional disturbances. Function should be viewed as an integrated concept, from the filling to the emptying phase.

1. **Explanation and demystification**: The first step is a dialogue between the child and the therapist, about normal bladder function. It is important to get the child interested in it's own condition. An essential part of this is explain, and show all images which can help.

2. **How to void**: instructions on how to void are the next step: a relaxed position in order to empty the bladder completely should be practised. The best position to relax the pelvic floor is sitting slightly forward, with the thighs supported and a little bit apart [Wennnergren et al. 1991].

3. **When to void**: to promote a normal bladder work schedule, a bladder regime is often applied [Hellström et al. 1987,1992]. This implies voluntary initiation of voiding on predetermined times with 1-3 hours intervals, and without previous
urge, in order to practise voluntary control over the bladder. Another goal is to regain a normal rhythm of bladder emptying. Frequency/volume charts are filled in by the child, scheduled to follow the daily life of the child. Children with urge start with shorter intervals, gradually increasing them as soon as the urgency attacks disappear. Children with lazy bladder have to learn to decrease the intervals.

4. **Pelvic Floor relaxation**: in children pelvic floor muscles almost never fail as emergency brake, except sometimes during imperative urge, or during uncontrolled laughing. However the most common problem occurs in children when they are unable to relax the pelvic floor during voiding. In some cases instructions and practise can remedy this problem, but in the more severe cases the treatment should focus specifically on the pelvic floor. Several programs exist with pelvic floor exercises and perception practice, tailored to suit children [Hoebeke et al. 1996, McKenna et al. 1999, Herndon et al. 2001]. A prospective evaluation [De Paepe et al. 1998] reported a success rate of more than 80% in 42 girls with a history of recurrent UTI and urodynamically documented bladder sphincter dysfunction. The studies describe physiotherapy exercises in an excellent way and show definite improvement of signs and symptoms. Controlled studies on physiotherapy alone are still missing, as programs described are always compound packages of pelvic floor exercises, biofeedback and behavioural therapy.

5. **Biofeedback**: implies perception of detrusor contraction (filling phase) or pelvic floor relaxation (emptying phase). This is achieved through monitoring of these activities, in a way which is easy to follow by the child. The feedback loop enables the child to influence the process, provided cognitive capacities are developed normally. Numerous studies reported on the efficacy of this treatment in children [Hellström et al. 1987, Jerkins et al. 1987, van Gool et al. 1992, Kjolseth et al. 1993 and 1994, Hoebeke et al. 1996, Vijverberg et al. 1997, Combs et al. 1998, De Paepe et al. 1998 and 2000, Porena et al. 2000, Schulman et al. 2001].

6. **Using flow patterns** as biofeedback will teach the child how to relax the pelvic floor during the voiding. The child sits on a toilet with a flow transducer, watching flow curve and EMG on-line on a computer display, trying to empty completely in one relaxed voiding.

7. **Inhibit detrusor contraction**: The contraction should be inhibited before it escalates. With correct central inhibition, the emergency brake of the pelvic floor is not needed. A common trick is to repeat loudly [Vijverberg et al. 1997]: “one, two,
three, do I have to pee". This little phrase is repeated until the contraction and the urge pass. Over-training should be avoided.

8. **Home training programmes**: After evaluation of fluid intake and eating habits, rules for a fixed intake are made, including reminders, designed for use between the visits to the hospital. Information and rules for application at home can be used:
   - every time that I feel that my bladder wants to pee, I go immediately to the toilet
   - during voiding I keep my stomach asleep, I don not strain but count, sing or whistle
   - after voiding I don not run away from the toilet immediately, but I count quietly up to five before wiping off
   - every time I go to the toilet I look if my pants are still dry. If they are wet I have to change them.

  ➤ 1.4.2.2. Treatment of constipation

1. The **defaecation diary** is used to teach the child to deal consciously with his bowel problem. These charts are used to learn the child how to obtain an appropriate liquid intake and a regular toilet visit. The schedule is adapted after evaluation at every consultation.

2. **Relaxation exercises** of the pelvic floor: see treatment of overactive bladder and NNBSD

3. **Perception of bladder filling** is learned with the help of little inflatable balloons.

4. **Posture on toilet**: a proper toilet posture for defaecation implies that the legs are spread and the feet supported, the knees should be higher than the hips. The back is slightly bent forward, which is the optimal position to reach perfect relaxation of the pelvic floor during straining [Wennergren and Oberg 1991]. In children who can not reach the floor with their feet a small bench or support is placed under the feet.

5. **Rules for application at home**:
   - drink water, pay attention to your diet (a lot of fibres, vegetables and fruit)
   - sit 3 times a day on the toilet after each meal
   - always pay attention to posture on the toilet and think of the relaxation exercises of the pelvic floor during straining.
1.5. Aims of the study

Many different factors are believed to interfere during the development of normal bladder-sphincter function. Among these the influence of the methods of potty-training and the time of onset of training may be especially important. Guidelines from health carers to young parents differ much, adding to the confusion on when and how to toilet train. According to some authors the achievement of bladder and bowel control is only based upon maturational processes, on which toilet training has no influence; others warn against a too early start of training, which might even have a negative influence on the normal physiological evolution to continence (a frequent mentioned cause for encopresis). Recent studies describe positive influences of potty-training on the development of normal bladder-sphincter function [Sillén and Hanson 2000, Hellström 2000, Hellström and Sillén 2001].

Until now little scientific information is available on potty-training. This thesis aims to acquire knowledge about it, and to make a first step towards a better understanding of the influence of the potty-training process during childhood on the achievement of bladder and bowel control at a later age.

We have gathered information on familial situation, personal and voiding habits, methods used during the training and eventual lasting problems with bladder and bowel control by means of a questionnaire. As no of the existing questionnaires did meet the objectives of our study, we prepared a set of 41 questions on this subject (see Addendum 1 and 2). The questionnaires were filled in by the parents without help from the investigators and collected from the respondents via a special mailbox or by personal collection.

In this thesis the following questions are addressed :

➢ Is it possible to gather valuable and reproducible information on potty-training by means of a questionnaire? (Paper 1)
➢ Are there significant differences in training methods originally used in a healthy control group and in a group of children with urodynamically proven bladder-sphincter dysfunction at a later age? (Paper 1)
➢ Is it possible that the evolution of the potty-training during the last sixty years contributed to an increase in lower urinary tract dysfunction? (Paper 2)
What are the voiding habits, prevalence of wetting episodes and reaction of the parents to signs of LUT-dysfunction in a large population of schoolchildren aged from 10 to 14 years? (Paper 3)

Are there differences in family situation, personal habits and particularly potty-training methods (time and reasons of the onset, way of training), used in two subgroups with and without LUT symptoms? (Paper 4)

What are the risk factors for recurrent urinary tract infections, and is there an influence of potty-training on the presence of recurrent UTI at age 10 to 14 years? (Paper 5).
Chapter 2

Synthesis of studies
2.1. Results of a questionnaire evaluating different aspects of personal and familial situation and the methods of potty training used in two groups of children with a different outcome of bladder control

Paper 1

The purpose was to validate the questionnaire (see addendum 1) and to study family situation, personal behaviour, actual micturition habits, the moment of starting and the way of potty-training in two groups of children with a different outcome of bladder control. Parents of 140 children filled in the questionnaire (see subjects and methods).

- To validate the questionnaires, data collected through questionnaires needed to be compared to objective urodynamical findings. To test the reliability about the urge-syndrome (defined as more than 7 mictions and/or the inability to regularly postpone the miction) questionnaires were distributed to 118 children who had undergone an urodynamical investigation during the last two years. Contact with the parents was made either through the health carer involved or by mail with an accompanying letter. Exclusion criterium was neurological disease. We collected a total of 50 completed questionnaires (24 boys and 26 girls, mean age 11.4 ± 2.4 years). All children with urge syndrome had a urodynamically proven functional bladder disorder: our questionnaire revealed no false positive results, but part of the children (12) with a urodynamically proven bladder dysfunction reported no urge-syndrome.

- Reliability of the answering of the questions on potty training methods and achievement of bladder- and bowel-control needed to be verified. Therefore questionnaires were distributed in the last two years of 3 primary schools in a village near to the investigators home. Parents were contacted through the teachers, who
after explanation agreed to hand out the questionnaire. After an interval of 6 months all parents were asked to fill in the same questionnaire again. The correlation between the two answers was evaluated using the KAPPA-test. Out of the 78 parents of schoolchildren (mean age 11.5 ± 0.8), 47 entered their evaluation a 2nd time. The reliability of the answering was very good: parents remember very well the way of training and the moment of starting the potty-training in order to obtain continence of their child and the exact age at which these objectives were achieved.

• To carry out a preliminary research on the influence of potty-training on achievement of bladder control at a later age, the whole population was divided in a symptom and symptom-free group, and familial situation, personal behaviour, voiding habits and methods for potty training were compared. Children were allocated to the symptom group if they had one or more symptoms of daytime wetting with/without night-time wetting, a history of UTI, more than 7 mictions a day and/or the inability to regularly postpone the voiding.

A total of 140 children were included: 66 boys and 74 girls.

Following results were found: methods of training differed between the groups with and without lasting problems. Parents in the symptom group started the training at a later age, had more tendency to punish and were more demanding when micturition did not readily start. The findings from our questionnaire suggest that the occurrence of urge syndrome at age 10 to 14 years may be influenced by wrong methods used during the dry training.

We found:

• Confusion as to the term incontinence: the majority of the parents (70%) considered their child to be continent in spite of day wetting several times a week
• Very few parents were searching spontaneously for help. Whether these “wait and see” attitude is due to the lack of information that medical help is available or to the shameful condition of urine-loss or to parents not considering incontinence as a worrisome condition, is at this stage not clear. The findings should in any case incite physicians and paediatricians to be more attentive to this problem.
2.2. Changes in the toilet-training of children during the last 60 years: the cause of an increase in lower urinary tract dysfunction?

Paper 2

To analyse the changes in toilet-training of children in the last three generations and to seek for a possible cause for the apparent increase in lower urinary tract dysfunction over that period. An abridged questionnaire with 25 questions was developed (Addendum 2) and has been distributed during 4 months in public places like schools (teachers and pupils), universities (students and staff), hospitals and homes (patients and staff). The completed questionnaires were collected via a special mail box or by personal collection.

The collected data on training methods, onset of the training and completion of continence were compared between three groups in function of the age of the persons who trained the children.

Subjects: Parents of three different generations, aged from 20 to over 60 years.

1. 60 years: 87 persons who trained 276 children
2. 40-60 years: 104 persons who trained 262 children
3. 20-40 years: 130 persons who trained 274 children

This a total of 321 people who toilet-trained a total of 812 children.

As reported by others, we found major changes in toilet-training in the last 60 years; one of those is the age of onset of toilet-training, which has been significantly postponed. One reason for starting training, i.e. bladder control during the afternoon nap (which can probably be considered as an indication of sufficient bladder
capacity) has become less important. Season (summer) has become a more important factor, as has starting school. Training by bladder drill, formerly widely used, was progressively abandoned and a more liberal attitude has been adopted by the youngest parents. Potty-chair and little potty were also progressively abandoned in favour for the use of a normal toilet.

There seems to be good concordance between the programmes currently proposed for treating bladder dysfunction in children and the traditional bladder-training methods used by parents 60 years ago. There are arguments in favour of the fact that a late start of training and a lack of structured training methods may be responsible for an increase in LUT dysfunction.

2.3. To study voiding habits and wetting in a large population, the relationship of those symptoms of LUT-dysfunction to formerly used methods for potty-training, and risk factors for recurrent UTI

Further research on a large population was necessary to confirm the findings of our preliminary group. As normally bladder and bowel control should be attained at age 10 to 14 years, we decided to study children in that age bracket. Contacts were made with the Scientific Association of Youth Health (Vlaamse Wetenschappelijke Vereniging voor Jeugdgezondheidszorg, presisdent Prof. Hoppenbrouwers), which after explanation of the aims of the study agreed to collaborate. Different centres all over Belgium, chosen at random with children of all social classes, participated. A total of 5646 questionnaires were distributed in the last two years of normal primary schools. The questionnaires were answered at home without the help of the investigators, and returned under closed envelopes to guarantee privacy. A detachable numbered talon (returned to the centres) permitted to treat the data in an absolutely anonymous way. Information on lasting LUT symptoms were secondarily send to the staff of the Medical School Centres in Excel files, once all the data were decoded. Children with day time and/or night-time wetting received a brochure with relevant information.

Subjects: Pupils in their last 2 years of normal primary schools, chosen at random, including children from all social classes, from rural and city environment: 5646
questionnaires (addendum 1) were distributed and we collected 4332 complete settings for 2215 boys and 2117 girls.

All data were encoded in Excel and are available for inspection. Statistical analysis included tabulation and basic statistical testing, using Statistica (Statsoft Inc, USA 1999) and multiple logistic regression, using Egret (Cytel Software Corp, USA 1989); p<0.05 was considered as statistical significant.

For Kappa test the levels of agreement are: full agreement value 1, very good between 0.81-0.99, good between 0.61-0.80 and moderate between 0.41-0.60.

2.3.1. Voiding habits and wetting in a population of 4332 Belgian schoolchildren aged between 10 and 14 years

Data from 4332 schoolchildren from 10 to 14 year old gave the following results:

Wetting or soiling episodes were reported by a total of 528 (12%) of the children: monosymptomatic nocturnal enuresis by 62 (1%), daytime wetting with/without nighttime wetting by 343 (8%), and faecal soiling by 123 (3%). We found significantly more girls in the wetting group, and the capacity to regularly postpone the voiding was significantly lower in this group. Significantly more children had nycturia in the group with wetting. Over 80% of children with MNE-episodes at least once a week consulted a health carer, for less than 20% of the children with day-wetting episodes, even if it concerned severe incontinence several times a week.

Children with daytime wetting with/without night-time wetting have very often bladder-sphincter dysfunction, which is in turn correlated with recurrent urinary tract infections, and all the associated risks. Eight percent of the 10 to 12 year old schoolchildren report daytime wetting with/without night-time wetting with some frequency. Wetting increased spectacularly in children, especially girls, with voiding frequencies of more than 10 times a day. Together with the presence of urge syndrome the prevalence of wetting is twice as high as in all other categories. Nycturia
seems to be an indicator for dysfunctional problems in children. Physicians and paediatricians should be encouraged to be more attentive to voiding habits at day and to night-time wetting in children and should initiate discussion about urinary en faecal problems with parents and children if the child has a high voiding frequency, urge and nycturia.

2.3.2. Results of a questionnaire evaluating different methods of potty training on the achievement of bladder control

Paper 4

The apparent increase of problems with bladder and bowel control, the good concordance of behavioural therapy for NNBSD and formerly used potty-training methods and the differences found in our first study in training methods used in children with a different outcome of bladder control, conducted us to analyse family situation, personal habits and toilet training methods used in two groups of children.

To study the relationship to training methods the whole population was divided into a symptom (928 children, 352 boys and 576 girls) and a control group (3404 children, 1963 boys and 1541 girls). Day-time wetting with or without night time wetting, independent of the severity and the frequency of the wetting, faecal soiling, and a history of urinary tract infections (UTI) were considered as signs of a non-normal outcome of bladder control (symptom group). When no history of previous or current UTI and/or no day- and or night time wetting was reported children were allocated to the so called control group. For some evaluations children with monosymptomatic nocturnal enuresis (MNE) are being evaluated separately.

No differences were found as to the family situation between the two groups. In the symptom group more below average school results and less independence in
homework and hygiene were reported. The age at which potty training started, was postponed in the symptom group and scheduled voiding was used less. In case scheduled voiding was used, the reaction of the parents when the attempt of voiding was unsuccessful was significantly different. In the control group most parents just postponed the voiding and had the child try later again, in the symptom group parents more frequently invited the child to push, made special noises or opened the tap.

Even if most children seem to achieve bladder and bowel control anyway, the significant differences in potty training between children with and without lasting problems of bladder control, support the idea that there is an influence of potty-training on achievement of continence. The postponement of the onset of the training beyond 18 months, the use of a normal toilet and the practice of certain methods to provoke a voiding (asking to push, opening the water tap) induce an increased risk for later problems with bladder control.

### 2.3.3. Risk factors for urinary tract infections in a population of 4332 Belgian schoolchildren aged between 10-14 years

**Paper 5**

To study the risk factors for existence and development of UTI, children were allocated to the group without UTI (3818 children, 2085 boys and 1733 girls), or a symptom group with an actual or former UTI (514 children, 130 boys and 384 girls. Information on UTI was obtained with the following questions:

1. had your child a urinary infection (yes/no),
2. if yes, how old was he at that moment (younger or older than 2.5 years),
3. how many infectious episodes have there been: one, > than one, once a year, > than once a year.

Subjects: The whole group (n=4332) was divided in a symptom group with a history of UTI (n=382) or recurrent UTI (n=132) and a control group without UTI (n=3829).
UTI is common in children, and uncomplicated in children with normal urinary tract anatomy and neurology. However numerous publications have reported on the risks of renal damage in children with recurrent UTI. Indeed, high prevalence of kidney scars have been reported for children, predominantly girls, during the first consultation with a urologist. Because the diagnosis in a febrile child is easily overlooked in the general practice, we wanted to study risk factors and indicators for the existence of UTI. The presence of daytime wetting and/or soiling, voiding frequencies of 10 times a day or more with or without urge, and nycturia are not only signs of NNBSD but are also the indicators for possible recurrent UTI. When all the indicators are simultaneously present, the relative risk for recurrent UTI is even higher.

Taking into account the correlation between NNBSD and UTI, and the differences in potty-training found between a symptom and symptom free group in our previous studies we again compared training methods used in the control group and in the group with history of recurrent UTI. Again we found significant differences in potty training: parents of the control group started the potty-training before 18 months and insisted less when the attempt to void was unsuccessful. Particularly the demand to strain during the development of normal bladder-sphincter co-ordination seems to lead in 46% of the cases to dysfunction.

The results seem to indicate that leaving the child on the potty and provoking the voiding, especially straining, implies a high risk for development of NNBSD, and consequently for recurrent UTI. Starting potty-training after 18 months and the use of a normal toilet involves some risks
Chapter 3

Results of a questionnaire evaluating different aspects of personal and familial situation, and the methods of potty-training in two groups of children with a different outcome of bladder control

E.BAKKER, J.D. van GOOL, JJ. WYNDAELE
Scand J Urol and Nephrol 2001: 35; 370-376
RESULTS OF A QUESTIONNAIRE EVALUATING DIFFERENT ASPECTS OF PERSONAL AND FAMILIAL SITUATION, AND THE METHODS USED OF POTTY TRAINING IN TWO GROUPS OF CHILDREN WITH A DIFFERENT OUTCOME OF BLADDER CONTROL

E.BAKKER, Physiotherapist, University of Antwerp, Belgium
Prof. Dr. J.D. van GOOL, MD, PhD, Pediatric Nephrologist, University of Antwerp, B
Prof. Dr. J.J. WYNDAELE, MD, PhD, DSc, Urologist, University of Antwerp, B

Abstract

Objective: Study family situation, personal behaviour and actual micturition habits, the moment of starting and the way of potty-training in two groups of children with a different outcome of bladder control.

Material and methods: Parents of 140 children, between 7 and 15 years old, filled in a questionnaire of 43 questions. They were divided in a symptom (73) and symptom free group (67) according to the outcome of bladder control.

Results: Parents remember very well the way of training and the moment of starting the potty-training in order to obtain continence of their child and the exact age at which these objectives were achieved. We found a confusion as to the term incontinence: the majority of the parents (70%) considered their child to be continent in spite of day wetting several times a week.

All children with urge syndrome who had undergone a urodynamic investigation (n=50) had an objective functional bladder disorder.

Conclusions: Methods of training differed between the groups with and without lasting problems. The symptom group started the training at a later age, had more tendency to punish and were more demanding when micturition did not readily start. The findings from our questionnaire strengthen our feeling that urge syndrome can be due to wrong methods used during the dry training.

Very few parents searched spontaneously for help, which should incite general practitioners and paediatricians to be more attentive at this problem.
Introduction

Only the most fundamental aspects of bladder and sphincter development in children are well understood. In former days, the infant bladder was accepted to be overactive, and thought to empty automatically at regular intervals through simple spinal reflexes and without control of higher centres [1].

Recently several authors pointed at spinal micturition pathways influenced by behaviour and/or arousal. The “dyssynergic” voiding patterns in newborns indicate however an incomplete coordination, which will at a later age be functionally controlled at several levels of the central nervous system [2]. This development is believed to be a largely maturational process, and is normally functional around the age of 4 years [3]. During the development of bladder-sphincter function, several factors are believed to interfere: bladder capacity, voluntary control, the diuresis, the potty-training et al. [4,5,6].

Hellström and Mattson state that this development is delayed or may not even occur in 3 to 8% of the children between 7 and 15 years [7,8]. The exact causes of such abnormal evolution, leading to non-neuropathic bladder-sphincter dysfunction (NNBSD), are yet unknown. The symptoms are urgency, urge-incontinence or emptying difficulties (dysfunctional voiding). In most cases the urodynamic findings show detrusor overactivity during filling and/or pelvic floor overactivity during voiding.

The association between urinary tract infection (UTI) and NNBSD in children between 4 and 15 years is well established. Hellström et al.[9] reported that one third of the girls who complained of daytime wetting and urgency had at least one period of urinary infection in the past. Hansson reported that the big majority of the girls with covert bacteruria had clinical and urodynamical evidence of bladder dysfunction [10]. There is not yet published confirmation, but the high incidence of NNBSD and the strong association with UTI must borne in mind the risk of upper urinary tract infections.

As most therapeutic strategies for NNBSD use cognitive training with success, we wanted to investigate if we could find any difference in the potty-training between children with and without lasting problems of bladder control.

The purpose of this study was to evaluate personal and micturition habits, the moment of starting and the way of potty-training used in children by a questionnaire and to compare the results in children with and without lasting problems of bladder control.
Material and Methods

A questionnaire of 43 questions was developed (added to the text) and filled in by the parents at home without help of the investigators for of a total of 140 children (66 boys, 74 girls, mean age 11,5 years).

The first 12 questions evaluated the family situation and the personal data of the child; the next 17 the current micturition habits at the time of the evaluation and the methods used for dry training; the last 14 questions documented eventual lasting bladder disorders: day- and/or night-time wetting and/or (recurrent) UTI in the past. The contact with the parents was made either through the health carer involved or through the teachers of the last two years of normal primary schools, who after explanation agreed to hand out the questionnaire. Introduction was an accompanying letter explaining the purpose of the evaluation. Exclusion was the existence of a neurological disease.

In order to test the reliability of the answering, all parents of the school population were asked to fill in the same questionnaire with an interval of six months. The correlation between the two answers was evaluated with the Kappa-test.

To test the value of the results about the urge syndrome (defined as more than 7 mictions a day and/or the impossibility to postpone the voiding), we correlated the answers with the data from the urodynamic investigations for the 50 subjects who had undergone this examination.

Statistical analysis was done with Chi-square test, Yates corrected ; p<0,05 was considered as statistically significant.

Results

The studied population was divided into 2 groups (see table 1) :

Symptom group : 73 children, 33 boys and 40 girls (45,2-54,8%), with bladder problems: day and/or night wetting, actual or former infectious episodes, urge syndrome. Amongst them 62 had consulted a urologist during the last two years: 50 had undergone urodynamic investigations. All had been treated, some with success. Eleven children are part of the school population.

Symptom free group : 67 children, 33 boys and 34 girls (49,2- 50,8%) without any problems with bladder control from the school population.

Out of the 78 parents of the school population 47 (=61,8%) agreed to fill in the questionnaire a second time. The overall agreement for the repeated answering was
very good (see table 2). Parents remembered very well the moment the child attained continence (0.89), the duration (0.79) and the methods (0.88) of the potty-training, and their reaction when no miction occurred when the attempt to empty was unsuccessful (0.82). The lowest score of agreement was obtained as to the reason to start the training (0.69), generally some reasons were added the 2nd time.

Urge-syndrome was reported by the parents of 37 (16 boys, 21 girls) of the 50 children who had undergone urodynamic investigations, all had an urodynamically proven bladder dysfunction (see table 3). For the other 12 children (7 boys, 5 girls) with urodynamically proven bladder dysfunctions parents reported no urge syndrome. Fifteen of the 50 children (3 boys, 12 girls) had had at least one period of UTI, all 15 had urodynamically proven bladder dysfunction, 14 reported urge syndrome.

The age, weight and length distribution of the symptom and symptom free group are given in table 1 and are not significantly different. The family situation was identical in all groups: more than 80 % of the children in both groups belonged to a stable family with partners in their first marriage. The school results were not different: the majority had average or above average school results. The ability to take responsibility for personal hygiene was significantly lower in the symptom group. We also found a statistically significant difference as to the capacity of the child to manage alone homework and honour appointments: 22% children (16) from the 1st group had to be systematically reminded of their tasks for only 6% (4) in the symptom free group. Significantly more children of the symptom group, mainly girls, did not take part in any extra-scholar activities (21% compared to 7% in the symptom free group). No association could be found between this less active behaviour and the age or the severity of urinary symptoms.

The age of starting the potty-training can be found in table 4. The majority of the parents of both groups trained their children between 18 and 24 months, although parents of the symptom free group started significantly (p= 0.04) earlier with the dry training than parents in the 1st group (32 % versus 15 %). At the moment of starting the potty-training, significantly (p<0.001) more children were dry during the siesta in the 2nd group, for 30% of the parents of this group this was even the mean reason to start the training. In those becoming dry after the age of 3 the percentage with dysfunctions was also found to increase significantly.

In the 2nd group parents choose one or two methods to train their children. Most commonly they used a little pot (71%), either at fixed hours (34%) or on demand of
the child (34%). This was in contrast with the symptom group where parents used three to four different methods at the time.

The reaction of the parents when no miction occurred was also significantly (p<0.001) different between the groups: in the 2nd group 60% of the parents did not insist and retried later, only 3% invited the child to push in order to produce urine and 13% opened the water tap. In the group with lasting problems 25% invited the child to push and 20% opened the water tap. The parents of the children of the 1st group were more ready to punish in case an accident happened: 17% compared to 1% in the 2nd group.

We found a highly significant difference (p<0.001) as to nycturia in the 2 groups: 24 (32.8%) has to stand up every night in the 1st group (12 are still wetting), for only 5 (7%) of the children in the 2nd group.

It was surprising that the majority of the parents (70%) considered their child to be continent in spite of day-wetting several times a week. It was only when the outer clothes were wetted too and needed to be changed that the great majority of the parents (72%) reported incontinence.

**Conclusions**

Although most children seem to achieve bladder control anyway, a certain number of them have lasting signs of NNBSD at a later age. The most obvious symptom is incontinence, in one third of the cases associated with UTI. There is no exact knowledge about the reasons of this poor co-ordination, but dysfunctional problems have been well documented and are not as rare as one might expect [3,11,12].

Anna Lena Hellström drew recently the attention that there may be a small risk of NNBSD developing in the period of transition to bladder control, a risk that probably increases if the transition period is prolonged and with the age of the child [13]. This hypothesis is strengthened by the findings of our study: not achieving dryness at 3 years seemed to be a factor of risk for the appearance of NNBSD at the age of 10-12 years.

Many different factors are interfering during this development, amongst these the influence of the methods of potty-training used as well as the onset of the training, may be important. The changes in the potty-training observed during the last 60 years [11,14], and the success of the training programs proposed for NNBSD [12,15], based amongst others on strict drinking and voiding schedules and the adopting of a correct voiding position, strengthen this hypothesis.
One method to acquire knowledge about this could be to compare methods which have been used in children with and without lasting dysfunctions. The questionnaire presented here made a first step to try to evaluate personal and micturition habits, the way and the time of onset of potty training used in children and the final outcome of bladder control at a mean age of 11 years. It was intended to be filled in by the parents at home without the help of the investigators, it therefore needed to be easy and reliable.

The response rate was good and our evaluation of the reproducibility of the filling in of the questionnaire after 6 months showed that parents remember just as well the moment and the way of potty-training they used, as the exact age at which these objectives were achieved.

The association between urodynamic findings and the answering revealed no false positive urge syndromes. We found however 8 boys who reported no urge syndrome in spite of urodynamically proven detrusor overactivity. This is probably partially due to the fact that children often adapt their drinking habits to their micturition frequency thus preventing urgency, frequency and wetting. We found it not unusual that some children limit their fluid intake to half a glass in the morning! But it also might indicate that bladder hyperactivity doesn’t lead systematically to “urge” symptoms [16]. There is a need for further investigations on a healthy population. These results however suggest that diagnosing NNBSD by means of a questionnaire is valuable as pointed out earlier by van Gool in 1984 [17].

The good school performances of both groups are in contrast with other findings in the literature. This might be due to the filling in by the parents of the questionnaire, which might lead to a more subjective appreciation of study results. The children with urinary symptoms in our study participated less in extra-scholar activities, needed more help for homework and more survey as to normal hygiene. That wetting is a very stressful event for children, leading to diminished self-esteem is well known [18,19]. Kyle observed in 1991 that the lack of independence and responsibility might rather be caused by the lasting urinary problems than that the urinary problems were the result of another behaviour [20]. The absence of association between the severity of the symptoms and this lack of maturity in our study once more reinforces the feeling that day- and/or night wetting, independent of the degree and frequency of wetting, is as much a hidden condition for children as it is for adults, and that parents and children feel ashamed to talk about this condition. That only very few children
with problems from the school population searched for medical help strengthens this opinion: 21 out of 88 children suffered from symptoms but only 4 had tried to get some help at this stage. It needs further study to clarify the exact causes for this. Other reasons may be the lack of knowledge that qualified help is available or the believe that this problems will disappear sooner or later spontaneously.

We observed some significant differences in the potty-training between the two groups: parents of children without lasting problems started to train earlier and accorded more importance to dryness during the afternoon nap, which simultaneously with a decrease in voiding frequency, can be considered as a sign of attainment of sufficient bladder capacity. The invitation to push when an attempt of voiding was unsuccessful, far more popular in the symptom group, could according to Hoebeke et al. [12] lead to NNBSD by reflex contraction of the pelvic floor on abdominal hyperpression.

The higher tendency to punish in case leakage occurred in the symptom group, is probably rather the result of the lack of success with the training, it however clearly shows the danger of such evolution and the need for evidence based rules for dry training.

Actually parents are advised to start the dry training when the child is “ready”, and to adjust the pace of training to the child’s individual needs as the maturational process is believed not to be influenced by an early onset or high intensity of training [5,14]. This is not only contradictory with our findings, but also with the former used training methods and the actual training programs for dysfunctional voiding, which are, among other things, based on the imposition of voiding and drinking schedules [1,12,20]. We found significant differences in children with and without lasting LUT problems not only in general independence but also in the way and the time they have been potty-trained, and the age at which they attained “continence”. Probably the cleanliness reported in our study was rather achieved through a very close control of the mother rather than on real control of the child itself.

The high association between day- and /or bed-wetting and UTI, combined with the observation that very few parents search spontaneously for help, 70% considered their child to be continent in spite of day wetting several times a week, should incite practicians and paediatricians to be far more attentive at this problem.

To confirm these results further research on a big healthy population has been done recently and we expect to report on this in a very near future.
References
15. Hellström AL.Treatment modalities in non-neuropathic bladder-sphincter dysfunction. Committee XI, 1st International Consultation on Incontinence, Monaco,


Questionnaire: see Addendum 1
Table 1.
Boys/girls distribution, age, weight, height, familial situation, behaviour and school results in function of the 2 groups: symptoms and symptom free.

<table>
<thead>
<tr>
<th></th>
<th>Symptom group</th>
<th>Symptom free group</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>general</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>total number</td>
<td>73</td>
<td>67</td>
</tr>
<tr>
<td>boys-girls</td>
<td>33-40</td>
<td>33-34</td>
</tr>
<tr>
<td>age [years]</td>
<td>11,42 ± 1,8</td>
<td>11,77 ± 0,7</td>
</tr>
<tr>
<td>weight [kg]</td>
<td>36,18 ± 11,38</td>
<td>37,65 ± 9,06</td>
</tr>
<tr>
<td>height [cm]</td>
<td>142,99 ± 15,05</td>
<td>147,43 ± 8,2</td>
</tr>
<tr>
<td><strong>familial</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>family</td>
<td>59</td>
<td>56</td>
</tr>
<tr>
<td>divorced</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>other partner</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>single</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>widow/widower</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>history of actual enuretics</td>
<td>13 [3-10]</td>
<td>3 [3-3]</td>
</tr>
<tr>
<td><strong>behaviour</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>washes only on command</td>
<td>15 [6-9]</td>
<td>8 [6-2]</td>
</tr>
<tr>
<td>needs to be reminded of schoolwork,..</td>
<td>16 [7-9]</td>
<td>4 [4-0]</td>
</tr>
<tr>
<td>no-extra scolar activity</td>
<td>15 [3-12]</td>
<td>5 [3-2]</td>
</tr>
<tr>
<td><strong>schoolresults</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>above average</td>
<td>33</td>
<td>25</td>
</tr>
<tr>
<td>average</td>
<td>33</td>
<td>29</td>
</tr>
<tr>
<td>below average</td>
<td>7</td>
<td>3</td>
</tr>
</tbody>
</table>
Table 2: Reliability of the answering after 6 months with Kappa test.

Levels of agreement: full agreement value 1, very good between 0.81 and 0.99 good between 0.61 and 0.80 and moderate between 0.41 and 0.60

<table>
<thead>
<tr>
<th>Question</th>
<th>Kappa Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name, age, sex, class</td>
<td>-</td>
</tr>
<tr>
<td>How is the actual family situation</td>
<td>1</td>
</tr>
<tr>
<td>Were there enuretics elder than 7 years in the family</td>
<td>1</td>
</tr>
<tr>
<td>If so, who</td>
<td>1</td>
</tr>
<tr>
<td>Are there actually enuretics elder than 7 years in the family</td>
<td>1</td>
</tr>
<tr>
<td>If so, who</td>
<td>1</td>
</tr>
<tr>
<td>Does he/she takes part in extra-scolar activities</td>
<td>0.9207</td>
</tr>
<tr>
<td>Does he/she washes him/herself</td>
<td>0.9574</td>
</tr>
<tr>
<td>Do you have to remind him/her of his homework and appointments</td>
<td>0.7786</td>
</tr>
<tr>
<td>At which age was he/she dry during the day</td>
<td>0.8887</td>
</tr>
<tr>
<td>At which age was he/she dry during the night</td>
<td>0.8559</td>
</tr>
<tr>
<td>At which age did he/she have bowel control during the day</td>
<td>0.8559</td>
</tr>
<tr>
<td>At which age did he/she have bowel control during the night</td>
<td>0.9033</td>
</tr>
<tr>
<td>Which sort of protections did you use</td>
<td>0.9591</td>
</tr>
<tr>
<td>When did you start the potty-training</td>
<td>0.7430</td>
</tr>
<tr>
<td>Was your child dry during the siesta at that time</td>
<td>0.8720</td>
</tr>
<tr>
<td>What did you use to collect the urine</td>
<td>0.9825</td>
</tr>
<tr>
<td>What was the reason to start the potty training during the day</td>
<td>0.8357</td>
</tr>
<tr>
<td>Which method did you use</td>
<td>0.8893</td>
</tr>
<tr>
<td>When did you do when the attempt to void was negative</td>
<td>0.8312</td>
</tr>
<tr>
<td>How many times a day does he/she goes to the toilet</td>
<td>0.8992</td>
</tr>
<tr>
<td>Does he/she stands up during the night</td>
<td>1</td>
</tr>
<tr>
<td>Can he/she postpone the miction</td>
<td>0.7773</td>
</tr>
</tbody>
</table>
Table 3.
Validation urge syndrome diagnosed by questionnaire and bladder sphincter-dysfunction diagnosed by urodynamic investigations for a total of 50 children.

<table>
<thead>
<tr>
<th></th>
<th>small bladder</th>
<th>normal bladder</th>
<th>big bladder</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>stable bladder during filling</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>less than 7 mictions a day</td>
<td>4</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>4 girls</td>
<td></td>
<td>1 boy</td>
<td>1 girl</td>
</tr>
<tr>
<td>7 or more mictions a day</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1 girl</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>inability to postpone the miction</td>
<td>6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2 boys/4 girls</td>
<td></td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>combination of 2 and 3</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1 girl</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>unknown by the parents</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1 boy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>bladder overactivity during filling</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>less than 7 mictions a day</td>
<td>5</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>5 boys</td>
<td></td>
<td>1 boy</td>
<td></td>
</tr>
<tr>
<td>7 or more mictions a day</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>2 boys</td>
<td></td>
<td>2 girls</td>
<td></td>
</tr>
<tr>
<td>inability to postpone the miction</td>
<td>13</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>6 boys/7 girls</td>
<td></td>
<td>2 boys/2 girls</td>
<td></td>
</tr>
<tr>
<td>combination of 2 and 3</td>
<td>7</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>4 boys/3 girls</td>
<td></td>
<td>1 girls</td>
<td></td>
</tr>
<tr>
<td>unknown by the parents</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Table 4.
Age at starting potty-training

<table>
<thead>
<tr>
<th>Table 4</th>
<th>Symptom</th>
<th>Symptom free</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 18 months</td>
<td>11</td>
<td>22</td>
<td>33</td>
</tr>
<tr>
<td>18&lt; &lt;24 months</td>
<td>39</td>
<td>31</td>
<td>70</td>
</tr>
<tr>
<td>25&lt; &lt;30 months</td>
<td>14</td>
<td>10</td>
<td>24</td>
</tr>
<tr>
<td>&lt; 30 months</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>unknown</td>
<td>8</td>
<td>4</td>
<td>12</td>
</tr>
</tbody>
</table>
Chapter 4

Changes in the toilet-training of children during the last 60 years: the cause of an increase in lower urinary tract dysfunction?

E. BAKKER, J.J. WYNDAELE

CHANGES IN THE TOILET TRAINING OF CHILDREN DURING THE LAST 60 YEARS: THE CAUSE OF AN INCREASE IN LOWER URINARY TRACT DYSFUNCTION?

E. BAKKER, Physiotherapist, University of Antwerp, Belgium
Prof. Dr. J.J. WYNDÆLE, MD, PhD, DSc, Urologist, University of Antwerp, Belgium

Objective: To analyse the changes in toilet-training of children in the last three generations and to seek a possible cause for the apparent increase in lower urinary tract dysfunction over that period.

Patients and methods: A questionnaire (25 questions) was developed and completed by 321 people who had toilet-trained 812 children. The population was divided into three groups according to the age of those who trained the children.

Results: There has been a major change in toilet-training in the last 60 years; the age at which toilet-training began has been significantly postponed. One reason for starting training, i.e. bladder control during the afternoon nap (which can probably be considered as an indication of sufficient bladder capacity) has become less important. Season (summer) has become a more important factor, as has starting school. Training by bladder drill, formerly widely used, was progressively abandoned and a more liberal attitude adopted by the youngest parents.

Conclusion: There seems to be good concordance between the programmes currently proposed for treating bladder dysfunction in children and the traditional bladder-training methods used by parents 60 years ago. To start bladder training when the child stays dry during the afternoon nap and use bladder drill might help to avoid permanent bladder dysfunction. The lack of formal bladder training may be responsible for an increase in lower urinary tract dysfunction.

Keywords: toilet-training, children, bladder instability, dysfunctional voiding

Introduction

Urinary incontinence is a stressful event for children, leading to diminished self-esteem with all its associated social and psychological problems [1]. The control of bladder and bowel function involves a complex integration of neurological pathways at the peripheral and central levels [2]. The correlation between bladder instability and symptoms has been well documented [3,4], but the exact causes of bladder instability
are as yet unknown [5,6]; hereditary factors have been suggested by some [7,8]. From the prevalence of symptoms in different countries and on the results of retraining [9,10], some influence of the methods of bladder training in preventing or inducing such dysfunction might be expected, but there is no clear information on this subject [11].

In our experience, the incidence of voiding problems has increased in recent years; whether this is a real increase or simply the result of a wider appreciation that medical help is available is uncertain. Such an increase might indicate that more recent training methods are not ideal. Thus the purpose of the present study was to evaluate any changes in the onset of toilet-training, the attitudes of parents and the results of training during the last 60 years in Belgium.

Patients and methods

A questionnaire comprising 25 questions was developed (Appendix 1); the first 10 questions were about the demographics (birthday, number of children, age of the children, number of grandchildren, their age and eventual participation of the grandparents in toilet-training). The next nine questions were specific to toilet-training, e.g. the diapers used, the age and reasons for starting training and the methods used. The last six questions were answered for each child and documented the age at which the child reached bowel and bladder control, and the duration of training.

The questionnaire was distributed during the first 4 months of 1999 to 2000 people in public places, e.g. hospitals (patients and staff), schools (teachers and pupils), and universities. A letter with the questionnaire explained the purpose of the study. The questionnaires were completed with no help from the investigators and collected from the respondents via a special mailbox or by personal collection. The validity of the questionnaire was tested in a previous study of a similar subject, by repeating the questionnaire after 6 months and comparing the results using the Kappa test (unpublished data).

Results

In all, 812 replies (32%) were completed by 321 people; most (788, 97%) were completed by female participants. The whole population was divided into three groups according to their age: group 1 comprised 87 people aged >60 years (mean 69.8) who trained 276 children; group 2, 104 people aged 40-60 years (mean 50.3) who
trained 262 children; and group 3, 130 people aged 20–40 years (mean 32.8) who trained 274 children (table 1).

The number of children per family decreased gradually in the three groups, as expected. The range of age of the children when the questionnaire was completed is shown in table 1. The number of grandchildren in each group and the active participation by grandparents in toilet-training their grandchildren is also given in Table 1; no participants in group 3 had grandchildren.

There was a significant difference in the age of onset of the toilet-training, and between day and night. Day-time toilet-training was started before 18 months old in only a fifth of children in group 3 and in half of those in group 2; however, in group 1, training was started before 18 months old in most and in half before 1 year old (table 1). The changes were similar for the start of night-time toilet-training, although in all groups toilet-training at night started at a later age than day-time training (table 1).

The age of the child was the most frequently reported reason for starting toilet-training in the three groups (64%, 54% and 61%, respectively). In groups 2 and 3, several other reasons were noted being (in order of importance), season (summer), start of school and request of the child. This differed from group 1, where the main reason for starting toilet-training was the attainment of bladder control during the afternoon nap (74%); the importance of such bladder control seems to have become less important over the study period. Fewer parents in group 2 mentioned it as reason for starting toilet-training, while in group 3 only a few parents considered it.

The change in the choice of diapers was as expected; disposable diapers were used by 3%, 42% and 98% of groups 1–3, respectively (disposable nappies were either not available or very expensive when group 1 were toilet-training their children).

A baby-chair with a hole in the seat to help train the child was more popular in previous generations; it was used by 175 children (63%) in group 1, but only 12 (4%) in group 3. Such a chair offers the advantage of using the gastric/colic reflex during and/or directly after a meal to provide an immediate reward to the child. Of the 264 children in all groups, 116 (44%) of those who used a baby-chair did so during a meal; fewer used it after or before a meal, or when demanded by the child. In the last 20 years it has been replaced by a normal toilet in most cases (145 in group 3), often with no reducing seat or support for the feet.

Parental attitudes to methods of training also apparently changed with time; younger parents tended to use more than one method. In group 3, most parents
removed the disposable nappies to promote continence (192, 69%); many awaited the request of the child to go to the toilet (131, 47%). Only nine (8%) of group 3 and 121 (23%) of group 2 used prompting as a training method, but it was frequently used in group 1 (210, 76%) and only a few (48, 17%) guided training by the child’s desire to void. There were minor differences in the use of punishing and/or reward methods among the groups. Group 3 had a tendency to reward more and punish less than groups 1 and 2, but in all groups more rewarding was used than punishing (17:1 in group 3, 35:1 in group 2 and 4:1 in group 1).

The reaction of parents when the child’s attempt to void was unsuccessful was significantly different among the groups. Most parents in group 2 and 3 (63% and 77%) encouraged the child to try again later, but only 41% of parents in group 1 did so. Many in group 1 used running water to provoke voiding. Encouragement with special noises was used more in group 1, but was also used in the other groups. Only a few children in group 3 (16) were asked to ‘push’ when an attempt to void was unsuccessful, which was not used by the parents in the other groups.

There were no significant differences in the duration of training; it was <6 months for most children in all three groups. The age at which training was successful differed among the groups, both for day and night continence, as for bladder and bowel control (Table 1). Day-time continence was achieved before 1 year old in 21% in group 1, but < 3% in the other two groups. Night-time bladder control before the age of 18 months is also shown in Table 1, with bladder control before 1 year old rarely achieved (8% in group 1, and one and two children in groups 2 and 3, respectively). The age at which bladder control was achieved was influenced by the age at which training was started. Bowel control during the night was achieved earlier and in more children in all groups; before 18 months in 75%, 45% and 35% of groups 1–3, respectively.

A few children (1% and 11% in groups 2 and 3, respectively) had not attained complete bowel and bladder control at the time the questionnaire was completed, which can be considered normal considering the age range in these groups. For most (90%) parents in the three groups, toilet-training was carried out mainly at home. The overall reliability of answering the questions, tested previously, was good and parents in group 1 seemed to remember more about their methods of training than those in groups 2 and 3, possibly because toilet-training followed stricter rules in that generation.
Discussion

The present results show major changes during the last 60 years in the child’s age at the initiation of toilet-training. Similar data were reported for other European countries over the same period [12–14]. In the eldest generation (parents born in 1920–1940) toilet-training was initiated mostly before 18 months old, and in half even before 1 year old. In group 2 (parents born in 1940–1960) there was an even distribution in the onset of training before or after 18 months old; in the youngest group (parents born in 1960–1980) most started after 18 months old. This change in the onset and intensity of toilet-training is probably partly caused by the introduction of disposable nappies and the labour-saving avoidance of extra laundry. Another possible factor is that in many households both parents go out to work. A more liberal education has also had an effect on this change [15]. Earlier generations believed strongly in the benefits of education using ‘drilling’. There were strict schedules for conducting such training [16,17]. In these schedules, the importance of bladder control during the afternoon nap was emphasized (this being considered as an indication that sufficient bladder capacity was attained). This is confirmed by the present results, where bladder control during the nap was mentioned as the most important reason for starting toilet-training in group 1. This factor gradually lost importance in succeeding generations, and currently only 4% reported dryness as a reason for starting toilet-training.

Prompting is no longer advocated and parents are recommended to adjust the onset of training to their child’s individual needs [18]. Most authors are convinced that the development of bladder and bowel control is a maturational process which cannot be accelerated by toilet-training [15,19].

The present findings contradict this theory; the age at which bladder and bowel control were achieved showed the same differences among the groups as the ages at the onset of training. This was predictable in view of the similar duration (1–6 months) of toilet-training in the three groups. At 18 months 71% of the children in group 1 were ‘drilled’ to be dry and clean, but only 17% were in group 3. However it is uncertain if being ‘doubly continent’ had the same meaning and value for children 40–60 years ago as what is currently termed ‘bladder and bowel control’. In 1943, Gesell [17] had already differentiated bladder and bowel control arising from the mother’s prompting and the achievement of this control at the child’s initiative. He noted a period (12-18 months old) during which the child was particularly receptive to training and indicated the importance of using a small potty adapted to the child.
Success was reported recently with treatment programmes for dysfunctional voiding associated with recurrent UTIs and/or daytime incontinence [9,10]. It is interesting to compare these programmes with the training techniques used 40 years ago. These programmes are based on the imposition of voiding and drinking schedules, on learning an adequate toilet posture with support for the feet [20], and proprioceptive and relaxation exercises for the pelvic floor. Except for the last, there is a marked agreement with the ‘drilling’ technique applied widely by parents three generations ago. These findings strengthen our proposal that the more frequent dysfunctional problems in children, e.g. urge syndrome, might be caused by inadequate methods of toilet-training used more recently, and that the early ‘drilling’ on attaining a particular bladder capacity was a way of avoiding later bladder instability. To confirm these results, further research on a healthy population has been started recently and will be reported soon.

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Table 1: Some results from the questionnaire for the three age groups

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
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<tbody>
<tr>
<td>Participants, n</td>
<td>87</td>
<td>104</td>
<td>130</td>
</tr>
<tr>
<td>Children, n</td>
<td>276</td>
<td>262</td>
<td>274</td>
</tr>
<tr>
<td>No of children/family</td>
<td>3.1</td>
<td>2.5</td>
<td>2.1</td>
</tr>
<tr>
<td>Age range children</td>
<td>20–60</td>
<td>5–40</td>
<td>&lt;1–20</td>
</tr>
<tr>
<td>Grandchildren?</td>
<td>74 (85)</td>
<td>26 (25)</td>
<td>0</td>
</tr>
</tbody>
</table>

Active participation of grandparents in training (grandparents/children):

<table>
<thead>
<tr>
<th>Number</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>by advice</td>
<td>8 (22)</td>
<td>5 (19)</td>
<td>-</td>
</tr>
<tr>
<td>during care</td>
<td>17 (47)</td>
<td>7 (26)</td>
<td>-</td>
</tr>
<tr>
<td>during a stay</td>
<td>11 (30)</td>
<td>9 (34)</td>
<td>-</td>
</tr>
</tbody>
</table>

Age of onset of toilet-training:

day-time

| < 18 months | 241 (88) | 120 (50) | 58 (22) |
| < 1 year    | 136 (49) | -        | -       |

night-time

| < 18 months | 119 (43) | 34 (13) | 14 (5)  |

Continence before 18 months old:

day-time

| 198 (71) | 109 (41) | 47 (17) |

night-time

| 167 (61) | 60 (23)  | 22 (8)  |

Appendix 1: see Addendum 2
Chapter 5

Voiding habits and wetting in a population of 4332 Belgian schoolchildren aged between 10 and 14 years

E. Bakker, M. van Sprundel, J.C. Van der Auwera, J.D. Van Gool, J.J. Wyndaele
Accepted Scan J Urol and Nephrol 2002
VOIDING HABITS AND WETTING IN A POPULATION OF 4332
BELGIAN SCHOOLCHILDREN AGED BETWEEN 10 AND 14 YEARS

E.BAKKER, Physiotherapist, University of Antwerp, Belgium
Prof. Dr. M. van SPRUNDEL, MD, MPH, Epidemiologist, University of Antwerp
J.C.VAN DER AUWERA, Statistician, University of Antwerp
Prof. Dr. J.D. van GOOL, MD, PhD, Pediatric Nephrologist, University of Antwerp, B
Prof. Dr. J.J. WYNDAAELE, MD, PhD, DSc, Urologist, University of Antwerp, B

Abstract

Objective: To determine the prevalence of daytime- with/without night-time wetting, in Belgium, in a group of 10 to 14 year old schoolchildren, and to study the voiding habits.

Subjects and methods: A questionnaire of 41 questions was developed and completed by 4332 parents at home.

Results: Wetting or soiling episodes were reported by a total of 528 (12%) of the children: monosymptomatic nocturnal enuresis by 62 (1%), daytime wetting with/without night-time wetting by 343 (8%), and faecal soiling by 123 (3%). We found significantly more girls in the wetting group, and the capacity to regularly postpone the voiding was significantly lower in this group. Significantly more children had nycturia in the group with wetting.

Conclusions

Children with daytime wetting with/without night-time wetting have very often bladder-sphincter dysfunctions, which is in turn correlated with recurrent urinary tract infections. Eight percent of the 10 to 12 year old schoolchildren report daytime wetting with/without night-time wetting with some frequency. Surprisingly few parents, especially in the daytime wetting group, searched for medical help. Physicians and paediatricians should be encouraged to be more attentive to wetting in children and initiate discussion about urinary en faecal problems with parents and children.

Keywords: Daytime wetting, night-time wetting, voiding habits, nycturia
Introduction

The purpose of this study was to determine the prevalence of day- and/or night-time wetting in Belgium in a group of healthy schoolchildren completing the last two years of a normal primary school (10 to 14 years), and to examine the degree of wetting, the frequencies, the combinations between day- and night time wetting, and possible relationships with age, sex, and voiding habits.

Several recent epidemiological studies report on the prevalence of wetting in children, especially night-time wetting [1,2]. Epidemiological data on daytime wetting are scarce, especially for children over 10 years old. For Belgium, as yet, no data are available on voiding habits and wetting in children at any age.

In order to obtain voluntary bladder control, a child has to pass through several developmental stages: the capacity of the bladder must increase to permit a decrease in the number of voidings per day, voluntary control over the striated pelvic floor muscles must be gained to permit easy initiation and stopping of voiding and maturation of the central nervous system must be complete enough to control the complex communication and coordination between specific peripheral and parts of the central nervous system [3,4]. During this development, several factors are believed to possibly interfere: diuresis, potty-training, drinking and voiding habits, hereditary factors, psychosocial factors [5,6].

A recent review states that this development is delayed in 3 to 8% of the children between 7 and 15 years. The exact causes for such an abnormal evolution are as yet unknown [7].

It is well established that wetting, especially daytime wetting, is a very stressful event leading to a diminished self-esteem [8,9,10]. "Wetting pants in class" was the third most stressful event mentioned by children, immediately coming behind "losing a parent" and "going blind" [11].

Children suffering from daytime wetting with or without night-time wetting very often have bladder-sphincter dysfunction: urge syndrome or dysfunctional voiding and high voiding frequencies [12,13]. It is important to keep in mind the correlation between bladder-sphincter dysfunction and recurrent urinary infection in children between 4 and 15 years: up to 50% of children with bladder-sphincter dysfunction have recurrent urinary tract infections [1,14,15].
**Subjects and Methods**

A questionnaire with 41 questions was developed: the first 9 questions evaluate the family situation and the actual personal data of the child; the next 14 are about the age at which continence was obtained, about actual voiding habits and the methods used for potty-training; the last 18 questions document actual daytime and/or without night-time wetting, faecal soiling, and actual or previous urinary tract infection (UTI).

The questionnaire was handed out to 5646 pupils in their last two years of normal primary school. Contact with the schools was made through 6 Centres for School Health. These centres were chosen at random and all schools had pupils from all social classes. There were no exclusion criteria to participate in this study. The parents were asked to participate by the schoolteachers, who after explanation, all agreed to hand out the questionnaire, with an accompanying letter explaining the purpose of the evaluation. The questionnaire was completed by the parents at home without help of the investigators, and returned in the classes to the schoolteachers.

The reliability of the answers was tested in 84 parents, chosen at random, who were asked to fill in the same questionnaire again, six months after the original questionnaire. The validity of the questionnaire was also tested by comparing questionnaires filled out by schoolchildren with those filled out by urologic outpatients [16].

An infectious episode was always considered as symptom. The incapacity to postpone voiding was considered a sign of urge syndrome.

Statistical analysis included tabulation and basic statistical testing, using Statistica (Statsoft Inc, USA 1999) and multiple logistic regression, using Egret (Cytel Software Corp, USA 1989); p<0.05 was considered as statistically significant.

**Results**

We collected a total of 4332 questionnaires, with data for 2215 boys and 2117 girls, mean age 11.5 ± 0.56 years. This is a response rate of 77%.

The whole population was divided into 2 groups, one without any wetting or soiling and one symptom group with wetting and/or soiling episodes, regardless of the degree or frequency of these episodes. The prevalence of the symptoms in function of sex can be found in table 1.
The normal group included 3804 children (88%; 1964 boys and 1840 girls), the symptom group 528 (12%; 251 boys and 277 girls). The proportion of girls was significantly (p=0.0397) higher in the symptom group, except for a subgroup with monosymptomatic nocturnal enuresis (MNE), where 76% boys were found. No differences were observed between symptom group and normal group in function of age, as expected in view of the small age range of the population evaluated. Significantly (p<0.001) more children in the symptom group had a formerly bedwetting family member (41%) than in the dry group (26%). This was especially true in the MNE group (61%).

1. Isolated night-time wetting only (MNE)

MNE was reported for 62 children (47 boys and 15 girls). Of the 62 children, 33 boys and 5 girls reported the MNE being primary (77%).

Forty two children (30 boys and 12 girls) wetted the bed with a frequency of more than once a month. Soaking wet beds or pyjamas were reported by 29 (23 boys and 6 girls) at least once a week. This represents less than 1% of the total population. Twenty children (17 boys, 3 girls) reported a bedwetting incidence of less than once a month.

The distribution of degree of bedwetting versus frequency does not show any significant trends. Seven children with MNE reported a voiding frequency of 7-10 times daily, as well as inability to postpone voiding: despite the fact that they did not report daytime wetting, they might have one of the recently described subtypes of MNE.

2. Daytime wetting with or without night-time wetting

Isolated daytime wetting was reported for a total of 192 (4%; 68 boys and 124 girls, daytime wetting with night time wetting for 151 (3.5%; 89 boys and 62 girls). Frequency versus degree of daytime wetting with or without night-time wetting is given in figure 1. One hundred fourteen children (3%); 55 boys and 59 girls, had less than one daytime wetting accident a month and could be considered occasional wetters. The majority of these occasional wetters just spotted their underpants. Daytime wetting more than once a day was reported by 6 children, all girls.

The degree of wetting clearly increases with the frequency: of the occasional wetters 2% reported severe wetting (under and upper clothes needed to be
changed), versus the group with daily wetting. Figure 1 shows this trend in the
distribution of degree versus frequency.

3. Faecal soiling
Soiling was reported for 123 (3%; 47 boys and 76 girls) children, in almost all
(90%) with a frequency of at least once a week. Three (2 boys and 1 girl) of these
123 children also suffered from associated night-time wetting, 1 several times a
week.

4. Voiding habits and nycturia
Significantly (p<0.001) more children in the symptom group were unable to
regularly postpone voiding: 27% (70 boys, 74 girls) in the symptom group
versus 6% (111 boys, 129 girls) in the normal group. The distribution of the
number of voidings per day peaks at a frequency of 4-6, both in boys (n=2196)
and in girls (n=2136). The voiding frequency was only significantly different
(p=0.001) between the 2 groups in the category with more than 10 voidings per
day: 3% in the symptom group for <0.5% in the normal group.
Urgency combined with more than 7 daily voidings was reported by 27 boys
and 22 girls (=1%) of the normal group and 22 boys and 18 girls (=8%) of the
symptom group. Urgency can be considered as a marker for urge syndrome, when
it occurs combined with a voiding frequency of 10 per day or more. A high voiding
frequency as such has no predictive value.

Figure 2 shows the distribution of voiding frequency versus urgency, with the
percentage for daytime wetting with/without night-time wetting superposed for
each subgroup. The combination of wetting, urgency and voiding 10 times a day
or more delineates urge incontinence. The distribution in figure 2 is the same for
boys as for girls.

There were also highly significant differences (p<0.001) for nycturia (figure 3)
between the 2 groups: in the dry group 67% (2512 children) never stood up
during the night, for only 36% (125) in the symptom group with daytime wetting
with/without night wetting, and 29% (18) in the group with MNE. A total of 157
(85 boys and 72 girls) reported nycturia with a frequency of at least once per
night: 102 of the 3804 children (2.6%) of the symptom free group and 55 of the
528 children (10.4%) in the symptom group. In the subgroup with urgency and
more than 7 daily voidings (49 boys, 40 girls) only 8 children reported being able to sleep the whole night without having to get up or being wet at morning. Only one parent reported not knowing if the child had to stand up at night.

In the subgroup with urgency and more than 7 daily voidings (49 boys, 40 girls) only 8 children reported being able to sleep the whole night without having to get up or being wet at morning.

5. Asking professional help

Of the 528 parents of the symptom group only 130 searched medical help for the wetting problem of their child. Daytime wetting seemed to be the least worrisome condition. Only 19 of the 192 parents (10%) who reported isolated daytime wetting searched for medical help, and this in spite of severe urinary incontinence. Parents of children where night-time wetting was associated with daytime wetting were more inclined to consult a health care professional with increasing frequency of the bedwetting. MNE was clearly the most important reason to ask for help: 66% (41 of the 62 children) with isolated bedwetting consulted a medical health care professional. Figure 4 juxtaposes isolated daytime wetting and isolated night-time wetting, with frequency of wetting cross tabulated, versus asking for professional help.

Eighty-seven of the 130 parents who asked for help consulted their family physician, and 38 of these were referred to a urologist. Twenty-seven others went directly to a urologist, and 16 to a paediatrician.

Of the 130 children for whom treatment or advice was sought, 63 were prescribed drugs, 39 were instructed to use a voiding diary, and 18 were prescribed pelvic floor therapy. A total of 48 (most MNE) used an alarm device.

Discussion

Questionnaires have been developed to help to diagnose behavioural problems, diuresis, micturition patterns, and others [17,18,19]. Our questionnaire was intended to be filled in by the parents at home without the help of the investigator and to collect information on wetting problems in children. Therefore it needed to be easy and reliable. Both purposes have been met. The response rate was 77%, reiteration of the answering was good to very good, and the questionnaire has been validated, comparing schoolchildren with age and sex matched urologic patients, in another study [16].
Our results revealed a high prevalence of wetting in children completing the last two years of a normal primary school. Of the 4332 schoolchildren, a total of 529 (12%) reported daytime and/or night time wetting or soiling.

In 1994, Mattsson [20] used a frequency/volume chart to investigate 7-15 year old schoolchildren (response rate 71,2%). Of the 242 children, 36 (14,9%) reported wetting. Isolated nocturnal enuresis occurred in 15 children (8%), another 2 reported occasional wetting. Fifteen (6,2%) reported daytime wetting, 4 girls had both symptoms. Habitual nycturia was found in 4%. At follow-up one year later, Mattsson found a persistently high rate of wetting confirming the original findings. As the age range of Mattsson’s population is much larger (7-15 years) than in our study (10 to 14 years), the lower prevalence of night time wetting we found (5% versus 8%) might probably be due to the spontaneous resolution rate of MNE [21]. The almost identical prevalences for daytime wetting in Mattsson’s study (7,9%) and in our study (8%), as well as the prevalences for nycturia, at least once a night, in these two studies (4,1% versus 3,7%) indicate that spontaneous resolution is less true for daytime wetting and nycturia.

These findings are similar to those of Swithinbank et al. [22]. In 1998 they completed a prospective longitudinal study using a questionnaire administered to a cohort of 1176 British schoolchildren, at 11-12 years of age and again at 15-16 years of age (response rate 79,9%). They noted a decrease in the prevalence of urinary symptoms with age. The regression in prevalence was a little more marked for night-time wetting: 5% in the 10-12 year-olds versus 1% at age 15-16 years. Daytime wetting, defined as wetting with some regularity, was reported initially by 12 % of children. We found an almost identical prevalence of day-time symptoms. At age 15-16 years, 3% of the British subjects still reported problems. From these data it appears clearly that the credo “urinary symptoms in children do not need treatment because they tend to disappear spontaneously” is incorrect.

In 1990, Hellstrom et al.. [23] studied the micturition habits in 3556 7-year old Swedish school entrants. They found for children without bladder symptoms a voiding frequency of 3-7 times a day. In 1994 Mattson [20] could not establish any differences in voiding parameters between children with daytime incontinence and a continent reference group. We found significant differences (p<0.001) between the group with or without symptoms only when the voiding frequency was more than 10 voiding per day. The incapacity to regularly postpone the visit to the toilet (urge) and the nocturia were also significantly different in our 2
groups. These differences were even more important in case the urge was combined with high micturition frequencies.

That only 126 of the 528 children with problems of bladder control sought medical help strengthens the opinion that incontinence is as much a hidden condition for children as it is for adults [24,25].

One possible reason for this might be that the families involved do not know that qualified help is available. The high number of parents who consulted for MNE (41 of the 62) might be due to the information about this disease through the Medical School Health Centres during the last years, and the fact that most families know about the condition from affected family members.

Taking into account that:

• if treatment is begun at an early age, it seem to have a greater chance of success with fewer complications [26,27,28],
• incontinence is a very stressful event for children leading to behavioural problems [28],
• self-esteem after treatment improves and attains the same levels as in healthy children [29,30],
• very few parents spontaneously search for medical help,

Physicians and paediatricians should be encouraged to be more attentive to wetting in children, especially daytime wetting, and initiate discussion about voiding and faecal problems with parents and children.

Acknowledgements - The authors are grateful to the Medical Health Centres and the Vlaams Wetenschappelijke Vereniging voor Jeugd gezondheidszorg [VWVJ, Scientific Association of Youth Health) involved in the distribution and collection of the questionnaires, and to all school teachers encouraging the children to participate.

References
16. Bakker E, van Gool JD, Wyndaele JJ. Different aspects of potty-training. Scand J Urol Nephrol 2001; accepted for publication
Table 1

Distribution in categories of wetting and soiling symptoms in boys and girls.

<table>
<thead>
<tr>
<th></th>
<th>Boys n=251</th>
<th>Girls n=277</th>
<th>Total n=528</th>
</tr>
</thead>
<tbody>
<tr>
<td>MNE</td>
<td>47</td>
<td>15</td>
<td>62</td>
</tr>
<tr>
<td>Daytime wetting</td>
<td>68</td>
<td>124</td>
<td>192</td>
</tr>
<tr>
<td>Daytime wetting with night-time wetting</td>
<td>89</td>
<td>62</td>
<td>151</td>
</tr>
<tr>
<td>Daytime soiling</td>
<td>45</td>
<td>75</td>
<td>120</td>
</tr>
<tr>
<td>Daytime soiling with night-time wetting</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

Figure 1

Daytime wetting with/without night-time wetting (n=343). The bars show degree (clothes wet, drawers wet, spots only) and frequency. The most severe degree of wetting drops in prevalence when it occurs once a month or less, while spotting shows the opposite trend. 95% confidence intervals and number of subjects are indicated for each category of frequency.
Figure 2

Number of voidings per day vs urgency, defined as the incapacity to regularly postpone the voiding. Number of subjects and 95% confidence intervals are given for each frequency group. With the number of voidings at 10 per day or more, the prevalence of urge increased significant. Bars lined in black indicate wetting: the prevalence of wetting is 20% in the category with more than 10 voidings a day and urgency, twice as high as in all other categories.
Figure 3
Incidence of nycturia in monosymptomatic nocturnal enuresis (MNE), daytime wetting with/without night-time wetting (INC) and in normal children (N). The prevalence of nycturia is twice as high in MNE and INC than in normal children. The number of subjects and the 95% confidence intervals are given for the 3 categories.

Figure 4 a,b
Asking for professional help vs frequency of wetting. Left panel, night-time wetting only (MNE, n=62). Right panel: daytime wetting only (n=194). Number of subjects and 95% confidence intervals are given for each category. Clearly, night-time wetting is the most important reason to ask for professional help, where daytime wetting tends to be kept in the dark.
Chapter 6

Results of a questionnaire evaluating the effects of different methods of potty-training on achieving bladder control

E. Bakker, J.D. Van Gool, M. van Sprundel, J.C. Van der Auwera, J.J. Wyndaele
BJU Int 2002; 90:456-461
RESULTS OF A QUESTIONNAIRE EVALUATING THE EFFECTS OF DIFFERENT METHODS OF TOILET TRAINING ON ACHIEVING BLADDER CONTROL

E. BAKKER, Physiotherapist, University of Antwerp, Belgium
Prof. Dr. J.D. van GOOL, MD, PhD, Pediatric Nephrologist, University of Antwerp, Belgium
Prof. Dr. M. VAN SPRUNDEL, MD, MPH, Epidemiologist, University of Antwerp
J.C. VAN DER AUWERA, Statistician, University of Antwerp
Prof. Dr. J. J. WYNDÆLE, MD, PhD, DSc, Urologist, University of Antwerp, Belgium

Abstract

Purpose: To analyse if family situation, personal habits and toilet training methods can influence the achievement of bladder control.

Material and Methods: A questionnaire with 41 questions was distributed to 4332 parents of children completing the last two years of normal primary school. The questionnaire has been tested for reproducibility of the answers in a random subgroup of 80 parents. The aims of the investigation were explained in an accompanying letter, and the response rate was 76.7%. The results were analysed using the Chi-square test, Yates corrected.

Results: Two groups of children were identified: one with no lower urinary tract symptoms (3404), and one with complaints about daytime wetting and night-time wetting, and urinary tract infections (n=928). The groups were termed “control” and “symptom group”, respectively. There were no differences in the family situation between the groups. The symptom group more “below average” school results and less independence in homework and hygiene were reported. The age at which toilet training started was significantly higher in the symptom group and scheduled voiding was used significantly less. The reaction of the parents when the attempt at voiding was unsuccessful was significantly different: in the control group most parents just postponed the effort and had the child try later again, whereas as in the symptom group more parents asked the child to push, made special noises or opened the tap.

Conclusions: These data show significant differences in toilet training between children with and with no lasting problems of bladder control. Postponing the onset of the training after 18 months of age, and using certain methods to provoke a voiding (asking to push, opening the water tap) probably increases the risk for later problems with bladder control.
**Key-words:** Toilet training, bladder instability, dysfunctional voiding, urinary infection, incontinence, children

**Introduction**

For a long time, detrusor-sphincter function in newborns, which is the basis of continence, was believed to be a simple reflex, occurring as the bladder fills. Recently, several authors noted that newborns already have a well-developed and functional spino-pontospinal micturition pathway with a micturition threshold, influenced by spinal and/or arousal mechanisms, which suggests more supra-spinal control than was previously thought to be present when so young [1,2]. Gladh et al. reported mean (range) voided volumes for newborns of 23 (range 1-77)ml and median voiding intervals of 49 minutes. However, the dyssynergic voiding patterns they observed, indicated that the coordination between detrusor contraction and urinary sphincter relaxation was still incomplete, which leads in 70% of the newborns to a residual volume > 10 ml. According to Olbing et al. the communication and coordination of the lower urinary tract are fully developed between 2,5 and 4 years [3].

Voiding problems are common in children and lead to symptoms such as incontinence, urinary tract infections, and urgency. The exact causes of such abnormal evolution, leading to lasting voiding problems are yet unknown. Most of the disorders occur in neurologically normal children and are believed to be functional in nature, the so called non neurogenic bladder sphincter dysfunction (NNBSD)[4].

Hellström recently suggested that during the transition to bladder control there might be a risk of developing NNBSD, a risk that probably increases when the transition period is prolonged and when the child starts the transition at a later age [5]. Wiener et al. suggested that functional voiding disorders might be caused by inadequate toilet habits and positions [6]. They proposed training programs in order to remedy those dysfunctions, and reported some success. In a recent study we were able to show that toilet-training methods have changed greatly in the last 60 years and hypothesized that this could be one cause of the reported high prevalence of voiding dysfunctions in school-aged children [7].

The purpose of the present study was to evaluate, through a questionnaire, family situation, personal habits, and particularly toilet training methods (time and reasons of onset, way of training), used in a population of children completing the last 2 years of a normal primary school. These data were compared in 2 subgroups of the population: one with and one with no LUTS.
Subjects and Methods

A questionnaire (41 questions) was developed [8]: the first 9 questions evaluated the family situation and the personal data of the child; the next 14 were about the age at which continence was achieved, micturition behaviour at the time of the evaluation and the methods used for dry training; the last 18 questions were to document lasting LUTS and signs: day-time wetting with or without night-time wetting, monosymptomatic enuresis nocturna (MNE) faecal soiling and/or actual or former (recurrent) urinary tract infections (UTI), and the applied treatment(s) for these disorders.

The questionnaire was distributed to 5646 pupils completing the last two years of normal primary school (mean age 11.5 ± 0.56 years). The schools were contacted through 6 centres of School Health, chosen at random and including children of all social classes in the group. There were no exclusion criteria for participation in the study. The parents were contacted through the schoolteachers, who after providing an explanation, agreed to distribute the questionnaires. An accompanying letter explained the purpose of the evaluation and introduced the questionnaire, which was answered by the parents at home with no help from the investigators, and was collected again at the schools. The reproducibility and the validation of the questionnaire was confirmed previously [8].

Day-time wetting with or without night-time wetting, independent of the severity and the frequency of the wetting, faecal soiling, and a history of urinary tract infections (UTI) were considered as signs of an abnormal outcome of bladder control, and these children were designated the “symptom” group. When no history of previous or current UTI and/or no day- and or night-time wetting was reported children were designated as the “control” group. For some evaluations children with MNE were evaluated separately.

The results were analysed using non-parametric tests, i.e. Chi square test (Yates corrected); with P<0.05 considered to indicate statistical significance.

Results

In all, 4332 replies were collected from 5646 questionnaires, and were complete for 2215 boys and 2117 girls (51% and 49%): this represents a response rate of 76.7%. The population was divided into the control group of 3404 children (1963 boys and 1541 girls, 57.6% and 45.2%) and the symptom group of 928 children (352 boys and 576 girls, 37.9% and 62.1%). There were no age differences between the
groups, but the proportion of girls was significantly (P<0.001) higher in the symptom group (Table 1).

There was a small but statistically significant difference (P=0.015) in the familial background between the groups: 86% of the control and 82% of the symptom group were from a stable first marriage. Coming from a one-parent family seemed to have no influence, but the so-called “recomposed” family (second marriage of both partners often with children of their 1\textsuperscript{st} and 2\textsuperscript{nd} union) was more frequent in the symptom group (7% versus 4%). The prevalence of the primary or secondary form of MNE was independent of the familial situation.

Significantly (P<0.001) more bedwetting in relatives was reported by the symptom group, at 37% (146 boys,195 girls) vs 25% (494 boys, 381 girls) in the control group. In the small group with MNE (47 boys and 15 girls), 61% (boys and girls) reported having had a bedwetting relative.

Children of the symptom group were reported to have statistically significantly (P=0.006) more frequent school results below average, at 12% (107) in the symptom group and 8% (279) in the control group. The ability to manage homework and appointments independently was also significantly (p<0.001) lower in the symptom group: 73% had to be frequently or systematically, reminded of their obligations, as against 68% of the control group. There were similar differences (p<0.001) were found between the groups to manage normal daily hygiene: in the symptom group 37% (341) washed themselves only on command vs 31% (1046) in the control group. The participation in extra-school activities was equal in both groups: most were involved in sports or music.

The age at onset of the toilet-training (Fig 1) was significantly (p<0.001) different: 32% of the parents of the control group started toilet training before 18 months, vs only 22% in the symptom group, where most (53%) of the parents started 6 months later. In the symptom group 17% started the training after 2½ years, but only 13% in the control group started so late; about 8% in both groups reported no longer remembering when they had started training (Table 1). Significant differences (P<0.001) were reported as to the age at which continence was achieved, both during the day and the night (Table 1).

Age was reported as the major reason for initiating toilet training: by 62% in the control group and 65% in the symptom group. School admittance was mentioned significantly more often (p= 0.001) as an incentive for training in the symptom group (30% versus 36%). Being dry during the child’s afternoon sleep seemed a little more
important for the parents of the control group (22% for 20% in the symptom group) but this difference was not significant.

There were no significant differences in the choice of receptacle used during toilet training, although more parents of the symptom group (29% versus 27%) used a normal toilet without a reducing seat and support for the feet. Significantly (p<0.001) more prompting, alone or simultaneously with other methods, was used by the parents in the control (68%) than in the symptom group (62%). The symptom group adopted a more liberal attitude and imitation was far more popular. Rewarding and punishing were also significantly different (p< 0.001): parents in the symptom group had a tendency to reward and punish more (53% vs 46%) in the control group, but in both groups more reward than punishment was used.

There was a major difference between the groups in the reaction of the parents when the child’s attempt to void was unsuccessful: most parents of the control group (83%) just encouraged the child to try later again and did not insist. This was in contrast with the attitude of the parents in the symptom group: 13% invited the child to “push” to obtain a void, 26% opened a water tap, and 43% encouraged them with special noises. Some of the parents tried 2 or 3 different ways simultaneously to stimulate the voiding. A similar low percentage of parents in both groups no longer remember any more their reactions in such circumstances (Table 2).

There was considerable confusion about the use of the terms “continence and incontinence” by the parents: 459 of the 466 parents in the symptom group considered their child to be continent, despite of severe day-time wetting (upper clothes needed to be changed) several times a day. Very few parents of the symptom group (126 of the 928) consulted a health carer: most of those who sought help consulted their GP. Night time wetting seemed to be far more alarming for the parents than day time wetting.

**Discussion**

As indicated in a previous study [8] we report our data on family situation, behaviour, and methods of toilet training in a large population of children. From the questionnaire used to gather the data, two subgroups could be defined: i.e. the symptom and the control group. Kyle et al. noted in 1991 that a lack of independence and below average school results might be caused by lasting LUTS, rather than these problems being the result of another behaviour [9]. Redsell and Collier confirmed the clinical evidence for increased behavioural problems in children with night-time
wetting. Moreover, they found that behavioural problems increased in older children, which might indicate that wetting was the primary problem [10]. In the present study, school results below average and a low degree of independence, for homework and for daily hygiene, were more prevalent in children with LUTS, which indeed suggests a lower self-esteem and self-confidence in this group.

The identical prevalence of primary and secondary MNE in our children with a different familial background is in agreement with the findings of Hirasing et al. in 1997 [11], who found no differences in behavioural and emotional problems between these two forms of MNE. However, the results contrasts with those of von Gontard et al., who reported higher total problem scores (Child Behaviour Check List Achenbach) for secondary MNE [12]. The present findings reinforce previous reports: with very few exceptions, bedwetting is not caused by psychological factors, but psychological and behavioural problems in children with bedwetting are a consequence of the wetting.

In the present study, 61% of all children with MNE had had a bed wetter in the family, which agrees with Bakwin [13], who reported in 1973 in about half of children with MNE at least one parent with night-time wetting. When both parents were bedwetters their offspring had a 70% chance of having MNE.

The association of NNBSD and the development of UTI, and the high prevalence of recurrent UTI in children with incontinence, has been well documented. The risks of developing renal scarring from UTI have also been reported [14,15]. By trying to understand the causes of the development of dysfunctional voiding problems, it might be possible to prevent them and contribute to decreasing renal scarring in children.

We chose an anonymous enquiry for the present study to obtain a high response rate in a large group of children. We were aware that the study design could make it impossible to verify retrospectively any urodynamic abnormalities in the symptom group. We reported previously [8] the association between the urodynamic findings and the answers from the questionnaire in a group of 140 children; no false positive urge syndromes were detected, indicating that diagnosing NNBSD using a questionnaire is valuable, as already described by van Gool et al. [16].

Toilet-training methods have changed considerably over the last 60 years is known: the onset of training is significantly postponed, scheduled voiding progressively abandoned, and the potty-chair often replaced by a normal toilet, even without a reducing seat or support for the feet [7]. Similar differences in training methods were found, and reported, in our previous study comparing two small groups of children with a different outcome of bladder control [8]. In the present study
conducted in a large population we again found these differences in training methods: significantly more parents in the non-symptomatic control group started potty-training before age 18 months, used schedules voiding and did not insist when the first attempt to void was unsuccessful.

In 1943, Gesell noted that at age 15-18 months the child is particularly receptive for toilet-training [17]: this corresponds with the period 15-24 months period during which Schmitt [18] reported a progressive increase of the intervals between voids. That more parents in our control group started training before age 18 months, as used by parents in the nineteen forties, might indicate that Gesell's assumption is right: i.e. initiating training before 18 months old is important.

When the child's attempt to void was unsuccessful more parents of the symptom group interfered: leaving the child on the toilet/potty until he/she voided, etc. Straining induces a reflex contraction of the pelvic floor (guarding reflex) and is considered harmful for the normal coordination between detrusor and pelvic floor [6]. The present findings indicate that such a danger is especially present if straining is used regularly during the development of normal bladder-sphincter function, eventually leading to NNBSD as noted recently by Hellström [5].

The major differences between dryness and cleanliness in the present children and in the studies of Largo et al. might arise through the different definition of "continence". Largo et al. defined being continent as having the capacity to manage independently the whole continence process (go to the potty/toilet, get undressed and initiate the voiding) [19,20]. They state that this continence process is largely maturational and not predominantly influenced by training. In their view, training and drill impose parental control. Gesell differentiated between being "dry-drilled" and having complete bowel and bladder control, drawing attention to the fact that being dry and clean was rather achieved through close control from the mother, rather than by demands of the child itself [17]. That "dryness" can be trained, as shown here, and that socio-cultural factors are more important determinants of toilet training than is currently thought, is suggested by the early (5-6 months old) achievement of day and night dryness of the children reported by de Vries and de Vries in 1977 [21]. The good results reported with retraining programs for NNBSD, based amongst others on the imposition of voiding and drinking schedules, even suggest that we can influence development of bladder control at any time [22,23].

Gesell [17] pointed out the importance of the use of a small potty, adapted to the child: the child’s bottom must be well supported and in a stable position during
voiding, to obtain good relaxation of the pelvic floor. This might explain the higher prevalence of symptoms in the present children who were trained on an adult toilet. Part of the training program proposed for NNBSD is learning an adequate toilet position with support for the feet, giving a stable position to permit relaxation of the pelvic floor and thus to obtain complete physiological emptying of the bladder [16,23]. The positive effects of toilet training have been documented in recent studies. Both Sillen et al. [24] and Jansson et al. [25] reported good results in a longitudinal study in children with dilating reflux trained when young.

Considering all these findings, the hypothesis that normal bladder-sphincter coordination is purely a maturational process which can not be influenced by toilet-training should be reconsidered. The bladder can probably be trained to be “quiet”, in imposing upon the urinary system a strict filling/emptying schedule. The best time to start this training seems to be before 18 months; there were significantly more symptoms in the present group when training started after that age.

In conclusion, physicians and paediatricians should pay more attention to wetting in children, and initiate discussion about toilet behaviour and problems of bladder control with parents and children. Ten years ago, Robson et al. [26] advised physicians to start discussions about toilet training with parents when the child was between 12-18 months of old. We strongly encourage such an attitude, as the present results seem to indicate that age and methods used during potty training probably influence the outcome of bladder control. A over-liberal attitude and a late start might favour the development of NNBSD. However, it is not yet possible to recommend one “correct” way of training, which might prevent all voiding problems, as most children seem to develop normally despite environmental conditions and harmful methods. The present results indicate risks when starting training after 18 months of age, when using a normal toilet, and especially when advocating straining to initiate the voiding.

Acknowledgements - The authors are grateful to the Medical Health Centres and the Vlaams Wetenschappelijke Vereniging voor Jeugd Gezondheidszorg (VWVJ, Scientific Association of Youth Health] involved in the distribution and collection of the questionnaires, and to all school teachers encouraging the children to participate.
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Table 1.

The number of children in function of age in years in the two groups: asymptomatic control group (CG) and symptom group (S) presented for male (m) and female (f)

<table>
<thead>
<tr>
<th>age</th>
<th>Group 1</th>
<th>Group2</th>
<th>m</th>
<th>f</th>
<th>m</th>
<th>f</th>
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<tbody>
<tr>
<td>10</td>
<td>11</td>
<td>3</td>
<td>6</td>
<td>5</td>
<td>0</td>
<td>3</td>
</tr>
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<td>425</td>
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<td>193</td>
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<td>6</td>
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<tr>
<td>total</td>
<td>875</td>
<td>341</td>
<td>494</td>
<td>381</td>
<td>146</td>
<td>195</td>
</tr>
</tbody>
</table>

Table 2.

Reaction of the parents when an attempt to void was unsuccessful in children without symptoms and with symptoms. Several answers at the time were possible.

<table>
<thead>
<tr>
<th>Reaction when no miction</th>
<th>group 1</th>
<th>group 2</th>
<th>statist. p</th>
</tr>
</thead>
<tbody>
<tr>
<td>try later again</td>
<td>2840 (83,4%)</td>
<td>735 (79,2%)</td>
<td>0,00263</td>
</tr>
<tr>
<td>wait until the miction</td>
<td>90 (2,6%)</td>
<td>73 (7,9%)</td>
<td>0</td>
</tr>
<tr>
<td>push</td>
<td>185 (5,4%)</td>
<td>122 (13,1%)</td>
<td>0</td>
</tr>
<tr>
<td>make special noises</td>
<td>1267 (37,2%)</td>
<td>396 (42,7%)</td>
<td>0,00247</td>
</tr>
<tr>
<td>opened the tap</td>
<td>719 (21,1%)</td>
<td>238 (25,6%)</td>
<td>0,00323</td>
</tr>
<tr>
<td>did not remember</td>
<td>194 (5,7%)</td>
<td>46 (5,0%)</td>
<td>0,38091</td>
</tr>
<tr>
<td>total</td>
<td>5101</td>
<td>1564</td>
<td>*</td>
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</table>
**Figure 1.**
The age at onset of training and achievement of continence as reported for children in the asymptomatic control group (3204), dark bars, and in the symptom group (928), light bars.
Chapter 7

Risk factors for urinary tract infection in a population of 4332 Belgian schoolchildren aged between 10-14 years.

E. BAKKER, J.D. van GOOL, M. van SPRUNDEL, J.C. VAN DER AUWERA, J.J. WYNDAELE
Submitted to the Eur J Ped 2002
Abstract:

**Purpose:** To analyse the risk factors for recurrent UTI, and the possible influence of potty-training.

**Material and Methods:** A questionnaire with 41 questions was filled in by 4,332 parents of children completing the last two years of normal primary school. Mean age 11.5 ± 0.56 years. Statistical analysis was done with Chi-square test, Yates corrected.

**Results:** Two groups of children emerged: one without any history of UTI and a symptom group with an actual or former UTI. A strong correlation between day- and/or night-time wetting, voiding frequency of more than 10 times a day, nycturia, soiling and recurrent UTI was found. No correlation between these factors and single UTI could be demonstrated. In the 343 wetting children, recurrent UTIs were equally distributed between boys and girls.

Potty-training started significantly earlier in children without UTI compared to those of the group with recurrent UTI. Parents of recurrent UTI’s insisted more when the first attempt to void was unsuccessful: in the group without UTI most parents just postponed and had the child try later again. In the group with recurrent UTI more parents asked the child to strain, made special noises or opened the tap.

**Conclusions:** Daytime with/without night-time wetting, more than 10 voidings a day, nycturia and soiling are indicators for recurrent UTI, if they are simultaneously present the relative risk for recurrent UTI is 60%. Our findings demonstrate that using certain methods to provoke a voiding during the potty-training (especially straining) may induce an increased risk for later problems with bladder control.
Introduction

In infants, voiding appears not to be fully co-ordinated, and often bladder-sphincter dyscoordination occurs, with multiple incomplete voids [41]. Normal function of the lower urinary tract depends on development of normal bladder capacity, maturation of urethral sphincter function and development of neural/volitional control over bladder-sphincter function[30]. Abnormalities in any of these categories may result in clinically evident abnormalities of bladder-sphincter control, so called non-neuropathic bladder-sphincter dysfunction (NNBSD). The correlation between recurrent urinary tract infection (UTI), and non-neuropathic bladder-sphincter dysfunction is strong and well documented [38,35,40].

NNBSD, recurrent UTI and vesico-ureteral reflux (VUR) form a well documented clinical complex in school-age children, especially in girls [27,37]. The complex causes considerable morbidity, both from infection and incontinence, and has a prevalence that peaks at 8% around the age of 7 years, slowly decreasing to about 2% around adolescence [15]. The nature of the relationship between NNBSD, UTI and VUR is unclear. Whether NNBSD may give rise to (recurrent) UTI, or whether a bacterial cystitis may trigger the development of persistent bladder-sphincter dysfunction, has not been clarified yet. At present there seems consensus that the triggering factor most often is immaturity of the coordination between detrusor and sphincter [1,26,25,36,38].

There is as yet no scientific information on the influence of potty-training on this development. Over the last 60 years methods of potty-training changed a lot: former generations started potty-training when the child could sit properly (around one year of age), and trained their children by putting them on a potty-chair at regular intervals (prompting). During the last decades a much more liberal attitude has been adopted [6].

Recent studies seem to indicate that there might be an influence of potty-training on the development of normal bladder-sphincter function. Janson et al. reported, in a longitudinal study in healthy children followed up from the neonatal period to age 3 years, incomplete emptying, until the children were potty-trained. With potty-training completed, they rarely found residual volumes. Identical findings were reported by Sillén et al, in a study of free voidings in children aged from 1½ to 5 years with dilating reflux. These authors also showed achievement of complete bladder emptying following toilet training [21,32].
In a former study [4] we reported significant differences in potty-training in children with and without lasting lower urinary tract problems, and these findings have been confirmed in a large population [3]. In this study, we want to call attention to symptoms which might indicate the presence of UTI, and we want to investigate the possible relationship between recurrent UTI and used methods of potty-training by comparing the methods used in children with and without recurrent UTI.

Subjects and Methods

A questionnaire with 41 questions was used, development, reproducibility and validation of the questionnaire was previously done and have been published elsewhere [4]. Nine questions evaluate the family situation and the actual personal data of the child; 14 questions are about the age at which continence was obtained, about actual voiding habits and about the methods used for potty-training; 18 questions document actual daytime wetting with or without night-time wetting, faecal soiling, urinary tract infection (UTI), and monosymptomatic enuresis nocturna (MNE).

The questionnaire was handed out to 5,646 pupils completing the last two years of normal primary school. Contact with the schools was made through six centres of School Health. These centres were chosen at random and the schools included all social classes. There were no exclusion criteria to participate in this study. The contacts with the parents were made through the schoolteachers, who after explanation, agreed to hand out the questionnaire, with an accompanying letter explaining the purpose of the evaluation. The questionnaire was completed by the parents at home without help of the investigators, and returned at school.

Information on UTI was obtained with the following questions:

1. had your child a urinary infection (yes/no)
2. if yes how old was he/she at that moment (younger than 2.5 years, 2.5 years or older)
3. how many infectious episodes were there (one, > than one, once a year, > than once a year).

When no UTI was reported, children were allocated to the group without UTI.

The incapacity to postpone the voiding was considered a sign of urge syndrome. It was however impossible to document the possible existence of eventual dysfunctional voiding through this questionnaire.
Statistical analysis included tabulation and basic statistical testing, using Statistica (Statsoft Inc, USA 19899) and multiple logistic regression, using Egret (Cytel Software Corp, USA 1989) ; p<0,05 was considered as statistically significant.

**Results**

We collected a total of 4,332 questionnaires, with complete sets of data for 2,215 boys and 2,117 girls (51% - 49%). This is a response rate of 77%. The mean age of the responders was $11.5 \pm 0.56$ years

The population was divided into a control group without any history of UTI, and a symptom group with an actual or historical UTI (see table 1).

No differences were observed between the 2 groups in function of age, to be expected in view of the small range of age in the evaluated population.

**Single and recurrent urinary tract infections, as reported by parents**

Of the 31 boys with a history of recurrent UTI, 17 (51%) had had their first infection before the age of 2.5 years. In the girls with recurrent UTI, only 21 out of 101 (21%) had the first infection before age 2.5 years ($p<0.001$).

Overall, UTI’s were far more prevalent in girls than in boys: 18.3% versus 5.4% ($p<0.001$). This significant difference in prevalence was the same for single infections as for recurrent infections.

**Correlation of reported UTI with wetting and other lower urinary tract symptoms**

Daytime wetting with/without night-time wetting

Figure 1 gives the distribution of UTI, single and recurrent, versus daytime wetting with/without night-time wetting, monosymptomatic night-time wetting (essentially MNE)), and faecal soiling.

In the total population of 4,332 children, 62 turned out to have MNE: 47 boys and 15 girls. The prevalence of recurrent UTI in this specific group, 2% ($n=1$), was the same as the prevalence in the children without wetting.

There is a strong correlation between historical recurrent UTI and daytime wetting with/without night-time wetting. This correlation is the same for boys and girls: 29 of the 157 boys with daytime wetting had had recurrent UTI, versus 31 of the 186 girls with daytime wetting. The overall prevalence of historical recurrent UTI in the children
with daytime wetting with/without night-time wetting is 12%, versus 2% in the children without wetting (p<0.001).

In the group of children with recurrent UTI significantly more faecal soiling was reported: 9.1% of the children with recurrent UTI for only 2.5% in the control group.

Voiding frequency, urgency and nycturia

In figure 2, the reported number of voidings per day is plotted versus the ability to regularly postpone voiding; when this ability reportedly was not present, this was considered to be a sign of urgency [4]. For each category of frequency/urgency, the prevalence of reported single and recurrent UTI is also plotted.

The prevalence of recurrent UTI is significantly (p<0.02) higher in the category with a voiding frequency of 10 times a day or more, regardless of the presence of urgency: the marker for infections is the voiding frequency. The prevalence of single UTI’s does not correlate with either voiding frequency or the presence of urgency.

The prevalence of recurrent UTI is also significantly (p<0.001) higher in the category with nycturia at least once a week: 130 of the 3,818 (3%) children without UTI has to get up at least once a night, against 14 of the 132 (10%) in the group with recurrent UTI.

Recurrent UTI versus start of potty training

No differences were found as to the motives to start the potty-training between the groups, but the training started significantly earlier in children without UTI compared to those of the group with recurrent UTI (p<0.05): 31% of the 3,829 children without historical UTI’s started before age 18 months, for only 21% of the 31 boys and 101 girls with recurrent historical UTI. In all groups training started somewhat earlier for girls than for boys.

In Table 2 we present the methods of training and the reaction of the parents when the child’s attempt to void was unsuccessful. Parents of children with recurrent infections using timed voiding, insisted significantly more (p<0.005) to obtain a voiding than the control group: 9 of the 79 parents (11%) in the group with recurrent UTI let the child on the potty until a voiding was obtained, for only 89 of the 2,567 parents (3%) in the control group. Of these 89 children 33 reported urinary problems: 24 daytime wetting with/without night-time wetting, 4 MNE, and 5 more than 10 voidings a day.


**Discussion**

The risks of recurrent UTI

Recurrent UTI is the second most common bacterial infection requiring medical attention. In general practice, the possibility of a UTI in a febrile child is easily overlooked. Numerous publications have reported on the risks of renal scarring in children with recurrent UTI.

Prevalence of renal scars at first referral is already high: Goldraich et al. [14] reported in a prospective study an average of 38% in 202 children. Smellie et al. in 1992 [34] reported even higher prevalences (49% in 309 children), and van Gool and de Jonge reported in a retrospective study an average of 30% in 93 children [38].

Vesico-ureteral reflux (VUR) is an important risk factor, but renal damage can also occur in the absence of reflux [19,20]. Late sequelae in female patients of renal scarring are known and well documented: (1)toxemia: 13-79%, (2)preterm delivery: 30-57%, (3)foetal growth retardation: 31-43%, (4)foetal loss:9-75% [24,7,11,23,22].

Once the diagnosis of renal scarring has been made, with careful management the incidence of new scars can be limited to 2-5%, as reported in prospective series [34]. Important factors provoking renal scarring are young age at first infection and delay of treatment. In young children, infections should be diagnosed pro-actively and treated as soon as possible in order to prevent renal scarring. Scrutinous history taking should reveal any sign or symptom of NNBSD: recurrent UTIs and NNBSD should be treated together not separately [31,37].

We found a statistically significant correlation only for recurrent UTI with daytime wetting, voiding frequency of 10 times a day or higher, nycturia and soiling episodes. We did not find such a correlation for MNE, and this confirms the findings published by Hanson in 1992 [14].

Single and recurrent UTI

The fact that a correlation with wetting or soiling is not found in children with one UTI, is probably due to the recollection of UTI’s as reported by parents, which will be more consistent for recurrent UTI’s than for just one single infectious episode. As our questionnaire was designed to be anonymous, to insure an optimal response rate, we could not verify the reported UTI’s as did Hellström et al. in 1990. They checked reported recurrent UTI’s by the parents against hospital records in a study on 7-year old Swedish school entrants the recollection of the parents on this topic was found to
be remarkably accurate [15]. In our results and discussion we focused on the 132 children reporting recurrent UTI’s.

Boys versus girls

The prevalence of recurrent UTI in girls in our population is similar to the one found in the cited cohort study of 7-year old Swedish school entrants. Our finding that 51% of the 31 boys with historical recurrent UTI had their first infection before the age of 2.5 years, versus 21% of the 101 girls with recurrent UTI (Table 2), may be explained by the high rate of congenital anomalies with obstructive uropathy in males. In the 343 wetting children equal infections for boys and girls were found.

Recurrent UTI and bladder-sphincter dysfunction

There is ample evidence in the literature on the correlation between voiding dysfunction and recurrent UTI, especially in girls: Snodgrass, in 1991, found up to 66% of girls with voiding dysfunction developing a UTI, while 40% of the girls with recurrent UTI had voiding dysfunction [35]. This finding was confirmed by others, who established strong correlation between recurrences of UTI as well as resolution rate of VUR (negative correlation) and NNBSD [9,39]. The suggestion that NNBSD may be predisposing to the development of infections has since been frequently confirmed, it has also been suggested that NNBSD result in renal damage even in the absence of VUR. Recently authors suggested that low birth weight may also be a risk factor for the development of renal damage among children with UTI without reflux [18].

Bladder and bowel dysfunction

Although the association between bladder and bowel dysfunction has been described in many reports, the exact pathophysiology remains unexplained [13,28,29]. The anatomical proximity of the bladder and the bowel and the identical innervation of the urethra and anal sphincter, make it tempting to conceptualise that dysfunction can occur in both systems simultaneously. The strong correlation we found in our population between faecal soiling and UTI supports this link.

The hypothesis is that efforts to maintain urinary continence may lead to a high tone of the pelvic floor muscles, resulting in dysfunctional and incomplete emptying of the bowel, leading to constipation and soiling [2,10].

Definitively the presence of daytime wetting and/or soiling, voiding frequencies of 10 times a day or more, and nycturia are not only signs of NNBSD [5] but are also
indicators for the possible existence of recurrent UTI. Especially when more than one indicator is present, there is a very high risk: 60% of the children combining the 3 indicators report recurrent UTI, they were all girls with a first infectious episode contracted after 2.5 years of age.

Potty-training

Very little is known about the exact causes of the abnormal evolution, leading to NNBSD. Recently it has been suggested that in the period of transition to bladder control there might be a risk of development of NNBSD [16]. Hellström et al. discussed in a recent paper the possible negative consequences of the postponement of the start of the potty-training during the last 60 years [17,6]. They noted that potty-training in toddlers suffering from bladder dysfunction improves bladder emptying, decreasing residual urine and resultant urinary tract infections. Two recent studies positively underline these findings [32,21]. A study on pelvic floor therapy (a combination of behavioural therapy, strict drinking and voiding schedules, and pelvic floor relaxation) by Hoebek et al. in 42 girls with NNBSD and recurrent UTI showed good results with a decrease of the number of infections after six months of treatment [19].

That potty training methodology changed a lot during the last 60 years is known: onset of training is significantly postponed, scheduled voiding is progressively abandoned, the potty is often replaced by a normal toilet, even without a reducing seat or support for the feet. The attitude of the parents when the first attempt to void is unsuccessful has also changed significantly: currently parents insist more [6]. In the present study we once more compared the training methods used in children without any UTI and children with recurrent UTI’s [36]. Again, we found significant differences: parents of the infection free group more often started the potty-training before 18 months and insisted less when the first attempt to void was unsuccessful. Particularly the demand to strain, which induces a reflex contraction of the pelvic floor, the guarding reflex [8], is considered harmful for the normal co-ordination between detrusor and pelvic floor; it seems to lead in 46% of the children to dysfunction if used during the development of normal bladder-sphincter co-ordination.
Conclusion

Urinary tract infections are common in children and should be diagnosed and treated as early as possible. Daytime wetting with/without night-time wetting, a voiding frequency of more than 10 times a day, and nycturia, are all indicators for abnormal bladder-sphincter function. When all indicators are simultaneously present the relative risk for recurrent UTI is 60%, with a high associated risk for renal scars.

It still seems not possible to recommend one absolutely “sure” way of potty-training, as the majority of the children develop normal bladder function, independent of the age at which the training was started and the methods used. The results from this study, confirming the findings of our previous papers, however indicate that

- Leaving the child on the potty and provoking the voiding when the first attempt was unsuccessful, especially with straining, implies a high risk for development of abnormal bladder-sphincter co-ordination.
- Starting potty-training after 18 months involves some risks
- Using a normal toilet, without a reducing seat and support for the feet in stead of a little potty adapted to the child involves a small risk.

Consequently, general physicians and paediatricians should not only take urinary symptoms very seriously and, as urinary incontinence is still a hidden condition, question the child and the parents on this topic, but they also might initiate discussion about toilet training with the parents before the child is 18 months.

References

3. Bakker E, van Gool JD, van Sprundel M, Van Der Auwera JC, Wyndaele JJ (2002) Results of a questionnaire evaluating the effects of different methods of potty training on the achievement of bladder control. BJU Int : accepted for publication
Table 1.
Prevalence of historical UTI’s, single or recurrent, in 2,215 boys and 2,117 girls

<table>
<thead>
<tr>
<th></th>
<th>single UTI</th>
<th>recurrent UTI</th>
<th>no UTI</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
<td>99 (5%)</td>
<td>31 (1%)</td>
<td>2,085 (94%)</td>
<td>2,215</td>
</tr>
<tr>
<td>Girls</td>
<td>283 (13%)</td>
<td>101 (5%)</td>
<td>174 (81%)</td>
<td>2,117</td>
</tr>
</tbody>
</table>

Table 2.
Actions of parents when attempts to void were unsuccessful, in 3618 children without UTI (6038 answers), versus 244 children with recurrent UTI (244 answers). The columns show the distributions of all answers; for the first three rows, the difference between 'recurrent UTI' and 'no UTI' was statistically significant (\(\chi^2 = 29.56\), df = 5, \(p<0.001\)).

<table>
<thead>
<tr>
<th>Reaction when no miction</th>
<th>Recurrent UTI</th>
<th>No UTI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Try later again</td>
<td>100 (41%)</td>
<td>3165 (52%)</td>
</tr>
<tr>
<td>Wait until the miction</td>
<td>15 (6%)</td>
<td>128 (2%)</td>
</tr>
<tr>
<td>Push/ Strain</td>
<td>17 (7%)</td>
<td>263 (4%)</td>
</tr>
<tr>
<td>Make special noises</td>
<td>64 (26%)</td>
<td>1445 (24%)</td>
</tr>
<tr>
<td>Opened the tap*</td>
<td>42 (17%)</td>
<td>826 (14%)</td>
</tr>
<tr>
<td>Did not remember</td>
<td>6 (3%)</td>
<td>211 (4%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>132</strong></td>
<td><strong>3818</strong></td>
</tr>
</tbody>
</table>
Figure 1.
Distribution of historical UTI versus daytime wetting with/without night-time wetting, monosymptomatic nocturnal enuresis, and faecal soiling, in 4,332 respondents.

Figure 2.
Number of voidings per day vs urgency (n=4332), with reported single and recurrent urinary tract infections for each category. Age and history of the urinary tract infection.
Chapter 8

Discussion
The exact mechanisms of control of the lower urinary tract by the central nervous system are still not well understood, but it is known that control occurs at different levels. The main influences of the CNS are inhibition of reflex detrusor contraction and co-ordination of detrusor contraction and sphincter relaxation (chapter 1.1. Development of bladder and bowel control).

Some knowledge exists about the development of this control during childhood. Between the 1st and 2nd year of life the maturation of autonomic nerves starts, leading to the awareness of bladder and bowel filling and to the ability to delay micturition and defecation by voluntary contraction of the pelvic floor and the sphincters. Complete urinary continence is obtained at a variable age, usually between 3.5 and 6 years, and bowel control somewhat earlier [Largo et al. 1999].

Remaining urinary and/or faecal incontinence are signs of an abnormal condition, which may have organic or functional origins. Organic causes can be varied: anatomical when there is pathology in the structure of the bladder-sphincter unit, or neurogenic when there is something wrong in the neurological structures. Functional causes are behavioural without overt organic or neurogenic origins.

The population we studied was aged between 10 and 14 years. Therefore we may expect the maturational process to be completed in most of them. Likewise it would seem probable that most anatomical and neurological abnormalities would already have been detected and treated. Such implicates that the vast majority of lasting bladder and bowel problems, reported in this thesis, has functional origins and can be classified amongst the non-neuropathic bladder-sphincter dysfunctions (NNBSD), first described by Bates et al. in 1970.

Functional voiding problems seem to increase in recent years [Vande Walle et al. 1995]. In our first study (paper 2) it was not clear whether this increase was due to a real increase or was rather the result of a better awareness and a wider appreciation of parents that medical help is available. Our findings in following studies however clearly show that very few children with daytime wetting are consulting a health-carer. This is even so when the child has wetting incidents, which makes the change of upper-clothes several times a day necessary. Night-time wetting, surprisingly, seems to be a more worrisome condition for parents than daytime wetting. In the case of MNE more than 80% consult a physician (figure 4, paper 3). Symptoms as daytime wetting, constipation with or without soiling, urgency and
frequency become mostly apparent only during history taking and even then some caution is needed.

In our survey, most parents of wetting children surprisingly report their child to be continent in spite of daytime accidents several times a week. The term “continence” does give rise to a lot of confusion, not only in history taking but also in scientific literature. It seems therefore preferable to question parents and children rather on “wetting” and on dirty underwear than to ask if there is “incontinence”. Moreover continence is used as well for “dry-drilled” as for managing the whole process without help, although both conditions represent very different things. It would therefore seem unlikely that the increase of voiding problems can be, exclusively, attributed to better awareness of the parents. On the contrary these data show that incontinence is still as much a hidden condition for children as it is for adults, and that parents feel reluctant to talk about it. Another cause for keeping the problem hidden may be that wetting has often been considered as a regressive phenomenon or indicator of a slight development delay, which would resolve spontaneously with time. The low self-confidence of incontinent children has been brought forward as an argument in favour of this hypothesis. But it is now been well established that the low self-esteem is rather the consequence of the chronic incontinence than a sign of development delay.

The vast majority of children achieve continence, but as much as 12% still have lasting symptoms of bladder-sphincter dysfunction at age 10 to 14 years (table 1 paper 3). The most obvious symptom is daytime incontinence, in one third of the cases associated with recurrent UTI. The prevalence of dysfunctional voiding problems is not as rare as one might expect [Hansson 1992, Chandra 1995, Olbing 1992, Hoebeke et al. 1996].

The real causes of such abnormal development of bladder-sphincter function are as yet mostly unclear (chapter 1.3). Vande Walle et al. suggested in 1995 that this disorder might be related with changes in our behaviour, that are stimulated by familial and social pseudo-reasons. Commercial interests and marketing play a major role, which leads to wrong dry-training and lack of time to void. Based on the results of retraining [Hanson et al. 1987, Hellström et al. 1987, Hellström 1992, Combs et al. 1998, De Paepe et al. 1985 De Paepe et al. 1981, Hoebeke et al. 1996], and the better emptying of the bladder in toilet trained children [Sillén and Hanson 2000], some influence of toilet training can be expected as well in preventing as in inducing NNBSD.
To gain knowledge about this, we compared several aspects of potty-training in children with and without lasting dysfunctions in a first group. We found significant differences for the age of onset and for the methods used. A later start, a less frequent use of scheduled voiding, more insistence to void if the first attempt was unsuccessful, and use of a non-adapted potty to the child’s bottom were significantly more frequent findings in those with lasting problems of bladder control.

The “early” start (before 18 months) done in the symptom-free group was opposite to the general consensus during the last years where authors have advised to rather postpone the training in order to favour “natural maturation”. Often a too early start and the use of strict schedules has been blamed for the development of elimination problems. The increase of eliminating dysfunctions during the last years does put doubt upon the benefits of a too liberal approach as advocated during the last decades. We have developed this further in our studies.

It is generally accepted that abdominal hyperpression induces a reflex perineal contraction, well known as the guarding reflex. Hyperpression will occur in case the child strains during voiding, a technique which seems particular disastrous if used during the developmental phase. Ninety percent of the children who during training were asked to strain presented symptoms of NNBSD at age 10 to 14 years. No treatise on toilet training advocates inviting the child to strain if the first attempt to void was unsuccessful, in contrast with other methods as opening the water tap. Probably straining as method to start miction is thus a behaviour transmitted within the population independent of scientific advice.

The use of an adult toilet, as often claimed by toddlers in order to do as the “big ones”, creates unfortunately a very unstable position for the child during voiding and insufficient leverage during defecation. In our first study the big majority (68%, 22 of the 32) of the children trained on an adult toilet reported NNBSD. Not only the lack of leg support has been proved very harmful for a correct relaxation of the pelvic floor [Wennergren et al. 1991], necessary for normal voiding. The insufficient leverage also leads to difficult and incomplete emptying of the bowel as the child cannot push against the bottom [Christorphersen 1991]. A long-term effect of this situation could be at one hand incomplete emptying of the bladder with high risks for development of recurrent UTI, and on the other hand constipation. Association between bowel and bladder dysfunctions has been described in many reports [O’Regan et al. 1985, Koff et al. 1998, Loenig-Bauke 1997, Dumont].
During our study we became aware that training may have known an evolution during the last decades. Therefore we run a comparison between formerly used training techniques, the actual training-methods and the “re”-training programs used today for dysfunctional voiding. We questioned parents (generally mothers) of three generations and compared onset of the training, methods used and results (being dry and clean). The most detailed information came surprisingly from the eldest group (> 60 years): replies as “my 1st child was dry at 12 months, the 2nd at 10 months, n°3 at 15 months” were not rare. In reading the remarks from this group, we had even the strong impression that they remembered far more about the potty training than actual parents. This is probably due to 2 main facts. At one side there were strict rules of training: mothers did not need to “catch” the child when he was “mature”, avoiding much stress about when and how to train. On the other hand the labour saving effects, once continence was obtained, were very motivating and it seems logical that mothers remember very well the age of continence as it coincided with an important decrease in laundry. One should however be well aware that this “continence” is rather cleanliness by close control of the mother than the capacity of the child to manage the whole continence process alone, as already described by Largo et al. [1996]. In more recent years the training has become more liberal and the possible impact of such attitude on the prevalence of NNBSD has been mentioned higher.

It is now generally accepted that the infant bladder is not emptying through simple spinal reflexes without any control of higher centres, and with a perfect co-ordination between bladder and sphincter. There are spinal micturition pathways influenced by behaviour and arousal resulting in “dyssynergic” voiding patterns, indicating incomplete co-ordination. It might therefore be necessary to impose a fixed filling-emptying rhythm on the bladder during the transition period to continence. This hypothesis is strengthened by the findings of recent studies who reported that toddlers suffering from bladder dysfunction improve their bladder emptying and decrease the residual urine and resultant UTI after potty-training [Koff and Murtagh 1983. Hellström et al. 1995, Willemsen and Nijman 2000, Bartkowski 2001]. Formerly used training methods show a remarkable agreement with actual treatment programmes for dysfunctional voiding. These latter are also based on the imposition of voiding and drinking schedules, on learning an adequate toilet posture and proprioceptive relaxation exercises for the pelvic floor. This could explain the better results with the potty-training obtained by the parents of the symptom-free group in our study who
started earlier and used more scheduled voiding. The critical point to start training did seem to be situated between 12 and 18 months.

These preliminary results were obtained in a rather limited number of children. To check the value of these findings further research on a big population was necessary. With the help of the Scientific Association of Youth Health, we collected data on training methods, voiding habits and wetting/soiling of 4332 children, aged between 10 to 14 years, completing the last two years of normal primary school. This survey gave interesting data.

Our results revealed an almost identical percentage for daytime wetting as reported by Hansson [1992] in a population of 3553 children of 7 years old. The lower prevalence of MNE compared to his study is probably due to the spontaneous resolution rate of MNE. The almost identical prevalence of incontinence and nycturia in our study on children 10 to 14 years and in Mattsson's study [1994], on a population aged from 7 to 15 years, indicates however that spontaneous resolution is less true for daytime wetting and nycturia. The believe that “urinary symptoms in children do not need treatment because they tend to disappear spontaneously” is thus incorrect, with the exception of MNE.

Our data of the large study show that urinary symptoms are common in children, and are easily ignored by parents and health carers: only 126 of our 528 children with symptoms sought for medical help, the big majority for night-time wetting. These findings underline the necessity for physicians and paediatricians to be attentive to signs of bladder and bowel dysfunction: high voiding frequency (> 10 times a day), urge (especially when combined with high voiding frequency), nycturia, wetting and/or soiling. One third of the children with regular daytime wetting of more than once a month have recurrent UTI. When all symptoms are simultaneously present, up to 60% of the children have recurrent UTI. The high prevalence of kidney scars in children, predominantly girls, when they consult for the first time a urologist with recurrent UTI, accentuate the importance for early diagnosis [Goldraich et al. 1989, van Gool and de Jonge 1989]. Complications of renal scars are toxaemia, preterm delivery, foetal growth retardation, and foetal loss [Kincaid-Smith and Fairley 1987, Becker et al. 1986, Cunningham et al. 1990, Jungers et al. 1991, Jones et al. 1996]. Once the diagnosis of recurrent UTI has been made, with careful management new scars are reported to have an incidence of 2-5% in prospective series [Jacobson et al.1992, Smellie et al.
1998]. This proves that an early start of treatment is essential for the preservation of renal function.

We found similar differences in training methods used in children with and without symptoms (paper 4), and in children with and without recurrent UTI (paper 5) as in our preliminary study in children with and without lasting problems of bladder control (paper 1).

- Onset of the training
In the symptom-free group onset of the training is significantly more frequent before age 18 months. In 1943 Gesell already noted a period during which the child was particularly receptive for training, coinciding with the increase of the intervals noted by Schmitt [1987]. In a recent paper Hellström [2000] discusses the possible negative consequences of the increasing postponement of bladder training on the development of NNBSD. Our findings confirm the risks of starting after age 18 months.

- Way of training
Scheduled voiding is used more often by parents of the symptom-free group. This adds prove to the earlier hypothesis that one should impose a strict filling-emptying rhythm upon the bladder during the transition period to continence. The use of several methods at the same time, as present in our symptom groups, might lead to “confusion” during the learning process. It is at this stage not clear whether the use of different methods together is the cause or the result of the lack of success of the training. The same goes for the more frequent punishing applied in these groups. However the identical duration of potty training reported in all groups pleads against the hypothesis that parents change methods because they consider the training as ineffective. The finding that the majority of the parents consider their child to be dry, in spite of daytime wetting, reinforces this idea. It is highly probable that occasional accidents are not considered as a failure of training by the parents, certainly not at that low age, and thus not as a reason to change training methods.

- Reactions when no miction occurred
Parents of the symptom group interfered on the spot: they left the child on the potty until a miction was obtained, asked to strain and used running water. The big majority of children, who were asked to strain during the transition period to bladder control, present voiding symptoms at age 10 to 14 years. Surprisingly straining was never used by parents 60 years ago. It is possible that the claim to
strain in order to obtain a voiding is due to the more stressing life style of most parents in recent years. The eternal lack of time of our modern society gives no time to try later again. It is for childhood voiding, as for a lot of other things “now or never”. It has already been described that straining, either to initiate or to accelerate the miction, or to obtain a better emptying of the bladder is very harmful for normal bladder sphincter co-ordination. It has been related to residual urine, lazy bladder and recurrent UTI’s. Parents who incite their children to strain enter a high risk of an abnormal bladder-sphincter function, leading to NNBSD.

- **Use of a normal toilet**

The danger of the use of a normal toilet, already described higher, is once more confirmed for this population. Gesell [1943] pointed out the importance of the use of a small potty, adapted to the child. Recent findings agree with his statements that the child’s bottom must be well supported and that the child must have a stable position during elimination. This might explain the higher prevalence of symptoms of children who were trained on a normal potty.

**Conclusions:**

It seems hazardous to recommend one absolutely optimal and safe way of potty training in order to avoid all risk of symptoms at a later age. Many children do seem to succeed with whatever method is used. But many also do not. Our data have made it possible to describe what may be considered good habits and what are definitely “wrong” ways of training, which should be avoided as they will lead in the majority of the cases to lasting voiding symptoms. The most important to avoid are inducing voiding with straining and using a toilet seat not adapted to the child’s bottom. Our data also show that starting training before 18 months and using scheduled voiding are not dangerous as claimed recently. These habits may even help to develop normal bladder-sphincter co-ordination. A too liberal attitude seems to lead on the contrary to the development of NNBSD. It seems likely that we can teach the bladder to be “quiet” in imposing a strict filling/emptying schedule.

The low percentage of parents searching spontaneously for medical help should incite physicians and paediatricians to be far more attentive to the signs of lasting problems for bladder control. Using “continence” as terminology in the history taking does seem to induce confusion and more detailed questioning is needed.
Chapter 9

Dutch Summary
Op welke manier het centrale zenuwstelsel de werking van de lagere urinewegen beïnvloedt is nog steeds niet volledig bekend. Wel is geweten dat deze controle plaats heeft op verschillende niveaus en onontbeerlijk is voor de normale werking van de blaas en darm. Bij bezenuwingsstoornissen of stoornissen aan de intrinsieke structuur van blaas en sfincter is de pathofysiologie gemakkelijk te begrijpen. Dit in tegenstelling tot functionele stoornissen, of niet-neurologische blaas-sfincter stoornissen (NNBSS), waarvan algemeen werd aangenomen dat het kind het verkeerd geleerd had. De bevindingen van recente studies, die hebben aangetoond dat reeds op zuigelingenleeftijd blaas-sfincter discoördinatie aanwezig is, trekt deze stelling in twijfel.

De goede resultaten bekomen bij NNBSS dankzij training, doen vermoeden dat zindelijkheidstraining een invloed zou kunnen hebben op het ontstaan of voorkomen van deze aandoening. Het doel van deze thesis is dan ook na te gaan of, en zo ja hoe, de zindelijkheidstraining de controle over blaas- en darmfunctie beïnvloedt. Een manier om hierover informatie te verkrijgen is om de toegepaste zindelijkheidstraining te vergelijken in kinderen met een verschillend eindresultaat qua blaas- en darmcontrole.

In de inleiding wordt de actuele kennis over de normale ontwikkeling van blaas en darm weergegeven en wordt de evolutie in zindelijkheidstraining door de eeuwen heen beschreven. Verder wordt in het kort de pathofysiologie en de behandeling van functionele blaas- en darmstoornissen overlopen, evenals de vraagstellingen van deze thesis.

In een eerste artikel wordt de methodologie beschreven en de vragenlijst gevalideerd op betrouwbaarheid en herhaalbaarheid. Enerzijds blijkt dat alle kinderen die in de enquête aandrangssyndroom rapporteren, een urodynamisch aantoonbare functionele afwijking hebben. Anderzijds blijkt dat ouders zich goed herinneren hoe en wanneer de zindelijkheidstraining uitgevoerd is. Methodologisch wordt de zindelijkheidstraining bij kinderen met en zonder symptomen met elkaar vergeleken. Als symptomen worden beschouwd: nat zijn overdag en/of ’s nachts, vuile strepen in de onderbroek, meer als 10 micties per dag en het niet kunnen uitstellen van de plas. Uit de gegevens blijkt dat er significante verschillen bestaan: in de groep van kinderen met problemen is later gestart met trainen, werd meer aangedrongen als de plas niet direct kwam en hadden de ouders meer neiging tot straffen. Opvallend was het gering aantal ouders van “natte” kinderen, die aangaven dat hun kind last had van incontinentie.
In een tweede artikel wordt de evolutie tijdens de laatste 60 jaar (3 generaties) qua zindelijkheidstraining geanalyseerd om te zoeken naar een mogelijke oorzaak voor het toenemende aantal plasproblemen bij kinderen. Het ging over een totaal van 812 kinderen, getraind door 321 mensen. Zestig jaar geleden werden kinderen getraind praktisch vanaf het moment dat ze konden zitten, 50% van de ouders begonnen zelfs voor de leeftijd van één jaar. De kinderen werden toen op regelmatige tijden op het potje gezet. Dit is in tegenstelling met wat jonge ouders van nu doen: nog slechts één vijfde van de ouders begint te trainen voor de 18 maanden, en het plassen op vaste tijden is door de meerderheid vervangen door plassen op aanvraag van het kind. Een groot verschil is echter de reactie van de ouders als er geen urine geproduceerd wordt: waar 60 jaar geleden gewoon later nog eens geprobeerd werd, dringen de ouders nu veel meer aan op een plas (oa. door te vragen om te duwen, iets wat nooit gedaan werd door de oudere generatie). Het zou goed kunnen dat het hectische leven van nu hiervan de oorzaak is: het “nu of nooit” syndroom heeft een vaste plaats verworven in de huidige opvoeding. De vervanging van de kakstoel en het potje door een normaal toilet, heeft zeker niet bijgedragen tot het aanleren van juist plasgedrag.

In een derde artikel worden de plasgewoontes en de symptomen van 4,332 Belgische schoolkinderen tussen de 10 en 14 jaar beschreven. Gezien de leeftijd van de kinderen lijkt het logisch dat neurologische en anatomische problemen reeds bekend zijn, en dat de bestaande blaas- en darmstoornissen een functionele oorsprong hebben. Vervolgens worden de kinderen verdeeld over 2 groepen: een groep van 3804 kinderen zonder problemen en een groep van 528 kinderen (=12%) met natte of vuile broekjes: 343 zijn nat overdag, 62 hebben monosymptomatisch bedwateren, 123 melden vuile broekjes. Aandrang (meer dan 7 plasjes per dag en het niet kunnen uitstellen van de plas) kwam significant meer voor in de symptoom groep, evenals nycturia. Opmerkelijk was het verschil in reactie van de ouders in functie van de symptomen: 66% van de ouders met kinderen die ‘s nacht nat waren consulteerden een arts, voor maar slechts 10% van de ouders voor de kinderen die overdag nat waren. Incontinentie bij kinderen is nog steeds een beschamende toestand die zo goed mogelijk verborgen dient te blijven.

In een vierde artikel wordt de manier van trainen vergeleken tussen 2 groepen van kinderen. In deze studie worden niet alleen de kinderen die nat en/of vuil zijn opgenomen in de symptomen groep, maar ook kinderen met een geschiedenis van urineweg infectie (UI). De groep met symptomen (n=928) begon later met trainen, gebruikte minder vaste plasschema’s en drongen meer aan als de plas niet direct
kwam als in de symptoomvrije groep (n= 3404). Tevens werd in de symptoom groep meer gebruik gemaakt van een volwassen wc.

In een vijfde en laatste artikel worden de risico factoren voor recidiverende UI besproken en de trainingsmethoden vergeleken tussen kinderen met recidiverende UI (n=132) en kinderen die nog nooit een UI hebben gehad (n=3818). Nat zijn overdag, soiling, meer dan 10 plasjes per dag en nycturia zijn niet alleen aanwijzingen voor NNBSS, maar ook voor recidiverende UI. Als deze symptomen simultaan aanwezig zijn hebben de kinderen een relatief risico van 60% op recidiverende UI. Weer vinden we dat ouders van kinderen uit de groep met recidiverende UI later begonnen is met trainen, meer aandrongen als de plas niet kwam, en meer gebruik maakten van een volwassen toilet.

In het afsluitende hoofdstuk wordt een algemene discussie gevoerd, en worden een aantal suggesties gegeven over verkeerde manieren van trainen.
Een thesis schrijven vertoont een grote overeenkomst met zwanger zijn voor de eerste keer... Als je aan het begin staat van het project, ben je enorm opgewonden en enthousiast. Boordevol ideeën en dromen over hoe je het gaat aanpakken. Als ongeveer één derde van de tijd verstreken is, begin je je af te vragen waar je aan begonnen bent, maar terugkeren is niet meer mogelijk. Je moet verder, en dan wordt het weer leuk: je merkt dat je het werken aan het onderwerp beheerst. Maar hoe dichter het moment komt waarop je de thesis moet neerleggen, hoe ongeruster je wordt. Er is zoveel dat je niet weet, de tijd is te kort.... En dan is het moment daar waar je de thesis uit handen moet geven, met gemengde gevoelens: blij omdat het klaar is en het wat rustiger wordt, triest omdat het project afgelopen is, ongerust over wat komen gaat.... Gelukkig heb ik nog nooit over “puberende” thesissen horen spreken, dus misschien valt de toekomst wel mee.

In de eerste plaats zou ik mijn ouders willen bedanken, die mij de gelegenheid hebben gegeven om te studeren: niet alleen de opleiding kinesitherapie, maar ook jaren later de specialisatie tot bekkenbodem kinesitherapeute. Hun vertrouwen in het slagen van deze thesis heeft mij veel geholpen. Ook naar mijn kinderen een oprechte dank, niet alleen voor de technische assistentie bij het gebruik van computers van Serge, en het inbrengen van gegevens van Laetitia, maar ook hun morele steun en humor gaf mij steeds weer energie. Een speciaal dankwoord voor Madeleine, die op de meest onmogelijke uren noodoproepen via de telefoon kreeg. Dank jullie wel dat jullie er steeds waren als het nodig was.

Een oprecht woord van dank naar mijn promotor, Professor Wyndaele. Professor, niet alleen uw enorme kennis, uw grenzenloze enthousiasme, maar vooral uw onbaatzuchtige inzet ter verbetering van het lot van de patiënten vervult mij met bewondering. U heeft mij weer laten geloven dat het in het leven belangrijker is wat men doet, dan wat men is. Hiervoor mijn oprechte dank. Ik ben er trots op de eerste te zijn die onder uw leiding promoveert, er zullen waarschijnlijk nog velen schapen volgen maar er is maar één eerste!
Een woord van dank wil ik eveneens richten aan Professor van Sprundel, mijn co-promotor voor zijn hulp bij het opstellen van de vragenlijsten en bij het opzetten van de grote enquête, en later zijn raadgevingen bij het uitschrijven en nalezen van de thesis.

Ook Professor van Gool stond steeds klaar om “plaatjes” te maken die boven het bed gehangen moesten worden. Volgens zeggen zou het artikel vanzelf geschreven worden als je er maar lang genoeg naar keek. Ik zal waarschijnlijk niet lang genoeg gekeken hebben, maar zonder de plaatjes was het zeer zeker nog moeilijker geweest. Hartelijk dank voor al de hulp, en de fijne gesprekken.

Een heel speciaal woord van dank voor Jean-Claude Van Der Auwera, die mij geholpen heeft bij de statistische verwerking van de gegevens. Steeds stond hij klaar (en praktisch binnen de 24 uur) om problemen die oprezen op te lossen. Dank je Jean-Claude voor je professionele aanpak, maar ook voor de prettige gesprekken buiten het onderwerp. Jij maakt deel uit van die mensen die voor ieder probleem een oplossing hebben.

De samenwerking met de Vlaamse Wetenschappelijke Vereniging voor Jeugdgezondheidszorg onder leiding van Prof Hoppenbrouwers was perfect, een hartelijk woord van dank naar alle centra die meegewerkt hebben aan het verspreiden en inzamelen van de vragenlijsten. Een heel warm dankwoord aan Dr Marijke Vermoeren, voor de prettige samenwerking en haar onthaal tijdens onze “vergaderingen”.

Een woord van dank wil ik zeker richten tot de mensen van de dienst Urologie, en in het bijzonder tot Dokter Stefan de Wachter, Joëlle Roenen, Dokter Verheyden, Ingrid Van Neyghen en Dirk Callens die steeds beschikbaar waren voor een babbel of een koffiepauze om het moreel van de troepen weer op te drijven. Dank jullie voor jullie collegialiteit en vriendschap.

Uiteindelijk ook een woord van dank aan alle mensen die van ver of dichtbij betrokken zijn geweest bij deze thesis: de ouders die de vragenlijsten hebben ingevuld, en vaak leuke opmerkingen toevoegden, de industrie (P&U, Charco) die financieel bijsprongen bij de realisatie.
Addenda

Addendum 1  Questionnaire 1
Addendum 2  Questionnaire 2
Addendum 3  Voiding chart
Addendum 1

A. GENERAL
1. Name :
   Birthday: _ _ / _ _ / 19 _ _
   Sex : M / F
   Class :
   Results : 1 / 2 / 3

2. How is the actual family situation ?
   0 Married
   0 Recomposed family
   0 Divorced
   0 Widow/widower
   0 Single

3. Were there enuretics in the family?
   0 Yes
   0 No

4. If so, who ?
   0 Father / Mother
   0 Brother[s] / Sister[s]
   0 Uncle[s] / Aunt[s]
   0 Nephew[s] / Niece[s]
   0 Don't know

5. Are there enuretics elder than 7 years in the family now ?
   0 Yes
   0 No

6. If so, who ?
   0 Father / Mother
   0 Brother[s] / Sister[s]
   0 Uncle[s] / Aunt[s]
   0 Nephew[s] / Niece[s]
   0 Don't know

B. SPECIFIC
7. Does he/ she takes part in extra-scholar activities ? More than one answer is possible
   0 No
   0 Yes, sport
   0 Yes, music
   0 Yes, youth-movement
   0 Yes, others, _ _ _ _ _
8. Does he/she washes him/her self
   0 Only on command
   0 Once a week
   0 Twice a week
   0 Daily

9. Do you have to remind him/her of his homework and appointments?
   0 Always
   0 Sometimes
   0 Never

C. POTTY – TRAINING

10. At what age was he/she dry during the day?
    0 Before 3 years
    0 After 3 years
    0 Not yet

11. At which age was he/she dry during the night
    0 Before 6 years
    0 After 6 years
    0 Not yet

12. At which age did he/she have total bowel control during the day?
    0 Before 2 years
    0 After 2 years
    0 Not yet

13. At which age did he/she have total bowel control during the night?
    0 Before 3 years
    0 After 3 years
    0 Not yet

14. Which sort of protections did you use?  More than one answer is possible
    0 Cotton diaper
    0 Pamper
    0 Plastic pants

15. When did you start the potty-training?
    0 Before 18 months
    0 Between 18 and 24 months
    0 Between 25 and 30 months
    0 After 30 months
    0 Don’t remember
16. Was your child dry during the siesta at that moment?
   0  Yes
   0  No
   0  Don’t remember

17. What did you use to collect the urine?
   0  Baby-chair
   0  Potty on a fix place
   0  Potty
   0  Reducing seat with feet support
   0  Reducing seat without support
   0  Normal WC with support
   0  Normal WC without support

18. What was the reason to start the potty-training during the day?
   More than one answer is possible
   0  Piddle on fixed times
   0  Retire the protection
   0  On demand of child
   0  Reward
   0  Punish
   0  Imitation

20. What did you do if there was no miction?
   0  Just try later again
   0  Say Pss-Pss
   0  Let them push
   0  Open the tap
   0  Wait until they piddled
   0  Don’t remember

21. How many times does he/she actually go to the toilet?
   0  Less than 4 times a day
   0  Between 4 and 6 times a day
   0  Between 7 and 10 times a day
   0  More than 10 times a day
   0  Don’t know

22. Does he/she gets up during the night?
   0  No
   0  Some times
   0  Once
   0  Twice or more
23. Can he/she postpone the miction?
   0  Yes
   0  No

24. Had your child a urinary infection?
   0  Yes
   0  No

25. If, yes, how old was he/she at that moment?
   0  Younger than 2.5 years
   0  Older than 2.5 years

26. How many times?
   0  Once
   0  More than once
   0  Once a year
   0  More than once a year

27. Are the pants sometimes soiled and/or wet
   0  Yes
   0  No

D. INCONTINENCE

28. If the child is still wet during the day, the
   0  Upper clothes need to be changed
   0  Pants need to be changed
   0  Pants are moist
   0  Pants are soiled

29. How often does this accidents occur?
   0  Several times a day
   0  Every day
   0  At least once a week
   0  At least once a month
   0  Less than once a month

30. What is, according to you, the reason of the daywetting?
   0  Wait to long
   0  Toilet at school to dirty
   0  Physical effort
   0  Laughing
   0  Stress
   0  Laziness
   0  Lack of hygiene
   0  Don't know
31. If the child is still wet at night, what is the frequency?
   0 Several times a night
   0 Every night
   0 At least once a week
   0 Less than once a week
   0 Less then once a month

32. Has the child been completely dry?
   0 Yes
   0 No

33. If so, how long ?
   0 Less then 6 months
   0 Between 6 months and 1 year

34. If the child wets the bed,
   0 The bed is wet
   0 Pyjamas are wet
   0 Pyjamas are moist
   0 Pyjamas are soiled

35. At what moment does the wetting occur ?
   0 Various periods
   0 Before midnight
   0 Between midnight and 4 a.m.
   0 After 4 a.m.

36. Does the child wake up after urinating ?
   0 Yes
   0 No

37. Do you use protections ?
   0 Yes
   0 No

38. What did you try until now ?
   0 Take off the protection
   0 Reward
   0 Ignore
   0 Punish
   0 Drink less after 4 p.m.
   0 Wake up during the night
   0 Others

39. Have you seen a doctor ?
   0 Yes
   0 No
40. If so, who?
    0 GP
    0 Urologist
    0 Psychologist
    0 Homoeopathist
    0 Paediatrician

41. What treatment did they use?
    0 Medicines
    0 Physiotherapy
    0 Miction chart
    0 Bed-wetting alarm

Addendum 2

Questionnaire for the evolution of toilet training in three generations

1. Date of birth: _ _/_ _/19 _ _
2. Sex: M/F
3. Do you have children?
    Yes
    No
4. If so, how many? _ _ _ _ _ _ _ _
5. How old are your children now? More as one answer is possible
    • Between 0 and 5 years
    • Between 5 and 10 years
    • Between 10 and 20 years
    • Between 20 and 40 years
    • Between 40 and 60 years
6. Do you have grandchildren?
    • Yes
    • No
7. If so, how many? _ _ _ _ _ _ _ _
8. How old are your grandchildren now? More as one answer is possible
    • Between 0 and 5 years
    • Between 5 and 10 years
    • Between 10 and 20 years
    • Between 20 and 40 years
    • Between 40 and 60 years
9. Did you participate in the toilet-training of your grandchildren?
   - Yes
   - No

10. If so, how?
   - By giving advice
   - In keeping the grandchildren during the day
   - During a stay

11. Which sort of protection did you use?
   - Cotton diaper
   - Flannel diaper
   - Disposable diaper
   - Plastic pants

12. How old was the child when you started the toilet-training?
   - Before 1 year
   - Before 18 months
   - Between 18 and 24 months
   - Between 25 and 30 months
   - After 30 months
   - Don’t remember

13. Was your child dry during their afternoon nap at that time?
   - Yes
   - No
   - Don’t remember

14. What was the reason for starting toilet-training during the day?
   - On demand of the child
   - His/her age
   - School
   - Comment of others/family
   - Season
   - When he/she was dry during the afternoon nap
   - Don’t remember

15. When did you started to train for continence during the night?
   - Before 1 year
   - Before 18 months
   - Between 18 and 24 months
   - Between 25 and 30 months
   - After 30 months
   - Just waited
16. What did you use to collect urine and excrement

- Baby-chair
- Potty in a fixed place
- Potty
- Reducing seat with foot-support
- Reducing seat without foot-support
- Normal WC with a foot-support
- Normal WC without a foot-support

17. Which method did you use?

- Urinate at fixed times
- Remove the diaper
- On demand of the child
- Reward
- Punish
- Imitation of a parent or an elder sister/brother
- Don't remember

18. If you used a baby-chair was this

- Before the meal
- During the meal
- After the meal
- On demand of the child

19. What did you do if there was no void?

- Just try later again
- Say Pss-Pss
- Let them push
- Open the tap
- Wait until they urinated
- Don't remember

20. At what age was your child/were your children dry during the day?

- Before 1 year
- Between 12 and 18 months
- Between 19 and 30 months
- After 2.5 years

21. At what age had your child/children total bowel control during the day?

- Before 1 years
- Between 12 and 18 months
- Between 19 and 30 months
- After 2.5 years
22. At what age was your child/ were your children dry during the night
   • Before 1 years
   • Between 12 and 18 months
   • Between 19 and 30 months
   • After 2.5 years
   • After 5 years
   • Still wet

23. At what age had your child/ children total bowel control during the night?
   • Before 1 years
   • Between 12 and 18 months
   • Between 19 and 30 months
   • After 2.5 years

24. How long did the toilet-training take?
   • Less than a month
   • Between 1 and 6 months
   • Between 7 months and 1 year
   • More than 1 year
   • Still wet

25. Where did the training mainly take place?
   • At home
   • With grandparents
   • At the daycare centre
   • In reception class
Addendum 3
Voiding chart

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Wetting : 1 moist, 2 wet, 3 dirty
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Universiteit Antwerpen

ONDERZOEK NAAR DE INVLOED VAN DE ZINDELIJKE DSTRAI NI NG OP DYSFUNCTIES VAN DE LAGERE URI NEWEGEN

Thesis voorgelegd tot het behalen van de graad van Doctor in de medische wetenschappen aan de Universitaire Instelling Antwerpen te verdedigen door

Wilhelmina BAKKER

Prof. Dr. J.J. Wyndaele
Prof. Dr. M. van Sprundel

Antwerpen 2002