

The Hordaland women's cohort: prevalence, incidence, and remission of urinary incontinence in middle-aged women

David Jahanlu · Steinar Hunskar

Received: 8 September 2009 / Accepted: 12 April 2010 / Published online: 7 May 2010
© The International Urogynecological Association 2010

Abstract

Introduction and hypothesis The aim of study is to prospectively investigate the prevalence, incidence, and remission of urinary incontinence (UI) in a cohort of middle-aged women.

Methods In 1997–1999, 2,229 randomly selected women aged 41–45 agreed to participate in the Hordaland Women's Cohort, and six almost identical postal questionnaires were sent them during the following 10 years. Response rate was 95.7% at inclusion and has remained 87% to 93% in subsequent waves; 64.1% answered all six questionnaires. UI variables include type, amount, frequency, and severity. **Results** Prevalence of UI increased by age until a peak in age group 51–52 years for any (50.3%) and significant (10.0%) UI. There was then a decrease in prevalence caused by a decrease in incidence and decrease in remission. Stress UI was the major type and most UI was of low severity.

Conclusion Prevalence of any UI is high in middle-aged women but reaches a peak followed by a decrease.

Keywords Incidence · Middle-aged women · Prevalence · Remission · Urinary incontinence

Introduction

Urinary incontinence (UI) is a prevalent condition among middle-aged women [1, 2]. UI is a subjective symptom that

can be presented in a variety of ways depending on type, frequency, and amount of leakage. It can be perceived as a part of normal life without any negative impact, or it can be a major physical or psychological health issue. Many factors can affect the development, progression, and remission of UI, and together, they increase the complexity of the natural history of UI, which is not yet fully understood. In particular, the transitional state of menopause in middle-aged women induces many hormonal changes. Decrease in sex hormones and other aging processes, together with predisposing and preexisting risk factors, induce changes in the urinary tract, vagina, and pelvis, and women become more susceptible to the development of bladder storage symptoms like urinary frequency, urgency, and stress incontinence [3–6].

Generally, the prevalence of UI increases steadily with age, especially there is an increasing proportion of urgency UI, but detailed analyses of the prevalence curve or the development patterns are scarce. Reviews have revealed an intriguing pattern of an increasing prevalence by age reaching an early peak in midlife and then, after a slight decrease, a further steady increase among the elderly [2, 7, 8]. This understanding is based on a few large high-quality cross-sectional studies [9–11]. For example, the Norwegian EPINCONT study found a peak prevalence of 27.1% in the age group 50–54 years, then a decrease to 22.4% among women aged 60–64 years, and then a further increase to a maximum of 29.9% among women 80–84 years of age.

Principally a decrease in prevalence can be due to treatment of UI patients, remission of existing UI, or decreased incidence. The latter can be due to several mechanisms and factors: a true biological effect, a reduced magnitude, or level of precipitating factors (e.g., sports or physical activity). An increased acceptance of existing symptoms as nonsignificant or also an age-dependent

D. Jahanlu (✉) · S. Hunskar
Department of Public Health and Primary Health Care,
University of Bergen,
Postbox 7800, 5020 Bergen, Norway
e-mail: david.jahanlu@isf.uib.no

S. Hunskar
e-mail: steinar.hunskar@isf.uib.no

change in how women respond to surveys can also change the incidence or remission rate. So far, there are no studies scrutinizing reason(s) of this change. Most epidemiological surveys are cross-sectional and use a wide age-span like a decade or half-decade and do not correlate to important risk factors that may change in perimenopausal phase of life.

In middle-aged women, information on incidence of UI is rather small and has been derived mainly from cohorts with either few follow-ups (mostly one) or rather long interval(s) between data recordings. There is often a limited description of the type and severity for incident cases [12–15]. The amount of information regarding remission of UI is even smaller [13, 15–19], and rates of remission vary considerably across the few studies that have investigated them [2, 13, 16].

The aim of this study was to investigate the prevalence, incidence, and remission patterns of UI in middle-aged women including type and severity, using a prospective cohort design. We especially wanted to search for a possible prevalence peak, using information from the same group of women during several waves of data recording. If such a peak was found, we wanted to determine how it was influenced by changes in incidence and remission rates.

Materials and methods

In order to analyze details of the natural history of UI in middle-aged women, data from a prospective cohort study with several follow-ups and detailed information about UI were used.

The Hordaland women's cohort

The Cohort was established in 1997 based on the Hordaland Health Study (HUSK). From the HUSK female source population aged 40–44 ($N=14,349$), a random sample of one fifth ($N=3,453$) was selected for participation. Two thousand, three hundred thirty-one (67.5%) of the selected women met at the screening station, and after oral and written information, 2,230 (95.7%) consented to take part in the study. Postal questionnaires, which were identical for the UI part each time, have been sent to participants of the Cohort every second year. Repeated questionnaire mailings to nonresponders ensure maximum follow-up, which remains 87% to 93% in the different waves of data collection. In 2008, the Cohort reached to the tenth year of follow up with six waves included. The age range of the participants was 41–45 in the first and 51–55 in the sixth wave of the Cohort. Details of the Cohort's methodology have been published separately [20].

Respondents included in the analysis

In order to analyze the prevalence curve of UI, we first used all data from the Cohort over a time period of 10 years. The age span was 41–55 years, but for power reasons, we analyzed the data by eight age groups (age span of 2 years in first seven groups and age 55 solely in the last one). We refer to these data as the first dataset. In the second step, for more detailed analysis, only women with complete datasets over the 10-year period were included; women who died, withdrawn, or did not answer one or more of the questionnaires were excluded. We refer to these data as the second dataset. Each woman could thus contribute to the datasets more than once depending on their age in different waves, but only once in each age group. Finally, we analyzed the group of 55-year-old women in the three last data collections on a one to one basis, so changes among the identical group of women could be shown.

UI variables

Types of UI were determined by questions about specific urinary symptoms [20]. If the woman answered “yes” on the question about loss of urine when coughing, sneezing, laughing, or lifting heavy items, a “stress” component was defined. If the woman answered “yes” on the question about leakage accompanied by sudden compelling desire to void, an urgency component was defined. If answering “yes” on both questions, mixed incontinence was defined. If the woman had answered “yes” on the question: “Do you have urinary leakage in other situations?” the leakage was defined as “other” type of UI; the same was done if the women answered “no” to both questions about leakage situation.

Frequency of UI was assessed by the question; “How often you have urinary leakage?” with five response categories (never, less than once a month, once or more than once a month, once or more than once a week, or every day/night). Amount of leakage was assessed by the question; “How much urine do you leak each time?” with four response categories (none, drops or little, small splashes, or larger amounts).

An incontinence severity index (ISI) developed by Sandvik et al. was used to characterize the severity of incontinence. ISI is based on information about frequency [0–4] and amount of leakage [0–3]. By multiplying the values of these two questions, an index value [0–12] is found. This index value is further categorized into a severity index with four levels: slight [1, 2], moderate [3–6], severe [8, 9] and very severe [12] UI. “Very severe” denotes leakage of large amounts every day and/or night, and because of the small percentage with this grade, we combined the “very severe” and “severe” groups into one group for the analyses.

In the analyses, “continent” was defined as ISI equal to zero. All other women were defined as having “any UI”

and categorized by ISI. Each woman’s indication of impact of UI was dichotomized to two levels: minor problem (no problem/a small nuisance) or bothersome (some to much bothered). Women with moderate and severe incontinence ($ISI \geq 3$) and who stated their UI to be bothersome were defined as having significant UI. The term “nonsignificant” UI was used for the rest.

Prevalence, incidence, and remission

Prevalence of any UI was calculated as the number of women reporting incontinence in each age group divided by the total number of women in the same age group. The prevalence of significant UI was calculated in the same way.

Two-year incidence of UI was calculated by dividing the number of new-onset incontinence by the number of “women at risk.” All continent women in one age group were defined as “at risk” for the next group. A 10-year incidence for any UI was calculated, and corresponding average incidence per year was calculated by dividing this number by 10.

Remission was defined as a change from “any UI” to “continent” after 2 years. We also calculated changes from significant to nonsignificant UI.

Ethics and approvals

The Norwegian Data Inspectorate and Regional Committee for Medical Research Ethics approved the Cohort. All personnel and staff involved in the Cohort are bound by an oath of confidentiality.

Statistics

All data are descriptive and presented as percentages. Prevalence estimates and 95% confidence intervals (CI) and differences between proportions for 95% CI were calculated. Fisher’s test was used to estimate a two-tailed *p* value. Statistical analyses were conducted using the SPSS, version 16.

Results

The first dataset consisted of a total of 13,058 questionnaires answered during 10 years, in six different waves of the Cohort. Any UI was reported 5,246 times (40.2%), while significant UI was reported 960 times (7.3%).

A total of 1,430 (64.1%) women answered all six questionnaires, and this gave us 8,580 complete data recordings for the second dataset. In the overall age range of 41–55 years, 46.6% reported any UI. In the same age range, 8.0% had significant UI. The mean age of all women was 47.8 years,

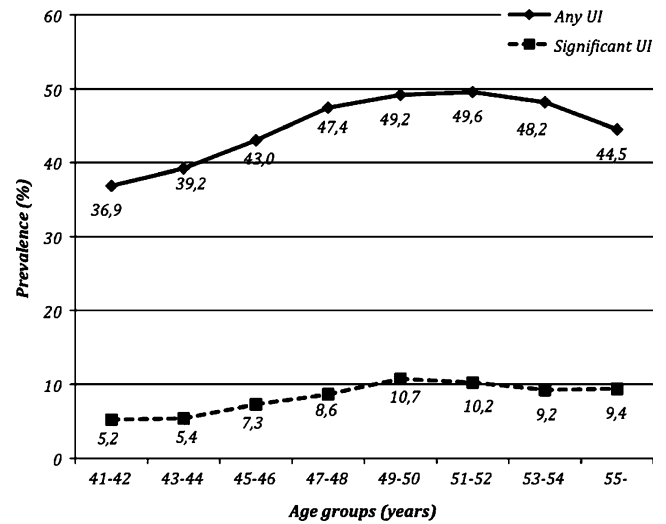


Fig. 1 Prevalence of “any” and “significant” UI by age groups for all women

48.1 for women with any UI, 48.6 years for women with significant UI, and 47.6 years for continent women.

Prevalence of UI

Figure 1 shows the prevalence of UI in the eight age groups including all women who participated in one or more waves (the first dataset). For any UI, the prevalence increased by age up to the sixth age group (51 to 52 years) and then decreased in the next two age groups. The fifth age group showed a small peak for significant UI, and then the prevalence decreased slightly. Relative increase in prevalence rate from the first age group to the peak was 34% ($p < 0.001$) for any UI and 105% ($p < 0.001$) for significant UI. The relative decrease in prevalence from the peak value to the

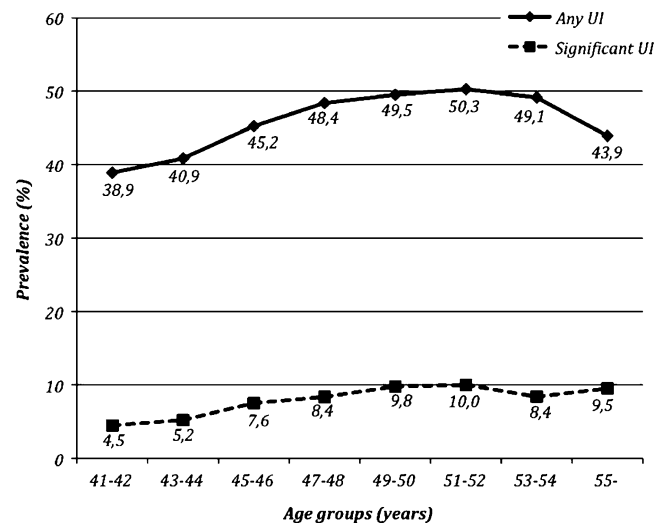


Fig. 2 Prevalence of “any” and “significant” UI by age groups for women with complete data set

last (55 years old) group is 10% and 12% for any and significant UI, respectively.

Since the last age group only contains women who were 55 years old in the sixth wave, we analyzed their pattern of change in prevalence separately. For any UI, the prevalence increased up to 49.3% in the fourth wave while they were 51 years old and then decreased to 46.5% at age 53 and 44.5% at age 55 ($p=0.29$). The pattern is thus similar to the total group.

Figure 2 shows the prevalence of UI for the second dataset (women with complete data). For both any and significant UI, the prevalence increased by age up to the sixth age group and then decreased in the seventh and eighth age group. Relative increase in prevalence rate from the first age group to the peak was 29% ($p<0.001$) for any and 122% ($p<0.001$) for significant UI. The relative decrease in prevalence from the peak value to the last (55 years old) group is 13% ($p=0.10$) and 5% ($p=0.93$) for any and significant UI, respectively. The proportion of significant UI increased from 12% in the youngest age group to 22% in the oldest ($p=0.03$). Analyses of the oldest group only showed a prevalence peak of 51.3% when they were 49 years old and then reduced to 43.9% when aged 55 years (absolute reduction of 7.4%, relative reduction of 14.4%, $p=0.18$).

Analyses of type distributions were performed using the second dataset. Among women with any UI in all ages, 42.6%, 12.3%, and 36.0% had stress, urgency, and mixed symptoms, respectively, while type distribution among women with significant UI was 25.5%, 8.4%, and 61.7%. Unclassified types of UI were found to be 8.1% for any UI and 4.2% for significant UI. Table 1 shows the distributions of any UI by type and severity for the eight age groups in the second dataset. For any UI, stress symptom is the most frequent type for all age groups, except the last. The proportion of mixed UI increases by age and becomes the most frequent type in the last age groups. The proportion of urgency symptoms and “other” types of UI varies only slightly between age groups, with absolute levels of about 10–15% and 6–10%, respectively. A stress component (stress and mixed symptoms combined) is thus present in 75–80% of the incontinent women, relatively stable over this age span.

For significant UI, mixed symptom was the most prevalent type for all age groups (data not shown), with a maximum proportion of 69.2% in the sixth age group, while stress UI had a maximum in the third age group (36.1%).

Distribution of severity groups by age groups is also shown in Table 1. A majority of women with UI has slight UI; this proportion decreases by age, however, while the proportion of moderate UI remains relatively stable around a third throughout the age span. Severe/very severe UI

Table 1 Distribution of type and severity of any urinary incontinence by age groups

Age groups (year)	Type					Severity		
	Stress	Urgency	Mixed	Other	Slight	Moderate	Severe/VS	
41–42	38.0 (31.7–44.5)	16.9 (12.4–22.3)	32.6 (26.8–38.9)	12.4 (8.5–17.2)	63.2 (57.0–69.0)	32.2 (26.7–38.4)	4.5 (2.6–8.0)	
43–44	45.0 (40.6–49.4)	11.2 (8.6–14.3)	35.5 (31.3–39.8)	8.3 (6.0–11.0)	63.5 (59.2–67.6)	33.3 (29.4–37.5)	3.2 (2.0–5.1)	
45–46	46.7 (42.6–47.9)	9.6 (7.4–12.1)	34.2 (30.5–37.9)	9.6 (7.4–12.2)	66.3 (60.1–67.4)	28.9 (25.5–32.5)	4.8 (3.4–6.7)	
47–48	45.5 (41.8–49.3)	12.6 (10.1–15.3)	33.7 (30.2–37.3)	8.2 (6.3–10.5)	62.9 (59.2–66.4)	32.4 (29.0–35.9)	4.8 (3.4–6.6)	
49–50	42.1 (38.4–45.8)	11.3 (9.1–13.9)	38.8 (35.2–42.5)	7.3 (5.5–9.5)	61.6 (57.9–65.1)	32.5 (29.1–36.0)	5.9 (4.4–7.9)	
51–52	38.8 (35.2–42.5)	14.3 (11.8–17.1)	35.5 (31.6–38.7)	7.2 (5.5–9.4)	60.4 (56.7–63.9)	33.8 (30.4–37.3)	5.8 (4.4–7.8)	
53–54	40.6 (35.8–45.5)	13.6 (10.6–17.3)	39.8 (35.1–44.7)	6.0 (4.1–8.6)	58.6 (53.7–63.3)	33.8 (29.3–38.5)	7.7 (5.5–10.7)	
55	33.7 (24.5–44.4)	10.8 (5.8–19.3)	49.4 (38.9–59.5)	6.0 (2.6–13.4)	57.8 (47.1–67.9)	31.3 (22.4–41.9)	10.8 (5.8–19.3)	

Data given as % (95% CI)

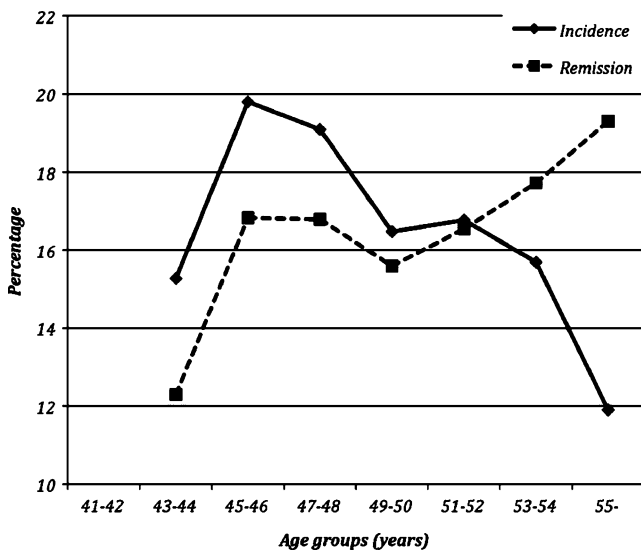


Fig. 3 Two-year incidence and remission of any UI by age groups

increased by age from less than 5% in the youngest to more than 10% in the eldest age group ($p=0.06$).

Incident UI and remissions

Figure 3 shows the 2-year incidence and remission of any UI by age groups in the second dataset. The patterns for incidence and remission of any UI are very similar up to the sixth age group, then the curves markedly separated as incidence decreases and remission increases for the seventh and eighth age groups. For the cohort as a whole, the absolute number of women with new onset UI is larger than the number of women with remission for the first five age groups, while for the seventh and eighth age groups, remission is higher than incidence also in absolute numbers (data not shown on figure).

For significant UI, there is a rather stable incidence rate around 3.5–4.5% for each age group (Table 2). The remission rate is stable around 30% until the two oldest age groups, where a marked increase to more than 40% is found, although not statistically significant ($p=0.08$).

At start, 61.4% ($n=878$) of 1,430 women were continent and defined as women at risk. After 10 years, 48.9% ($n=429$) of them had symptoms of any UI. The overall 10-year incidence of any UI thus corresponds to an average incidence

of 4.9% per year for women aged 41–55 years, when first and final data collection were used for the calculation.

Discussion

This 10-year prospective follow-up study with six waves of data collection confirms that the point prevalence of both any and significant UI in middle-aged women steadily increases by age until it reaches a peak in the age groups of 49–52 years. There is then a decrease in prevalence for both groups. This pattern is found when all women in the cohort are analyzed and also when only those with complete data recordings are included. The cohort design reveals that the decrease is caused both by a decrease in incidence and an increase in remission. Symptoms of stress UI are the major type, and most UI is of low severity, although increasing over the observation period.

Strengths and limitations of the study

The Cohort represents a relatively large random sample of about 15% of the total population of women born between 1953 and 1957 in the county of Hordaland, Norway. The overall recruitment rate was very high (96%), the later response rates very satisfactory, and with a minimal number of dropouts. Almost 65% of the women participated with complete datasets in all the six waves of data collections used in the present report. Together with the cohort's rather narrow age span, short intervals between the waves, and studying the same women with the same measures, we are allowed to study details of changes in the epidemiology of UI during this decade of women's life, at a level not usually found in follow up studies of UI. We have an extensive number of variables, and we mostly use validated questionnaires or questions used in previous research, so results can be compared between studies [9, 20, 21]. The incontinence case definition is in accordance with the new definition of the ICS [22].

Even though more than 2,000 women included, statistical power was a problem during analyses due to small sample size for some subgroups, thus increasing the risk of Type II errors. Analyses including only women who contributed in all six waves may have favored women

Table 2 Incidence and remission of "significant" urinary incontinence by age groups

Age groups (year)	43–44	45–46	47–48	49–50	51–52	53–54	55
Incidence (%)	21/590 (3.6)	48/1172 (4.1)	46/1316 (3.5)	57/1302 (4.4)	46/1279 (3.6)	27/882 (3.1)	8/169 (4.7)
Remission (%)	8/28 (28.6)	18/65 (27.7)	35/108 (32.4)	37/120 (30.8)	43/139 (30.9)	42/101(41.6)	8/18 (44.4)

Data given as proportions and (%)

especially interested or generally more concerned about their health status, potentially increasing the prevalence of UI. We have, however, no indication that the inclination to respond is somehow linked to type or severity distribution of UI and thus reducing the generalizability of our results. A more detailed analysis of the small differences between the source and cohort populations is found in a previous publication [20].

Prevalence, incidence, and remission

Despite the fact that we somewhat limited the definition of any UI by using Sandvik index, the prevalence of any UI was high and steadily increased from the first to the sixth age group. Other studies have found peak prevalence at age 50–55 years [9, 11] and 50–59 years [10], but with different prevalence levels (27–60%), probably partly depending on the definition of UI and the age categorization [23]. Over the 10-year period, we found a relative increase in prevalence of about 30% for any UI and more than a doubling of significant UI. The high prevalence of mixed UI could be due to confounding factors such as severity of UI, and there is, therefore, a need for further investigations of this issue.

Our definition for significant UI was the same as used in EPINCONT study, which reported 7% significant UI, similar to our result (8%). The pattern and peak for significant UI was also similar. There is, however, no general agreement upon criteria for what might be called significant UI, and most studies using this term are more clinical series than epidemiological surveys. Our definition for significant UI is rather strict and may include most women that should be denoted potential patients.

Probably due to lack of statistical power, the reduction in prevalence of UI in women aged 53+ was not statistically significant. But similar trends were found in all our analyses, and we, therefore, acknowledge this decrease as a real epidemiological effect. The eventual biological mechanisms behind this pattern are not known. We have found, however, the decrease is due to a combined effect of decreased incidence and increased remission rates, with the latter surpassing incidence both in relative and absolute numbers in the two oldest age groups.

We found a relatively stable incidence rate until the peak prevalence value. Previous studies have generally reported incidence estimates close to ours [13, 24, 25], while the decrease in incidence rate has not been published before. Also, our overall remission rate fits well with previous literature [13, 15, 18, 26], again with no previous documentation of the significant increase for women aged 53+. Our data confirm earlier concepts of UI being a dynamic condition, with many women shifting from a state of incontinence to continence and vice versa [13, 27].

Severity and type

Over the observation period, we saw a shift in both type and severity distributions. Mixed symptoms and severe/very severe grade of UI increased, as found in other studies [7, 9, 28, 29]. It is unresolved how the natural history of type and severity is linked [12, 30], and this topic should be further investigated.

Conclusion

By detailed analyses of data from a prospective cohort, we have been able to show how prevalence and incidence patterns of UI change in middle-aged women. The mechanisms behind the decreased incidence, increased remission, and thus the reduction in prevalence are not known, and dimensions like physiological changes, treatment effects, and explanations associated with epidemiological methodology should be further investigated.

Acknowledgements The Hordaland women's cohort as a sub-study of the Hordaland Health Study was performed in collaboration with the Norwegian National Health Screening Service and the University of Bergen.

Funding was obtained from Norwegian Research Council (NFR), The Western Norway Regional Health Authority, and the University of Bergen.

Conflict of Interest None.

References

- Grodstein F, Fretts R, Lifford K, Resnick N, Curhan G (2003) Association of age, race, and obstetric history with urinary symptoms among women in the nurses' health study. *Am J Obstet Gynecol* 189:428–434
- Hunnskaar S, Burgio K, Diokno A, Herzog AR, Hjalmas K, Lapitan MC (2003) Epidemiology and natural history of urinary incontinence in women. *Urology* 62:16–23
- DeLancey JO, Kane Low L, Miller JM, Patel DA, Tumbarello JA (2008) Graphic integration of causal factors of pelvic floor disorders: an integrated life span model. *Am J Obstet Gynecol* 199:610.e1–610.e5
- Goepel C, Hefler L, Methfessel HD, Koelbl H (2003) Periurethral connective tissue status of postmenopausal women with genital prolapse with and without stress incontinence. *Acta Obstet Gynecol Scand* 82:659–664
- Ashton-Miller JA, DeLancey JO (2007) Functional anatomy of the female pelvic floor. *Ann N Y Acad Sci* 1101:266–296
- Smith AR, Hosker GL, Warrell DW (1989) The role of pudendal nerve damage in the aetiology of genuine stress incontinence in women. *Br J Obstet Gynaecol* 96:29–32
- Fultz NH, Herzog AR (2000) Prevalence of urinary incontinence in middle-aged and older women: a survey-based methodological experiment. *J Aging Health* 12:459–469
- Cheater FM, Castleden CM (2000) Epidemiology and classification of urinary incontinence. *Baillieres Best Pract Res Clin Obstet Gynaecol* 14:183–205

9. Hannestad YS, Rortveit G, Sandvik H, Hunskaar S (2000) A community-based epidemiological survey of female urinary incontinence: the norwegian epincont study. *Epidemiology of incontinence in the county of nord-trondelag*. *J Clin Epidemiol* 53:1150–1157
10. Minassian VA, Stewart WF, Wood GC (2008) Urinary incontinence in women: variation in prevalence estimates and risk factors. *Obstet Gynecol* 111:324–331
11. Swanson JG, Kaczorowski J, Skelly J, Finkelstein M (2005) Urinary incontinence: common problem among women over 45. *Can Fam Physician* 51:84–85
12. Hunskaar S, Burgio K, Clark A, Lapitan MC, Nelson R, Sillen U et al (2004) Epidemiology of urinary (UI) and faecal (FI) incontinence and pelvic organ prolapse (POP). In: Abrams P, Cardozo L, Khoury S, Wein A (eds) *Incontinence, basics and evaluation*. Health Publication, Plymouth, pp 255–312
13. Townsend MK, Danforth KN, Lifford KL, Rosner B, Curhan GC, Resnick NM et al (2007) Incidence and remission of urinary incontinence in middle-aged women. *Am J Obstet Gynecol* 197(167):e161–e165
14. Holtedahl K, Verelst M, Schiefloe A, Hunskaar S (2000) Usefulness of urodynamic examination in female urinary incontinence—lessons from a population-based, randomized, controlled study of conservative treatment. *Scand J Urol Nephrol* 34:169–174
15. Samuelsson EC, Victor FT, Svardsudd KF (2000) Five-year incidence and remission rates of female urinary incontinence in a swedish population less than 65 years old. *Am J Obstet Gynecol* 183:568–574
16. Moller LA, Lose G, Jorgensen T (2000) Incidence and remission rates of lower urinary tract symptoms at one year in women aged 40–60: longitudinal study. *BMJ* 320:1429–1432
17. Ostbye T, Seim A, Krause KM, Feightner J, Hachinski V, Sykes E et al (2004) A 10-year follow-up of urinary and fecal incontinence among the oldest old in the community: the canadian study of health and aging. *Can J Aging* 23:319–331
18. Herzog AR, Diokno AC, Brown MB, Normolle DP, Brock BM (1990) Two-year incidence, remission, and change patterns of urinary incontinence in noninstitutionalized older adults. *J Gerontol* 45:M67–M74
19. McGrother CW, Donaldson MM, Shaw C, Matthews RJ, Hayward TA, Dallosso HM et al (2004) Storage symptoms of the bladder: Prevalence, incidence and need for services in the UK. *BJU Int* 93:763–769
20. Jahanlu D, Qureshi SA, Hunskaar S (2008) The hordaland women's cohort: a prospective cohort study of incontinence, other urinary tract symptoms and related health issues in middle-aged women. *BMC Public Health* 8:296
21. Sandvik H, Seim A, Vanvik A, Hunskaar S (2000) A severity index for epidemiological surveys of female urinary incontinence. Comparison with 48-hour pad weighing tests. *Neurourol Urodyn* 19:137–145
22. Abrams P, Cardozo L, Fall M, Griffiths D, Rosier P, Ulmsten U et al (2002) The standardisation of terminology of lower urinary tract function: report from the standardisation sub-committee of the international continence society. *Am J Obstet Gynecol* 187:116–126
23. Thom D (1998) Variation in estimates of urinary incontinence prevalence in the community: Effects of differences in definition, population characteristics, and study type. *J Am Geriatr Soc* 46:473–480
24. Sherburn M, Guthrie JR, Dudley EC, O'Connell HE, Dennerstein L (2001) Is incontinence associated with menopause? *Obstet Gynecol* 98:628–633
25. Hagglund D, Walker-Engstrom ML, Larsson G, Leppert J (2004) Changes in urinary incontinence and quality of life after four years. A population-based study of women aged 22–50 years. *Scand J Prim Health Care* 22:112–117
26. Moller LA, Lose G, Jorgensen T (2000) The prevalence and bothersomeness of lower urinary tract symptoms in women 40–60 years of age. *Acta Obstet Gynecol Scand* 79:298–305
27. Milsom IAD, Lapitan MC, Nelson R, Sillén U, Thom D (2009) Epidemiology of urinary (UI) and faecal (FI) incontinence and pelvic organ prolaps (POP). In: Abrams P, Cardozo L, Khoury S, Wein A (eds) *Incontinence*. Health Publication, Plymouth, pp 35–111
28. Melville JL, Katon W, Delaney K, Newton K (2005) Urinary incontinence in us women: a population-based study. *Arch Intern Med* 165:537–542
29. Herzog AR, Fultz NH (1990) Prevalence and incidence of urinary incontinence in community-dwelling populations. *J Am Geriatr Soc* 38:273–281
30. McKinlay JB, Link CL (2007) Measuring the urologic iceberg: design and implementation of the boston area community health (BACH) survey. *Eur Urol* 52:389–396