



ANTTI PÖYHÖNEN

Longitudinal Study on Occurrence and
Prognosis of Male Lower Urinary
Tract Symptoms



ACADEMIC DISSERTATION

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UNIVERSITY OF TAMPERE

ANTTI PÖYHÖNEN

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ACADEMIC DISSERTATION

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To *Miia,*
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List of original publications

This dissertation is based on the following original communications, which are referred to in the text by Roman numerals (I–V).

- I Pöyhönen A, Häkkinen JT, Koskimäki J, Hakama M, Tammela TLJ, Auvinen A (2012): Prevalence of hesitancy in 30-80-year-old Finnish men: Tampere Ageing Male Urological Study (TAMUS). *BJU Int*; 109(9): 1360–4.
- II Pöyhönen A, Auvinen A, Koskimäki J, Hakama M, Tammela TLJ, Häkkinen JT (2012): Prevalence and bother of postmicturition dribble in Finnish men aged 30-80 years: Tampere Ageing Male Urologic Study (TAMUS). *Scand J Urol Nephrol*; 46(6): 418–23.
- III Pöyhönen A, Häkkinen JT, Koskimäki J, Hakama M, Tammela TLJ, Auvinen A (2013): Empirical evaluation of grouping of lower urinary tract symptoms: principal component analysis of Tampere Ageing Male Urological Study data. *BJU Int*; 111(3): 467–73.
- IV Pöyhönen A, Häkkinen JT, Koskimäki J, Tammela TLJ, Auvinen A (2014): Natural course of lower urinary tract symptoms in men not requiring treatment – a 5-year longitudinal population-based study. *Urology*; 83(2): 411–5.
- V Pöyhönen A, Auvinen A, Häkkinen JT, Koskimäki J, Hakama M, Tammela TLJ (2014): Outcomes of medical and surgical treatment for lower urinary tract symptoms (benign prostatic obstruction) – a population-based cohort study. *Int J Clin Pract*; 68(3): 349–55.

Abbreviations

AUA	American Urological Association
BACH	Boston Area Community Health survey
BOO	bladder outlet obstruction
BPH	benign prostatic hyperplasia
DAN-PSS-1	Danish Prostatic Symptom Score
EAU	European Association of Urology
EpiLUTS	Epidemiology of LUTS
ICS	International Continence Society
IPSS	International Prostatic Symptom Score
LUTS	lower urinary tract symptoms
OAB	overactive bladder
PCA	principal component analysis
TAMUS	Tampere Ageing Male Urologic Study
TURP	transurethral resection of prostate

Abstract

Objectives:

The aim of this epidemiological study was to determine the prevalence and burden of lower urinary tract symptoms (LUTS) in male population with an extension to younger cohorts (30 to 50-year-old men). The study was conducted to evaluate the relationship of 12 different LUTS symptoms and assess which symptoms are contingent upon each other. Follow-up studies were used to determine the natural course of LUTS in untreated men and evaluate how well medical and surgical treatments affect different symptoms.

Population and methods:

In this population-based study the target population was 30 to 80-year-old men from the Pirkanmaa area, Finland. A self-administered postal questionnaire survey was conducted in 2004. In the two follow-up studies of this dissertation the three oldest age groups from 60 to 80 years were used. Endpoint assessment was based on the 2004 questionnaire and information on determinants was gathered from the questionnaire of 1999. Demographic data were collected and lower urinary tract symptoms were evaluated using the Danish Prostatic Symptom Score (DAN-PSS-1) questionnaire. Overall participation proportion was 59% (4,384 men out of 7,470) in the 2004 questionnaire. In the longitudinal analyses the 1,679 men who responded to both questionnaires were included in the study. In addition to frequently used statistical methods principal component analysis was used to assess how LUTS relate to each other.

Results:

LUTS were also common among young (30-year-old) men, as 45% of them experienced urgency and 43% experienced postmicturition dribble. Both prevalence and severity of LUTS increased with age. Storage symptoms especially increased steeply with age. LUTS were classified using principal component analysis to evaluate how symptoms inter-correlated with each other. Three components were formed representing voiding, storage and incontinence symptoms. In five-year follow-up all LUTS fluctuated substantially. Incidence of different LUTS varied from 1% to 13%, with a more than 10-fold difference in incidence. Remission of

symptoms was more similar for different symptoms. About half of the symptoms resolved spontaneously in five years.

Surgical and medical treatment options for LUTS due to benign prostatic obstruction were compared over a five-year period. Surgical treatment reduced symptoms, while among patients with medical treatment or no treatment LUTS became worse. In individual symptoms, dysuria and postmicturition dribble were the only symptoms with better outcomes for medical than surgical treatment.

Conclusions:

Minor LUTS are common in all ages and severe symptoms become more common with age. Storage symptoms increase more than voiding (e.g. hesitancy) and postmicturition symptoms (e.g. postmicturition dribble). LUTS fluctuate and spontaneous recovery is frequent. In terms of correlations between individual symptoms, they could be divided to voiding, storage and incontinence symptoms. Men with severe LUTS benefit more from surgical than medical treatment.

Tiivistelmä

Tavoitteet:

Väitöstutkimuksen tavoitteena oli selvittää virtsaamisoireiden vallitsevuutta suomalaisilla miehillä. TAMUS(Tampere Ageing Male Urologic Study)-tutkimus laajennettiin nyt koskemaan myös nuorempia, 30- 50 –vuotiaita miehiä. Lisäksi pyrittiin selvittämään 12 virtsaamisoireen suhdetta toisiinsa pääkomponenttianalyysillä. Pitkittäistutkimuksen tavoitteena oli tarkastella virtsaamisoireiden muuttumista ajan kuluessa sekä lääkkeellisen ja kirurgisen hoidon tuloksia viiden vuoden seuranta-aikana väestöpohjaisessa tutkimusasetelmassa.

Menetelmät:

Tutkimuksen aineisto kerättiin vuonna 2004 pirkanmaalaisilta 30-80-vuotiailta miehiltä käyttämällä postikyselyä. Pitkittäistutkimuksessa käytettiin kolmea vanhinta ikäluokkaa (60-80 –vuotiaita). Vuoden 2004 kyselyä käytettiin seurannan pääteipisteenä ja aiempaa vuoden 1999 kyselyä tutkimuksen alkupisteenä. Virtsaamisoireita selvitettiin Danish Prostatic Symptom Score (DAN-PSS-1) kyselykaavakkeella. Osallistumisaste vuoden 2004 kyselyssä oli 59% (4384 miestä 7470:stä vastasi kyselyyn). Pitkittäistutkimuksissa oli mukana 1679 miestä, jotka vastasivat molempiin kyselykiertoosiin. Yleisimpien käytössä olevien tilastotieteellisten menetelmien lisäksi käytettiin pääkomponenttianalyysiä selvittämään virtsaamisoireitten suhdetta toisiinsa.

Tulokset:

Virtsaamisoireet olivat yleisiä jo 30-vuotiailla miehillä, 45% heistä koki virtsauspakkoa ja 43% jälkitiputtelua. Virtsaamisoireet vaikeutuivat ja niiden yleisyys lisääntyi iän mukana. Erityisesti kerääntymisoireet yleistyivät iän mukana. Pääkomponenttianalyysin avulla virtsaamisoireet ryhmiteltiin sen mukaan, miten ne liittyivät toisiinsa. Muodostui kolme ryhmää, jotka edustivat tyhjennysoireita, kerääntymisoireita ja virtsankarkailu-oireita. Virtsaamisoireiden ilmaantuvuus vaihteli 1% ja 13% välillä viiden vuoden seurannassa. Noin puolet alkujaan oireisista vastaajista tuli oireettomiksi seurantajakson aikana.

Leikkaushoidon ja lääkehoidon vaikutusten vertailussa leikkaushoito vähensi virtsaamisoireita, kun vastaavasti lääkehoitoa saaneilla ja ilman hoitoa olleilla mie-

hillä oireet lisääntyivät. Virtsaamiskipu ja jälkitiputtelu olivat ainoat oireet, joissa tulokset lääkehoidossa olivat paremmat kuin leikkaushoidossa.

Johtopäätökset:

Lievät virtsaamisoireet ovat yleisiä kaikenikäisillä. Iän mukana oireet vaikeutuvat, kerääntymisoireet yleistyvät enemmän kuin tyhjennysoireet (esim. virtsantulon viipyminen) tai virtsaamisen jälkeiset oireet (esim. jälkitiputtelu). Yksittäisen oireen vaikeusaste vaihtelee ja oireilla on taipumus parantua itsestään. Virtsavaivat esiintyvät yhdessä ja ne voidaan jakaa tyhjennysoireisiin, kerääntymisoireisiin ja virtsankarkailu-oireisiin. Miehet, joilla virtsaamisoireet ovat hankalia, hyötyvät enemmän leikkaushoidosta kuin lääkehoidosta.

1 Introduction

Lower urinary tract symptoms (LUTS) are an extremely prevalent condition in male population (S. O. Andersson et al., 2004; Glasser et al., 2007). Male LUTS have previously been thought to be caused mainly by benign prostatic enlargement. Epidemiological studies have shown, however, that the prevalence and severity of LUTS increased with age in both men and women (Irwin et al., 2006). Nowadays LUTS are therefore regarded as a combination of storage, voiding and postmicturition symptoms that tend to exacerbate with age, occur in a comparable fashion among both men and women and are related to several organs and physiological processes (Chapple et al., 2008). It is estimated that numbers of affected individuals are increasing over time, with the greatest increase in burden anticipated in developing regions (Irwin et al., 2011). In the UK over a one-year period, over a third of people aged over 40 years are estimated to have a healthcare need for urinary storage symptoms and a fifth are estimated to require healthcare, thereby constituting a major public health problem (McGrother et al., 2004).

To study LUTS more thoroughly and also in young men, we evaluated two symptoms in detail: hesitancy from the voiding symptom group and postmicturition dribble from the postmicturition symptom group. Hesitancy is believed to be one of the earliest symptoms of bladder outlet obstruction, which may be caused by enlargement of the prostate or dysfunction in the synchronous function of the bladder and sphincter (Reynard & Abrams, 1995). Postmicturition dribble, however, is believed to be caused by a failure of the bulbocavernosus muscle to perform the normal reflex post-void milking mechanism with the consequence that urine is trapped in the bulbar area of the urethra after voiding (Wille et al., 2000). Enlarged prostate is also associated with postmicturition dribble (Paterson et al., 1997).

One way to learn more about LUTS is to evaluate how symptoms correlate with each other. This could help to learn more, for example, about the pathogenesis of LUTS. The current International Continence Society standardization of terminology divides LUTS into voiding, storage and postmicturition symptoms. The postmicturition symptoms group was a new addition in the 2002 revision, before that the feeling of incomplete emptying was classified either in the voiding or the storage symptoms group, depending on what was thought to cause the symptom (e.g. prostatic hyperplasia, bladder irritation) (Abrams et al., 2003).

The terms natural course or natural history of LUTS are used to describe the fluctuation of symptoms over time. Longitudinal studies make it possible to evaluate changes in LUTS. These studies have shown a slow but measurable progression in urinary symptom severity but also a great deal of variability between individuals in the rate of change in symptom severity and bother over time (Jacobsen et al., 1996; Sarma et al., 2002).

The two main policies for the treatment of LUTS due to benign prostatic obstruction are medical and surgical treatment. The treatment choices are relatively clear in many cases, but men with severe symptoms but no major complications such as retention present a therapeutic challenge. One community setting study from the Mayo Clinic suggested that medical treatment may not benefit these men to the extent as clinical trials suggest (Krambeck et al., 2012).

The Tampere Ageing Male Urologic Study (TAMUS) is a longitudinal study initiated in 1994. Questionnaires have been sent at five-year intervals to the Finnish male target population. The aim has been to learn more about LUTS and in this dissertation the focus is on above mentioned considerations.

2 Review of the literature

2.1 Terminology

The standardization of the terminology of lower urinary tract function was first conducted by the International Continence Society (ICS) in 1976 (Bates et al., 1976). The terminology has subsequently been revised several times over the years and the latest report was published in 2002 (Abrams et al., 2003). In this report LUTS were defined as subjective indicators of a disease or change in condition as perceived by the patient, caregiver or partner possible leading him/her to seek help from health care professionals. LUTS can be classified into voiding, storage and postmicturition symptoms.

Voiding symptoms occur during the voiding phase while the detrusor muscle actively contracts leading to the voiding phase of bladder emptying. Six different voiding symptoms have been introduced: slow urinary stream, splitting or spraying of the stream, intermittent urinary stream, hesitancy, straining and terminal dribble.

Storage symptoms are experienced during the filling of the bladder and are more or less due to overactivity of the detrusor muscle. They are divided into increased daytime frequency, nocturia, urgency and urinary incontinence.

Postmicturition symptoms occur immediately after micturition and include a feeling of incomplete emptying and postmicturition dribble.

2.2 Evaluation methods for LUTS

Numerous questionnaires have been developed to assess LUTS and both of LUTS. The Boyarsky system was introduced in 1976, including nine questions about different symptoms, scored on a range of 0 to 3 points (Abrams et al., 1995). The Madsen-Iversen system was developed in 1983, evaluating nine symptoms graded mainly on a scale of 0 to 3 (Barry, Fowler, O'Leary, Bruskewitz, Holtgrewe, & Mebust, 1992; Oesterling et al., 1994). The American Urological Association (AUA) appointed a committee to develop a validated instrument for measuring LUTS. This AUA symptom index introduced in 1992 later became later known as the International Prostate Symptom Score (IPSS) in 1995,

when one question concerning quality of life was added (Barry, Fowler, O’Leary, Bruskewitz, Holtgrewe, Mebust, et al., 1992). The IPSS contains questions about seven different symptoms with five response options for each question.

The Danish Prostatic Symptom Score (DAN-PSS-1) was first published in 1991 (Hansen et al., 1998; Meyhoff et al., 1993). It contains questions on 12 symptoms, adding incontinence, dysuria and terminal dribble. All 12 symptoms are rated for severity and also for bother. All questions are evaluated on a scale from 0 to 3 points.

The IPSS and DAN-PSS-1 questionnaires have been shown to be valid and reliable instruments for the measurement of LUTS and these questionnaires are in wide clinical use (Hansen et al., 1995; Netto et al., 1999). However, these questionnaires have not demonstrated any correlation between bladder outlet obstruction and symptom severity (Nitti et al., 1994; Pannek et al., 1998).

2.3 Prevalence of LUTS

The prevalence of LUTS is well documented in multiple surveys. The problem is that prevalence varies from survey to survey, because of differences in study cohorts and assessment methods. Several major population-based epidemiological studies have evaluated the prevalence of LUTS.

The BACH (Boston Area Community Health) survey included a racially and ethnically diverse random sample of 5,503 men and women aged 30–79 years from Boston, MA, USA. Information was gathered by two-hour interview, usually in the respondent’s home between 2002 and 2005. The authors found that 18.7% of men had moderate or severe LUTS (IPSS >7) and prevalence increased with age (10.5% at age 30–39 years to 25.5% at age 70–79 years) (Kupelian et al., 2006). The most frequent symptoms were increased daytime frequency (27.8%) and nocturia (25.3%).

EPIC was a population-based, cross-sectional telephone survey of 19,165 adults aged over 18 years in five countries (Canada, Germany, Italy, Sweden and the United Kingdom) in 2005. The total prevalence of moderate to severe LUTS as determined by IPSS scores was about 6%, 64% of respondents reported at least one LUTS. Among men, the prevalence of all individual LUTS increased linearly with age (Irwin et al., 2009). The most frequent symptoms were nocturia (48.6%), terminal dribble (14.2%) and sensation of incomplete emptying (13.5%).

EpiLUTS (Epidemiology of LUTS) was a cross-sectional, population-representative survey conducted via the Internet in the USA, the UK and Sweden. A total of 20,000 men and women aged 40–99 years were included in the study from randomly selected participants, who received an e-mail invitation to par-

ticipate. The total prevalence of moderate to severe LUTS as determined by IPSS scores was 28.3% and the prevalence of all LUTS increased with advancing age in men (Coyne et al., 2009). The most frequent symptoms were nocturia (72.3%), terminal dribble (45.5%) and postmicturition incontinence (29.7%). They also found that symptom groups overlapped as about half reported LUTS from more than one symptom group (Sexton et al., 2009).

The findings of these large epidemiologic studies show that the prevalence of LUTS does not differ by gender or race, but voiding symptoms are more common in men and storage symptoms are more common in women (Llorente, 2010).

TAMUS (the Tampere Ageing Male Urological Study) was initiated in 1994. A postal questionnaire with DAN-PSS-1 was used and the study cohort at baseline consisted of 50, 60, and 70-year-old men, 3,152 men overall, from the Finnish city of Tampere and 11 small adjacent municipalities. Prevalence of any moderate or severe symptom was 30% and 89% reported at least one symptom (Koskimaki et al., 1998). LUTS likewise increased with age in this study. The most frequent symptoms were postmicturition dribbling (63%), nocturia (56%) and increased daytime frequency (47%).

BLUES (the Brazilian LUTS Epidemiology Study) evaluated 1,500 men aged over 30 years using interviewers and IPSS scores. Of the male participants, 68% had storage symptoms, 40% had voiding symptoms and 31% postmicturition symptoms. The most frequent symptoms were nocturia (64%), terminal dribble (29%) and postmicturition dribble (21%) (Moreira et al., 2013).

VITA (the Vienna Trans-Danube Aging Study) was a population-based study conducted in Austria. The study cohort was small: only 96 men aged 75 years. The researchers found that 74% of men had increased daytime frequency, 69% of men had nocturia more often than twice per night, 54% of men had urgency and 24% of men had urinary incontinence (Wehrberger et al., 2012).

In conclusion, epidemiological studies have shown that LUTS are a combination of storage, voiding and postmicturition symptoms that tend to increase with age, occur in a comparable fashion among both men and women and are related to several organs and physiological processes (Chapple et al., 2008). However, comparison between studies is challenging due to different study cohorts and evaluation methods.

2.4 Incidence and remission of LUTS

Determining the incidence of LUTS requires longitudinal studies. Most published studies have been cross-sectional, so the incidence of LUTS is less well documented than the prevalence. Incidence is the rate at which a certain event occurs, as the number of new cases of a specific symptom occurring over a cer-

tain period in a population. Remission refers to diminution or abatement of the symptom.

One of the earliest studies on the follow-up of LUTS was performed in Edinburgh, Scotland using the AUA symptom index. In 1996 a study on a community-based cohort of 1,627 men aged 40–79 years with three-year follow-up reported significant increases over time in both mean symptom and bother levels for nocturia, urgency, dribbling, intermittency and incomplete emptying, but considerable proportions of men also reported fluctuation in symptom level (Lee et al., 1996). In a subsequent report, the findings were similar in five-year follow-up (Lee et al., 1998).

The Health Professionals Follow-up Study was a large study of 25,879 men aged over 40 years with a follow-up time of 16 years (1992–2008) in the USA. The IPSS was used to evaluate LUTS. The age-standardized incidence rate of modest to worse LUTS was 40.5 per 1,000 man-years and progression to severe LUTS 44.9 per 1,000 man-years. LUTS incidence and progression rates were high and rose steeply as men aged (Platz et al., 2012).

The BACH survey published a longitudinal study of 1,610 men with 4.8 years of follow-up. They found that 8.5% of men among those with no or mild LUTS at baseline had moderate to severe LUTS at endpoint (Maserejian et al., 2013)

The Olmsted County Study of Urinary Symptoms and Health Status (Minnesota, USA) evaluated 2,300 men aged 40–79 years with 3.5-year follow-up using the AUA symptom index and demonstrated a slow but measurable progression in urinary symptom severity (Jacobsen et al., 1996). Another analysis from the Olmsted study material demonstrated that there was a great deal of variation between individuals in the amount of longitudinal change in lower urinary tract symptom severity and bother (Sarma et al., 2002).

In USA 5,700 men were followed for two years in the Osteoporotic Fractures in Men Study and a third of men with no or mild LUTS developed clinically significant LUTS (Parsons et al., 2010). In a Spanish study, 463 men with no or mild LUTS were followed for two years, and the incidence of symptom progression was 10% in men aged 40 years or older (Moreno Sierra et al., 2011).

In Austria, 456 men were followed-up for five years; no change was reported by 19%, a worsening of symptoms by 50% and an improvement by 31% (Temml et al., 2003). In Japan three-year follow-up was conducted in 223 men and no definite increase in overall prevalence was observed, as cases of new LUTS and remissions were equally common (Masumori et al., 2003). The Flint Men's Health Study evaluated 175 black men aged 40 to 79 years at four-year intervals, finding that 26% of men with no or mild symptoms at baseline had moderate to severe symptoms at follow-up, this progression was observed across all ages (Sarma et al., 2004).

In Japan a 15-year longitudinal community-based study with 135 participants was conducted and clinical measurements were also evaluated. Symptom scores and quality of life index deteriorated, prostate volume and PSA level increased and peak urinary flow rate decreased (Fukuta et al., 2012). The same study reported that severity of LUTS, decreased peak urinary flow rate, enlarged prostate volume, high prostate-specific antigen value and internal prostatic architecture predicted risk for treatment for LUTS (Fukuta et al., 2013).

The Krimpen Study from the Netherlands reported population-based study of 1,688 men with 2.1-year follow-up concerning nocturia. The incidence rate of nocturia was 23.9% and the resolution rate was 36.7% (van Doorn et al., 2011, 2013).

These studies showed that LUTS are dynamic conditions with frequent remission. These studies show a progression in the incidence of LUTS, which is reasonable as symptoms tend to increase with age. Many of these studies on the incidence of LUTS had rather small cohorts, which impairs their precision, and also illustrates the difficulty of conducting longitudinal studies.

2.5 Bother of LUTS

Studies concerning the bother of specific LUTS are rather rare, because a large proportion of studies use questionnaires without questions on the bother of a specific symptom.

In Surahammar (Sweden), a population-based study with 504 men using the DAN-PSS-1 questionnaire showed that storage symptoms appear to impair quality of life more than voiding and postmicturition symptoms, urge incontinence was the most distressing symptom (Engstrom et al., 2006; Engstrom et al., 2004). The total burden of LUTS was related to self-assessed health, sadness and happiness (Engstrom et al., 2005).

Combined data from the Olmsted County Study of Urinary Symptoms and Health Status and the Flint Men's Health Study reported that 34% of white men had moderate/severe LUTS compared with 41% of black men, but it also demonstrated greater LUTS severity in black men than in white men, while black men reported less bother for any given level of LUTS severity (Sarma et al., 2003).

An earlier publication by the TAMUS group introduced a bother index, calculated as the ratio of the number of men with bother score higher than symptom score to that with bother score lower than symptom score. Using this index, incontinence symptoms and slow stream were the most bothersome. Straining, postmicturition dribble and hesitancy were the most well-tolerated symptoms (Hakkinen et al., 2007).

Overactive bladder (OAB) according to the ICS definition is a condition that includes urgency with or without urge incontinence, usually with increased daytime frequency and nocturia. OAB symptoms may be quite bothersome and may negatively affect quality of life, increase anxiety and depression, and increase healthcare usage, especially in women, but also in men (Milsom et al., 2012).

LUTS severity was also shown to be a risk factor for severe sleep disturbance in men (Helfand et al., 2011). Study has also showed that voiding symptoms are the most prevalent, but storage symptoms were the most bothersome (Peters et al., 1997).

The latest paper on this subject is from Finland. It suggests that the LUTS with the greatest population-level burden were urgency (7.9% with at least moderate bother), stress urinary incontinence (6.5%), nocturia (6.0%), postmicturition dribble (5.8%) and urgency urinary incontinence (5.0%) (Agarwal et al., 2014).

2.6 Grouping of LUTS

The current ICS standardization of terminology divides LUTS into voiding, storage and postmicturition symptoms (Abrams et al., 2003). The classification is based on anatomical, physiological and urodynamic considerations. Few studies have been conducted to evaluate inter-relationships among symptoms in population-based settings.

The Health Professionals Follow-up Study (page 18) used factor analysis to arrive at grouping symptoms in 1998. They analyzed 1856 men with physician-diagnosed benign prostatic hyperplasia (BPH) and divided LUTS into filling and voiding groups (Welch et al., 1998). In their analysis, there were seven symptoms (incomplete emptying, intermittency, slow stream, hesitancy, frequency, urgency and nocturia) as they used the AUA questionnaire.

A report from the EPIC study (page 16) used exploratory factor analysis to evaluate the grouping of LUTS with 20 different symptoms. They divided symptoms into three categories: voiding symptoms, predominantly storage symptoms and storage items related to urinary incontinence (Coyne et al., 2012).

In the latest ICS classification of LUTS a postmicturition symptoms class was created including feeling of incomplete emptying and postmicturition dribble. Feeling of incomplete emptying was previously classified inconsistently as voiding symptoms or storage symptoms. However, although the work of the ICS standardization subcommittee has been praised, inconsistencies and sources of confusion have also occurred (Homma, 2008).

2.7 Clinical evaluation of LUTS

First the overall health status should be evaluated, as many diseases affect LUTS, among them neurological diseases (Ransmayr et al., 2008). LUTS should be evaluated and using a validated symptom questionnaire (e.g. DAN-PSS-1 or IPSS) could be beneficial (Hansen et al., 1995). Examination of patients concentrates on eliminating phimosis and narrowing of the urethral meatus (Barroso et al., 2003). Digital rectal examination of the prostate yields information on the size and consistence of the prostate (Roehrborn et al., 1997). Urinalysis and blood analysis (prostate specific antigen and creatinine) should be carried out (Finne et al., 2008; Partin et al., 1996). Ultrasound examination can be performed to assess kidneys and especially the amount of residual urine, which is one major factor when assessing possible treatment options. Ultrasound examination yields information about the size, shape and composition of the prostate (Hough & List, 1991; Vilmann et al., 1987). However, the size of the prostate and LUTS are not significantly correlated (Rosier & de la Rosette, 1995; Simpson et al., 1996). Uroflowmetry yields information on the strength of urine flow. If it is less than 10 mL/s, there is over 90 percent probability of lower urinary tract obstruction (Reynard et al., 1998). Pressure-flow examination is the best examination to assess possible obstruction, so it is used if there are some doubts e.g. before surgical treatment (McGuire, 1992). Urethrocystoscopy is performed if there is a possibility of urethral stricture or if there is blood in urine (Madsen & Bruskewitz, 1995).

2.8 Treatment of LUTS

2.8.1 *Information and lifestyle advice*

In mild symptoms, when complications have been ruled out, giving adequate information about the condition and reassuring the patient may suffice. Lifestyle advice may also be beneficial, for example, reduction of fluid intake at night, decreasing caffeine and alcohol consumption or treatment of constipation (Brown et al., 2004). For example, in postmicturition dribble, urethral milking or pelvic floor muscle exercises could be beneficial (Paterson et al., 1997).

2.8.2 Medical treatment

2.8.2.1 Alpha 1- adrenoceptor antagonists

In clinical practice, alpha-blockers have been prescribed for men with moderate to severe LUTS with all sizes of prostate. The mechanism of action is thought to be that of reducing prostate tone and bladder outlet obstruction. Urodynamic studies have shown that alpha-blockers have little effect on bladder outlet resistance and improvement of LUTS during medication correlates poorly with obstruction (Barendrecht et al., 2008; Kortmann et al., 2003). Controlled studies have shown that alpha-blockers reduce LUTS scores by 40% and improve the maximum urinary flow rate by about 30% (Arnold, 2001; Djavan et al., 2004).

2.8.2.2 5-alpha-reductase inhibitors

5-alpha-reductase inhibitors reduce prostate size and thereby have a positive effect on LUTS. Medication induces apoptosis of the prostate epithelial cells by inhibiting the formation of dihydrotestosterone in the prostate cells. Prostate size reduction is about 20–25% in the first 6–12 month and the reduction may be greater in long-term treatment (Roehrborn et al., 2002). 5-alpha-reductase inhibitors not only reduce LUTS and increase flow rate, but also reduce long-term risk of acute urinary retention or need for surgery (Roehrborn et al., 2009). 5-alpha-reductase inhibitors can only be used for patients with enlarged prostate, with a prostate volume of at least 30–40 ml.

2.8.2.3 Phosphodiesterase (PDE) 5 Inhibitors

PDE5 inhibitors are used for the treatment of erectile dysfunction, but they also reduce LUTS, possibly due to the reduction of the smooth muscle tone of the detrusor, prostate and urethra (K. E. Andersson et al., 2011). One of the PDE5 inhibitors, tadalafil is also registered for the treatment of LUTS with daily doses (Donatucci et al., 2011; Roehrborn, McVary, et al., 2008).

2.8.2.4 Muscarinic receptor antagonists

Muscarinic receptor antagonists inhibit muscarinic receptors in bladder and reduce smooth muscle cell contractions (Chess-Williams et al., 2001). According to the EAU guidelines they are contraindicated in men with benign prostatic hyperplasia (BPH)/ bladder outlet obstruction (BOO) due to the possibility of incomplete bladder emptying or development of urinary retention, but may still

be considered for men with moderate to severe LUTS suffering predominantly from bladder storage symptoms (Herschorn et al., 2010; Roehrborn et al., 2006).

2.8.2.5 Beta-3-adrenoceptor agonist

Beta-3-adrenoceptor agonist is a new type of drug for OAB. It stimulates beta-3-receptors on the surface of the muscle cells relaxing the detrusor muscle in the wall of bladder. This relaxation increases the bladder capacity. Drug trials have shown that this is a useful treatment option for OAB causing with no adverse effects on voiding urodynamics (Nitti, Khullar, et al., 2013; Nitti, Rosenberg, et al., 2013).

2.8.2.6 Antidiuretics

Vasopressin increases water re-absorption and urinary osmolality and at the same time decreases water excretion and urine volume (Hvistendahl et al., 2005). Desmopressin is a synthetic analogue of vasopressin, which is taken before retiring at night and decreases urine volume for approximately 8–12 hours (Abrams et al., 2002). If nocturia is caused by nocturnal polyuria (the urine volume at night is high), desmopressin can be taken. There is a significant possibility of hyponatraemia, especially in patients over 65 years, and this restricts its use.

2.8.3 Surgical treatment

The optimal treatment for LUTS must be determined individually on the basis of clinical findings and the degree of bother that symptoms cause. In complicated cases, such as in urinary retention, renal insufficiency due to urinary retention or bladder calculi, surgery is the treatment of choice. The EAU guidelines recommend transurethral resection of prostate (TURP) as a surgical standard with prostate sizes of 30–80 ml and moderate-to-severe LUTS, while open prostatectomy is the first choice of surgical treatment when the prostate size exceed 80–100 ml in the absence of Holmium lasers (Reich et al., 2006). The first treatment of choice for small prostates and prostates without prostate middle lobe should be transurethral incision of the prostate (TUIP) (Hellstrom et al., 1986; Riehmman et al., 1995). Various surgical treatment systems have been developed using techniques such as transurethral microwave thermotherapy, radiofrequency energy or Holmium laser (Gilling et al., 2008; Hill et al., 2004; Mattiasson et al., 2007). These systems are not used in Finland. Greenlight laser vaporization of prostate however has been adopted for the surgical treatment for LUTS in Finland (Ruszat et al., 2008).

In all these surgical procedures the aim is to relieve the obstruction of the bladder neck. They relieve LUTS symptoms better than medication and also increase maximum flow rates more than medication (Yang et al., 2001). Surgical procedures always carry a risk of complications. Bleeding and urinary infections are possible, although with new instrumentation these risks are decreased (Whelan et al., 2013). The risk for bladder neck stenoses and urethral strictures is about 4–5% (Madersbacher & Marberger, 1999). The risk for stress urinary incontinence is about 2% in endoscopic procedures and up to 10% in open procedures (M. Oelke, 2012; Tubaro et al., 2001).

3 Aims of the study

The aim of this study is to evaluate the aspects of LUTS that have not been extensively studied previously, for a better understanding of this common health problem. The specific aims of this dissertation are as follows:

1. To determine the prevalence and burden of LUTS, also in younger (30 to 50-year-old) men, two symptoms were evaluated in detail, hesitancy and postmicturition dribble (Studies I–II)
2. To evaluate the relationship of 12 different LUTS symptoms, to assess which symptoms relate to each other (Study III)
3. To describe the natural course of LUTS among untreated men (Study IV)
4. To compare how medical and surgical treatment alleviate various symptoms (Study V)

4 Materials and methods

4.1 Study design

This dissertation is a part of the TAMUS project, which is a large population-based epidemiological study of male urological symptoms. The first questionnaire was mailed in May 1994 and a reminder questionnaire was sent three months later to men who had not responded to the first one. The same men were approached using the same method every five years. In the 2004 survey younger men were added to the study cohort. This dissertation mainly relies on the questionnaire of 2004, but the 1999 questionnaire was also used in the follow-up studies (IV–V).

The study protocol was reviewed by the Tampere University Hospital Committee of Research Ethics (tracking number 99050).

4.2 Study population

As mentioned above, TAMUS is a longitudinal study with the same men contacted at five-year intervals. Selection for the study was based on place of residence and age. Men living in the city of Tampere, Finland and in the municipalities of Hämeenkyrö, Kuhmalahti, Kuru, Kylmäkoski, Luopioinen, Pälkäne, Ruovesi, Sahalahti, Urjala, Viljakkala and Vilppula at the beginning of the study year were chosen as the target population. Other inclusion criteria were the year of birth, with men born in 1924, 1934 and 1944 included in the study. In 2004 a questionnaire was also sent to men born in 1954, 1964 and 1974 living in the same area, representing 30-, 40-, and 50-year-old men at entry. The men were identified from the Population Register Center.

The original age groups from 1994 and 1999 were naturally diminished, so the older age groups in 2004 included fewer men. Detailed numbers of study subjects and participation for the 2004 questionnaire are presented in Figure 1.

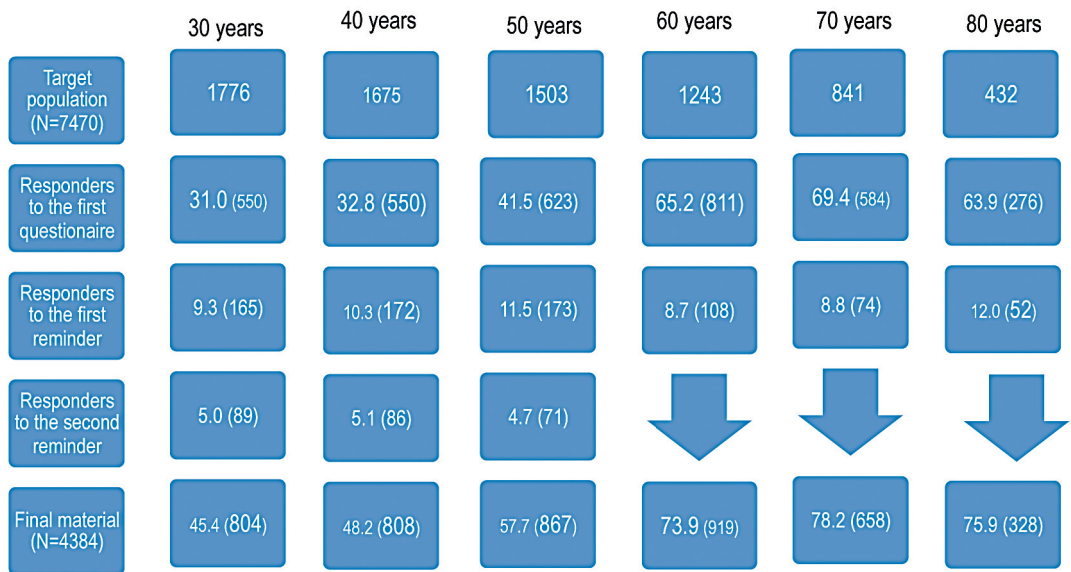


Figure 1.
Chart illustrating responders in different questionnaire rounds in 2004 survey Percentage (N)

In Study IV and Study V evaluating longitudinal changes the 1999 questionnaire was used as the starting point of the follow-up. In these studies only the three oldest age groups were available for study, as the 2004 questionnaire was the first for younger men. Only men, who had responded to both questionnaire were included, which reduced the study cohort to less than 1,700 men (Figure 2).

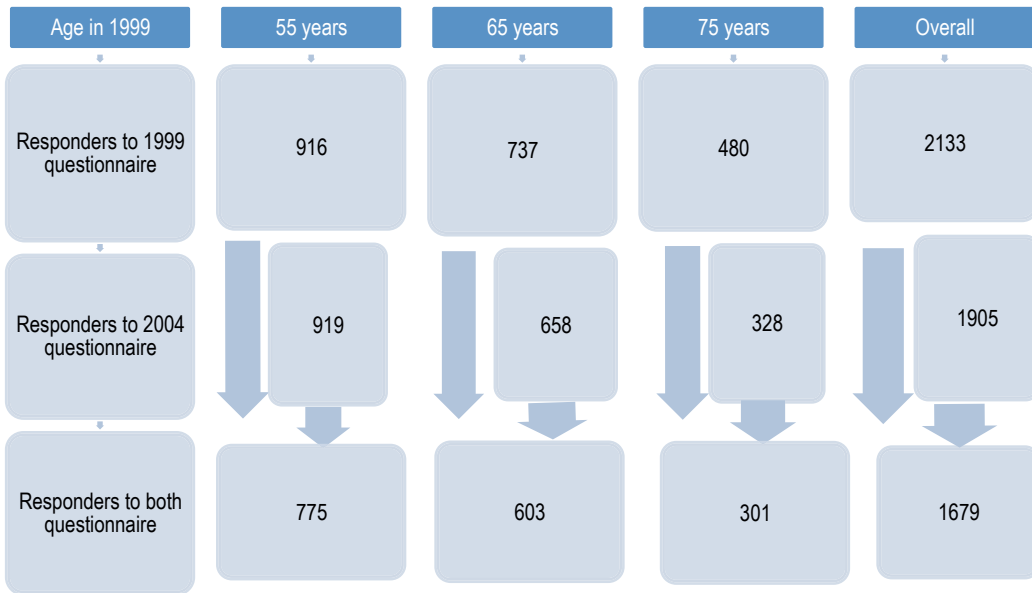


Figure 2.
Flow chart illustrating formation of the study cohort (Study IV and V)

4.3 Questionnaire

Information was collected by means of a mailed self-administered questionnaire. A covering letter, the study questionnaire and a prepaid return envelope were sent to the study subjects.

The questionnaires used in the 1999 and 2004 surveys were identical (Appendix 1). The first questionnaire at each survey was sent in spring, in May 1999 and in April 2004. After three months, a reminder questionnaire was sent to the men who did not respond to the initial one. In 2004, three younger age groups were added to the study population. After the first reminder, the participation proportion was below 50 percent, so a second reminder round was sent to these three younger age groups three months after the first reminder. After each mailing two months elapsed before data collection was closed and data were recorded.

Studies I–V all used the 2004 questionnaire. The Studies I–III used all six age groups in the 2004 survey. In Studies IV–V, only the three oldest age groups were evaluated.

The 2009 questionnaire was used in Study V. The follow-up information on changes in medication taken and possible surgical procedures concerning the medication treatment group was used. No further use of the 2009 questionnaire was made for this dissertation.

4.4 Assessment of responses

4.4.1 *Demographic factors*

Occupation, marital status, overall health and illnesses, height and weight, smoking status, alcohol and caffeine consumption, use of medications, history of medical examinations and operations (classification shown in the results section) were recorded in the questionnaire. At the end of the questionnaire there were 15 questions on quality of life based on the Finnish 15D instrument for health-related quality of life (Sintonen, 2001).

In all five (I–V) studies, the sociodemographic data were used to evaluate selection bias, as men responding to different study rounds were compared to those responding to the 2004 questionnaire.

4.4.2 *Lower urinary tract symptoms*

Information on lower urinary tract symptoms was collected using the DAN-PSS-1 questionnaire (Hansen et al., 1995; Meyhoff et al., 1993). Questions one, two and four as well as question ten on dysuria (pain or burning during voiding) pertained to voiding symptoms. Questions three and five were considered postmicturition symptoms. Questions from six to twelve (excluding question ten) addressed storage symptoms. Every question had two parts, question A and B. The A part concerned frequency or how severe the symptom was and the B part how much bother the symptom caused (Appendix).

For Study I, only the first question of the DAN-PSS-1 questionnaire was used. The first question (1A) concerning hesitancy was “Do you have to wait for urination to start?” Response alternatives were No/Rarely/Often/Always. The 1B question about bother was “If you have to wait to start urination, is this a problem for you?” with response options No problem/Small problem/Moderate problem/Major problem.

For Study II one symptom (question 5A, postmicturition dribble) was also evaluated. Question 5A was “Do you experience dribbling after voiding when you feel you have finished urination?” with four response options. Bother (5B) was also evaluated with four graded options.

Study III used all twelve A-questions of the DAN-PSS-1 questionnaire on frequency or severity of symptoms, but bother (B-questions) was not evaluated in this study.

In Study IV the men who had responded to both the 1999 and 2004 questionnaires formed the study population. The aim of the study was to evaluate the natural course of LUTS in follow-up so only men who had received no LUTS treatment in 1999 were included. Men with a history of prostate cancer were also excluded from the study.

Study V compared the outcome of LUTS between men who had received medical and surgical treatment. All twelve symptoms were compared. The medical treatment group comprised men who had started alpha-blocker or 5alpha-reductase inhibitor medication between 1999 and 2004. The surgical treatment group included men, who had undergone a TURP or open prostatectomy during the same time period. Men receiving no treatment for LUTS comprised the non-treated group. Men with a history of prostate cancer were likewise excluded from this study.

4.5 Statistical analysis

In Studies I and II, which concerned only one symptom, a two-sided chi-square test was used to assess differences in prevalence and bother by age group. The correlation between frequency and bother of symptom in both studies was evaluated using Kendall tau-b test, which assesses the strength of association of the cross-tabulations when both variables are measured on an ordinal scale (Agresti, 2010).

Study III used Spearman's rho test to evaluate correlations between LUTS. The main statistical analysis method, however, was principal component analysis (PCA). PCA provides a means to reduce the dimensionality of a data set consisting of a large number of interrelated variables while retaining as much as possible of the variation present in it. In other words, it can be used to combine nearly the same information as provided by the original variables by combining them into a small number of new summary vectors. This is achieved by transforming a new set of variables, the principal components, which are uncorrelated, and ordered so that the first few retain most of the variation present in all of the original variables (Jolliffe, 2002).

In Studies IV and V, a linear-by-linear test was used to assess the significance of the association between two ordinal variables, or an ordinal and an interval/scale variable.

Statistical Package for the Social Science (SPSS Inc., Chicago, IL, USA) versions 17.0 and 20.0 was used for data analysis.

5 Results

5.1 Participation

Overall participation proportion was 59% as 4,384 men out of 7,470 returned the questionnaire in 2004. Even though the three youngest age groups (30-, 40-, and 50-year-old) were sent a second reminder round, the proportion of participation was still lower among these younger men. In the oldest age groups participation exceeded 75%, but was only 45% in the 30-year-old men (Figure 1).

In the follow-up studies (Studies IV and V) the 60-, 70, and 80-year-old age groups in 2004 were used. Only men responding to both the 1999 and the 2004 questionnaires were included in these studies. The longitudinal approach decreased the study material as 1,905 men responded to the 2004 questionnaire and 1,679 were included in follow-up studies (Figure 2).

Responses to the demographic questions showed that younger men were better educated. While in the oldest age groups about half of the men had only elementary school education, in the youngest age group 40% of the men had university education. In all age groups about two thirds or three quarters of men were married or cohabiting (Table 1).

Table 1.
Prevalence (%) of some demographic characteristics in the 2004 TAMUS study population

Characteristic	Age (years)					
	30	40	50	60	70	80
Marital status, $p < 0.001$						
Married or cohabiting	69	71	71	77	78	70
Bachelor, divorced or widower	31	29	29	23	22	30
Education, $p < 0.001$						
Elementary school	4	9	18	31	49	56
Intermediate stage	34	47	41	40	32	24
College	22	25	24	18	12	9
University	40	19	17	11	7	11
Occupational status, $p < 0.001$						
White-collar worker	50	38	34	19	0	0
Blue-collar worker	37	40	41	23	1	1
Self-employed	5	10	10	5	1	0
Unemployed	6	9	9	11	0	0
Retired	1	3	6	42	98	99
Student	1	0	0	0	0	0
Change in overall health in past five years, $p < 0.001$						
Worse	19	30	41	51	60	74
Same	72	61	53	43	35	23
Better	9	9	6	6	5	3
Previously diagnosed medical conditions and surgical procedures						
Depression	9	10	10	10	7	5
Diabetes	1	2	4	10	14	14
Elevated blood pressure	5	17	28	40	48	39
Coronary arterial disease	0	0	2	7	21	27
Surgery for BPH	0	0	0	1	6	13
Radical prostatectomy	0	0	0	1	2	2

To detect possible selection bias in the 2004 questionnaire, response rounds were compared and there were no major differences in demographic characteristics.

5.2 Prevalence of LUTS

The most prevalent symptom was urgency (66%), followed by postmicturition dribble (58%), nocturia (49%) and feeling of incomplete emptying (45%). The largest proportion of moderate or severe symptoms was in postmicturition dribble as 22% of all men reported moderate or severe symptoms. The lowest prevalence was in non-specified incontinence and stress incontinence, overall prevalence was lower than ten percent for both symptoms. Urge incontinence in storage symptoms and slow stream and dysuria in voiding symptoms had a prevalence of about 20 percent. More prominent symptoms (moderate or severe) were rare in all these five symptoms, prevalence were about 1–2 percent (Figure 3).

The progression of LUTS with age was most obvious in storage symptoms. Both overall prevalence of symptoms and prevalence of more severe cases increased with age (Figure 4).

Both postmicturition symptoms, feeling of incomplete emptying and postmicturition dribble, increased with age as did the prevalence of more severe symptoms. Severe postmicturition dribble was also common among younger men. In the oldest age groups, there was a levelling out “plateau” in prevalence of postmicturition dribble, such that 60-, 70- and 80-year-old men had almost the same prevalence (Figure 5).

The only voiding symptom to show a clear increase with age was slow stream (Figure 6). Hesitancy and straining had consistently high prevalence across all age groups. Dysuria had also remained at the same level, about twenty percent regardless of age.

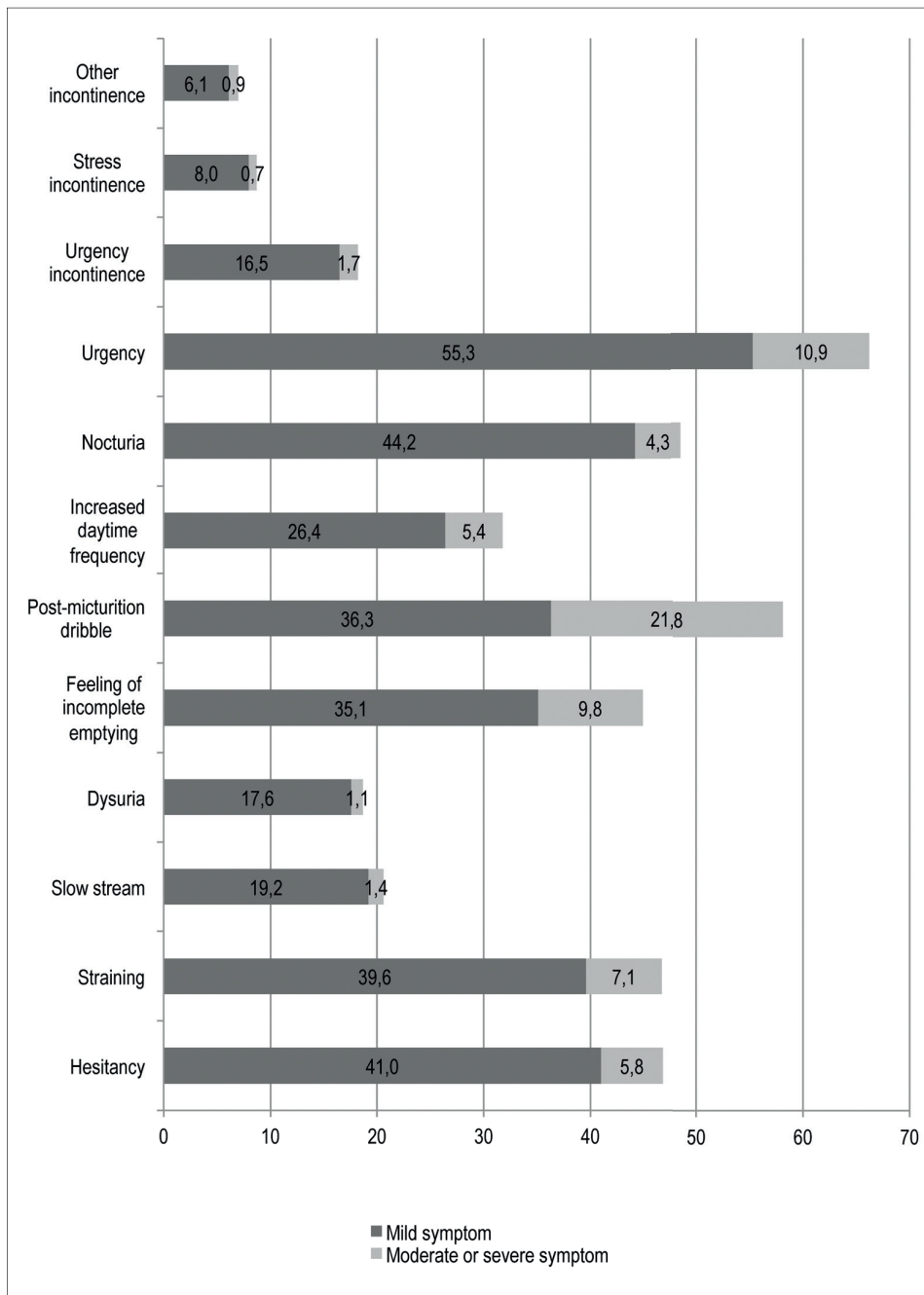
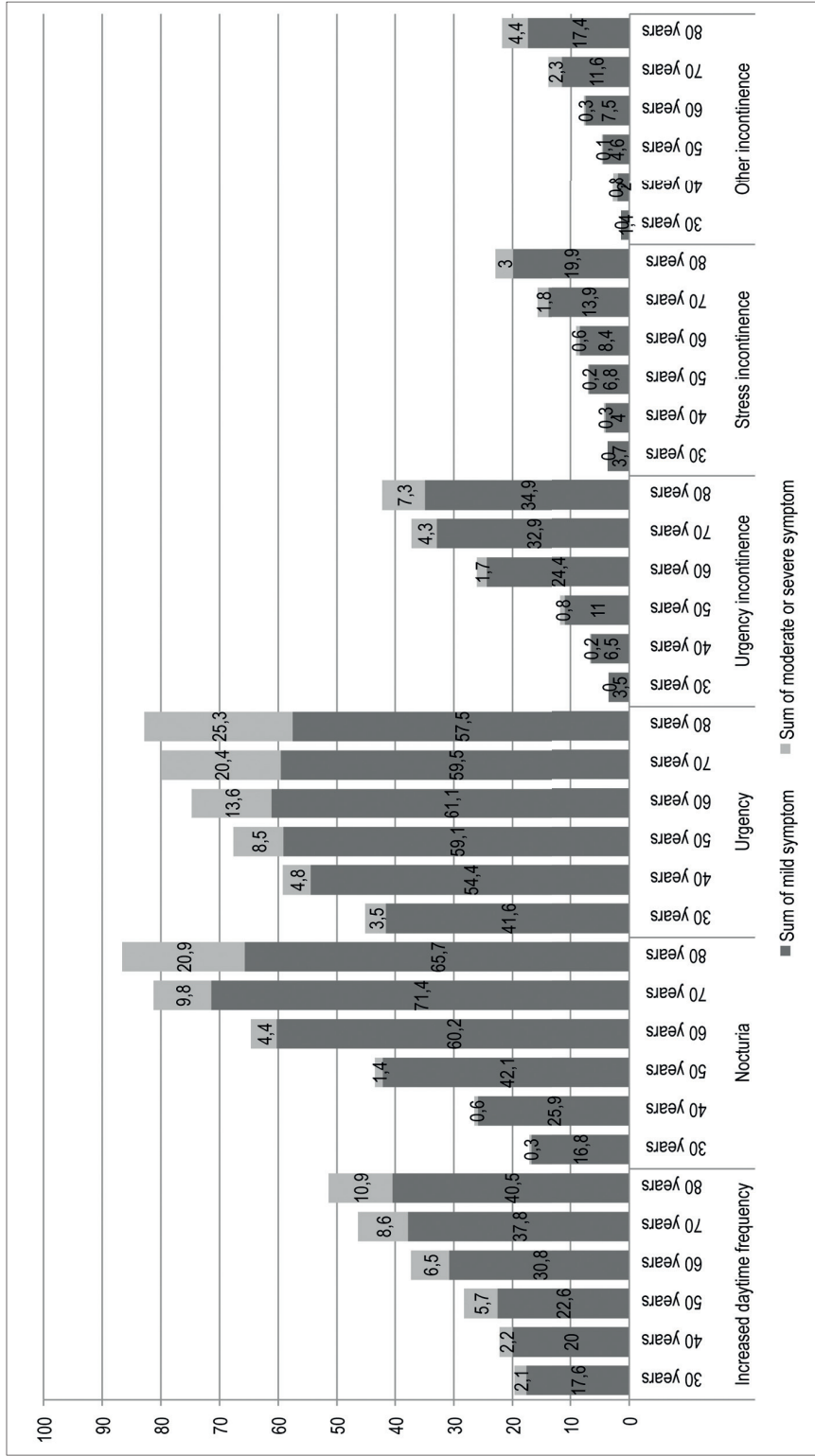


Figure 3.
Overall prevalence of LUTS in TAMUS 2004 cohort in percent

Figure 4.
Prevalence of storage symptoms in TAMUS 2004 cohort



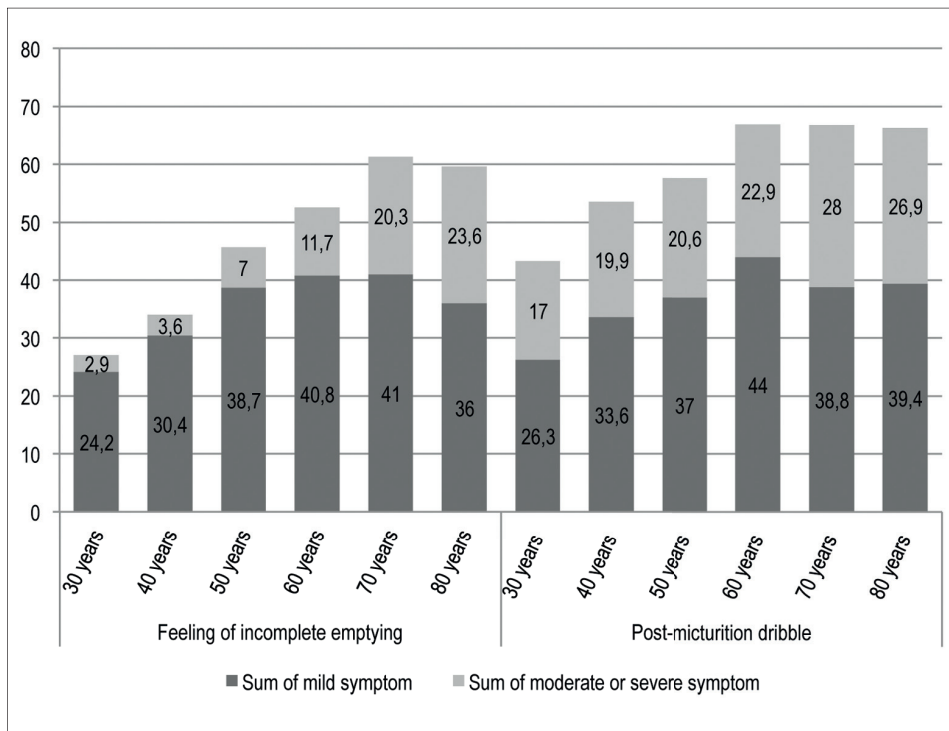
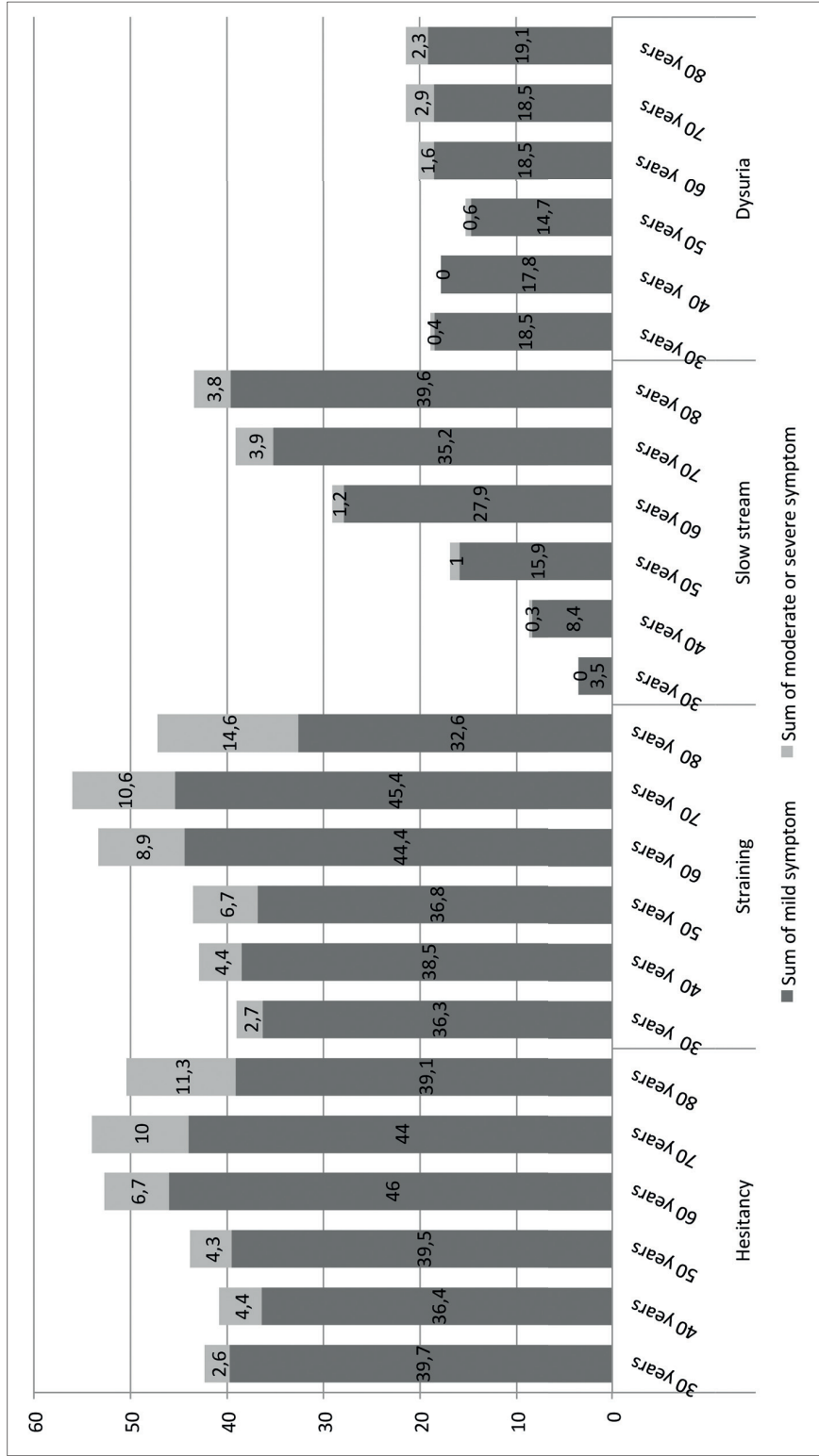


Figure 5.
Prevalence of postmicturition symptoms in TAMUS 2004 cohort in percent

Figure 6.
Prevalence of voiding symptoms in TAMUS 2004 cohort in percent



5.3 Bother of LUTS

Two symptoms were evaluated in detail in this dissertation. Of the voiding symptoms, hesitancy and postmicturition dribble had a high prevalence, also among younger men.

5.3.1 Bother of hesitancy

The bother and frequency of hesitancy were statistically significantly associated. Men with mild hesitancy (rare frequency) most often reported no problem with it (61%) or only minor bother (37%). Of the men with more severe symptoms (hesitancy often or always) the majority (59%) reported minor bother and a third (32%) moderate or major bother. The proportion of men reporting bother increased with age (Table 2).

Table 2.
Bother of hesitancy by age in TAMUS 2004 cohort

Age (years)	Bother of hesitancy % (N)			Total
	No problem	Small problem	Moderate or major problem	
30	87.9 (699)	10.7 (85)	1.4 (11)	(795)
40	84.8 (666)	14.3 (112)	0.9 (7)	(785)
50	82.1 (698)	15.5 (132)	2.4 (20)	(850)
60	74.0 (665)	23.0 (207)	3.0 (27)	(899)
70	68.8 (432)	26.4 (166)	4.8 (30)	(628)
80	68.9 (206)	25.8 (77)	5.3 (16)	(299)
Total	79.1 (3366)	18.3 (779)	2.6 (111)	(4256)

p<0.001, Linear-by-Linear Association test

5.3.2 Bother of postmicturition dribble

Postmicturition dribble had a higher bother score than hesitancy. Prevalence of postmicturition dribble was also higher than prevalence of hesitancy and both prevalence and bother increased with age. The severity and bother were statistically significantly associated. Moderate and major problems increased from 3.7% in 30-year-old men to 12.5% in the oldest (80 years) age group (Table 3).

Table 3.
Bother of post-micturition dribble by age

Age (years)	Bother of post-micturition dribble % (N)			Total
	No problem	Small problem	Moderate or major problem	
30	74.8 (599)	21.5 (172)	3.7 (30)	100(801)
40	68.5 (549)	27.0 (216)	4.5 (36)	100(801)
50	64.0 (551)	30.4 (262)	5.6 (48)	100(861)
60	56.1 (506)	36.5 (329)	7.4 (67)	100(902)
70	51.3 (326)	36.8 (234)	11.9 (76)	100(636)
80	52.2 (155)	35.3 (105)	12.5 (37)	100(297)
Total	62.5 (2686)	30.7 (1318)	6.8 (294)	(4298)

$p < 0.001$, Linear-by-Linear Association test

5.4 The grouping of LUTS

LUTS were analysed using principal component analysis to detect intercorrelations between them. Three summary variables were formed as a result of the analysis, which could be classified as voiding, storage and incontinence symptoms (Table 4). In the youngest age group (30 years) PCA did not produce main components due to the low prevalence of LUTS in this age group. In 70-year-old men only two components emerged, but in the remaining four age groups, consistent principal components emerged. Overall correlations between the symptoms were rather weak. This approach resulted, however, in a new symptom group as post-micturition symptoms merged with voiding symptoms and incontinence symptoms were separated from storage symptoms.

Table 4.
Principal component analysis of the LUTS in 30-80-year-old men (3 component emerged)

	Component			
	Eigenvalue	1	2	3
Hesitancy		4.248	1.460	1.021
Straining	0.844	-0.064	0.077	
Dysuria	0.815	-0.058	-0.035	
Slow stream	0.580	0.202	0.131	
Feeling of incomplete emptying	0.552	-0.017	-0.303	
Postmicturition dribble	0.517	-0.055	-0.400	
Stress incontinence	0.328	0.212	-0.219	
Other incontinence	0.055	0.849	0.054	
Daytime frequency	-0.016	0.841	-0.046	
Nocturia	-0.072	-0.002	-0.749	
Urgency	0.064	-0.014	-0.700	
Urge incontinence	0.094	0.070	-0.665	
	-0.077	0.479	-0.514	

Values in bold face indicate that the symptom loaded on to the factor (>0.300)

5.5 Natural history of LUTS

All twelve symptoms fluctuated over the five-year period. Incidence of symptoms varied by a factor of ten and remission varied by a factor of four.

5.5.1 Incidence of LUTS

The highest incidence was in postmicturition symptoms (postmicturition dribble 13% and feeling of incomplete emptying 11%) followed by urgency (10%). Other symptoms had incidences ranging 1–6% (Table 5).

5.5.2 Remission of LUTS

Remission, or disappearance of the symptom, was considerably more frequent than incidence and varied from 22 to 89 % (Table 5). The highest remission rate was in slow stream, but this was based on a small number of subjects. The lowest remission rate was in urge incontinence also with few subjects.

Table 5.
Changes of LUTS in 5-year follow-up, TAMUS 1999–2004

	Men asymptomatic at baseline		Men with symptom at baseline		No. of men
	Remained asymptomatic	Symptom incidence, % [95% CI]	Remained symptomatic	Symptom recovery, % [95% CI]	
Postmicturition symptoms					
Feeling of incomplete emptying	1070/1197	11 [9-12]	47/78	40 [29-51]	1275
Postmicturition dribble	854/977	13 [11-15]	165/288	43 [37-49]	1265
Voiding symptoms					
Hesitancy	1149/1213	5 [4-7]	32/66	52 [39-64]	1279
Straining	1124/1192	6 [4-7]	39/82	52 [41-64]	1274
Slow stream	1251/1271	2 [1-2]	1/9	89 [52-100]	1280
Dysuria	1246/1261	1 [0.7-2]	4/9	56 [21-86]	1270
Storage symptoms					
Increased daytime frequency	1170/1228	5 [4-6]	29/61	52 [39-65]	1289
Nocturia	1177/1236	5 [4-6]	25/44	43 [28-59]	1280
Urgency	1037/1155	10 [9-12]	86/128	33 [25-42]	1283
Urgency incontinence	1238/1264	2 [1-3]	7/9	22 [3-60]	1273
Stress incontinence	1253/1260	1 [0.2-1]	1/3	67 [9-99]	1263
Other incontinence	1256/1269	1 [0.6-2]	2/6	67 [22-96]	1275

5.6 Outcomes of treatment options in benign prostatic obstruction

In Study V symptom relief was compared between men receiving medical treatment (alpha-blockers, 5-alpha-reductase inhibitors) and those reporting surgical treatment (TURP or open prostatectomy). The third group consisted of untreated men, who had the lowest symptoms scores. The surgical treatment group had the highest symptoms scores, as mild symptoms are usually treated medically and severe symptoms more often surgically. The surgical treatment caused symptom reduction in all LUTS groups, and the greatest reduction was found in voiding symptoms. In the medically treated and no treatment groups all the symptom scores deteriorated, more in the medically treated group than in the untreated control group (Figure 7).

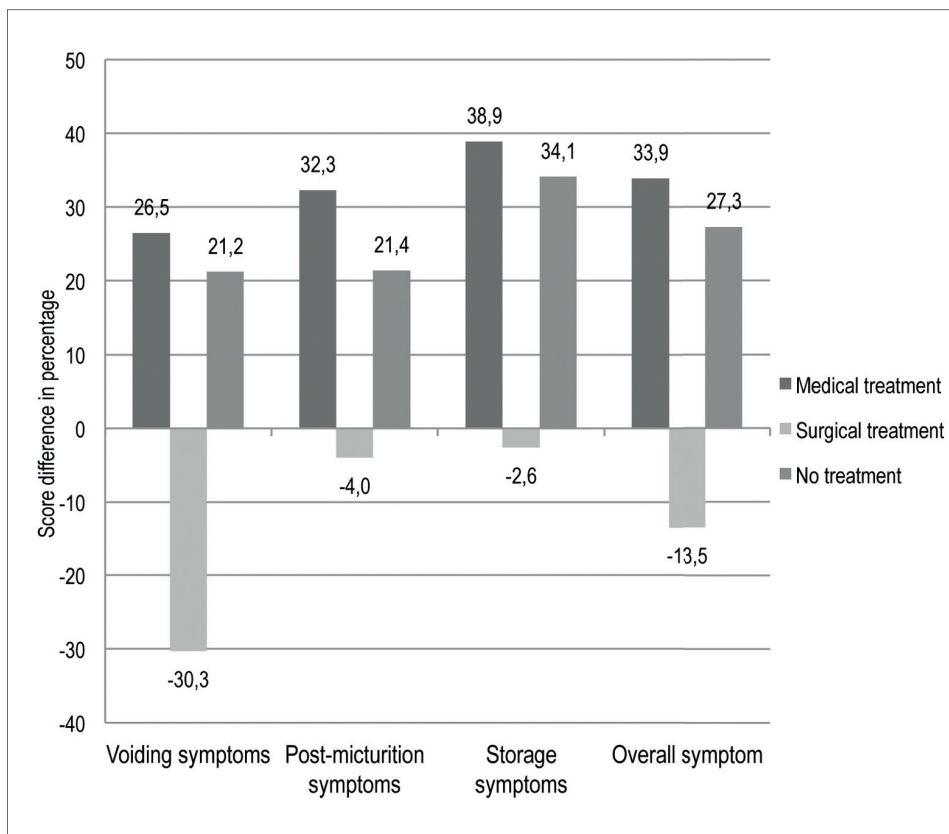


Figure 7.
Symptom score changes between before and after/during treatment in different treatment groups

When each symptom was analysed separately, surgical treatment was again associated with a reduction in the prevalence of most symptoms. In all voiding symptoms (except dysuria), prevalence of feeling of incomplete emptying, increased daytime frequency and urgency diminished by about 10 percentage points in the surgical treatment group. Postmicturition dribble and dysuria were symptoms with slightly better results in the medically treated than in the surgical treatment group. Among both medically treated men and men without treatment the prevalence of symptomatic men increased in all twelve LUTS.

6 Discussion

In this dissertation, occurrence and prognosis of male lower urinary tract symptoms were evaluated using longitudinal analysis of the Tampere Ageing Male Urological Study (TAMUS) material. For the first time younger men (30 to 50 years old) were also included in the study. Studies I and II focused on the prevalence of two common but seldom studied symptoms, hesitancy and postmicturition dribble. These studies showed that symptoms were also frequent in younger men, although with increasing age they become more frequent and more severe. In Study IV LUTS showed a significant tendency for remission.

To better understand the aetiology of LUTS, principal component analysis was used to ascertain which symptoms correlate with each other. The results suggest that LUTS could be divided into voiding, storage and incontinence symptoms on the basis of their statistical intercorrelations to each other (III).

The treatment options (medical or surgical treatment) for LUTS caused by benign prostatic obstruction were evaluated in a population-based approach (V), and the results suggested that surgical treatment reduced LUTS scores better than medical treatment.

6.1 Participation and study design

TAMUS is based on postal questionnaires, unlike many other population based epidemiological studies on LUTS e.g. BACH, EPIC, and EpiLUTS. Another Finnish urological population-based study also used postal questionnaire and achieved a participation of 62% (Tikkinen et al., 2006). In our study, the overall participation proportion was 59% as 4,384 men out of 7,470 returned the questionnaire in 2004. One common problem in population-based studies is suboptimal participation, but it seems that older Finnish men especially are active in responding to postal surveys. Among younger men the participation proportion was markedly lower. The three oldest cohorts in the TAMUS survey were born in 1924, 1934 and 1944 and have been in the TAMUS study since 1994, so these groups naturally diminished due to increased mortality with increasing age.

One advantage of conducting a population-based study in Finland is the well-developed population register system, which enables comprehensive identification of target populations for population-based studies.

As our target population consists in part of retired men, postal questionnaire is reasonable way to gather information. Participation would likely have been much lower if a web-based questionnaire had been used and it could also have caused more bias (Balter et al., 2005; Klovning et al., 2009). Telephone surveys and personal interviews are also used in large population-based surveys; all these methods have their own advantages and shortcomings (Bowling, 2005).

6.2 Prevalence and bother of LUTS

Prevalence of LUTS is widely documented in the literature. The problem however, is that the differences in methodologies of studies and presentations of results reduce the comparability of the findings. Nevertheless the general trend is clear and our results are consistent with it. Prevalence of LUTS increases with age as does the proportion of men with more severe symptoms. However, a different pattern in prevalence of symptoms was seen with increasing age. Symptom prevalence and severity increased with age for storage symptoms and slow stream among voiding symptoms. Younger men (30 to 40 years old) reported symptoms, but these were mostly mild. Benign prostatic enlargement is a well-known cause for LUTS, and does not cause problems in younger men, but could explain why symptoms become worse around retirement age (Jacobsen et al., 2001). Degenerative illnesses increase with age, which, in addition to poorer overall health, could both cause LUTS (Lepor, 2005).

6.2.1 *Prevalence and bother of hesitancy*

Bother of hesitancy was evaluated (Study I) and about 20% of men reported at least a minor problem. Moderate or major problems were reported by about 5% of the oldest men and about one percent of the youngest men. It was a fairly well tolerated symptom in our study, but in one earlier study evaluating 475 men it was stated that hesitancy was one of the most bothersome symptoms (Eckhardt et al., 2001).

6.2.2 *Prevalence and bother of postmicturition dribble*

Another symptom, postmicturition dribble was more common than hesitancy (Study II). Almost half of the 30-year-old men and two thirds of the oldest men reported postmicturition dribble, but severe symptoms were rare. Bother of postmicturition dribble increased with age, but no longer in the oldest men, as men

may possibly become used to symptoms or used various methods to cope with their symptom (toilet paper, pads, milking methods) (Robinson, 2008).

6.3 Incidence and remission of LUTS

As earlier studies indicate, LUTS fluctuate over time. Knowing more about this natural course could also yield more information about the causes of LUTS. In an ideal study the follow-up should be long and symptoms should be evaluated at frequent intervals. No such studies have been presented and we were also unable to use such an approach. Our study (Study IV) assessed the natural course of LUTS in five-year follow-up. Men undergoing treatment for LUTS were excluded from the study, which may have biased the results as the most difficult symptoms were not covered. Another decision that should be considered is dividing men into symptomatic and symptom-free. In our study the classification combined mild symptoms with asymptomatic men and moderate with severe symptoms. This method reduces fluctuation from mild symptoms that can be regarded as inconsequential.

In our fairly large study cohort, incidence varied about ten folds from one to thirteen percent. Possibly more importantly, remission was very common, as about half of the symptomatic men became symptom-free. This strong tendency to remission should be kept in mind in clinical decision-making. What are the factors underlying symptoms, and what causes fluctuation in LUTS. This needs further investigations but certain transient conditions such as prostatitis or maybe the early phase of BPH, could cause fluctuation in symptoms. Or it may be that men adapt to the symptoms over time?

Our findings concur with those in the literature. There was progression in LUTS over time (Jacobsen et al., 1996; Platz et al., 2012). But fluctuation was also reported (Lee et al., 1998; Sarma et al., 2002).

6.4 Subgroups of LUTS

To better understand LUTS and justify their classification, interrelations between various symptoms should be determined. In Study III, symptoms were grouped using principal component analysis (PCA). This approach has rarely been used, in fact, at the time of conducting the studies included in the dissertation, only one comparable study had been published using exploratory factor analysis and its results were comparable to ours (Coyné et al., 2012). The results were very similar across age groups. In the youngest age group (30-year-old), symptoms were so uncommon that PCA was not feasible. In the oldest age group (80-year-old), storage symptoms were prominent as in younger men voiding symptoms were the first

component to converge. This finding is comparable to the results regarding prevalence of LUTS, as storage symptoms are more common in older men, but voiding symptoms are more constant, which accounts for the prominence of voiding symptoms in younger men. Incontinence symptoms seem to constitute one entity. In an epidemiological approach, one incontinence entity could possibly be used, but in clinical practice it is imperative to distinguish between stress incontinence and urgency incontinence, because the treatment options are completely different, although stress incontinence is rare in men except in postoperatively.

Postmicturition symptoms were grouped together with voiding symptoms in PCA. Postmicturition symptoms could be perceived as late phase voiding symptoms. The feeling of incomplete emptying or residual urine may be caused by an unsuccessful voiding phase. In our analysis, terminal dribble and postmicturition dribble were combined into a single entity, as we used the DAN-PSS-1 questionnaire. In the ICS standardization of terminology, terminal dribble is defined as a voiding symptom and postmicturition dribble as a postmicturition symptom. Therefore in our analysis, part of postmicturition dribble is actually terminal dribble. In the BACH study, too, over 50% of the men with voiding symptoms also had postmicturition symptoms, compared to less than 50% of respondents who reported storage symptoms (Maserejian et al., 2011). This would suggest that postmicturition symptoms are related to voiding symptoms, although they were separated into their own entity in the latest ICS classification of LUTS (Homma, 2008).

6.5 Treatment options for LUTS

Optimal treatment for LUTS should be decided individually. The decision should be based on clinical findings and the patient's preferences. Several studies on medication for LUTS and surgical treatment for LUTS have been conducted, but studies comparing these two are lacking. Mild symptoms should be treated with surveillance, lifestyle advice or medical treatment. At the other end of the spectrum, if there are complications such as urinary retention or bladder calculi, surgical treatment is indicated (Oelke 2012). What should be done with patients who present with bothersome symptoms but no complications?

We evaluated medical and surgical treatments results using the DAN-PSS-1 questionnaire. This was not a randomized study, so the treatment groups were not equal. We used a population-based approach and this analysis was not the obvious one from a ten-page questionnaire, so it may evince more "honest" answers than those in more specific studies. In specific studies on treatment methods, responders may produce distorted answers, either positive or negative, depending on the situation. In this population-based study, no clinical measurements such as

residual urine amount or prostate size were available. On the other hand, the alleviation of symptoms is more important than some measurements. Research has shown that there was no significant relationship between prostate size and LUTS (Rosier & de la Rosette, 1995; Simpson et al., 1996). However, our goal was to evaluate the outcome of the treatment in terms of patient outcomes.

Nowadays combination medical therapy with alpha1-adrenoceptor antagonist and 5-alpha reductase inhibitors is more common than at the time of our study. Studies have shown that this combination therapy provides considerably more benefit than monotherapies alone (McConnell et al., 2003; Roehrborn, Siami, et al., 2008). In our study a small proportion of men on medical therapy had combination therapy. If the proportion had been larger the results might have been more favourable for the medical therapy group.

Our study and another similar study yielded very similar results (Krambeck et al., 2012). In both studies surgical treatment was more effective than medical treatment. In fact, the results for the medical treatment group and the no treatment group differed only slightly. In both studies, the follow-up time was fairly long and men on medication may have stopped taking the medication, even if they reported taking it. Or maybe the benefits of medication decrease over time? In light of these results men with severe LUTS should be treated more aggressively with surgical treatment at the early stage of the disease.

6.6 Strengths and limitations of the study

The TAMUS project differs from many other epidemiological population-based LUTS studies worldwide. Using Finland's complete and well-organized population register system we were able to conduct more representative population-based studies than most others workers. The target population was randomly selected to represent general Finnish male population. Participation proportion was reasonably high compared to those of other studies, thereby increasing the generalizability of the results. Lack of information is a concern if non-responders are frequent. For that reason we evaluated various response rounds to the 2004 questionnaire and found no statistical differences between demographic or symptom data from different answering rounds. This would suggest that major non-responder bias is unlikely.

As TAMUS is a study with interview rounds at five-year intervals, it was able to evaluate the changes in LUTS. Longitudinal studies are less frequent than prevalence studies for obvious reasons; they are more time-consuming and harder to carry out. In Studies IV and V two interviews at five-year interval were used, so the exact time of change could not be known. If time interval between interviews had been shorter, short time fluctuation of LUTS could have been evaluated.

Self-administered postal questionnaire are probably the best way to collect information from older men. Among young men e-mail would be feasible, but not among older men (Balter et al., 2005; Klovning et al., 2009). Postal questionnaire may also yield more reliable information than personal or phone interviews, as men may be less prone to distort their answers. Respondents have been shown to give more positive and socially desirable responses in interview surveys than in self-report (e.g. postal) surveys (Bowling, 2005). On the other hand, while responding to the questionnaire at home family member or friend may influence the responses. However, this may be positive in the oldest age groups with possible memory problems as the answers could be more truthful.

The TAMUS study cohort represents Finnish population, which is almost entirely Caucasian. The results cannot be fully generalized to more diverse populations if there are racial differences in LUTS. Many studies have not found significant differences between ethnic groups in LUTS (Fowke et al., 2011; Markland et al., 2010). The findings are not entirely conclusive, as some differences have been detected (Coyne et al., 2013; Platz et al., 2002; Sarma et al., 2003; Van Den Eeden et al., 2012).

TAMUS concerns men only, which is a shortcoming as many other population-based studies include both sexes. As in self-administered questionnaires generally, the study did not have access to patient records or any clinical findings concerning the study subjects.

6.7 Future aspects

The TAMUS project continues and next study round will be conducted in 2014. This will enable a five years longer follow-up time and changes in LUTS can be evaluated over a longer time period. The effects of LUTS on quality of life could be determined. Subgroups of men suffering from severe LUTS could be clinically assessed, including the clinical findings behind symptoms.

Conclusions

Many population-based studies have shown that LUTS are very common and also affect younger men. In our study population, prevalence of LUTS was also high, varying from 7% to 66% in individual symptoms. Mild symptoms were prominent, but the proportions of severe symptoms differed with storage symptoms showing the most marked tendency to increase with age.

In five-year follow-up almost half of the symptomatic men recovered. Incidence varied from 1% to 13%, with a more than 10-fold difference between various LUTS.

PCA was used to evaluate correlations between symptoms. This analysis yielded a fairly consistent result in different ages. According to our analysis, symptoms can be divided into three components, namely voiding, storage and incontinence symptoms.

Men with severe LUTS caused by benign prostatic obstruction benefit more from surgical than from medical treatment.

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Appendix

The 1999 and 2004 original TAMUS questionnaire:
(10 pages, starting on next page)

MIESTEN UROLOGISET OIREET

OSA I

TAUSTATIEDOT:

Olkaa hyvä ja vastatkaa alla oleviin kysymyksiin rastittamalla sopiva vaihtoehto tai täydentämällä kysymykseen liittyvä vastaustila.

1 HENKILÖTIEDOT
SYNTYMÄAIKA <input type="text"/> / <input type="text"/> / 19 päivä kuukausi vuosi
2 AMMATTI
<input type="checkbox"/> Olen työelämässä ja ammattini on (kirjoittakaa ruutuun) <input type="text"/>
<input type="checkbox"/> Olen eläkkeellä, ammattini oli <input type="text"/>
<input type="checkbox"/> Olen työttömänä, ammattini on <input type="text"/>
3 KOULUTUS
<input type="checkbox"/> Kansakoulu
<input type="checkbox"/> Ammattikoulu tai vastaava
<input type="checkbox"/> Opistotutkinto
<input type="checkbox"/> Yliopisto- tai korkeakoulututkinto
4 SIVILISÄÄTY
<input type="checkbox"/> Naimisissa tai avoliitossa
<input type="checkbox"/> Eronnut Vuonna <input type="text"/>
<input type="checkbox"/> Leski Vuodesta <input type="text"/>
<input type="checkbox"/> Naimaton
5 TERVEYS
Viimeisen viiden vuoden aikana terveyteni on
<input type="checkbox"/> Huonontunut voimakkaasti
<input type="checkbox"/> Huonontunut hieman
<input type="checkbox"/> Pysynyt ennallaan
<input type="checkbox"/> Parantunut hieman
<input type="checkbox"/> Parantunut selvästi

6 PITUUS JA PAINOPituuteni on cmPainoni on kg**7 TUPAKOINTI**

Tupakoitko nykyään tai oletteko koskaan tupakoinut säännöllisesti?
Tupakoinnilla tarkoitetaan savukkeiden, sikarien tai piipun polttoa.

- 0 En**
 1 Kyllä
 2 Olen lopettanut tupakoinnin

Jos tupakoitte tai olette tupakoineet, vastatkaa vielä seuraaviin kysymyksiin:

Minä vuonna aloititte **säännöllisen** tupakoinnin? Vuonna
 Jos olette lopettanut tupakoinnin, minä vuonna? Vuonna

Kuinka paljon poltatte **päivittäin** nykyään?
 Tai, kuinka paljon poltatte päivittäin ennen lopettamista?

Savukkeita tai pikkusikareja kpl
 Piippua pesällistä
 Sikareja kpl

8 MUUT NAUTINTOAINEEET

Juotko kahvia tai teetä päivittäin?

- 0 En**
 1 Kyllä, _____ kuppia kahvia päivässä.
 2 Kyllä, _____ kuppia teetä päivässä.

Juotko alkoholipitoisia juomia?

- 3 En lainkaan.** Voitte siirtyä kysymysryhmään 9.
 4 Kyllä, satunnaisesti, mutta en joka viikko.
 5 Kyllä, viikoittain

Jos käytätte alkoholia viikoittain, arvioikaa keskimääräinen **viikoittainen** kulutuksenne tässä.

Olutta _____ pulloa (1/3 l)
 Viiniä _____ pulloa (3/4 l), tai _____ (12 cl) lasillista
 Väkeviä _____ pulloa (1/2 l), tai _____ (4 cl) lasillista

9 SAIRAUDET JA VAMMAT

Sairastatteko tai oletteko joskus sairastanut jotain seuraavista sairauksista? (Rastittakaa Teillä olevat tai joskus olleet sairaudet.)

0 En sairasta, enkä ole sairastanut mitään näistä sairauksista.

- 1 Sokeritauti
- 2 Kohonnut verenpaine
- 3 Sepelvaltimotauti
- 4 Muu sydänsairaus
- 5 Nivelkulumia
- 6 Ummetus
- 7 Ulosteen pidätyskyvyttömyyttä
- 8 Keuhkosairaus
- 9 Neurologinen sairaus, mikä _____

- 11 Pikäaikainen selkäkipu
- 12 Selkäytimen vamma
- 13 Selkärankareuma
- 14 Masennus
- 15 Nivelreuma
- 16 Maha- tai pohjukaissuolen haava
- 17 Korkea veren kolesteroli
- 18 Uniapnea
- 19 Syöpä, mikä _____

10 Aivoverenkierron häiriö tai halvaus

10 TUTKIMUKSET JA LEIKKAUKSET

Onko Teille tehty viimeisen viiden vuoden aikana jokin seuraavista tutkimuksista tai leikkauksista? (Merkitkää rasti.)

0 Ei mitään tässä luetelluista.

- 1 Peräsuolen poistoleikkaus
- 2 Lonkka- tai polviproteesileikkaus
- 3 Selkäleikkaus
- 4 Verisuonileikkaus, (koronaariohitus, valtimon pullistuma tai ahtauma tms.)
- 5 Eturauhasen höyläysleikkaus (TURP)
- 6 Eturauhasen liikakasvun avoleikkaus
- 7 Eturauhasen poistoleikkaus syövän vuoksi
- 8 Virtsarakkoon kohdistunut leikkaus (avoin tai täyhystysleikkaus)
- 9 PSA-verikoe (eturauhassyöpätesti)

11 MUU HOITO

Oletteko viimeisen viiden vuoden aikana saanut hoitoa erektiohäiriön vuoksi?

- 0 En
- 1 Kyllä

Jos olette saanut hoitoa, valitkaa tästä saamanne hoito:

- 2 Tablettihoito Mikä lääke _____
- 3 Pistohoito _____
- 4 Muu hoito Mikä _____

Oletteko viimeisen viiden vuoden aikana saanut hoitoa miehen vaihdevuosisäilyjen (andropaussi) vuoksi?

- 5 En
- 6 Kyllä Mitä hoitoa _____

12 LÄÄKKEET

Pyydämme Teitä vielä kirjoittamaan alla oleville riveille kaikki tällä hetkellä säännöllisesti käyttämänne lääkkeet annostuksineen.

En käytä säännöllisesti mitään lääkettä

LÄÄKE	ANNOS

Nyt voitte siirtyä kyselyn seuraaviin osiin, joissa kysytään yksityiskohtaisia virtsaamiseen, sukupuolielämään ja yleiseen elämän laatuun liittyviä asioita.

OSA II

2.1 VIRTSAAMINEN JA SUKUPUOLITOIMINNAT:

Tämä kysely koostuu kahdenlaisista kysymyksistä:

A-kysymyksissä kysytään oireen esiintymistä tai voimakkuutta.

B-kysymyksissä kysytään, kuinka paljon **haittaa** Teille mahdollisesta oireesta aiheutuu.

Vastatkaa jokaiseen kysymykseen merkitemällä rasti sopivan vastausvaihtoehdon kohdalle.

1 A Täytyykö virtsaamisen alkamista odottaa? <input type="checkbox"/> Ei koskaan <input type="checkbox"/> Harvoin <input type="checkbox"/> Usein <input type="checkbox"/> Aina	1 B Mikäli joudutte odottamaan virtsaamisen alkamista, kuinka paljon siitä on Teille haittaa? <input type="checkbox"/> Ei lainkaan <input type="checkbox"/> Vähän <input type="checkbox"/> Kohtalaisesti <input type="checkbox"/> Hyvin paljon
2 A Tuleeko virtsa omasta mielestänne: <input type="checkbox"/> Normaalisti <input type="checkbox"/> Heikosti <input type="checkbox"/> Hyvin heikosti <input type="checkbox"/> Tipoitain	2 B Mikäli virtsa tulee heikosti, kuinka paljon siitä on Teille haittaa? <input type="checkbox"/> Ei lainkaan <input type="checkbox"/> Vähän <input type="checkbox"/> Kohtalaisesti <input type="checkbox"/> Hyvin paljon
3 A Tuntuuko, että virtsatesanne rakko tyhjenee täysin? <input type="checkbox"/> Kyllä, aina <input type="checkbox"/> Usein <input type="checkbox"/> Harvoin <input type="checkbox"/> Ei koskaan	3 B Mikäli tunnette, ettei rakko tyhjene täysin, kuinka paljon siitä on Teille haittaa? <input type="checkbox"/> Ei lainkaan <input type="checkbox"/> Vähän <input type="checkbox"/> Kohtalaisesti <input type="checkbox"/> Hyvin paljon
4 A Joudutteko ponnistamaan virtsaamisen aloittamiseksi tai virtsaamisen jatkamiseksi? <input type="checkbox"/> En koskaan <input type="checkbox"/> Harvoin <input type="checkbox"/> Usein <input type="checkbox"/> Aina	4 B Mikäli joudutte ponnistelemaan, kuinka paljon siitä on Teille haittaa? <input type="checkbox"/> Ei lainkaan <input type="checkbox"/> Vähän <input type="checkbox"/> Kohtalaisesti <input type="checkbox"/> Hyvin paljon
5 A Tippuuko virtsa vielä, vaikka luulitte virtsaamisen loppuneen (jälkitippuminen)? <input type="checkbox"/> Ei koskaan <input type="checkbox"/> Kyllä, WC:ssä <input type="checkbox"/> Hieman alushousuihin <input type="checkbox"/> Runsaasti alushousuihin	5 B Mikäli jälkitippumista esiintyy, kuinka paljon siitä on Teille haittaa? <input type="checkbox"/> Ei lainkaan <input type="checkbox"/> Vähän <input type="checkbox"/> Kohtalaisesti <input type="checkbox"/> Hyvin paljon
6 A Kuinka pitkä on pisin kahden virtsaamisen välinen aika päivällä? <input type="checkbox"/> Yli 3 tuntia <input type="checkbox"/> 2-3 tuntia <input type="checkbox"/> 1-2 tuntia <input type="checkbox"/> Alle tunti	6 B Mikäli joudutte virtsaamaan usein, kuinka paljon siitä on Teille haittaa? <input type="checkbox"/> Ei lainkaan <input type="checkbox"/> Vähän <input type="checkbox"/> Kohtalaisesti <input type="checkbox"/> Hyvin paljon
7 A Kuinka monta kertaa joudutte virtsaamaan yön aikana? <input type="checkbox"/> 0 kertaa <input type="checkbox"/> 1-2 kertaa <input type="checkbox"/> 3-4 kertaa <input type="checkbox"/> 5 kertaa tai useammin	7 B Mikäli joudutte virtsaamaan yöllä, kuinka paljon siitä on Teille haittaa? <input type="checkbox"/> Ei lainkaan <input type="checkbox"/> Vähän <input type="checkbox"/> Kohtalaisesti <input type="checkbox"/> Hyvin paljon
8 A Tuleeko Teille äkillinen virtsaamistarve? <input type="checkbox"/> Ei koskaan <input type="checkbox"/> Harvoin <input type="checkbox"/> Usein <input type="checkbox"/> Aina	8 B Mikäli Teille tulee äkillinen virtsaamistarve, kuinka paljon siitä on Teille haittaa? <input type="checkbox"/> Ei lainkaan <input type="checkbox"/> Vähän <input type="checkbox"/> Kohtalaisesti <input type="checkbox"/> Hyvin paljon
9 A Tuleeko virtsaamisen tarve niin voimakkaana että virtsa karkaa ennen kuin ehditte WC:hen? <input type="checkbox"/> Ei koskaan <input type="checkbox"/> Harvoin <input type="checkbox"/> Usein <input type="checkbox"/> Aina	9 B Mikäli virtsa karkaa ennen kuin ehditte WC:hen, kuinka paljon siitä on Teille haittaa? <input type="checkbox"/> Ei lainkaan <input type="checkbox"/> Vähän <input type="checkbox"/> Kohtalaisesti <input type="checkbox"/> Hyvin paljon
10 A Tunnetteko virtsatesanne kipua tai poltetta? <input type="checkbox"/> En koskaan <input type="checkbox"/> Harvoin <input type="checkbox"/> Usein <input type="checkbox"/> Aina	10 B Mikäli virtsatesanne tuntuu kipua tai poltetta, kuinka paljon siitä on Teille haittaa? <input type="checkbox"/> Ei lainkaan <input type="checkbox"/> Vähän <input type="checkbox"/> Kohtalaisesti <input type="checkbox"/> Hyvin paljon

11 A Karkaako virtsaa fyysisen ponnistuksen aikana (esim. yskiessänne, aivastaessanne tai nostaessanne)? <input type="checkbox"/> Ei koskaan <input type="checkbox"/> Harvoin <input type="checkbox"/> Usein <input type="checkbox"/> Aina	11 B Mikäli virtsaa karkaa fyysisen ponnistuksen aikana, kuinka paljon siitä on Teille haittaa? <input type="checkbox"/> Ei lainkaan <input type="checkbox"/> Vähän <input type="checkbox"/> Kohtalaisesti <input type="checkbox"/> Hyvin paljon
12 A Karkaako virtsaa ilman fyysistä ponnistusta ja ilman virtsaustarvetta? <input type="checkbox"/> Ei koskaan <input type="checkbox"/> Harvoin <input type="checkbox"/> Usein <input type="checkbox"/> Aina	12 B Mikäli virtsaa karkaa ilman fyysistä ponnistusta ja virtsaustarvetta, kuinka paljon siitä on Teille haittaa? <input type="checkbox"/> Ei lainkaan <input type="checkbox"/> Vähän <input type="checkbox"/> Kohtalaisesti <input type="checkbox"/> Hyvin paljon
13. Kuinka tyytyväinen olette seksielämäänne?	<input type="checkbox"/> Erittäin tyytyväinen <input type="checkbox"/> Melko tyytyväinen <input type="checkbox"/> En tyytyväinen enkä tyytymätön <input type="checkbox"/> Melko tyytymätön <input type="checkbox"/> Erittäin tyytymätön
14. Kuinka monta kertaa keskimäärin olette yhdynnässä viikon aikana?	_____ kertaa
15. Onko Teillä ollut vaikeuksia saada siitin jäykistymään ennen yhdyntää?	<input type="checkbox"/> Ei koskaan <input type="checkbox"/> Joskus <input type="checkbox"/> Melko usein <input type="checkbox"/> Aina, yhdyntä ei onnistu lainkaan
16. Onko Teillä ollut vaikeuksia saada siitin pysymään jäykkänä yhdynnän aikana?	<input type="checkbox"/> Ei koskaan <input type="checkbox"/> Joskus <input type="checkbox"/> Melko usein <input type="checkbox"/> Aina, yhdyntä ei onnistu lainkaan

2.2 KANSAINVÄLINEN EREKTIOITOIMINTA KYSELY

Valitkaa ja merkitkää rastilla kunkin kysymyksen vastausvaihtoehdoista se, joka parhaiten kuvaa tilannettanne viimeisen kuuden kuukauden aikana. Valitkaa jokaiseen kysymykseen **ainoastaan yksi** vastaus!

1. Millaiseksi arvioitte luottamuksenne siihen, että voitte saavuttaa erektion ja säilyttää sen yhdynnän ajan?	1 Hyvin vähäiseksi 2 Vähäiseksi 3 Kohtalaiseksi 4 Suureksi 5 Hyvin suureksi
2. Kun Teillä oli seksuaalisen kiihottumisen aikana erektioita, kuinka usein ne olivat tarpeeksi kovia yhdyntään?	0 Ei seksuaalista toimintaa. 1 Ei koskaan tai ei juuri koskaan. 2 Muutaman kerran (harvemmin kuin joka toisella kerralla). 3 Joskus (noin joka toisella kerralla). 4 Useimmiten (useammin kuin joka toisella kerralla). 5 Melkein aina tai aina.
3. Kuinka usein pystyitte yhdynnässä ylläpitämään erektion sisään työntymisen jälkeen?	0 Ei seksuaalista toimintaa. 1 Ei koskaan tai ei juuri koskaan. 2 Muutaman kerran (harvemmin kuin joka toisella kerralla). 3 Joskus (noin joka toisella kerralla). 4 Useimmiten (useammin kuin joka toisella kerralla). 5 Melkein aina tai aina.
4. Kuinka vaikeaa Teidän oli säilyttää erektionne yhdynnän loppuun saakka?	0 En yrittänyt yhdyntää. 1 Äärimmäisen vaikeaa. 2 Hyvin vaikeaa. 3 Vaikeaa 4 Hieman vaikeaa. 5 Ei lainkaan vaikeaa.
5. Kun yrititte sukupuoliyhdyntää, kuinka usein saitte siitä tyydytystä?	0 En yrittänyt yhdyntää. 1 En koskaan tai en juuri koskaan. 2 Muutaman kerran (harvemmin kuin joka toisella kerralla). 3 Joskus (noin joka toisella kerralla). 4 Useimmiten (useammin kuin joka toisella kerralla). 5 Melkein aina tai aina.

OSA III
ELÄMÄNLAATU:

Seuraavissa kysymyksissä esitetään vaihtoehtoja, jotka kuvaavat mahdollisen sairautenne Teille aiheuttamaa haittaa ja toimintahäiriön astetta. Lukekaa ensin kunkin kysymyksen kaikki vastausvaihtoehdot huolellisesti läpi. Merkitkää sen jälkeen rastilla se vaihtoehto, joka parhaiten kuvaa terveydentilianne tänään. **Jokaisesta kysymyksestä valitaan vain yksi vaihtoehto.**

1. Liikuntakyky
<input type="checkbox"/> Pystyn kävelemään ja liikkumaan normaalisti (vaikeuksitta) sisällä, ulkona ja portaissa. <input type="checkbox"/> Pystyn kävelemään vaikeuksitta sisällä, mutta ulkona tai portaissa on pieniä vaikeuksia. <input type="checkbox"/> Pystyn kävelemään ilman apua sisällä (välinein tai ilman), mutta ulkona tai portaissa melkoisin vaikeuksin tai toisen avustamana. <input type="checkbox"/> Pystyn kävelemään sisälläkin vain toisen avustamana. <input type="checkbox"/> Olen täysin liikuntakyvytön ja vuoteen omana.
2. Näkö
<input type="checkbox"/> Näen normaalisti, eli näen lukea lehteä ja TV:n tekstejä vaikeuksitta silmälasella tai ilman. <input type="checkbox"/> Näen lukea lehteä tai TV:n tekstejä pienin vaikeuksin silmälasella tai ilman. <input type="checkbox"/> Näen lukea lehteä tai TV:n tekstejä huomattavin vaikeuksin silmälasella tai ilman. <input type="checkbox"/> En näe lukea lehteä enkä TV:n tekstejä ilman silmälasia tai niiden kanssa, mutta näen kulkea ilman opasta. <input type="checkbox"/> En näe kulkea ilman opasta eli olen lähes tai täysin sokea.
3. Kuulo
<input type="checkbox"/> Kuulen normaalisti eli kuulen hyvin normaalia puheääntä kuulokojeen kanssa tai ilman sitä. <input type="checkbox"/> Kuulen normaalia puheääntä pienin vaikeuksin. <input type="checkbox"/> Kuulen normaalia puheääntä melkoisin vaikeuksin, keskustelussa on käytettävä normaalia kovempaa puheääntä. <input type="checkbox"/> Kuulen kovaakin puheääntä heikosti, olen melkein kuuro. <input type="checkbox"/> Olen täysin kuuro.
4. Hengitys
<input type="checkbox"/> Pystyn hengittämään normaalisti eli minulla ei ole hengenahdistusta eikä muita hengitysvaikeuksia. <input type="checkbox"/> Minulla on hengenahdistusta raskaassa työssä tai urheillessa, reippaassa kävelyssä tasamaalla tai lievässä ylämäessä. <input type="checkbox"/> Minulla on hengenahdistusta kävellessä muitten samanikäisten vauhtia tasamaalla. <input type="checkbox"/> Minulla on hengenahdistusta pienenkin rasituksen jälkeen, esimerkiksi pukeutuessa, peseytyessä tai levossa. <input type="checkbox"/> Minulla on hengenahdistusta lähes koko ajan, myös levossa.
5. Nukkuminen
<input type="checkbox"/> Nukun normaalisti, eikä minulla ole ongelmia unen suhteen. <input type="checkbox"/> Minulla on lieviä uniongelmia, esimerkiksi nukahtamisvaikeuksia tai heräilen satunnaisesti yöllä. <input type="checkbox"/> Minulla on melkoisia uniongelmia, esimerkiksi nukun levottomasti, uni ei tunnu riittävän. <input type="checkbox"/> Minulla on suuria uniongelmia, esimerkiksi joudun käyttämään usein tai säännöllisesti unilääkettä. Herään säännöllisesti yöllä tai aamuisin liian varhain. <input type="checkbox"/> Kärsin vaikeasta unettomuudesta, esimerkiksi unilääkkeiden runsaasta käytöstä huolimatta nukkuminen on lähes mahdotonta. Valvon suurimman osan yöstä.
6. Syöminen
<input type="checkbox"/> Pystyn syömään normaalisti eli itse ilman mitään vaikeuksia. <input type="checkbox"/> Pystyn syömään pienin vaikeuksin, esimerkiksi hitaasti, kömpelösti, vapisten tai erityisapuneuvoin. <input type="checkbox"/> Tarvitsen hieman toisten apua syömisessä. <input type="checkbox"/> En pysty syömään itse lainkaan, vaan minua pitää syöttää. <input type="checkbox"/> En pysty syömään itse lainkaan, vaan minua pitää syöttää joko letkulla tai suonensisäisellä ravintoliuksella.
7. Puhuminen
<input type="checkbox"/> Pystyn puhumaan normaalisti, eli selvästi, kuuluvasti ja sujuvasti. <input type="checkbox"/> Puhuminen tuottaa minulle pieniä vaikeuksia, esimerkiksi sanoja on etsittävä tai ääni ei ole riittävän kuuluva tai se vaihtaa korkeutta. <input type="checkbox"/> Pystyn puhumaan ymmärrettävästi, mutta katkonaisesti, ääni vapisten, sammaltaen tai änkyttäen. <input type="checkbox"/> Muilla on vaikeuksia ymmärtää puhettani. <input type="checkbox"/> Pystyn ilmaisemaan itseäni vain elein.
8. Eritystoiminta
<input type="checkbox"/> Virtsarakkoni ja suolistoni toimivat normaalisti ja ongelmitta <input type="checkbox"/> Virtsarakkoni tai suolistoni toiminnassa on lieviä ongelmia, esimerkiksi minulla on virtsaamisvaikeuksia tai kova tai löysä vatsa. <input type="checkbox"/> Virtsarakkoni tai suolistoni toiminnassa on melkoisia ongelmia, esimerkiksi minulla on satunnaisia virtsanpidätysvaikeuksia tai vaikea ummetus tai ripuli. <input type="checkbox"/> Virtsarakkoni tai suolistoni toiminnassa on suuria ongelmia, esimerkiksi minulla on säännöllisesti "vahinkoja" tai peräruiskeiden tai katetroinnin tarvetta. <input type="checkbox"/> En hallitse lainkaan virtsaamistani tai ulostamistani.

<p>9. Tavanomaiset toiminnot</p> <p><input type="checkbox"/> Pystyn suoriutumaan normaalisti tavanomaisista toiminnoista, esimerkiksi ansiotyöstä, opiskelusta, kotityöstä ja vapaa-ajan toiminnoista.</p> <p><input type="checkbox"/> Pystyn suoriutumaan tavanomaisista toiminnoista hieman alentuneella teholla tai pienin vaikeuksin.</p> <p><input type="checkbox"/> Pystyn suoriutumaan tavanomaisista toiminnoista huomattavasti alentuneella teholla tai huomattavin vaikeuksin tai vain osittain.</p> <p><input type="checkbox"/> Pystyn suoriutumaan tavanomaisista toiminnoista vain pieneltä osin.</p> <p><input type="checkbox"/> En pysty suoriutumaan lainkaan tavanomaisista toiminnoista.</p>
<p>10. Henkinen toiminta</p> <p><input type="checkbox"/> Pystyn ajattelemaan selkeästi ja johdonmukaisesti, muistini toimii täysin moitteettomasti.</p> <p><input type="checkbox"/> Minulla on lieviä vaikeuksia ajatella selkeästi ja johdonmukaisesti, muistini ei toimi täysin moitteettomasti.</p> <p><input type="checkbox"/> Minulla on melkoisia vaikeuksia ajatella selkeästi ja johdonmukaisesti, minulla on jonkin verran muistinmenetystä.</p> <p><input type="checkbox"/> Minulla on suuria vaikeuksia ajatella selkeästi ja johdonmukaisesti, minulla on huomattavaa muistinmenetystä.</p> <p><input type="checkbox"/> Olen koko ajan sekaisin ja vailla ajan ja paikan tajua.</p>
<p>11. Vaivat ja oireet</p> <p><input type="checkbox"/> Minulla ei ole mitään vaivoja tai oireita, esim. kipua, särkyä, pahoinvointia, kutinaa jne.</p> <p><input type="checkbox"/> Minulla on lieviä vaivoja tai oireita, esimerkiksi kipua, särkyä, pahoinvointia, kutinaa jne.</p> <p><input type="checkbox"/> Minulla on melkoisia vaivoja tai oireita, esim. kipua, särkyä, pahoinvointia, kutinaa jne.</p> <p><input type="checkbox"/> Minulla on voimakkaita vaivoja tai oireita, esim. kipua, särkyä, pahoinvointia, kutinaa jne.</p> <p><input type="checkbox"/> Minulla on sietämättömiä vaivoja tai oireita, esim. kipua, särkyä, pahoinvointia, kutinaa jne.</p>
<p>12. Masentuneisuus</p> <p><input type="checkbox"/> En tunne itseäni lainkaan surulliseksi, alakuloiseksi tai masentuneeksi.</p> <p><input type="checkbox"/> Tunnen itseni hieman surulliseksi, alakuloiseksi tai masentuneeksi.</p> <p><input type="checkbox"/> Tunnen itseni melko surulliseksi, alakuloiseksi tai masentuneeksi.</p> <p><input type="checkbox"/> Tunnen itseni erittäin surulliseksi, alakuloiseksi tai masentuneeksi.</p> <p><input type="checkbox"/> Tunnen itseni äärimmäisen surulliseksi, alakuloiseksi tai masentuneeksi.</p>
<p>13. Ahdistuneisuus</p> <p><input type="checkbox"/> En tunne itseäni lainkaan ahdistuneeksi, jännittyneeksi tai hermostuneeksi.</p> <p><input type="checkbox"/> Tunnen itseni hieman ahdistuneeksi, jännittyneeksi tai hermostuneeksi.</p> <p><input type="checkbox"/> Tunnen itseni melko ahdistuneeksi, jännittyneeksi tai hermostuneeksi.</p> <p><input type="checkbox"/> Tunnen itseni erittäin ahdistuneeksi, jännittyneeksi tai hermostuneeksi.</p> <p><input type="checkbox"/> Tunnen itseni äärimmäisen ahdistuneeksi, jännittyneeksi tai hermostuneeksi.</p>
<p>14. Energisyys</p> <p><input type="checkbox"/> Tunnen itseni terveeksi ja elinvoimaiseksi.</p> <p><input type="checkbox"/> Tunnen itseni hieman uupuneeksi, väsyneeksi tai voimattomaksi.</p> <p><input type="checkbox"/> Tunnen itseni melko uupuneeksi, väsyneeksi tai voimattomaksi.</p> <p><input type="checkbox"/> Tunnen itseni hyvin uupuneeksi, väsyneeksi tai voimattomaksi, lähes "loppuun palaneeksi".</p> <p><input type="checkbox"/> Tunnen itseni äärimmäisen uupuneeksi, väsyneeksi tai voimattomaksi, täysin "loppuun palaneeksi".</p>
<p>15. Sukupuolielämä</p> <p><input type="checkbox"/> Terveystilani ei mitenkään vaikeuta sukupuolielämääni.</p> <p><input type="checkbox"/> Terveystilani vaikeuttaa hieman sukupuolielämääni.</p> <p><input type="checkbox"/> Terveystilani vaikeuttaa huomattavasti sukupuolielämääni.</p> <p><input type="checkbox"/> Terveystilani tekee sukupuolielämäni lähes mahdottomaksi.</p> <p><input type="checkbox"/> Terveystilani tekee sukupuolielämän mahdottomaksi.</p>

OSA IV

TOIMINTAKYKY JA AKTIIVISUUS:

4.1. YLEINEN TOIMINTAKYKY

Valitkaa kunkin kysymyksen jäljestä teille sopiva vastausvaihtoehto.

1.	Oletteko viime aikoina pystynyt keskittymään töihinne?
	<input type="checkbox"/> Paremmin kuin tavallisesti
	<input type="checkbox"/> Yhtä hyvin kuin tavallisesti
	<input type="checkbox"/> Huonommin kuin tavallisesti
	<input type="checkbox"/> Paljon huonommin kuin tavallisesti
2.	Oletteko viime aikoina valvonut paljon huolien vuoksi?
	<input type="checkbox"/> En ollenkaan
	<input type="checkbox"/> En enempää kuin tavallisesti
	<input type="checkbox"/> Jonkin verran enemmän kuin tavallisesti
	<input type="checkbox"/> Paljon enemmän kuin tavallisesti
3.	Onko Teistä viime aikoina tuntunut siltä, että mukana olonne asioiden hoidossa on...
	<input type="checkbox"/> Tavallista hyödyllisempää
	<input type="checkbox"/> Yhtä hyödyllistä kuin tavallisesti
	<input type="checkbox"/> Vähemmän hyödyllistä kuin tavallisesti
	<input type="checkbox"/> Paljon vähemmän hyödyllistä kuin tavallisesti
4.	Oletteko viime aikoina tuntenut kykeneväne päättämään asioista?
	<input type="checkbox"/> Paremmin kuin tavallisesti
	<input type="checkbox"/> Yhtä hyvin kuin tavallisesti
	<input type="checkbox"/> Huonommin kuin tavallisesti
	<input type="checkbox"/> Paljon huonommin kuin tavallisesti
5.	Oletteko viime aikoina tuntenut olevanne jatkuvasti rasituksen alaisena?
	<input type="checkbox"/> En ollenkaan
	<input type="checkbox"/> En enempää kuin tavallisesti
	<input type="checkbox"/> Jonkin verran enemmän kuin tavallisesti
	<input type="checkbox"/> Paljon enemmän kuin tavallisesti
6.	Onko Teistä viime aikoina tuntunut siltä, ettette voisi selviytyä vaikeuksistaanne?
	<input type="checkbox"/> Ei ollenkaan
	<input type="checkbox"/> Ei enempää kuin tavallisesti
	<input type="checkbox"/> Jonkin verran enemmän kuin tavallisesti
	<input type="checkbox"/> Paljon enemmän kuin tavallisesti
7.	Oletteko viime aikoina kyennyt nauttimaan tavallisista päivittäisistä toimistanne?
	<input type="checkbox"/> Enemmän kuin tavallisesti
	<input type="checkbox"/> Yhtä paljon kuin tavallisesti
	<input type="checkbox"/> Vähemmän kuin tavallisesti
	<input type="checkbox"/> Paljon vähemmän kuin tavallisesti
8.	Oletteko viime aikoina kyennyt kohtaamaan vaikeutenne?
	<input type="checkbox"/> Paremmin kuin tavallisesti
	<input type="checkbox"/> Yhtä hyvin kuin tavallisesti
	<input type="checkbox"/> Huonommin kuin tavallisesti
	<input type="checkbox"/> Paljon huonommin kuin tavallisesti
9.	Oletteko viime aikoina tuntenut itsenne onnettomaksi ja masentuneeksi?
	<input type="checkbox"/> En ollenkaan
	<input type="checkbox"/> En enempää kuin tavallisesti
	<input type="checkbox"/> Jonkin verran enemmän kuin tavallisesti
	<input type="checkbox"/> Paljon enemmän kuin tavallisesti
10.	Oletteko viime aikoina kadottanut itseluottamuksenne?
	<input type="checkbox"/> En ollenkaan
	<input type="checkbox"/> En enempää kuin tavallisesti
	<input type="checkbox"/> Jonkin verran enemmän kuin tavallisesti
	<input type="checkbox"/> Paljon enemmän kuin tavallisesti
11.	Oletteko viime aikoina tuntenut itsenne ihmisenä arvottomaksi?
	<input type="checkbox"/> En ollenkaan
	<input type="checkbox"/> En enempää kuin tavallisesti
	<input type="checkbox"/> Jonkin verran enemmän kuin tavallisesti
	<input type="checkbox"/> Paljon enemmän kuin tavallisesti
12.	Oletteko viime aikoina tuntenut itsenne kaiken kaikkiaan kohtalaisen onnelliseksi?
	<input type="checkbox"/> Enemmän kuin tavallisesti
	<input type="checkbox"/> Yhtä paljon kuin tavallisesti
	<input type="checkbox"/> Vähemmän kuin tavallisesti
	<input type="checkbox"/> Paljon vähemmän kuin tavallisesti

4.2 LIIKUNTA-AKTIIVISUUS

Seuraavissa kysymyksissä kysytään aikaa, jonka käytätte fyysiseen aktiivisuuteen tavallisen viikon aikana. Niissä tiedustellaan toiminnoista, joita teette työpaikallanne, siirtyessänne paikasta toiseen, osana koti- ja pihatöitä sekä vapaa-aikananne virkistykseen, kuntoiluun tai urheilun vuoksi.

1.A	Kuinka monena päivänä tavallisen viikon aikana fyysinen aktiivisuutenne on ruumiillisesti rasittavaa (vaatii kovaa ponnistelua ja saa selvästi hengästymään), esimerkiksi painavien taakkojen nostamista, aerobicia tai reipasta pyöräilyä? Vastaus: _____ päivänä.
1.B	Kuinka paljon aikaa tavallisesti käytätte kaikkiaan tuollaisena päivänä rasittavaan fyysiseen aktiivisuuteen? Vastaus: _____ tuntia _____ minuuttia.

2.A	Kuinka monena päivänä tavallisen viikon aikana fyysinen aktiivisuutenne on ruumiillisesti kohtuukormitteista (vaatii kohtuullista ponnistelua ja saa hengästymään lievästi), esimerkiksi kevyiden taakkojen kantamista tai pyöräilyä tasaista vauhtia. Älkää laskeko mukaan kävelyä. Vastaus: _____ päivänä.
2.B	Kuinka paljon aikaa tavallisesti käytätte kaikkiaan tuollaisena päivänä kohtuukormitteiseen fyysiseen aktiivisuuteen? Vastaus: _____ tuntia _____ minuuttia.

3.A	Kuinka monena päivänä tavallisen viikon aikana kävelette vähintään 10 minuuttia kerrallaan? Tähän sisältyy kävely töissä ja kotona, kävely paikasta toiseen siirtyessänne ja kaikki muu kävely, jota ehkä harrastatte virkistykseen, urheilun ja kuntoiluun vuoksi tai vapaa-aikananne. Vastaus: _____ päivänä viikossa.						
3.B	Kuinka kauan aikaa tavallisesti käytätte kaiken kaikkiaan kävelyn tuollaisena päivänä? Vastaus: _____ tuntia _____ minuuttia.						
3.C	Millaista vauhtia yleensä kävelette? Kävelettekö <table border="1"><tr><td>1</td><td>ripeästi, niin että hengästyitte selvästi?</td></tr><tr><td>2</td><td>kohtalaisen nopeasti, niin että hengästyitte lievästi?</td></tr><tr><td>3</td><td>rauhallisesti, niin että ette hengästy?</td></tr></table>	1	ripeästi, niin että hengästyitte selvästi?	2	kohtalaisen nopeasti, niin että hengästyitte lievästi?	3	rauhallisesti, niin että ette hengästy?
1	ripeästi, niin että hengästyitte selvästi?						
2	kohtalaisen nopeasti, niin että hengästyitte lievästi?						
3	rauhallisesti, niin että ette hengästy?						

Viimeiset kysymykset koskevat aikaa, jonka käytätte päivittäin istumiseen työssä, kotona, tehdessänne opiskelutehtäviä tai vapaa-aikananne. Tähän sisältyy aika, jonka käytätte pöydän ääressä istumiseen, ystävien luona olemiseen, lukemiseen tai television katselemiseen tai loikoiluun.

4.A	Kuinka paljon aikaa käytätte yleensä istumiseen arkipäivänä ? Vastaus: _____ tuntia _____ minuuttia päivässä. Kuinka paljon aikaa käytätte yleensä istumiseen lauantaina ja sunnuntaina ?
4.B	Vastaus: _____ tuntia _____ minuuttia päivässä.

**Sydämelliset kiitokset vastauksistanne!
Palautuskirje kuoren postimaksu on valmiiksi maksettu.**

Original publications

Prevalence of hesitancy in 30–80-year-old Finnish men: Tampere Ageing Male Urological Study (TAMUS)

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Study Type – Therapy (symptom prevalence)
Level of Evidence 2a

What's known on the subject? and What does the study add?

In several population-based studies the prevalence of hesitancy has varied from 20% to 52%. Studies concern mostly older men ≥50-years-old. Knowledge of troublesomeness that hesitancy causes is very scarce.

This is a large population-based study on hesitancy in men with a wide age range. This study reports the prevalence of hesitancy from 30-year-old men to 80-year-old men. The bother of hesitancy is reported and this is also presented in different age groups.

OBJECTIVE

- To estimate the prevalence and bother of hesitancy by age group.

MATERIALS AND METHODS

- In this population-based study, the target population was 30- to 80-year-old men from Pirkanmaa County, Finland.
- Information was collected by means of a mailed self-administered questionnaire in 2004. The overall participation proportion was 58.7% (4384 men out of 7470).
- The Danish Prostatic Symptom Score (DAN-PSS-1) questionnaire was used to evaluate urinary symptoms, particularly hesitancy. Logistic regression was used for multivariate analysis.

RESULTS

- Almost half of the men (46.8%, 95% CI 45.3–48.3%) reported hesitancy at least

occasionally, but only 0.5% (95% CI 0.3–0.7%) had hesitancy every time they urinated. The prevalence of any hesitancy was 42.3% at 30 years and 50.5% at 80 years of age (trend $P < 0.001$). Only a few men reported hesitancy often or always, prevalence increasing with age from 2.6% to 11.4% (trend $P < 0.001$).

- Hesitancy caused a small problem for 18.3% of the men and a moderate or major problem for 0.9–5.3%. Only 3% of the men with infrequent hesitancy reported more than a small problem, whereas 59% of the men with hesitancy often or always reported a small problem and 32% reported a moderate or major problem.
- Two other voiding symptoms, straining and weak stream, were strongly associated

with hesitancy (with odds ratios exceeding 80).

CONCLUSIONS

- Mild hesitancy is very common in men of all ages.
- Severe cases are rare, but the prevalence increases with age.
- Hesitancy is a well-tolerated urinary symptom.

KEYWORDS

epidemiology, hesitancy, prevalence, urinary tract physiological processes

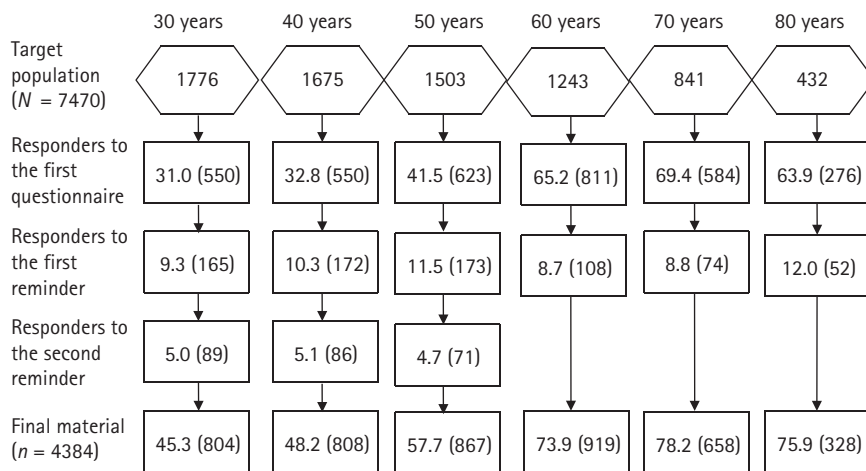
INTRODUCTION

Hesitancy is a common urinary symptom classified in the subgroup of voiding symptoms of LUTS. Hesitancy refers to difficulty in initiating micturition resulting in a delay in the onset of voiding after the individual is ready to pass urine [1]. The prevalence and severity of LUTS increase with age in both men and women [2–4]. Traditionally,

all male LUTS have been thought to reflect mainly prostatic disorders, especially benign prostatic enlargement. However, epidemiological studies have shown that LUTS are a combination of storage, voiding and postmicturition symptoms that tend to increase with age, occur in a comparable fashion among both men and women and are related to several organs and physiological processes [5]. An important feature may

be structural and functional changes in the aging bladder leading to detrusor overactivity [6]. Hesitancy is believed to be one of the earliest symptoms of bladder outlet obstruction, which can be caused by enlargement of the prostate or dysfunction in the synchronous function of the bladder and sphincter [7]. Psychological and emotional aspects can also influence the perception and reporting of hesitancy [8].

FIG. 1. Flow chart illustrating responders in different questionnaire rounds.



Few studies have assessed the prevalence of hesitancy in populations covering wide age groups of both sexes [9–12]. In population-based studies the prevalence of hesitancy has varied from 20 to 52%. Especially, in young and middle-aged men, studies on hesitancy are scarce and its burden in terms of frequency or troublesomeness is not known. In the third round of the Tampere Ageing Male Urological Study (TAMUS) we expanded the target population into younger men in their third and fourth decades. With this cross-sectional study of the men aged from 30 to 80 years, we were able to estimate the prevalence and bother of hesitancy and their relation to age.

MATERIALS AND METHODS

This study is a part of the population-based TAMUS project. Details of the earlier study rounds have been described elsewhere [12,13]. The material for this study was collected in 2004. The target population lived in Tampere and 11 small rural municipalities surrounding the city of Tampere in Pirkanmaa County, Finland. The population of Tampere was 203 000 in 2004 and about 80% of the target population lived in Tampere.

The original study population of TAMUS in 1994 included all the men born in 1924, 1934 and 1944 living in the study area at the beginning of the study. The men were identified from the Population Register Centre. Over the years the original study population has naturally diminished and

aged and at the time of the study they were aged 60, 70 and 80 years. The first questionnaire for this survey was mailed in April 2004 to 2510 men and a reminder questionnaire was sent 3 months later to men who had not responded to the initial one. The final response proportion was 76%. Detailed information about the study population and flow is shown in Fig. 1.

In the 2004 TAMUS survey, new cohorts of men born in 1974, 1964 and 1954 were recruited. Inclusion criteria and study protocol were identical to that used with the older population. The participation percentage was lower in younger than in older men. In all, 1723 of the 4954 men in these age groups returned the first questionnaire in April 2004 and a reminder questionnaire was sent at the same time as to the original TAMUS men. The second reminder questionnaire was sent subsequently and a final response proportion of 50% was achieved (Fig. 1). In all the questionnaire rounds, the data collection was closed and data were recorded 2 months after the mailing.

Information was collected by means of a mailed self-administered questionnaire. A personally addressed letter including a covering letter, study questionnaire and prepaid return envelope was sent to the study subjects. Background data were collected on occupation, marital status, overall health status and illnesses, medication use and history of medical examinations and operations.

The Danish Prostatic Symptom Score (DAN-PSS-1) questionnaire was used to evaluate urinary symptoms. The questionnaire was translated to Finnish and validated by back-translation. Men were instructed to use the past month as a time frame when evaluating their urinary symptoms. The question concerning the prevalence of hesitancy was 'Do you have to wait for urination to start?', with response alternatives No/Rarely/Often/Always. The bother of the symptom was evaluated by the question 'If you have to wait to start urination, is this a problem for you?', with response options No problem/Small problem/Moderate problem/Major problem. During data entry, if two alternatives were chosen instead of one for the DAN-PSS-1 questions, the worst option was recorded.

For the analysis, men reporting hesitancy often and always were combined in some analyses, because of the small number of men with frequent hesitancy in all age groups.

The Statistical Package for the Social Science (SPSS) version 17.0 (SPSS Inc., Chicago, IL, USA) and STATXACT version 4 (Cytel Software Corporation, Cambridge, MA, USA) were used in the data analysis. The two-sided chi-squared test was used to assess differences in prevalence and bother by age group. For relation between ordinal variables, a linear-by-linear test was used. Correlation between frequency and bother of hesitancy was evaluated using Kendall tau-b. Kendall tau-b tests the strength of association of the cross-tabulations when both variables are measured at the ordinal level. Values range from -1 to $+1$ (corresponding to perfect negative to positive association) and a value of zero indicates the absence of association. Also the Kappa coefficient was calculated, indicating agreement beyond chance, with $+1$ indicating perfect agreement and 0 indicating consistency similar to that expected based on chance alone. For all tests, a critical value for significance was set to 5%.

Logistic regression was used to evaluate the relationship between hesitancy and other symptoms of LUTS. Hesitancy was divided into two categories, none or rare and often or always. Other symptoms were divided into three categories no, mild, and moderate or strong. Comparison

was made with and without age as a covariate.

The study protocol was approved by the Tampere University Hospital Committee of Research Ethics (tracking number #99050).

RESULTS

The overall participation was 58.7% (4384 out of 7470). The youngest men had lowest participation (45.3%) and in the oldest groups the response proportion exceeded 75% (Fig. 1).

Level of education was higher among younger men (Table 1). Older men more frequently reported worsening of health during the past 5 years and also chronic diseases (such as diabetes and elevated blood pressure), as well as surgical operations (e.g. transurethral resection of prostate).

There were no major differences in demographic characteristics between the three answering rounds among age groups.

Of all the men, 46.8% (95% 45.3–48.3%) reported hesitancy at least rarely (Table 2). Only a minor fraction of the men reported hesitancy often or always (2.6% in the youngest and 11.4% in the oldest, $P < 0.001$). Very few men (0.5%) had hesitancy every time they urinated. Only 2.3% of the 80-year-old men always had hesitancy and the proportion was 0.5% or less in the other age groups.

Hesitancy caused minor bother to 18.3% (95% CI 17.1–19.5%) of the men in our study population (Table 3). Only 0.9–5.3% of men in different age groups had a moderate or major problem as the result of hesitancy. Bother of hesitancy increased with age ($P < 0.001$). Of the men aged 80 years 1.7% indicated a major problem with prevalence about half of that at age 70 years and below 1% also in younger age groups.

The frequency and bother of hesitancy were statistically significantly associated (Kendall tau-b 0.59, $P < 0.001$ and Kappa 0.41, $P < 0.001$, Table 4). Men who reported experiencing hesitancy rarely, indicated no bother at all (61.4%) or only minor bother (36.8%). Of the men with hesitancy often or always, more than half (58.8%) reported a

TABLE 1 Prevalence (%) of some demographic characteristics in the 2004 TAMUS study population

Characteristic	Age (years)					
	30	40	50	60	70	80
Marital status, $P < 0.001$						
Married or cohabiting	69	71	71	77	78	70
Bachelor, divorced or widower	31	29	29	23	22	30
Education, $P < 0.001$						
Elementary school	4	9	18	31	49	56
Intermediate stage	34	47	41	40	32	24
College	22	25	24	18	12	9
University	40	19	17	11	7	11
Occupational status, $P < 0.001$						
White-collar worker	50	38	34	19	0	0
Blue-collar worker	37	40	41	23	1	1
Self-employed	5	10	10	5	1	0
Unemployed	6	9	9	11	0	0
Retired	1	3	6	42	98	99
Student	1	0	0	0	0	0
Change in overall health in the past 5 years, $P < 0.001$						
Worse	19	30	41	51	60	74
Same	72	61	53	43	35	23
Better	9	9	6	6	5	3
Previously diagnosed medical conditions and surgical procedures						
Depression	9	10	10	10	7	5
Diabetes	1	2	4	10	14	14
Elevated blood pressure	5	17	28	40	48	39
Coronary arterial disease	0	0	2	7	21	27
Surgery for BPH	0	0	0	1	6	13
Radical prostatectomy	0	0	0	1	2	2

BPH, benign prostatic hyperplasia.

TABLE 2 Prevalence of hesitancy by age

Age (years)	Frequency of hesitancy, % (n)			Total	No. missing
	No	Rarely	Often or Always		
30	57.7 (462)	39.7 (318)	2.6 (21)	(801)	3
40	59.2 (474)	36.4 (291)	4.4 (35)	(800)	8
50	56.2 (486)	39.5 (341)	4.3 (37)	(864)	3
60	47.3 (429)	46.0 (418)	6.7 (61)	(908)	11
70	46.1 (292)	44.0 (279)	9.9 (63)	(634)	24
80	49.5 (148)	39.1 (117)	11.4 (34)	(299)	29
Total	53.2 (2291)	41.0 (1764)	5.8 (251)	(4306)	78

$P < 0.001$, Linear-by-Linear Association test

small problem and a third (32.0%) reported a moderate or major problem. Of the small group of men with hesitancy always (23 subjects), a third (34.8%) experienced major problems, a quarter (26.1%) moderate problems and a third (34.8%) small problems. When age groups were

separately investigated, the association between frequency and bother increased in a linear fashion with age from 0.46 in 30-year-olds to 0.68 in 80-year-old men.

Logistic regression analysis showed a very strong association between hesitancy and

TABLE 3 Bother of hesitancy by age

Age (years)	Bother of hesitancy, % (n)			Total	No. missing
	No problem	Small problem	Moderate or major problem		
30	87.9 (699)	10.7 (85)	1.4 (11)	(795)	9
40	84.8 (666)	14.3 (112)	0.9 (7)	(785)	23
50	82.1 (698)	15.5 (132)	2.4 (20)	(850)	17
60	74.0 (665)	23.0 (207)	3.0 (27)	(899)	20
70	68.8 (432)	26.4 (166)	4.8 (30)	(628)	30
80	68.9 (206)	25.8 (77)	5.3 (16)	(299)	29
Total	79.1 (3366)	18.3 (779)	2.6 (111)	(4256)	128

$P < 0.001$, Linear-by-Linear Association test.

TABLE 4 Relation between frequency and bother of hesitancy

Bother	Hesitancy			Total no. men
	Never	Rarely	Often or Always	
No problem	2291	1049	23	3363
Small problem	0	628	147	775
Moderate or Major problem	0	31	80	111
Total no. men	2291	1708	250	4249

Kendall tau-b = 0.59, $P < 0.001$; Kappa 0.41, $P < 0.001$.

straining, unadjusted odds ratio (OR) 91.5 (95% CI 57.2–146.1) and age-adjusted OR 83.2 (95% CI 51.8–133.6) for moderate or strong straining. Also weak stream had a very strong association with hesitancy, unadjusted OR 82.5 (95% CI 45.8–148.6) and age-adjusted OR 93.7 (95% CI 50.2–174.8) for moderate or severe weak stream. A feeling of incomplete emptying also had a clear association with hesitancy, although not as strong as straining and weak stream, unadjusted OR 19.5 (95% CI 13.4–28.5) and age-adjusted OR 17.1 (95% CI 11.5–25.4).

DISCUSSION

We evaluated the occurrence of hesitancy in a population-based study of the male population covering men aged from 30 to 80 years. Mild hesitancy was very common in all ages. Severe cases were rare, but the prevalence strongly increased with age. Hesitancy caused only a relatively minor bother for most affected men.

To our knowledge no similar studies specifically concerning hesitancy have been

published previously. This population-based study was designed to provide accurate and generalizable estimates of occurrence of hesitancy. Information was collected by means of a mailed self-administered questionnaire that should be less prone to bias than, for example, web-based surveys [14]. The target population covered all men in the target ages in the study area and we achieved a good response rate compared with earlier population-based surveys. Older Finnish men traditionally answer questionnaire surveys conscientiously, but younger men are less willing to participate [15,16]. Therefore we used two reminders for the younger age groups (30- to 50-year-old) and managed to attain an overall participation proportion of 45% or higher also for the younger men.

No major differences were found between the three answering rounds among the age groups 30–50 years. The older men had only two answering rounds and only 12% of the responses were obtained by reminder, so it is not surprising that no major differences were found between rounds among older men. Although we have no information about men who did

not answer the questionnaire, the lack of difference between answering rounds (in for instance mean DAN-PSS scores) indicates that major selection bias is unlikely and our results are likely to represent the whole population.

This is a large population-based study on hesitancy in men with a wide age range. Mild symptoms were common in younger men, suggesting that hesitancy is probably not a prostate-related problem. Men with neurological dysfunction, spinal cord trauma for example, have an increased prevalence of hesitancy and other LUTS. Videourodynamic studies in younger men have shown that primary vesical neck obstruction, obstruction localized to the membranous urethra (pseudodyssynergy), impaired bladder contractility or acontractile bladder can cause voiding symptoms [17,18]. Detrusor overactivity is also a common finding in men with LUTS, but most commonly causes urgency not hesitancy [19,20]. A previous study showed a positive correlation between hesitancy and detrusor bladder neck dyssynergy [21]. Seldom experienced hesitancy could also be caused by an over-expanded bladder that does not contract properly when urination starts. Several psychological aspects have also been related to hesitancy [8].

More severe hesitancy increases with age. Older men have more illnesses (neurological diseases for example) and worse overall health and hesitancy may have more complex and multidimensional aetiology among them than in younger men [22]. Benign prostatic enlargement is a well-known cause of urinary symptoms in older men [23]. Benign prostatic enlargement may cause additional pathological changes in the bladder neck, which leads to more severe symptoms in older men. Most degenerative conditions increase with age, which could also explain why hesitancy is more severe in older men. Detrusor underactivity may also contribute to this. Mild symptoms were constant across different age groups and may therefore reflect different pathological changes.

Hesitancy has a strong association with two other voiding symptoms. Straining and weak stream are closely related to hesitancy. A feeling of incomplete emptying was also associated with hesitancy, although much more weakly than the previous two

symptoms. This finding could also indicate that hesitancy has a shared aetiology or pathophysiology with these symptoms.

One out of five men reported at least a small problem with hesitancy, and more severe interference was experienced by one in 20 of the oldest men and fewer in the younger age groups. Hesitancy does not appear to be among the most bothersome problems in LUTS. As the frequency of hesitancy increases the bother also increases.

Minor hesitancy affects more than 40% of men in all age groups. Severe cases are much less frequent with prevalence increasing from 2.6% at age of 30 years to 11.4% among men of 80 years. Hesitancy is a relatively well-tolerated urinary symptom.

ACKNOWLEDGEMENTS

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CONFLICT OF INTEREST

None declared.

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Abbreviations: TAMUS, Tampere Ageing Male Urological Study; DAN-PSS-1, Danish Prostatic Symptom Score; OR, odds ratio.

ORIGINAL ARTICLE

Prevalence and bother of postmicturition dribble in Finnish men aged 30–80 years: Tampere Ageing Male Urologic Study (TAMUS)

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Abstract

Objective. The aim of this study was to determine the prevalence and bother of postmicturition dribble in relation to age in the male population. **Material and methods.** Information for a population-based study was collected by means of a mailed self-administered questionnaire, which was returned by 4384 men out of 7470 (58.7%). The participants were men aged 30–80 years from the Pirkanmaa Region in Finland. The Danish Prostatic Symptom Score (DAN-PSS-1) questionnaire was used to evaluate their urinary symptoms. SPSS was used in the data analysis. Two-sided chi-squared test and Kendall tau-b test were used for analysis. **Results.** The overall prevalence of postmicturition dribble was 58.1% (95% confidence interval 56.6–59.6). Prevalence of postmicturition dribble increased with age ($p < 0.001$). In men aged 60–80 years, two-thirds reported postmicturition dribble and approximately one out of four had dribbling into their trousers after voiding. In the 30-year-old group, over 40% reported postmicturition dribble and almost one out of five had also dribbling into their trousers. One out of five men in the 30-year-old group reported minor bother; the proportion of men reporting bother increased with age to one-third of the men in the oldest cohort ($p < 0.001$). **Conclusions.** The prevalence of the postmicturition dribble was found to be high in this survey. Half of the 30-year-old men and two-thirds of the men aged 60–80 years had postmicturition dribble. Dribbling into trousers increased with age but as a severe symptom, it was rare (0.5%). Minor problems from postmicturition dribble were common, but major bother occurred seldom (1.1%).

Key Words: bother, epidemiology, lower urinary tract symptoms, postmicturition dribble, prevalence.

Introduction

Postmicturition dribble is a term used for the symptom of experiencing involuntary loss of urine immediately after a person has finished passing urine, usually after leaving the toilet in men, or after rising from the toilet seat in women [1]. Postmicturition dribble is classified as a postmicturition symptom in the standardization of terminology of lower urinary tract symptoms (LUTS) by the International Continence Society (ICS). Postmicturition symptoms, which are experienced immediately after micturition, consist of the feeling of incomplete emptying and postmicturition dribble. Previously, for a long time, all male LUTS were

considered associated only with prostatic pathology, especially benign prostatic hyperplasia. Later epidemiological studies have demonstrated that LUTS are a progressive, age-related, non-gender-specific and non-organ-specific combination of storage, voiding and postmicturition symptoms, with both men and women experiencing them [2]. Studies clearly show that the prevalence and severity of LUTS increase with age in both men and women [3–6].

Postmicturition dribble can be a very embarrassing and stressful condition. However, it is a condition that in many cases can be treated. Earlier studies suggested that one cause of postmicturition dribble is a failure of the bulbocavernosus muscle to perform a normal reflex

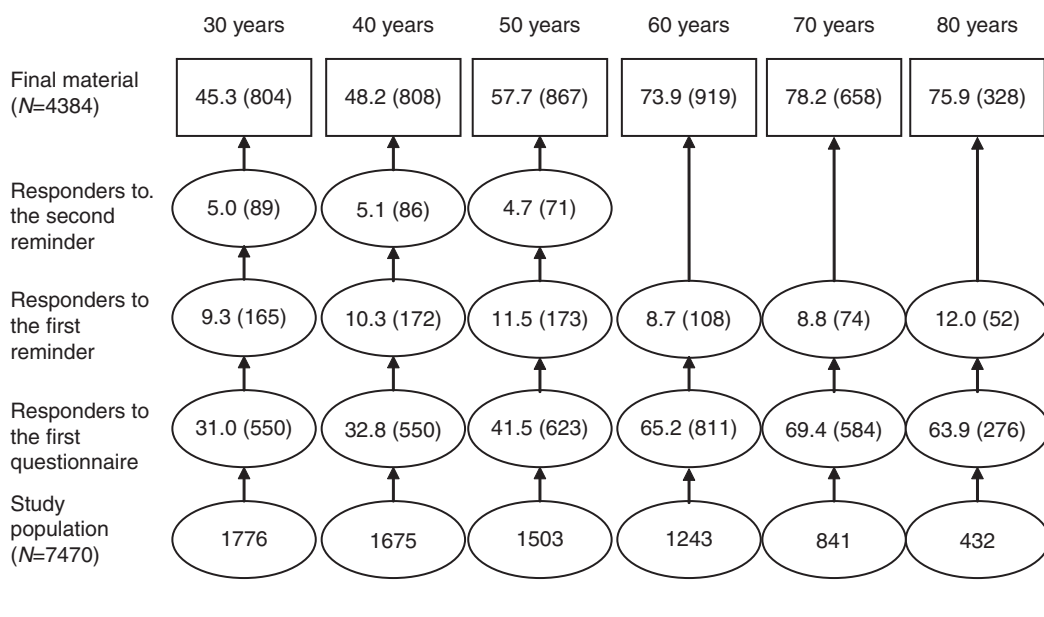


Figure 1. Flowchart illustrating responders in different questionnaire rounds.

postvoid milking mechanism, which results in a failure to evacuate urine that has pooled and become trapped in the bulbar area of the urethra after voiding [7]. However, it is also stated that postmicturition dribble is associated with enlarged prostate [8]. Treatments for postmicturition dribble are bulbar urethral massage and pelvic floor muscle exercises [9]. Men with a diagnosed urethral stricture, prostate enlargement or congenital diverticulum who have postmicturition dribble may benefit from surgery [9].

Some studies have previously documented the prevalence of postmicturition dribble. A Swedish study in 1997 used a postal questionnaire and the study population was over 10 000 men aged 45–90 years. The survey found that dribble was encountered in almost 30% of all men irrespective of age and that only a minor tendency towards an increase with age was reported [10]. Another postal questionnaire survey was performed by the Tampere Ageing Male Urologic Study (TAMUS) group. In 1994, over 3000 men aged 50–70 years responded and the overall prevalence of postmicturition dribble was 63%. Forty-eight per cent of the men had a mild symptom and 15% a moderate or severe symptom [11]. Five years later in the same study population the prevalence of postmicturition dribble was almost the same at 64% and it seemed that the symptom probably appeared in early middle age and then remained fairly constant, resulting in a high, unchanging prevalence in the study population [12]. The internet-based EpiLUTS study indicated an overall prevalence of 46% [4]. In the EPIC study, which used computer-assisted telephone

interviews, the prevalence of postmicturition dribble was very low, only 5.5% overall [6]. The recent BACH study indicated that postmicturition symptoms (a feeling of incomplete emptying and postmicturition dribble) had an overall prevalence of 11.8% and that the prevalence increased after the age of 50 years [13].

The present study looked at the prevalence and bother of postmicturition dribble in a randomly selected population based on 30–80-year-old male cohorts. A postal questionnaire was used to collect the data because it causes less bias than other methods such as telephone, internet or personal interviews. The width of the study population age scale probably gives valid information on the effect of aging on the prevalence and bother of postmicturition dribble.

Material and methods

This study is a part of the population-based TAMUS survey. Details of the earlier study rounds have been described elsewhere [11,14]. This study was conducted in the year 2004 and the study population was the same as in the earlier TAMUS survey, including all the men in the study cohorts living in the city of Tampere or the 11 rural municipalities in the Pirkanmaa Region, Finland. In 2004, Tampere was the fourth biggest city in Finland, with a population of 203 000.

The study population of the 2004 survey included the original TAMUS population born in the years 1924, 1934 and 1944. Over the years these cohorts have naturally diminished. To mirror the whole Finnish male population, three younger cohorts, i.e.

Table I. Prevalence (%) of some demographic characteristics in the 2004 TAMUS study population.

Characteristic	Age (years)					
	30	40	50	60	70	80
Marital status						
Married or cohabiting	69	71	71	77	78	70
Bachelor, divorced or widower	31	29	29	23	22	30
Education						
Elementary school	4	9	18	31	49	56
Intermediate stage	34	47	41	40	32	24
College	22	25	24	18	12	9
University	40	19	17	11	7	11
Occupational status						
White-collar worker	50	38	34	19	0	0
Blue-collar worker	37	40	41	23	1	1
Self-employed	5	10	10	5	1	0
Unemployed	6	9	9	11	0	0
Retired	1	3	6	42	98	99
Student	1	0	0	0	0	0
Previously diagnosed medical conditions and surgical procedures						
Depression	9	10	10	10	7	5
Diabetes	1	2	4	10	14	14
Elevated blood pressure	5	17	28	40	48	39
Coronary arterial disease	0	0	2	7	21	27
Surgery for benign prostatic hyperplasia	0	0	0	1	6	13
Radical prostatectomy	0	0	0	1	2	2

men born in 1954, 1964 and 1974, were added to the survey. The final study population consisted of 7470 men. Approximately 80% of the study population, as well as the men who returned the questionnaire, lived in Tampere. The men were identified using the services of the Population Register Center.

The first survey round was made in April 2004. Detailed information on the participation in the survey rounds is shown in Figure 1. Details about the 2004 TAMUS survey were published earlier [15]. Postmicturition dribble was evaluated using the Danish Prostatic Symptom Score (DAN-PSS-1) questionnaire. The question concerning the prevalence of postmicturition dribble was: "Do you experience dribbling after voiding, when you feel you have finished urination?" There were four response alternatives: Never, In the toilet, Small amounts into the trousers, Large amounts into the trousers. The bother of postmicturition dribble was evaluated by the question: "If you experience dribbling after voiding, is this a problem to you?" and the response alternatives were: No problem, Small problem, Moderate problem, Major problem.

SPSS (Statistical Package for the Social Sciences) version 17.0 was used in the data analysis. The two-sided chi-squared test was used to assess differences in prevalence and bother by age groups. For the

relation between ordinal variables, a linear-by-linear test was used. The correlation between the frequency and the bother of postmicturition dribble was evaluated using Kendall tau-b, which tests the strength of association of the cross-tabulations when both variables are measured at the ordinal level. The values range from -1 (100% negative association) to $+1$ (100% positive association) and a value of zero indicates the absence of association. For all tests, a critical value for significance was set at 5%.

The study protocol was approved by the Tampere University Hospital committee of research ethics (tracking number #99050).

Results

The overall participation was 58.7% (4384 out of 7470). The youngest cohort (30-year-olds) had the lowest participation (45.3%), while the response rate in the oldest groups exceeded 75% (Figure 1).

There were no major differences in the demographic characteristics between the initial and the reminder rounds when different age groups were compared.

The proportion of married or cohabiting men was almost constant in all age groups. Younger men were

Table II. Prevalence of postmicturition dribble by age.

Age (years)	Prevalence of postmicturition dribble			Total	Missing no.
	No	Yes, in toilet	Yes, in trousers		
30	454 (56.7)	211 (26.3)	136 (17.0)	801 (100)	3
40	372 (46.4)	269 (33.6)	160 (20.0)	801 (100)	7
50	364 (42.3)	319 (37.0)	178 (20.7)	861 (100)	6
60	298 (33.0)	397 (44.0)	207 (23.0)	902 (100)	17
70	211 (33.2)	247 (38.8)	178 (28.0)	636 (100)	22
80	100 (33.7)	117 (39.4)	80 (26.9)	297 (100)	31
Total	1799 (41.9)	1560 (36.3)	939 (21.8)	4298 (100)	86

Data are shown as *n* (%).

$p < 0.001$, Linear-by-Linear Association test.

more educated and were more often white-collar workers than older men. In the older age groups, overall health was more likely to have worsened during the previous 5 years. Chronic illnesses as well as urological interventions were more common with age (Table I).

The overall prevalence of postmicturition dribble was 58.1% (95% CI 56.6–59.6) (Table II). The prevalence of postmicturition dribble increased with age ($p < 0.001$). In men aged 60–80 years, only one-third reported no postmicturition dribble and about one out of four men also had dribbling into their trousers. In the 30-year-old group, 43% reported postmicturition dribble and 17% also had dribbling into their trousers after voiding. Overall, only 0.5% of the men reported a large amount of urine dribble into their trousers. Only a couple of them were from the youngest and middle aged cohorts, but in the groups of men aged 70 and 80 years the prevalence was 1.3% and 2.0%, the absolute number of men being small, however, only eight and six men, respectively.

The bother of postmicturition dribble increased with age ($p < 0.001$). Postmicturition dribble caused minor bother for 22% of the 30-year-old men, while

the proportion increased with age so that one-third of men had minor bother in the oldest age groups (Table III). The prevalence of moderate or major problem also increased with age, from 3.7% in 30-year-old men to 12.5% in 80-year-old men. Overall, 1.1% of the men reported major problems, the most severe bother from postmicturition dribble. In 30-year-old men, 1.0% reported major problems, but with age the percentage decreased until it increased to 2.4% in the 70-year-old men's group. In 80-year-old men, the percentage was 2.0%.

The degree and bother of postmicturition dribble were statistically significantly associated and the Kendall tau-b value for the association was 0.65 ($p < 0.001$) (Table IV). The association was constant in different age groups, with the smallest value being 0.62 in 60-year-old men and the highest value being 0.68 in 70-year-old men.

Discussion

The objective of this study was to determine the prevalence and bother of postmicturition dribble in a randomly selected male study population. The

Table III. Bother of postmicturition dribble by age.

Age (years)	Bother of postmicturition dribble			Total	Missing no.
	No problem	Small problem	Moderate or major problem		
30	599 (74.8)	172 (21.5)	30 (3.7)	801 (100)	3
40	549 (68.5)	216 (27.0)	36 (4.5)	801 (100)	7
50	551 (64.0)	262 (30.4)	48 (5.6)	861 (100)	6
60	506 (56.1)	329 (36.5)	67 (7.4)	902 (100)	17
70	326 (51.3)	234 (36.8)	76 (11.9)	636 (100)	22
80	155 (52.2)	105 (35.3)	37 (12.5)	297 (100)	31
Total	2686 (62.5)	1318 (30.7)	294 (6.8)	4298 (100)	86

Data are shown as *n* (%).

$p < 0.001$, Linear-by-Linear Association test.

Table IV. Relation of degree and bother in postmicturition dribble.

Bother	Degree of postmicturition dribble (no. of men)			Total
	No	Yes, in toilet	Yes, in trousers	
No problem	1799	718	169	2686
Small problem	0	779	539	1318
Moderate or major problem	0	63	231	294
Total	1799	1560	939	4298

Kendall tau-b = 0.65 ($p < 0.001$).

overall prevalence was high and it increased as the men aged, but after the age of 60, the prevalence stayed rather constant, increasing only slightly. Minor bother from postmicturition dribble was very common, while major problems were rare.

There are only a few studies in the literature on postmicturition dribble [4,6,10–12]. These studies have focused on the prevalence of the symptom in cross-sectional surveys and the effects of the symptom on quality of life have been less well documented. Earlier studies have mostly concentrated on elderly cohorts. In the present study, population-based survey was performed and the target population included all the men of chosen ages living in the target area. This is possible because of the well-functioning population register in Finland. A mailed self-administered questionnaire was used as it is a well-accepted method of data collection in this society and probably causes less bias than many other methods such as telephone or web-based interviews [16]. A clear limitation in this study was the rather low response rate in the younger cohorts. Younger men are less willing to participate in surveys, but with two reminder mailings an overall participation rate of over 50% in younger men was achieved [17,18]. There were no major differences in the demographic characteristics between the responses for the initial mailing and the remainder rounds, indicating that major selection bias is improbable and the results are likely to represent the whole study population.

The gross prevalence of postmicturition dribble in this study was almost 60%. This is one of the highest numbers in the literature, one cause perhaps being the question of terminal dribble. There is a fine line between terminal dribble and postmicturition dribble and, unfortunately, the DAN-PSS-1 questionnaire cannot detect these two symptoms very well. In the present study, this concerns especially the men who reported the alternative “yes, in the toilet”. Some of these men probably had terminal dribble instead of postmicturition dribble. In the earlier TAMUS investigations, it was presumed that postmicturition dribble started in early middle age and then remained fairly constant, resulting in a high unchanging prevalence in the study population [11,12]. Now,

based on the information gained on the 30–50-year-old cohorts, this hypothesis was strengthened. It may be postulated that postmicturition dribble is surprisingly common and increasing in men in early middle age but, in men over 60 years old, the proportion of men with postmicturition dribble is constant. The tendency for increasing prevalence with increasing age was also found in the Swedish study [10].

A quarter of the men in their thirties and forties and half of the men in their seventies and eighties suffered from dribble at least in small amounts. However, major bother was rare. A clear statistical relation was found between worsening postmicturition dribble and the bother it causes. Postvoid dribble into the trousers clearly caused more bother than milder dribble. This finding is in line with earlier studies, which have suggested that postmicturition dribble is one of the most troublesome forms of LUTS [19]. It has also been stated previously that men use various methods (toilet paper, different kind of pads and manipulation of bulbous urethra with a finger) to cope with postmicturition dribble [9]. In this way the men may get used to the symptom, which may lead to reporting less bother for certain symptom levels, which in turn may be seen as a plateau in older men’s bother curve.

As postmicturition dribble is also rather common in younger men, a probable pathophysiological mechanism may be, instead of prostatic enlargement only, a failure of the bulbocavernous muscle to perform a normal postvoid milking reflex, with urine becoming trapped in the bulbar area of the urethra just after voiding. Parallel to this, at least two randomized trials of pelvic floor exercises in postmicturition dribble have found training to be an effective treatment for postmicturition dribble [8,20]. As the prevalence of postmicturition dribble increases and the bother of the symptom grows worse by the age that is known for a period of rapid prostatic growth, the benign prostate enlargement itself, or some mechanisms behind it, can also cause postmicturition dribble. It can be speculated that there may be a simple mechanical connection between an enlarged prostate and postmicturition dribble. Possible mechanisms may be entrapment of urine in the obstructed prostatic

urethra and/or that the enlarged prostate causes additional disturbance to the bulbocavernous muscle function. However, these hypotheses need to be tested thoroughly in further studies.

In conclusion, the prevalence of postmicturition dribble is high and fairly constant. In this study, half of the men in their thirties and two-thirds of the men aged 60–80 years experienced postmicturition dribble. Dribble increases with age but severe cases involving wetting the trousers after voiding are rare. A similar increase with age was found in bother caused by postmicturition dribble, and the relationship of increasing bother with increasing degree of dribble was clear and statistically significant in this study.

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Empirical evaluation of grouping of lower urinary tract symptoms: principal component analysis of Tampere Ageing Male Urological Study data

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What's known on the subject? and What does the study add?

- The ICS has divided LUTS into three groups: storage, voiding and post-micturition symptoms. The classification is based on anatomical, physiological and urodynamic considerations of a theoretical nature. We used principal component analysis (PCA) to determine the inter-correlations of various LUTS, which is a novel approach to research and can strengthen existing knowledge of the phenomenology of LUTS. After we had completed our analyses, another study was published that used a similar approach and results were very similar to those of the present study.
- We evaluated the constellation of LUTS using PCA of the data from a population-based study that included >4000 men. In our analysis, three components emerged from the 12 LUTS: voiding, storage and incontinence components. Our results indicated that incontinence may be separate from the other storage symptoms and post-micturition symptoms should perhaps be regarded as voiding symptoms.

Objective

- To determine how lower urinary tract symptoms (LUTS) relate to each other and assess if the classification proposed by the International Continence Society (ICS) is consistent with empirical findings.

Materials And Methods

- The information on urinary symptoms for this population-based study was collected using a self-administered postal questionnaire in 2004.
- The questionnaire was sent to 7470 men, aged 30–80 years, from Pirkanmaa County (Finland), of whom 4384 (58.7%) returned the questionnaire.
- The Danish Prostatic Symptom Score-1 questionnaire was used to evaluate urinary symptoms. Principal component analysis (PCA) was used to evaluate the inter-correlations among various urinary symptoms.

Results

- The PCA produced a grouping of 12 LUTS into three categories consisting of voiding, storage and incontinence

symptoms. Post-micturition symptoms were related to voiding symptoms, but incontinence symptoms were separate from storage symptoms.

- In the analyses by age group, similar categorization was found at ages 40, 50, 60 and 80 years, but only two groups of symptoms emerged among men aged 70 years. The prevalence among men aged 30 was too low for meaningful analysis.

Conclusions

- This population-based study suggests that LUTS can be divided into three subgroups consisting of voiding, storage and incontinence symptoms based on their inter-correlations.
- Our empirical findings suggest an alternative grouping of LUTS. The potential utility of such an approach requires careful consideration.

Keywords

classification, epidemiology, LUTS, principal component analysis, urology

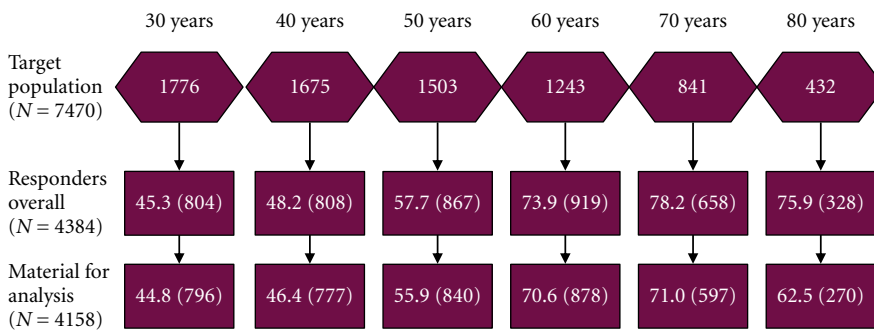


Fig. 1 Flow chart showing responders for analysis.

Introduction

Lower urinary tract symptoms include a wide range of complaints and physiological phenomena. Population-based studies have indicated that LUTS are very common and also affect younger men [1–4]. The ICS has divided LUTS into three groups: storage, voiding and post-micturition symptoms [5]. The classification is based on anatomical, physiological and urodynamic considerations of a theoretical nature. Storage symptoms are experienced during the storage of urine in the bladder, voiding symptoms while passing urine and post-micturition symptoms occur after voiding. Pain symptoms and those associated with sexual intercourse or pelvic organ prolapse are considered separately.

In the present study, we evaluated how well the current ICS classification is corroborated by empirical findings by exploring the inter-relationships among 12 LUTS to determine which symptoms occur together in a population-based study of men aged 30–80 years. We used principal component analysis (PCA) to determine the inter-corelations of various LUTS, which is a novel approach to research and could strengthen the existing knowledge about the phenomenology of LUTS. Recently, after we had completed our analyses, another study was published that used a similar approach and its results were similar to those of the present study [6].

Materials and Methods

The present report is a part of the population-based Tampere Ageing Male Urologic Study (TAMUS) cohort study [7,8]. The first TAMUS survey was conducted in 1994 and the survey has been repeated every 5 years since then. Data for the present study was gathered in 2004.

The original TAMUS study population included men born in 1924, 1934 and 1944. They represented 80, 70 and 60-year-old men in the study. An additional group of men was recruited who were born in 1954, 1964 and 1974 to represent 50-, 40- and 30-year-old men.

The majority of the target population lived in Tampere, which was the third largest city in Finland with a population of 203 000 in 2004. About 20% of the target population lived in 11 small rural municipalities surrounding the city of Tampere in Pirkanmaa County. All men in this area, born in the aforementioned years, were included in the study. The men were identified from the Population Register Centre and invited to enroll in the study.

Self-administered questionnaires were posted in personally addressed letters with a prepaid return envelope enclosed. The first questionnaire was sent in April 2004 to 7464 men. A reminder questionnaire was sent 3 months later and for the younger age groups a second reminder questionnaire was also used. In all rounds, data collection finished and data were recorded 2 months after posting. Detailed participant numbers are shown in Fig. 1.

Background information about men was obtained through the questionnaire and has been published previously in more detail [9,10]. LUTS were evaluated using the Danish Prostatic Symptom Score (DAN-PSS)-1 [11,12]. The score system is based on the severity of 12 LUTS related to storage, voiding and post-micturition symptoms. Three questions related to sexual function were not used in the present study. The severity of each symptom was graded by the respondent on a scale from 0 (no symptoms) to 3 (severe symptoms). The preceding 4-week period was used as the time frame for the questionnaire.

Background information was analysed using a two-sided chi-squared test and a linear-by-linear test. Correlations between LUTS were evaluated using Spearman's rank correlation coefficient (r). A value of zero indicates the absence of association and value 1 corresponds to perfect association. LUTS were evaluated by using PCA. PCA provides a means of reducing the dimensionality of a dataset consisting of a large number of inter-related variables, while retaining as much as possible of the variation present in the dataset. In other words, it can be used to combine nearly the same information as provided

by the original variables by combining them into a small number of new summary vectors. This is achieved by transforming to a new set of variables, the principal components, which are uncorrelated, and ordered so that the first few retain most of the variation present in all of the original variables [13]. We used PCA to divide the 12 LUTS into smaller groups and evaluated which symptoms seemed to relate to each other. For this purpose a covariance or correlation matrix is created and principal components selected that provide both maximum correlation with the original variables and minimum correlation with each other. Various rotation methods are used to simplify data structure. Unlike confirmatory factor analysis, the PCA was entirely data-driven (exploratory), i.e. we imposed no restrictions on the number of summary variables (principal components), nor was any previous hypothesis incorporated into the analysis about which symptoms should be combined together (such as symptoms should represent a meaningful joint entity or set of characteristics i.e. comprehensibility criterion). An eigenvalue >1.0 was used as the criterion to include a summary variable in the analysis, in accordance with conventional procedures in PCA.

The PCA was performed for all men and then for each age group separately. Data were checked and a Kaiser–Meyer–Olkin index of sampling adequacy and a Bartlett test of sphericity were used to evaluate the factorability of the correlation matrix. In all analyses, Bartlett tests gave a P value <0.001 , but it must be borne in mind that the Bartlett test can also give statistically significant results for minor correlations in large samples. Kaiser–Meyer–Olkin test scores were also high (0.876 for the entire dataset and, although they decreased with age, the score was still 0.809 even in the age group of 40 years). Generally it is required that the Kaiser–Meyer–Olkin score should be ≥ 0.60 for the data to be suitable for PCA. Oblimin rotation was used for the analysis. SPSS (Statistical Package for the Social Sciences) version 17.0 was used in the data analysis.

The study protocol was approved by the Tampere University Hospital Committee of Research Ethics (tracking number 99050).

Results

The overall participation rate was 58.7% (4384 returned questionnaires out of 7470). More detailed information about participation is shown in Fig. 1. A total of 226 men did not answer all the 12 questions in DAN-PSS-1 and they were excluded from analysis. Incomplete responses were more common in the older age groups. In total, 4158 men were included in the PCA.

For all individual LUTS, mild symptoms were much more common than moderate or severe symptoms (Fig. 2). Correlations between LUTS are shown in Table 1.

Correlations among different voiding symptoms, including feeling of incomplete emptying, were stronger than among other LUTS, and high correlations were also found among different types of incontinence. Overall correlations among symptoms were weak.

In the PCA for all 4158 men, three summary variables (principal components) were formed as a result of the analysis of inter-correlations among symptoms, and they largely corresponded to entities classifiable as voiding, incontinence and storage symptoms (Table 2). No main component corresponding to post-micturition symptoms emerged, but post-micturition dribble showed a weak correlation with voiding symptoms. The main component corresponding to voiding symptoms showed a strong correlation ($r > 0.8$) with hesitancy and straining, but only a weak (<0.5) correlation to post-micturition dribble. Similarly, the incontinence component had strong correlations with stress and other incontinence symptoms. Urge incontinence was classified with the storage symptoms, but it also had a strong association with incontinence symptoms. Likewise, weak stream and feeling of incomplete emptying were allocated among voiding symptoms, but were also associated with storage symptoms. Overall, the main component related to storage symptoms had the least prominent profile, with moderate to weak correlations with individual symptoms, except in the oldest age group (80 years), among whom the main component that was related to storage symptoms showed good correlations to its components.

In the analyses by age group, the youngest men (30-year-olds) could not be analysed separately because of the failure of the Oblimin rotation to converge owing to low prevalence of LUTS. In the 70-year-old men, only two components were found (voiding component separately and incontinence/storage symptoms combined), while in the other age groups three components emerged similar to the main analysis of all men, containing mainly voiding, storage and incontinence symptoms, respectively (Table 3). Urge incontinence showed loadings with both incontinence and storage components in the age groups 50, 60 and 80 years, similar to the overall analysis. In addition, hesitancy and straining showed the strongest correlations with the voiding component in the age-specific analyses. Likewise, the individual symptoms had only weak-to-moderate correlations with the summary component for storage symptoms in each age group. Post-micturition dribble showed only a weak correlation ($r = 0.3–0.4$) with the voiding component (except in the age group 70 years, where there was a moderate correlation with the combined incontinence/storage component).

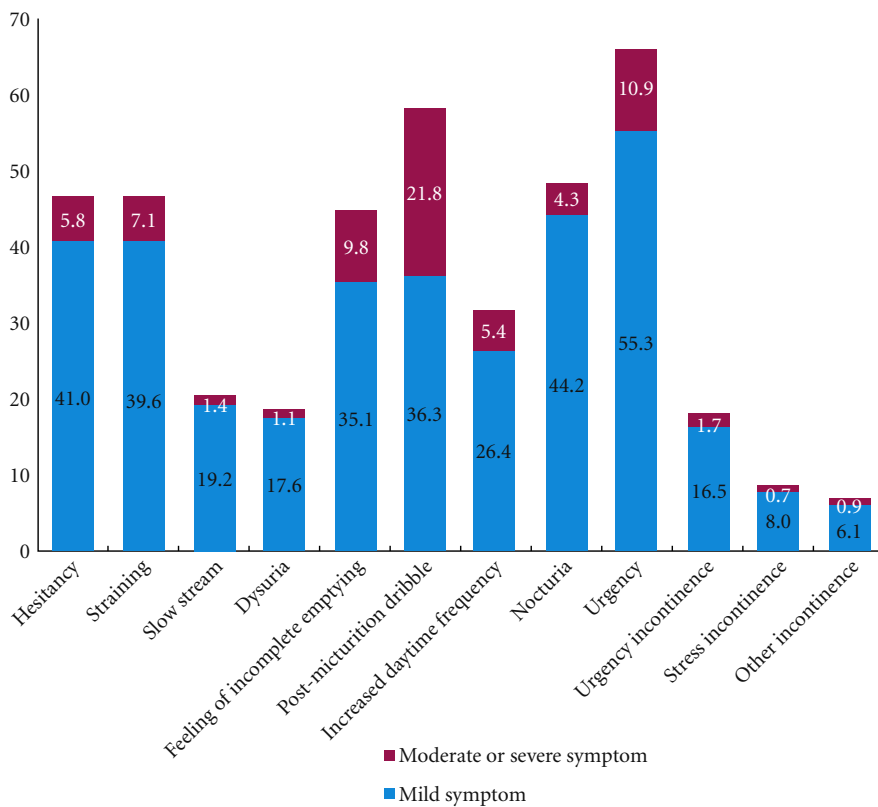


Fig. 2 Prevalence (%) of individual LUTS in the TAMUS 2004 cohort.

Discussion

We evaluated the constellation of LUTS using PCA of the data from a population-based study of >4000 men. In our analysis, three components emerged from the 12 LUTS, namely, voiding, storage and incontinence components. Overall, our findings pointed to a need for some revision of the ICS classification, as the grouping into voiding, storage and post-micturition symptoms were partly, but not entirely consistent with the current taxonomy. Our results indicated that incontinence may be separate from the other storage symptoms and post-micturition symptoms should perhaps be regarded as voiding symptoms.

The PCA results were very similar in all age groups. In the youngest age group (30-year-old men) symptoms were so mild and uncommon that PCA could not be performed. In the 70-year-old men, the analysis resulted in only two components, the incontinence group was linked to the storage component, which in older men is to be expected and in fact incontinence symptoms are storage symptoms in the ICS classification. The oldest group (80-year-old men) was substantially smaller than the other groups, but the classification of symptoms was consistent with the younger men (40- and 50-year-old men). Storage symptoms had a prominent profile in the oldest age group, as expected. Overall, the correlations among LUTS were similar across most age groups, which indicated the validity

of our analysis and the uniform nature of LUTS over a wide age range. Post-micturition symptoms (post-micturition dribble and incomplete emptying) were fused to the voiding component. By contrast, incontinence symptoms (urgency incontinence, stress incontinence and other incontinence) formed a component of their own. Urgency and urgency incontinence were very closely correlated. Urgency incontinence was related to two components (cross-loading) in almost every age group. This is probably because urgency incontinence is firstly an incontinence symptom but also closely associated with urgency and it can be difficult even for patients to distinguish between these two.

Voiding symptoms seemed to correlate with each other and the so-called post-micturition symptoms were included in the voiding symptoms. Storage symptoms formed another main group, but it seemed that incontinence symptoms should be a third class, instead of post-micturition symptoms, if we base the categorization on how these symptoms are related to each other. The ICS symptom taxonomy was conceived on theoretical grounds and lacked an empirical foundation. The present study provides a new perspective on LUTS.

Principal component analysis is a mathematical procedure (based on linear orthogonal transformation) that can be

Table 3 Correlations among symptoms (ICS classification) and principal components in different age groups.

Symptom	40-year-old men			50-year-old men			60-year-old men			70-year-old men			80-year-old men		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Eigenvalue	3.388	1.369	1.202	3.792	1.437	1.184	4.026	1.674	1.009	4.109	1.715	1.009	5.015	1.304	1.018
Voiding symptoms															
Hesitancy	0.807	-0.044	-0.095	0.777	-0.080	0.001	0.904	-0.029	0.180	0.787	-0.125	-0.187	0.917	-0.187	-0.075
Straining	0.777	-0.110	0.063	0.810	-0.085	0.030	0.830	0.023	0.038	0.851	-0.089	-0.007	0.780	-0.007	-0.201
Slow stream	0.684	0.128	-0.220	0.632	0.086	0.094	0.730	-0.126	-0.137	0.620	0.210	0.250	0.619	0.250	0.081
Dysuria*	0.467	0.058	0.101	0.586	0.297	-0.281	0.538	0.087	-0.032	0.365	0.334	0.188	0.580	0.188	0.123
Post-micturition symptoms															
Feeling of incomplete emptying	0.683	-0.022	0.172	0.644	-0.048	0.214	0.614	0.043	-0.193	0.691	0.113	0.707	0.068	0.113	-0.031
Post-micturition dribble	0.409	0.082	0.124	0.402	0.124	0.273	0.296	0.303	-0.166	0.203	0.557	0.380	0.143	0.557	-0.351
Storage symptoms															
Increased daytime frequency	-0.087	0.073	0.748	-0.004	-0.050	0.737	-0.040	-0.028	-0.794	0.127	0.487	0.669	-0.019	0.669	-0.141
Nocturia	0.087	-0.078	0.647	0.225	-0.069	0.495	0.095	-0.095	-0.671	0.192	0.445	0.761	0.023	0.445	0.133
Urgency	0.209	0.067	0.521	0.152	0.122	0.606	0.056	0.108	-0.675	0.218	0.590	0.673	0.084	0.590	-0.102
Urgency incontinence	-0.040	0.600	0.334	-0.137	0.476	0.573	-0.068	0.475	-0.461	-0.074	0.803	0.498	-0.002	0.498	-0.464
Stress incontinence	0.133	0.771	-0.164	0.094	0.829	-0.073	0.001	0.850	0.084	-0.169	0.775	-0.089	0.147	0.775	-0.870
Other incontinence	-0.035	0.816	-0.003	-0.022	0.815	0.089	0.028	0.828	0.008	-0.188	0.776	0.171	-0.068	0.776	-0.818

*Not included in ICS classification.

The DAN-PSS-1 questionnaire used in the present study was slightly different from that used in the EPIC and BACH studies, as the items on terminal dribble and post-micturition dribble were combined into a single question. Our questionnaire also included assessment of dysuria among the voiding symptoms, unlike the ICS symptom categorization [5]. Correlations among individual symptoms were relatively low indicating that none of the 12 items could be replaced.

Finland has a strong history of population-based epidemiological studies, and we not only achieved a high response proportion, but also maintained it over a follow-up period spanning 15 years. A full description of the TAMUS study protocol has been published earlier [7,8]. We used a postal questionnaire, which is less prone to bias in symptom reporting than other methods of data collection [17]. There were no major differences in the symptom prevalence between early and late responders, which indicates that major selection bias is unlikely, but no information was available on non-responders. Non-response would, however, affect our findings only if the pattern between LUTS was strongly different among non-responders than participants.

Our findings suggest that LUTS could be coherently divided into subgroups consisting of voiding, storage and incontinence symptoms. Post-micturition symptoms could be included in the voiding symptoms. Combining various incontinence symptoms into a separate category might draw attention to therapeutic approaches tailored for the group of patients. The findings are consistent with clinical practice, with different diagnostic and treatment options for incontinence symptoms than other LUTS.

In conclusion, in this population-based study, PCA based on correlations among different LUTS was used to construct an empirical classification of urinary symptoms. Three components emerged that largely correspond to voiding, storage and incontinence symptoms. As compared with the ICS classification, post-micturition symptoms were combined with voiding symptoms. Storage symptoms formed one entity, but incontinence symptoms constituted a separate component. The constellation of symptoms was consistent for men aged 40, 50, 60 and 80 years.

Acknowledgements

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Conflict of Interest

None declared.

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Abbreviations: DAN-PSS, Danish Prostatic Symptom Score; ICS, International Continence Society; PCA, principal component analysis; TAMUS, Tampere Ageing Male Urological Study.

Natural Course of Lower Urinary Tract Symptoms in Men Not Requiring Treatment — A 5-Year Longitudinal Population-based Study

Antti Pöyhönen, Jukka T. Häkkinen, Juha Koskimäki, Teuvo L. J. Tammela, and Anssi Auvinen

OBJECTIVE	To evaluate the natural course of lower urinary tract symptoms (LUTS) by quantifying their longitudinal changes.
METHODS	A population-based study of men aged 55, 65, or 75 years in Pirkanmaa region, Finland was conducted with a 5-year follow-up (1999-2004). Mailed self-administered questionnaire with the Danish Prostatic Symptom Score instrument was used to evaluate LUTS. Men with any treatment for LUTS or a history of prostate cancer were excluded.
RESULTS	A total of 1331 men were included in the study. All 12 symptoms exhibited considerable fluctuation over time. Incidence of specific symptoms varied by a factor of 10 and remission by a factor of 4. Overall, common symptoms varied most strongly in terms of incidence and remission, whereas the less common ones such as incontinence behaved in a more stable fashion. Remission was more frequent than incidence for all individual LUTS components. The highest incidence was found for post-micturition symptoms and urgency. Remission was most common in weak stream and least frequent in urgency and urgency incontinence.
CONCLUSION	LUTS are dynamic conditions with strong spontaneous fluctuation over time. Remission was more common than incidence. The strong propensity for spontaneous resolution should also be borne in mind in treatment decisions including prescription practices. UROLOGY 83: 411–415, 2014. © 2014 Elsevier Inc.

Lower urinary tract symptoms (LUTS) are highly prevalent conditions in all populations, and the number of affected individuals is projected to increase with aging populations.¹ Numerous studies have reported widely varying estimates of the prevalence of LUTS.²⁻⁵ The wide variations might be partly attributable to differences in study protocols and characteristics of study populations. Furthermore, some variation in symptom prevalence might be because of temporary recovery of underlying pathologic processes such as prostatitis/pelvic pain syndrome spontaneously or because of changes in lifestyle or environmental factors.

Symptoms in benign prostate hyperplasia (BPH) probably vary also, especially in the early phase.⁶ Such spontaneous recuperation in symptom intensity is reflected in fluctuation of prevalence of LUTS in longitudinal studies.⁷

For better understanding of the etiology and pathogenesis of LUTS, natural history of symptoms in the absence of treatment should be characterized. This requires longitudinal studies with data on symptom incidence, as it cannot be evaluated in cross-sectional studies. Few representative follow-up studies with low attrition have been conducted, which is an impediment to comprehension of the natural history of LUTS.⁸⁻¹³

In clinical practice, medical treatment for LUTS is widely used. Men complaining of symptomatic uncomplicated BPH or bladder overactivity are usually treated with oral medication. Long-term medical treatment for LUTS is a therapeutic mainstay. Understanding the natural course of the symptoms is needed to assess treatment response and define appropriate indications for LUTS medication, to avoid over- and under-treatment.

The aim of the study was to provide quantitative estimates of the natural course of LUTS in terms

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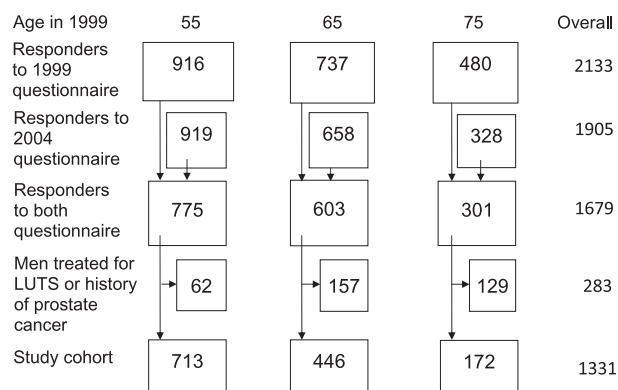


Figure 1. Flow chart illustrating formation of the study cohort.

of incidence (*de novo* occurrence) and recovery over a 5-year period in Tampere Ageing Male Urologic Study (TAMUS) cohort with men aged 55, 65, and 75 years at baseline.

MATERIALS AND METHODS

This analysis was conducted within the population-based TAMUS cohort study. In 1999 and 2004, the questionnaire was sent to the men, who were born during selected years (1924, 1934, and 1944) and residing in Tampere or 11 surrounding rural municipalities in Pirkanmaa region at the beginning of 1994 (when first TAMUS questionnaire was sent). Men were identified through the Population Register Centre in January 1999 and 2004.

A questionnaire with a covering letter and a prepaid returning envelope was mailed to all the men in the study population in both questionnaire rounds.¹⁴⁻¹⁷ Nonresponders were reminded with a second mailing after 3 months. For this longitudinal analysis, we included only those men who completed both surveys (Fig. 1). LUTS were evaluated by the means of Danish Prostatic Symptom Score (DAN-PSS-1).¹⁸ Information was also collected on sociodemographic factors and medical and surgical history, including medications. Medications were reported with commercial names but converted into anatomical therapeutic chemical classification codes. All the men reporting a history of prostatic cancer or surgical or medical treatment for BPH or LUTS in either questionnaire were excluded from the study. The 4-week period preceding the completion of the questionnaire was used as the time frame for evaluating symptoms. The 4 response options of the DAN-PSS-1 questionnaire for each symptom were recoded into a binary variable: no symptom (no or mild symptom) or clinically relevant symptom (moderate or severe symptom). Changes in each man's individual responses between the 1999 and 2004 surveys were compared. Men who responded no symptom (score 0) and mild symptom (score 1) were included to no clinical symptom group, and moderate (score 2) and severe symptom (score 3) were included to clinically significant symptom group. New symptom was found if score 0 or 1 was changed to 2 or 3. Remission vice versa, as high scores 2 or 3 was changed to 0 or 1. Persistent symptoms meant that symptom score was 2 or 3 in both questionnaires.

Changes in LUTS during the 5-year follow-up were coded into 4 categories: remained asymptomatic, new (incident) symptom,

remission of previous symptom, and persistent symptom. Incidence and remission rates of the symptoms during the follow-up were calculated as the ratio of the frequencies of events (transitions during the follow-up from symptomatic to asymptomatic state and vice versa) to number of men, that is, incidence as the number of initially asymptomatic men who became symptomatic relative to all asymptomatic men at baseline, and recovery as the proportion of symptomatic men at entry who became asymptomatic.

Exact 95% confidence intervals for incidence and recovery probability were estimated assuming that the numbers of events followed a binomial distribution using JavaStat.

The study protocol was reviewed by the Tampere University Hospital Committee of Research Ethics (tracking number 99050).

RESULTS

Altogether, 2133 men responded to the 1999 survey and 1905 men to the 2004 survey corresponding to participations of 68% and 76%, respectively. There were no major differences in sociodemographic indicators between men responding the first mailing and those returning their forms after a reminder. Only those 1679 men, who completed both questionnaires, were included in the analysis and after exclusions because of missing responses, the final sample consisted of 1331 men (Fig. 1).

The proportions of symptomatic men whose symptom resolved during the follow-up ranged 22%-89% for various LUTS, and of the initially asymptomatic men, 1%-13% reported a new-onset symptom for a specific type of LUTS after 5 years (Table 1). Resolution of existing symptoms was more common than occurrence of new symptoms for all LUTS. The lowest incidence (1-2 new cases per 100 men) was found for all types of incontinence and dysuria and weak stream. Incidence was highest (10-13 cases per 100 men) for post-micturition symptoms and urgency. When symptoms were examined between different age groups, incidence and recovery were rather similar, as men got older also incidence rose, but also recovery was more common (Table 2). One exception seemed to be nocturia, as in the oldest age group incidence was high, but recovery was low.

Of the men with voiding symptoms at baseline, roughly half recovered during the 5-year follow-up, that is, remission was as frequent as persistence (with the exception of very high remission in weak stream based on only 9 symptomatic men at baseline). Of the voiding symptoms, hesitancy and straining exhibited a similar pattern with remission approximately 50 per 100 men and incidence approximately 5 per 100 men.

Of the storage symptoms, urgency had the highest incidence 10 per 100 men. Increased daytime frequency and nocturia had similar incidence (5 per 100 men) and comparable remission (20-30 per 100), whereas urge incontinence and other incontinence showed both low incidence and low remission (although the latter were based on small number of affected men).

At the beginning of follow-up, 1.2%, 4.8%, and 9.2% of the men had medication for LUTS, further 0.3%,

Table 1. Changes of lower urinary tract symptoms in 5-year follow-up, Tampere Ageing Male Urologic Study 1999-2004

Symptoms	Men Asymptomatic at Baseline		Men With Symptom at Baseline		No. of Men
	Remained Asymptomatic	Symptom Incidence, % (95% CI)	Remained Symptomatic	Symptom Recovery, % (95% CI)	
Post-micturition symptoms					
Feeling of incomplete emptying	1070/1197	11 (9-12)	47/78	40 (29-51)	1275
Post-micturition dribble	854/977	13 (11-15)	165/288	43 (37-49)	1265
Voiding symptoms					
Hesitancy	1149/1213	5 (4-7)	32/66	52 (39-64)	1279
Straining	1124/1192	6 (4-7)	39/82	52 (41-64)	1274
Weak stream	1251/1271	2 (1-2)	1/9	89 (52-100)	1280
Dysuria	1246/1261	1 (0.7-2)	4/9	56 (21-86)	1270
Storage symptoms					
Increased daytime frequency	1170/1228	5 (4-6)	29/61	52 (39-65)	1289
Nocturia	1177/1236	5 (4-6)	25/44	43 (28-59)	1280
Urgency	1037/1155	10 (9-12)	86/128	33 (25-42)	1283
Urgency incontinence	1238/1264	2 (1-3)	7/9	22 (3-60)	1273
Stress incontinence	1253/1260	1 (0.2-1)	1/3	67 (9-99)	1263
Other incontinence	1256/1269	1 (0.6-2)	2/6	67 (22-96)	1275

CI, confidence interval.

3.9%, and 11% of the men were operated for LUTS from the youngest (55 years) to the oldest (75 years) age group. Five years later, 4.6%, 11.8%, and 17.2% of men had medication for LUTS, further 1.6%, 7.5%, and 17.2% of men were operated for LUTS. Prostate cancer was diagnosed in 1.4%, 7.3%, and 9.3% of the men in different age groups at the end of the follow-up. All those men were excluded.

COMMENT

We evaluated longitudinal changes in LUTS (transitions between symptomatic and asymptomatic states) during 5-year follow-up in a population-based study of men aged 55-75 years at entry. Of the symptomatic men at baseline, about half remained symptomatic, with the highest persistence (least frequent recovery) in urgency and urgency incontinence. More than 10-fold differences in incidence of various LUTS were found. An inverse relation between incidence and recovery was observed.

The dynamics of LUTS is illustrated by the finding that in 5 years, a similar number of men with symptoms at baseline remained symptomatic and experienced remission, as also found in earlier studies.^{9,12,13} However, the occurrence pattern in terms of incidence and recovery varied across different LUTS. In this cohort of men aged 55-75 years, 2 of the most prevalent voiding symptoms, hesitancy and straining, showed a similar pattern. The remission probabilities of urgency and urgency incontinence were lower than those for other storage symptoms. The prevalence of nocturia is known to be high in older men, so it is not surprising that there was high incidence and low remission concerning nocturia in the oldest age group.

The TAMUS study uses mailed self-administered questionnaires. The rationale was that the participation would probably be low for a web-based questionnaire in an elderly population.^{19,20} Our advantage in Finland is

a well-organized population register system. Using this system we could systematically find study patients in the certain area. Participation rate is one problem of population-based studies; however, in TAMUS survey, we achieved participation rate of about 70%, which is a comparable result. According to these facts, we believe that this is a genuinely representative, generalizable, unbiased population-based study. Nonresponse and missing information can bias study results even in a study with a response proportion well above 50%, if participation is selective. However, no substantial difference between men responding early vs after a reminder was found in symptoms (for instance mean DAN-PSS scores) or sociodemographic factors, indicating that major selection bias was unlikely. In ethnic issue, our study population is a homogenous one containing almost purely Caucasian men.

We divided symptom status into presence and absence of moderate to severe LUTS for the analysis. Such classification appears clinically reasonable, that is, it has face validity. The difference between no symptom at all and mild symptoms is very hard to interpret, and setting the cutoff between none and minor symptoms could cause meaningless fluctuation. The time frame for evaluating LUTS was 1 month, to reduce the effect of transient symptoms.

Men receiving treatment for LUTS before or during the follow-up were excluded from the study. So this study did not include men with the most severe LUTS triggering treatment-seeking. The proportions of men treated for LUTS were 6.7%, 19.7%, and 37.2% from the youngest to the oldest age groups. Men with a history of prostate cancer were also excluded, because treatment for cancer is likely to induce LUTS.

In a previous study, 5700 men were followed up in the USA for 2 years, and a third of the men (mean age 73 years) with no or mild LUTS developed clinically significant LUTS.¹¹ In Japan, a 3-year follow-up of 223

Table 2. Changes of lower urinary tract symptoms in 5-year follow-up

Symptoms	Remained Asymptomatic	Symptom Incidence	Remained Symptomatic	Symptom Recovery	No
55-year-old men					
Feeling of incomplete emptying	615 (88.1)	54 (7.8)	15 (2.1)	14 (2.0)	698
Post-micturition dribble	464 (66.8)	66 (9.5)	93 (13.4)	72 (10.3)	695
Hesitancy	645 (92.1)	29 (4.1)	13 (1.9)	13 (1.9)	700
Straining	633 (90.7)	33 (4.7)	15 (2.2)	17 (2.4)	698
Weak stream	686 (98.4)	6 (0.9)	1 (0.1)	4 (0.6)	697
Dysuria	686 (98.6)	6 (0.9)	1 (0.1)	3 (0.4)	696
Increased daytime frequency	640 (91.3)	23 (3.3)	16 (2.3)	22 (3.1)	701
Nocturia	669 (95.5)	20 (2.9)	5 (0.7)	6 (0.9)	700
Urgency	590 (84.3)	51 (7.3)	38 (5.4)	21 (3.0)	700
Urgency incontinence	686 (98.4)	7 (1.0)	4 (0.6)	0 (0)	697
Stress incontinence	689 (99.6)	2 (0.3)	0 (0)	1 (0.1)	692
Other incontinence	693 (99.6)	2 (0.3)	0 (0)	1 (0.1)	696
65-year-old men					
Feeling of incomplete emptying	338 (79.9)	53 (12.5)	23 (5.5)	9 (2.1)	423
Post-micturition dribble	284 (67.6)	40 (9.5)	52 (12.4)	44 (10.5)	420
Hesitancy	375 (88.2)	23 (5.4)	14 (3.3)	13 (3.1)	425
Straining	365 (86.1)	22 (5.2)	18 (4.2)	19 (4.5)	424
Weak stream	411 (96.9)	9 (2.1)	0 (0)	4 (1.0)	424
Dysuria	409 (97.4)	7 (1.6)	2 (0.5)	2 (0.5)	420
Increased daytime frequency	390 (90.9)	23 (5.4)	7 (1.6)	9 (2.1)	429
Nocturia	383 (90.1)	17 (4.0)	15 (3.5)	10 (2.4)	425
Urgency	332 (77.8)	50 (11.7)	32 (7.5)	13 (3.0)	427
Urgency incontinence	406 (96.9)	10 (2.4)	2 (0.5)	1 (0.2)	419
Stress incontinence	415 (99.4)	1 (0.2)	1 (0.2)	1 (0.2)	418
Other incontinence	417 (98.4)	4 (0.9)	1 (0.2)	2 (0.5)	424
75-year-old men					
Feeling of incomplete emptying	117 (76.0)	20 (13.0)	9 (5.8)	8 (5.2)	154
Post-micturition dribble	106 (70.7)	17 (11.3)	20 (13.3)	7 (4.7)	150
Hesitancy	129 (83.8)	12 (7.8)	5 (3.2)	8 (5.2)	154
Straining	126 (82.9)	13 (8.6)	6 (3.9)	7 (4.6)	152
Weak stream	154 (96.9)	5 (3.1)	0 (0)	0 (0)	159
Dysuria	151 (98.1)	2 (1.3)	1 (0.6)	0 (0)	154
Increased daytime frequency	140 (88.1)	12 (7.5)	6 (3.8)	1 (0.6)	159
Nocturia	125 (80.7)	22 (14.2)	5 (3.2)	3 (1.9)	155
Urgency	115 (73.7)	17 (10.9)	16 (10.3)	8 (5.1)	156
Urgency incontinence	146 (93.0)	9 (5.8)	1 (0.6)	1 (0.6)	157
Stress incontinence	149 (97.4)	4 (2.6)	0 (0)	0 (0)	153
Other incontinence	146 (94.2)	7 (4.6)	1 (0.6)	1 (0.6)	155

Data presented as N (%).

men showed no definite increase in overall prevalence, as new LUTS and remissions were equally common.⁹ In Austria, 456 men were followed up for 5 years with no change reported by 19%, worsening by 50%, and improvement by 31%.¹³ The Olmsted County Study included about 2300 men with 3.5-year follow-up demonstrated a slow, but measurable progression in urinary symptom severity.⁸ Another analysis of the Olmsted County Study demonstrated regression toward the mean, when annual changes in symptom and bother scores were related to the baseline scores.¹² In 463 Spanish men aged 40 years or older with no or mild LUTS, the incidence of symptoms progression was 10% over 2 years.¹⁰ These studies used different design and analysis; so direct comparison of the results is difficult. They concentrated mainly on the overall burden of LUTS, whereas we evaluated the changes in various

symptoms separately. Incidence and remission of LUTS appear lower in Finland than in the USA and Austria, although a cautious interpretation is warranted given the differences between study populations and procedures.

Recent studies that used cluster analysis to divide study patients into groups on the basis of symptom profiles suggested that the mean ages among men with various symptom profiles were rather similar; however, the most symptomatic clusters consisted of the oldest responders.^{21,22} In our earlier study, principal component analysis produced a grouping of 12 LUTS into 3 categories consisting of voiding, storage, and incontinence symptoms. Post-micturition symptoms were related to voiding symptoms, but incontinence symptoms were separate from storage symptoms.²³ Our present study on the transitions of the symptoms indicates that the probability of remission relative to incidence is high for all

LUTS. Post-micturition symptoms and urgency had less tendency toward spontaneous resolution (ratio of remission to incidence rate 3-4). Weak stream and stress and other incontinence are at the opposite end of the spectrum. Our results demonstrate a large difference in incidence and remission between voiding and post-micturition symptoms, with substantial variability among the storage symptoms.

The strong variation in remission shown in the present study has implications for clinical decision making. The high frequency of spontaneous recovery should be considered when prescribing medication for LUTS or evaluating treatment effects. This spontaneous fluctuation of LUTS can be incorrectly interpreted as treatment effect in clinical practice or in treatment studies. Maybe this fluctuation is because of early phase of BPH or some transient irritation such as prostatitis? Or maybe men adapt to LUTS with time, so they no longer feel bothered about them?

CONCLUSION

Incidence varied by a factor of 10 and remission 4-fold among various LUTS. Post-micturition symptoms had higher incidence than voiding or storage symptoms. Roughly half of the men with LUTS at baseline still had the condition at 5 years, but similar numbers had also become asymptomatic.

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Outcomes of medical and surgical treatment for lower urinary tract symptoms (benign prostatic obstruction) – a population-based cohort study

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SUMMARY

Objective: To compare outcome of lower urinary tract symptoms (LUTS) between men with medical and surgical treatment. **Materials and methods:** A questionnaire was mailed to men aged 55, 65 and 75 years living in Tampere region, Finland in 1999 and the survey was repeated in 2004. LUTS were evaluated using DAN-PSS-1 questionnaire. A total of 1679 men (68% of the eligible) responded to both questionnaires. Of them, 114 men reported LUTS at baseline and medical treatment in the repeat survey and 47 men with LUTS had received surgical treatment. Seventy-two men with prostate cancer were excluded. Men with no medical treatment or surgery for LUTS in either questionnaire were included to no-treatment group. **Results:** The men after surgical treatment showed a reduction in all LUTS symptom groups. However, among the medically treated and untreated men, all the symptoms worsened during the follow up. The proportion of symptomatic men after surgery was lower than among the medically treated men. In men with medical treatment, the prevalence of all 12 LUTS increased. Dysuria and postmicturition dribble were the only symptoms that had slightly better results in medical than in surgical treatment group. **Conclusions:** In this population-based study, operative treatment seemed to relieve LUTS, whereas medical treatment only slowed down their progression. These findings suggest that men with surgical treatment experience a more favourable outcome in LUTS than those receiving medical treatment.

Introduction

Lower urinary tract symptoms (LUTS) are very common in men (1–3). Younger men have also LUTS, but as men are ageing, the prevalence and severity of LUTS increases, although LUTS could also fluctuate to some extent (4,5). As populations grow older, costs for the treatment of LUTS are also likely increase rapidly, which underscore the importance of comparisons of effectiveness and costs of conservative and operative treatments (6).

The optimal treatment for LUTS must be decided individually based on the clinical findings and the degree of bother that symptoms cause. In complicated cases, such as in urinary retention, renal insufficiency resulting from urinary retention or bladder calculi, surgery is the treatment of choice. Several randomised, placebo-controlled trials have shown the efficacy of pharmacological treatments and based on them, the EAU guidelines on the management of male LUTS

recommended alpha-blockers, 5alpha-reductase inhibitors (if prostate is enlarged) or combination of these two therapies for men with moderate-to-severe LUTS (7–10). Studies have also shown the effectiveness of surgical treatment for LUTS (11,12). EAU guidelines recommend transurethral resection of prostate (TURP) for surgical standard with prostate sizes of 30–80 ml and moderate-to-severe LUTS, whereas open prostatectomy is the first choice of surgical treatment, when the prostate size exceed 80–100 ml in the absence of Holmium lasers.

Men with mild LUTS should be only watched and maybe giving lifestyle advice. Men with moderate symptom are probably treated with pharmacological therapy, if treatment is required. The question is what to do with the men with severe, uncomplicated LUTS. Very little is known about this topic. In fact, a recent community-setting study from the Mayo Clinic suggested that medical treatment may not benefit the men to the same extent as clinical trials

What's known

One earlier community-setting study has conducted from subject. Study from the Mayo Clinic suggested that medical treatment may not benefit the men to the same extent as clinical trials suggest.

What's new

Our results suggest that men with severe symptoms benefit more from surgical than medical treatment.

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Disclosure

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suggest (13). Perhaps, men with severe symptoms could be treated more aggressively with surgical treatment early on? Do we just delay the inevitable surgical treatment with medical treatment, with potentially worse treatment results because of this delay?

We used our population-based cohort to evaluate patient outcomes after medical and surgical treatment in a naturalistic setting.

Materials and Methods

This study is a part of the Tampere Ageing Male Urological Study. The details of this project have been published previously (14,15). The study cohort was formed from the National Population Register Center and it comprised all the men born in the years 1924, 1934 and 1944 who lived in the city of Tampere and 11 surrounding municipalities in Pirkanmaa Region, Finland. The material for this study was collected using questionnaire surveys performed in 1999 and 2004. In both rounds, the questionnaire was sent to study cohort, and after 3 months, a reminder questionnaire was sent to the men who did not respond to the initial one.

The Danish Prostatic Symptom Score (DAN-PSS-1) questionnaire was used to evaluate LUTS. In DAN-PSS-1, 12 different types of symptoms were scored from 0 to 3, 0 meaning no symptom and 3 indicating severe symptom (16). The 4-week period prior filling out the questionnaire was used as the time frame for evaluating LUTS. In some analyses (comparing symptoms individually), we divided symptoms to no clinical symptom including no and mild symptom score and, respectively, to clinically significant symptoms comprising moderate or severe symptom. Demographic and medical data were also collected. The medications were provided using brand names and converted into anatomical therapeutic chemical classification system codes.

Only men responding to both questionnaires were included in the study. Men with medical treatment were defined as those who reported use of alpha-blockers or 5alpha-reductase inhibitors in the 2004 questionnaire and indicated no such medication in the 1999 questionnaire. In the surgical treatment group, men who had TURP or open prostatectomy between 1999 and 2004 questionnaires were included. Men reporting no treatment (regardless of DAN-PSS LUTS scores) comprised the non-treated group. Men with a history of prostate cancer were excluded from the study, five men with surgical treatment, two men receiving medical treatment and 65 untreated men.

SPSS (Statistical Package for the Social Science, IBM, Armonk, NY) version 20.0 was used in the data

analysis. For the relation between ordinal variables, a linear-by-linear test was used. The study protocol was approved by the Tampere University Hospital Committee of Research Ethics (tracking number #99050).

Results

In total, 2133 men (68% of the eligible) returned the study questionnaire in 1999 and 5 years later, participation proportion was 76% with 1905 men responding in 2004. No major differences between answering rounds were found in socio-demographic indicators, for example marital status, education, occupational status (publisher earlier) (14,15).

Only responders to both questionnaires were included in this follow-up study, overall 1679 men. Of these men, 116 (6.9%) had started alpha-blockers or 5alpha-reductase inhibitors treatment and 52 (3.1%) men were operated (TURP or open prostatectomy) between 1999 and 2004. Men with the history of prostate cancer were excluded from the study, meaning reduction in study groups by five men from surgical treatment group, two men from medical treatment group and 65 men from no-treatment group.

The mean age of men treated surgically was 71.5 years and in the medical treatment group 70.6 years, whereas the mean age among untreated men was 65.9 years (Table 1). In the 1999 baseline questionnaire, no men had medical treatment for LUTS in the surgical treatment group. In the 2004, two men in the surgical treatment group had alpha-blocker medication.

Initially, the men with surgical treatment had the highest score for every symptom and the untreated men the lowest ones (Table 2). The surgically treated men had reduction in all LUTS symptom group, the

Table 1 Ages and treatments by treatment modality

	Medical treatment N = 114	Surgical treatment N = 47	No treatment N = 1331
Age			
60 years	30	10	713
70 years	47	20	446
80 years	37	17	172
Medication			
Alpha-blockers	63	2	–
5alpha-reductase inhibitors	42	–	–
Combination	9	–	–
Surgery			
TURP	–	39	–
Open prostatectomy	–	8	–

Table 2 Mean DAN-PSS-1 symptom scores by symptom type at entry and in the repeat survey (before and during/after treatment)

	Voiding symptoms*		Postmicturition symptoms [†]		Storage symptoms [‡]		All symptoms (overall score)	
	Baseline	Follow up	Baseline	Follow up	Baseline	Follow up	Baseline	Follow up
Medical treatment								
Mean	2.38	3.01	1.86	2.46	2.96	4.11	7.17	9.60
N	112	113	111	114	113	113	109	111
SD	1.76	2.05	1.29	1.28	1.80	2.68	3.67	4.56
Surgical treatment								
Mean	3.10	2.16	2.27	2.18	3.92	3.82	9.35	8.09
N	49	50	51	50	52	49	49	47
SD	2.31	2.00	1.36	1.29	2.23	2.47	4.68	5.15
No treatment								
Mean	1.46	1.77	1.31	1.59	2.11	2.83	4.84	6.16
N	1331	1336	1347	1348	1340	1322	1295	1292
SD	1.55	1.74	1.14	1.25	1.74	2.12	3.49	4.09

*Including four symptoms: hesitancy, weak stream, straining, dysuria.

[†]Including two symptoms: feeling of incomplete emptying, postmicturition dribble.

[‡]Including six symptoms: increased daytime frequency, nocturia, urgency, urgency incontinence, stress incontinence, other incontinence.

clearest reduction was in voiding group. Both among the medically treated and among untreated men, all the symptom scores worsened during follow up (Figure 1).

When various LUTS were evaluated one at a time, surgical treatment was associated with a large reduction in the prevalence of symptoms. All voiding symptoms combined, as well as feeling of incomplete emptying, increased daytime frequency and urgency seemed to respond well to surgical treatment (Figure 2). In these symptoms, surgical treatment resulted in about 10 percentage point reduction in symptomatic men (Figure 3). Dysuria and postmicturition dribble were the only symptoms that had slightly better results in the medical treatment group (Figure 4). Among the men receiving medical treatment, the proportion of symptomatic men increased in all 12 LUTS. Also, the untreated men had a slight increase in the prevalence of all symptoms.

Incontinence symptoms were uncommon. The surgically treated men with urgency incontinence showed symptom relief unlike medically treated, but also stress incontinence was more uncommon after surgical than medical treatment group (Figure 5).

Discussion

We evaluated the outcomes of surgical and medical treatment of LUTS in terms of DAN-PSS-1 symptom scores in a community-based setting. Our results suggest that surgically treated men with voiding

experience large long-term symptom relief than those receiving medical treatment. In postmicturition symptoms, men with operative treatment showed clear improvement in the feeling of incomplete emptying, but no relief in postmicturition dribble. Surgically treated men reported also reduction in storage symptoms (increased daytime frequency, urgency, urgency incontinence), except nocturia. Stress and other incontinence symptoms among symptomatic men increased less in the surgically than medically treated group. Similarly, a smaller increase in the prevalence of nocturia was also found among the surgically treated group (from 11% to 15%) than medically treated men (from 8% to 19%). Among men who had received medical treatment, symptom prevalence increased in all 12 LUTS. An increase in prevalence of all LUTS was also seen in the untreated men.

A recent study from the Mayo Clinic using Olmsted County evaluated LUTS therapies in the community (13). In their long follow-up (mean 13.7 years), 28% of the men received medical or surgical therapy, whereas in our study, the median follow-up time was 2.5 years and during that time, 10.1% men received treatment for LUTS. A key limitation in both the Mayo and ours was the small number of surgically treated men. The results of the Mayo Clinic study were largely similar to ours. Medical treatment with alpha-blockers or 5alpha-reductase inhibitors did not substantially reduce symptoms, while a major reduction in symptoms

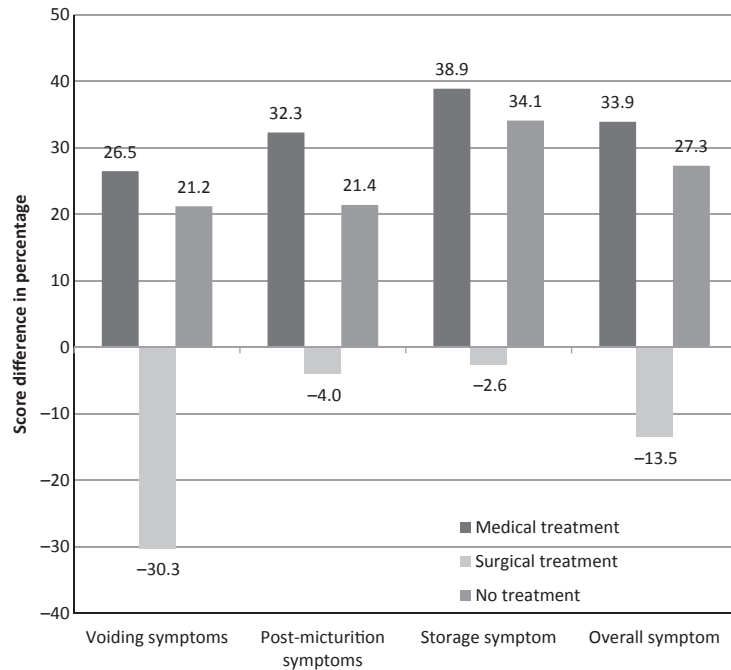


Figure 1 Score changes between before and after/during treatment in different treatment groups

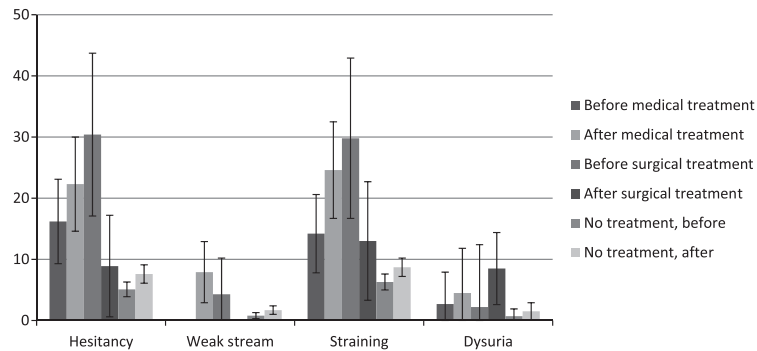


Figure 2 Prevalence of voiding symptoms before and after treatment in percentages

was observed among the patients treated with laser vaporisation and TURP.

In clinical practice, it is well known that medication for LUTS is often stopped by the patients. This is in many cases attributable to side effects or simply lack of any benefits from the drug. We were concerned about this issue. As this postal survey was conducted also 5 years earlier and men with medication for LUTS at that time were excluded, the men reporting medications for LUTS have used their medication at least for same time (0–5 years). Furthermore, in postal surveys like this, men probably do not feel need to please the interviewer and report their self-stopped medication that could happen in oral interview especially with their doctors. That was why we were especially interested what

happened to these men with medical treatment after initial follow up. Therefore, we asked them the same questionnaire 5 years later in the 2009. Sixty-one men answered, nine of them (15%) were operated (TURP) during the 5-year follow up. From those men whose medications were known, 30/49 (61%) were still using medication for LUTS. So, one of six men was operated and almost two thirds were still using medication. What these numbers mean, should be further investigated. Maybe, the medication is sufficient treatment and men are satisfied for their treatment. Maybe, men or their doctors are afraid of operation and possible complications of surgical treatment. If that is a case, these kinds of studies are more than welcome to provide more information about the effectiveness of treatment choices.

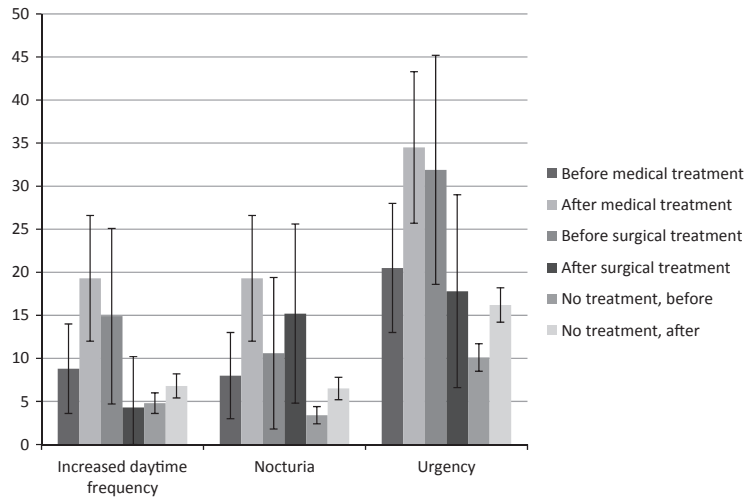


Figure 3 Prevalence of storage symptoms before and after treatment in percentages

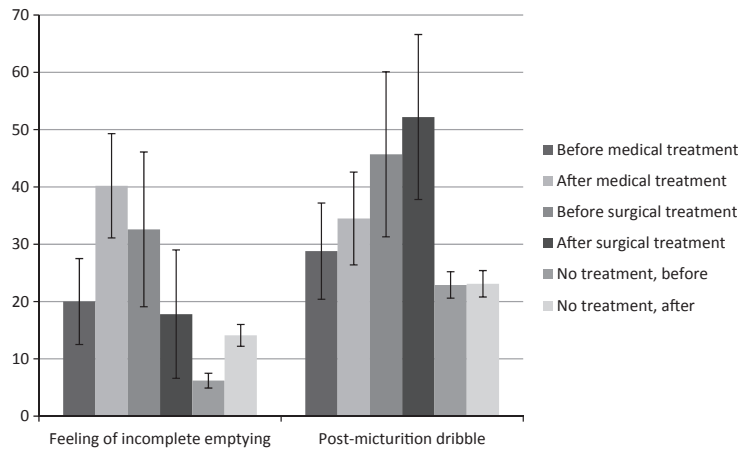


Figure 4 Prevalence of postmicturition symptoms before and after treatment in percentages

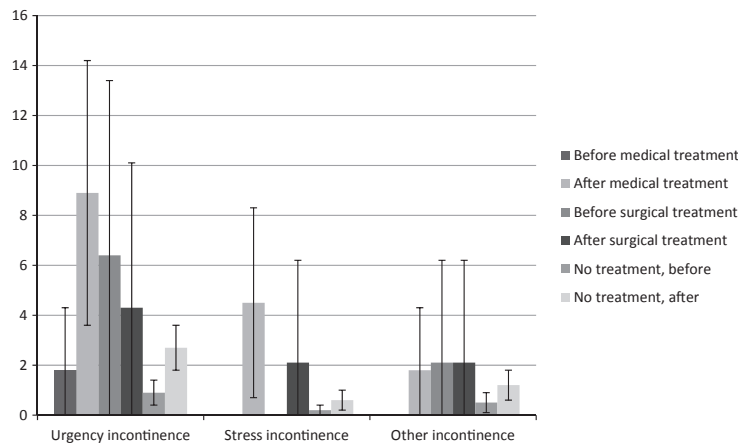


Figure 5 Prevalence in incontinence symptoms before and after treatment in percentages

The outcome in terms of posttreatment voiding symptoms was superior in surgically treated to medically treated men. This can be explained by the fact that surgical treatment (TURP or open prostatectomy) removes mechanically prostate tissue causing bladder outlet obstruction (BOO). The mechanism of action for medication is based on relaxing smooth musculature in the bladder neck and prostate (alpha-blockers) or reduction in the prostate size (5alpha-reductase inhibitors), which reduce BOO less effectively than surgery, although medical therapy has reduced symptoms in clinical trials (7–10). Medication has been suggested to relieve storage symptoms as quickly and to the same extent as voiding symptoms, whereas operative treatment is thought to improve storage symptoms to a lesser extent and/or more slowly than voiding symptoms (17).

Reduction in the feeling of incomplete emptying could also be explained with same mechanism as voiding symptoms. The findings suggest that surgery releases mechanical obstruction allowing improved bladder emptying, which is not achieved by other treatments. However, in another postmicturition symptom, postmicturition dribble, a similar, approximately 6% increase in symptom prevalence was observed in both treatment groups. As postmicturition dribble is rather common also in younger men, a probable pathophysiological mechanism may be, instead of prostatic enlargement only, a failure of the bulbocavernosus muscle to perform a normal postvoid milking reflex, with urine becoming trapped in the bulbar area of the urethra just after voiding (18). Surgical treatment could increase this 'dead space' distal from bladder neck and even exacerbate postmicturition dribble.

Also, prevalence of most storage symptoms decreased among the surgically treated men, whereas they increased among the medically treated men. When storage symptom scores were compared, score stayed practically in same level among surgically treated as among medically treated men score increased. Nocturia increased during follow up regardless of treatment, although less in surgically treated men. This finding is consistent with the previous studies showing a strong increase in nocturia with age groups (19,20).

Incontinence is a feared complication of operative treatment. The prevalence of stress incontinence after TURP has been reported to be 2.2% (21). This is similar to that in our study, where, although even stronger increase occurred in medically treated men. Stress incontinence among men having alpha-blocker therapy may occur as a result of smooth sphincter relaxing. Stress incontinence increased slightly also in untreated men.

We used a population-based approach to evaluate the outcomes of surgical and medical treatment. As the study is not a randomised trial, comparability of the groups with different treatments is a key issue, as confounding by selection bias (case mix) and confounding by indication can potentially distort the results of non-randomised studies. Yet, the extent and direction of bias in non-randomised studies needs to be examined carefully and the importance of robust results with large effect size for evaluating treatment effectiveness has been clearly recognised (22). The baseline LUTS scores were higher in surgically than medically treated men in all LUTS except dysuria. Therefore, any selection bias will favour medical treatment. Furthermore, the posttreatment scores were lower for surgically than medically treated men in all LUTS except nocturia and postmicturition dribble. Hence, the direction of bias is such that it cannot reverse the direction of difference in comparison of surgical vs. medical treatment of LUTS, but its more stringent control in this study (by e.g. propensity scores) would only strengthen the conclusions. Hence, our findings are robust and cannot be attributable to the potential biases inherent in non-randomised design. The advantages of the study include improved generalisability because of a representative patient population that is more heterogeneous than in clinical trials with strict exclusion criteria and realistic treatment setting across a variety of healthcare providers. A postal questionnaire was used in data collection and higher participation (68–76%) achieved than has been reported by other methods such as telephone or web-based interviews (23,24). LUTS were the main topic of the questionnaire, but information was collected also on socio-demographic factors, etc. Comparison of different treatment options for LUTS was not explicitly mentioned in the study leaflet, so the men were in that sense blinded. Our non-randomised design in a naturalistic setting differs from the clinical trials comparing the effectiveness of surgical and medical treatments. A disadvantage of this approach was the lack of clinical detail on, e.g. prostate size. The treatment decisions were made by urologists and other clinicians, based on the current treatment practices for LUTS. In our study, only nine men had combination treatment with concurrent use of an alpha-blocker and 5alpha-reductase inhibitor. Nowadays, such combination treatment is used more frequently than at the time of our study. It should be more effective than single medication alone (25). Our goal in this study was not evaluate the decision making, but to evaluate the outcome of the treatment in terms of patient outcomes.

Conclusion

In this population-based study, we evaluated outcomes of men receiving surgical and medical treatments for LUTS. Our results suggest that men with severe symptoms benefit more from surgical than medical treatment.

Acknowledgement

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