Published in final edited form as:

Int Urogynecol J. 2016 May ; 27(5): 763–772. doi:10.1007/s00192-015-2888-1.

Epidemiology of Mixed, Stress & Urgency Urinary Incontinence in Mid-Aged/Older Women: Importance of Incontinence History

Yuko M. Komesu, MD¹, Ronald M. Schrader, PhD.², Loren H. Ketai, MD¹, Rebecca G. Rogers, MD¹, and Gena C. Dunivan, MD¹

¹University of New Mexico Health Sciences Center

²University of New Mexico Clinical and Translational Science Center

Abstract

Introduction & Hypothesis—Urinary incontinence (UI) is common and the relationship between its subtypes is complex. Our objective was to describe the natural history and predictors of incontinence subtypes, Stress, Urgency and Mixed, in mid-aged and older U.S. women. We hypothesized that past UI subtype history predicted future UI subtype status and sought to determine the extent to which this occurred.

Methods—We analyzed longitudinal urinary incontinence data in 10,572 community-dwelling women 50 in the 2004–2010 Health and Retirement Study database. Mixed, Stress, Urgency incontinence prevalence (2004,2006,2008,2010) and 2-year cumulative incidence and remissions (2004–6,2006–8 2008–10) were estimated. Patient characteristics and incontinence subtype status 2004–2008 were entered into a multivariable model to determine predictors for incontinence subtype occurrence in 2010.

Results—Prevalence of each subtype in this population (median age 63–66) was 2.6%–8.9%. Subtype incidence equaled 2.1–3.5% and remissions for each varied between 22.3–48.7%. Incontinence subtype incidence predictors included ethnicity/race, age, body mass index, functional limitations. Compared to White women, Black women had decreased odds of incident Stress Incontinence, Hispanic women had increased odds of Stress Incontinence remission. Age 80–90 and severe obesity predicted incident Mixed Incontinence. Functional limitations predicted Mixed and Urgency Incontinence. The strongest predictor of incontinence subtypes was incontinence subtype history. Presence of the respective incontinence subtypes in 2004 and 2006 strongly predicted 2010 recurrence [Odds Ratio (OR) Stress Incontinence=30.7, Urgency OR=47.4, Mixed OR=42.1].

Corresponding Author: Yuko M. Komesu MD University of New Mexico Health Sciences Center Department of Obstetrics and Gynecology MSC10-5580 1 University of New Mexico Albuquerque, New Mexico 87131-0001 Phone: 505-272-9712, ykomesu@salud.unm.edu.

Contributions/Author Participation:

Komesu YM: Project development, Data Analysis, Manuscript writing

Schrader RM: Project development, Database Creation, Statistical Analysis, Manuscript writing

Ketai LH: Project development, Manuscript writing

Rogers RR: Manuscript writing

Dunivan GC: Manuscript writing

Conclusions—Although remissions were high, prior history of incontinence subtypes predicted recurrence. Incontinence status is dynamic but tends to recur over the longer term.

Keywords

Incidence; Predictors; Mixed/Stress/Urgency Urinary Incontinence

Introduction

More than 20 million U.S. women suffer from incontinence, a costly condition which increases with age [1,2,3,4]. Unprecedented growth of the population over age sixty-five highlights the need to examine the natural history of incontinence, particularly those subtypes more prevalent in older women [5]. Our current work focuses on UI subtypes in this population and uses modeling techniques that allow us to examine a broad array of UI subtype predictors, including the impact of prior UI subtype status on future UI subtype status.

We previously characterized the dynamic nature of incontinence in women in the Health and Retirement Study (HRS), a large, longitudinal, community-based population of mid-aged and older subjects [6]. Our current work takes advantage of the fact that for the past one-and-a-half decades, the HRS has asked questions distinguishing UI subtypes. Subjects are followed over discrete, consecutive time periods allowing use of multivariable analysis to develop predictive models for UI subtypes. Both incontinence history and patient characteristics were included in this study's models to concurrently assess their impact on future UI subtype status. Our objective was to describe the natural history of Stress Urinary Incontinence (SUI), Urgency Urinary Incontinence (UUI) and Mixed Urinary Incontinence (MUI) in older women and ascertain their predictors. We hypothesized that past UI subtype history predicted future UI subtype status and sought to determine the extent to which this occurred.

Materials & Methods

Data Source/Study Dates

Subjects were community dwelling women in the HRS 2004–2010. The HRS has examined older Americans' health with in-person, biennial interviews since 1992 and posts results on a publically available database [7]. HRS participants are chosen using multi-stage probability sampling [8]. Additional cohorts have been added every 6 years (1998, 2004, 2010) to maintain a steady state sample of participants. The HRS oversamples Black and Hispanic subjects, allowing sub-group analysis of minorities and provides sampling weights based on U.S. Census data to adjust for oversampling [8]. Zero weights are assigned to subjects institutionalized at survey follow-up to reflect community-dwelling estimates.

Our population consisted of women 50 with incontinence status information in the 2004 HRS database. We ascertained UI subtype prevalence in these women 2004, 2006, 2008 and 2010. Subjects for two year incidence/remission analyses (2004–06, 2006–08, 2008–10) had baseline and follow-up incontinence information. UI subtype prevalence, incidence and

remission are reported using weight adjusted proportions. We also included overall UI estimates to provide a context with which to interpret UI subtype estimates. This study was granted exempt review board status (HRRC #07-284) as all information in the HRS public database were de-identified.

Population Characteristics

We previously identified UI risk factors in an earlier HRS population; these included age, ethnicity/race, BMI, history of psychiatric illness (including depression), functional limitations and medical co-morbidities [6]. In the current study age was stratified by decade (6th–10th). Ethnicity/race was categorized as White, Black, Hispanic and Other. BMI groups are noted in Table 1. We assessed functional limitations as a continuous variable (percentage of total) based on nine questions in the HRS, also described previously [6]. Medical comorbidities (hypertension, diabetes, cancer, lung disease, heart disease, arthritis, stroke) were categorized as ordinal variables (0,1,2, 3) based on subject history [6].

Definitions

Incontinence definitions were based on questions noted in Figure 1. Frequency of urine loss greater than one day in the last month affirmed UI. We defined UUI as affirmation of the urgency question, SUI as affirmation of the stress question, MUI as affirmation of both, and Uncategorized UI as affirmation of neither. Figure 1 also includes prevalence, incidence and remission definitions. Remission was defined as UI at baseline which resolved at follow-up and transitions from one UI subtype to another were not considered remissions.

Computations/Statistical Analysis

We estimated prevalence and two year incidence/remission of UI/UI subtypes. Because subjects' ages spanned five decades, we also estimated proportions as age-stratified data. Multinomial logistic regression compared UI subtypes and associations with decade. Binary logistic regression analyzed associations between UI and decade (SAS/STAT@9.3). Results are reported as OR with 95% CI.

We evaluated incontinence predictors and focused on information prior to 2010 that best predicted incontinence in 2010. This longitudinal analysis evaluated whether prior incontinence status and patient characteristics (2004, 2006, 2008) independently predicted 2010 incontinence. We developed a binary (present or absent UI) model for overall UI and a multinomial model for UI subtypes; MUI, SUI, UUI, and uncategorized. Transition models (called Markov models) were fit using multivariable logistic regression. These models, as described by Diggle et. al, assumed subjects are in one of a limited number of discrete states (e.g. no UI, UUI, SUI, MUI, uncategorized), and transition probabilities between states were estimated [10]. These models have an associated 'order', which is the number of past time intervals employed to predict the future. In fitting models using logistic regression, order is determined by the number of significant interactions between predictors and past states, as well as the number of significant past states. These transition chains are characterized by a transition matrix which records probabilities of transitions from one state to the next. Transition events (presence/absence of UI/UI subtypes) were used to generate odds of incontinence occurrence and resolution and to indicate the effect that past states have in

predicting future states. We fit models and dropped non-significant interactions with earlier states and non-significant earlier states to arrive at transition models with lowest possible order.

Using logistic regression we modeled subjects' 2010 incontinence status controlling for the following independent variables in 2004, 2006 and 2008; incontinence status, age, ethnicity/race, medical co-morbidities, functional limitations, BMI, psychiatric history and associated interactions. The dependent variable was the multinomial outcome with categories no UI, UUI, SUI, MUI, uncategorized UI. Computation was performed using ProcSurveylogistic with sampling weights from 2010 and generalized logit link in SAS®9.3. This was a large set of predictor variables and most terms were non-significant. We dropped non-significant terms ($p = 0.05$) to arrive at a parsimonious model with lowest possible order.

Results

Population characteristics are noted in Table 1. Prevalence populations numbered 10,572 in 2004 to 7,908 in 2010. Incidence data were available for 9,545–7,842 women during these same years. Approximately 9–12% of participants were missing follow-up information in each of the two year increments; the majority due to death or institutionalization and <2% due to other reasons. Participants' median ages ranged between 63–66 years, the majority were White, overweight, with a median of 1–2 functional limitations and medical co-morbidities.

UI prevalence ranged between 19–26% and increased with age. Relative to the 6th decade, prevalence increased in all subsequent decades (all $P < .0001$). For example, UI occurred in 14.5–18% of women in the 6th decade and occurred in 39–42% of women in the 10th decade of life. UUI, MUI and SUI prevalence differed with respect to aging. UUI increased with age for all years ($P < .0001$). UUI age-related increases were most apparent in 2004; relative to the 6th decade, UUI odds in the 7th equaled 2.18 (CI=1.5–3.15) and by the 10th UUI odds increased nine-fold (OR= 9.19, CI=5.56–15.20). MUI prevalence, relative to the 6th decade, consistently increased in the 8th–10th decades (all $P = .005$). MUI in the 7th decade, relative to the 6th, did not increase in all time intervals and was increased only in 2004 ($P = .003$) and 2006 ($P < .001$). SUI did not increase with decade in any time interval (all $P = .28-.99$).

Two year incidence/remissions are noted in Tables 2 and 3. UI subtype transitions (e.g. resolution, persistence or change to other UI subtypes) are noted in Figure 2. UI incidence ranged between 11.8–13.3%, while the incidence of each UI subtype was approximately 3% (Table 2). UI remission was 30.0–34.6% and UI subtypes remissions ranged from 22–48% (Table 3). MUI had lowest probability of remission. Relative to MUI, SUI remission odds ranged from 1.5 (CI=1.2–2.0) in 2004–6 to 1.8 (CI=1.4–2.3) 2006–08, and relative to MUI UUI remission ranged from 1.5 (CI=1.1–1.9) 2004–6 to 1.7 (CI=1.3–2.2) 2006–8.

Subject characteristics in the multivariable model which predicted UI subtype incidence/remission included functional limitations, race/ethnicity, age and BMI, though their impact varied between subtypes. Increasing functional limitations predicted MUI and UUI in a linear fashion; whereas two limitations predicted incident UUI and MUI [UUI OR=1.1

(CI=1.03–1.15), MUI OR=1.7 (CI=1.5–2.0)], nine limitations predicted UUI and MUI odds more markedly [UUI OR=3.0 (CI=1.5–6.2), MUI OR=11.8 (CI=6.0–23.2)]. Race/ethnicity, rather than functional limitations were important predictors for SUI; Black women had decreased odds of incident SUI (OR=0.5, CI=0.3–0.9) and Hispanic women had increased odds of SUI remission (OR=7.7, CI=1.1–53.4). Age and BMI were only predictors for MUI and their associations were very narrow; only the 9th decade predicted incident MUI (OR=2.8, CI=1.5–5.3), and only BMI 35 predicted increased MUI incidence (OR=1.6, CI=1.1–2.4) and decreased remission (OR=0.6, CI=.4–0.9). The dominant predictors of UI subtype incidence/remission, rather than specific patient characteristics, were prior UI subtype status/history; presence of a specific subtype in 2004 and 2006, increased odds of that subtype's recurrence in 2010 thirty to forty-fold (Figure 3).

Discussion

This study adds significantly to the small body of literature regarding UI subtype epidemiology in older women. The large cohort included in this study's multivariable analysis allowed robust evaluation of UI subtype predictors. Its longitudinal analysis uniquely included incontinence status as a variable in the regression analysis which both solidified and quantified the importance of incontinence history in UI subtypes.

We found UI was prevalent and increased with age. Age-related associations differed between UI subtypes. UUI and MUI increased with age whereas SUI did not, reinforcing previous reports [9,11,12,13,14]. Two year UI incidence in this cohort, annualized to 5.9–6.7%, was comparable to the 7% incidence reported in older women by an international review [9]. The incidence and prevalence rates found in this study are consistent with others, supporting our definitions and methodology. Our study also provides additional insight into UI subtypes. HRS UI subtype two year incidence was approximately 3% for each subtype and remission was 22–48%.

Longitudinal studies of UI subtypes in older women are few and even fewer have identified subtype predictors [13,14,15,16]. HRS subject characteristics which independently predicted UI subtypes included ethnicity/race, age, functional limitations/physical disability and BMI. These differed between subtypes. Ethnicity/race was a predictor of SUI but not UUI or MUI. The role of ethnicity/race, a reported negative predictor of SUI in younger/mid-aged Black women [9,17] has been evaluated infrequently in older women. This study found Black women had decreased incident SUI. Black race also decreased likelihood of future SUI. Unlike reports in younger women [9,17], in our work ethnicity/race did not predict UUI. The high prevalence of UUI in older compared to younger women may overshadow differences in incidence attributable to race.

Physical disabilities/limitations have been reported to predict overall UI in older women [19]. The number of functional limitations was linearly related to the likelihood of developing MUI and UUI. Functional limitations were particularly strong predictors of incident MUI. Odds of developing incident MUI were 11-fold higher in women with a maximal number of functional limitations.

Few have reported the importance of BMI in UI subtype prediction and most existing reports have not specifically evaluated older populations. In mid-aged women Waetjen noted BMI increases of 5 kg/m² increased SUI 30% and UUI 15%.¹⁷ In a population of younger/mid-aged women BMI ≥ 35 increased incident SUI three-fold, MUI five-fold and UUI six-fold [20]. Our HRS study is one of the few reporting obesity as an incontinence predictor in older women; BMI had a specific effect on MUI prediction. Women with BMI ≥ 35 in 2008, had greater odds of developing MUI in 2010 and lesser odds of MUI resolution. Even after accounting for other covariates, high BMI, a modifiable risk factor, significantly predicted MUI.

Although subject characteristics were important incontinence predictors, this analysis demonstrated that prior UI subtype history had the greatest effect. To our knowledge, only one other group evaluated prior UI history as an incontinence predictor [19]. Using methods similar to ours, that study employed transitional logistic regression analysis and evaluated overall UI over 2 years in 1,017 post-menopausal women. That analysis also found prior UI was the strongest incontinence predictor. Prior UI increased odds of UI at follow-up by 24.7 (CI=18.5–33.2). Our study evaluated UI subtypes. Utilizing all UI subtypes in a multinomial model, we found UI subtype history increased UI subtype incidence 30–40 fold.

Our study quantified the degree to which incontinence history increased probability of recurrence. We found UI subtype status information from all three preceding time intervals (2004,2006,2008) improved prediction of UI subtypes in 2010 and underscored the importance of prior incontinence status as a predictor (Figure 3). A repeated history of UI subtype was most predictive of 2010 recurrence. When a specific subtype was present in 2004 and 2006, recurrence odds for that subtype in 2010 increased thirty to forty-fold. Subtype presence in the immediate preceding time interval was a stronger predictor than more distant intervals; 2006 UI subtype status was more powerful than 2004 status in predicting 2010 subtypes. Despite high remissions, UI subtypes recurred and were more refractory to resolution over longer time periods.

This study does have limitations, including lack of validated questionnaires and treatment data. Regarding questionnaires, we note questions similar to those employed in the HRS have characterized incontinence in other studies with comparable findings [14,17,21]. The likelihood that treatment confounds our results is also small. Less than 20% of women with mild-moderate UI seek care.⁹ In the setting of SUI, surgery is chosen by only 2% of patients [11,22]. Neither is UUI treatment likely to affect long-term continence; medication achieves continence in only 8–12.5% of patients and is often discontinued [23].

In conclusion, this study presents a unique, longitudinal evaluation of UI subtype epidemiology in a large, community-dwelling population of older women. Its innovative models found that prior incontinence subtype status profoundly affects future incontinence. Although shorter observation intervals suggest that incontinence status is dynamic with high remission [6,15,24], over longer observation, incontinence has a propensity to recur. As populations age, incontinence will increase; understanding UI subtypes will affect treatment and healthcare resource planning.

Acknowledgments

Sources of the work:

1) The Health and Retirement Study, Data products (CORE files 2004, 2006, 2008, 2010 and Cross Wave: Tracker 2010 file public use dataset). Produced and distributed by the University of Michigan with funding from the National Institute on Aging (*grant number NIA U01AG009740*). Ann Arbor, Michigan. U.S.A. 2) The current research was also supported by the National Center for Research Resources and the National Center for Advancing Translational Sciences of the National Institutes of Health through *Grant Number 8UL1TR000041*, The University of New Mexico Clinical and Translational Science Center

Disclosures:

Komesu, YM: Co- PI for “Brain Centered Therapy versus Medication for Urgency Urinary Incontinence_An RCT,” Grant Number 5R-01AT007171-03. NIH PA-10-067. Funding Source: NIH (Primary: NCCIH)

Schrader, R: Co-Investigator Grant Number 5R-01AT007171-03 (see above)

Ketai, LH: Co-PI Grant Number 5R-01AT007171-03 (see above)

Rogers, RR: Co-Investigator Grant Number 5R-01AT007171-03 (see above), Up-to-Date & McGraw-Hill royalties, Associate Editor IUJ, Editorial Board Female Pelvic Medicine and Reconstructive Surgery and Obstetrics & Gynecology, DSMB Chair Transform Trial, ABOG Subspecialty Board Member,

Dunivan, GC: Liberate Site PI, American Urogynecologic Society Education Committee

References

- Landefeld CS, Bowers BJ, Feld AD, et al. National Institutes of Health State-of-the-Science Conference Statement: Prevention of Fecal and Urinary Incontinence in Adults. *Annals of Internal Medicine*. 2008; 148(6):449. [PubMed: 18268289]
- Kannan H, Radican L, Turpin RS, et al. Burden of illness associated with lower urinary tract symptoms including overactive bladder/urinary incontinence. *Urology*. 2009; 74:34. [PubMed: 19428076]
- Hu TW, Wagner TH, Bentkover JD, et al. Costs of Urinary Incontinence and Overactive Bladder in the United States: A Comparative Study. *Urology*. 2004; 63:461. [PubMed: 15028438]
- Nygaard I, Barber MD, Burgio KL, et al. Prevalence of Symptomatic Pelvic Floor Disorders in US Women. *JAMA*. 2008; 300(11):1311. [PubMed: 18799443]
- [Retrieved 6-11-2014] The Older Population: 2010. Issued November 2011. Available at: <http://www.census.gov/prod/cen2010/briefs/c2010br-09.pdf>.
- Komesu YM, Rogers RG, Schrader RM, et al. Incidence and remission of urinary incontinence in a community-based population of women 50 years. *Int Urogynecol J Pelvic Floor Dysfunct*. 2009; 20(5):581. [PubMed: 19229462]
- Produced and distributed by the University of Michigan with funding from the National Institute on Aging (*grant number NIA U01AG009740*). Ann Arbor, MI: 2004–2010. Health and Retirement Study, Data products (CORE files 2004, 2006, 2008, 2010 and Cross Wave: Tracker 2010 file0 public use dataset. Available at: <http://hrsonline.isr.umich.edu> [Last retrieved 2-5-2014]
- Sampling Weights Revised for Tracker 2.0 and Beyond. Available at: <http://hrsonline.isr.umich.edu/sitedocs/wghtdoc.pdf> and Updates to HRS Sample Weights. Available at: <http://hrsonline.isr.umich.edu/sitedocs/userg/dr-013.pdf>.
- Milsom, I.; Altman, D.; Lapitan, M., et al. Epidemiology of urinary incontinence (UI) and faecal incontinence (FI) and pelvic organ prolapse (POP). In: Abrams, P.; Cardozo, L.; Khoury, S., et al., editors. *Incontinence*. 4th. Plymouth, United Kingdom: Health Publications; 2009.
- Diggle, P.J.; Heagerty, P.; Liang, K.-Y., et al. Book Chapter 10. Transition Models. 2. New York: Oxford University Press; 2009. Analysis of Longitudinal Data; p. 190-207.
- Hunnskaar S, Lose G, Sykes D, et al. The prevalence of urinary incontinence in women in four European countries. *British J Urol Int*. 2004; 93:324.

12. Coyne KS, Sexton CC, Thompson CL, et al. The prevalence of lower urinary tract symptoms (LUTS) in the USA, the UK and Sweden: results from the Epidemiology of LUTS (EpiLUTS) study. *BJU International* J. 2009; 104:352.
13. Thom DH, Brown JS, Schembri M, et al. Incidence and Risk Factors for Change in Urinary incontinence Status in a Prospective Cohort of Middle-Aged and Older women: The Reproductive Risk of Incontinence Study in Kaiser. *J Urol*. 2010; 184:1394. [PubMed: 20727544]
14. Lifford KL, Townsend MK, Curhan GC, et al. The Epidemiology of Urinary Incontinence in Older Women: Incidence, Progression, and Remission. *J Am Geriatr Soc*. 2008; 56(7):1191. [PubMed: 18492035]
15. Nygaard IE, Lemke JH. Urinary incontinence in rural older women: prevalence, incidence and remission. *J Am Geriatr Soc*. 1996; 44(9):1049. [PubMed: 8790229]
16. Irwin DE, Milsom I, Chancellor MB, et al. Dynamic Progression of Overactive Bladder and Urinary Incontinence Symptoms: A Systematic Review. *Euro Urol*. 2010; 58:532.
17. Waetjen LE, Liao S, Johnson WO, et al. Factors Associated with Prevalent and Incident Urinary Incontinence in a Cohort of Midlife Women: A Longitudinal Analysis of Data. *Study of Women's Health Across the Nation*. *Am J Epidemiol*. 2006; 165(3):309. [PubMed: 17132698]
18. Goode PS, Burgio KL, Redden DT, et al. Population Based Study of Incidence and Predictors of Urinary Incontinence in Black and White Older Adults. *J Urol*. 2008; 179:1449. [PubMed: 18295279]
19. Jackson SL, Scholes D, Boyko EJ, et al. Predictors of Urinary Incontinence in a Prospective Cohort of Postmenopausal Women. *Obstet Gynecol*. 2006; 108:355.
20. Townsend MK, Danforth KN, Rosner B, et al. Body-mass index, weight gain, and incident urinary incontinence in middle-aged women. *Obstet Gynecol*. 2007; 110:346. [PubMed: 17666610]
21. Minassian VA, Devore E, Hagan K, et al. Severity of Urinary Incontinence and Effect on Quality of Life in Women by Incontinence Type. *Obstet and Gynecol*. 2013; 121:1083.
22. Reynolds WS, Dmochowski RR, Penson DF. Epidemiology of Stress Urinary Incontinence in Women. *Curr Urol Rep*. 2011; 12:370. [PubMed: 21720817]
23. Shamliyan, T.; Wyman, J.; Kane, RL. Comparative Effectiveness Review No. 36. Rockville, MD: Agency for Healthcare Research and Quality; 2012 Apr. Nonsurgical Treatments for Urinary Incontinence in Adult Women: Diagnosis and Comparative Effectiveness. (Prepared by the University of Minnesota evidence-based practice Center under Contract No. HHSA 290-2007-10064-I.) AHRQ Publication No. 11(12)-EHC074-EF. Available at: www.effectivehealthcare.ahrq.gov/reports/final.cfm
24. Herzog AR, Diokno AC, Brown MB, et al. Two-Year Incidence, Remission, and Change Patterns of Urinary Incontinence in Noninstitutionalized Older Adults. *J Gerontol*. 1990; 45(2):67.

Brief Summary

A number of factors predicted urinary incontinence subtype occurrence in this population of older women, but a patient's history of incontinence was the greatest predictor.

Incontinence Definitions:

UI= Answered 'Yes' Urine loss > 1 day in the last month

SUI= Answered 'Most/Some of the time' to Stress & 'Rarely/Don't Know' to Urgency

UUI= Answered 'Most/Some of the time' to Urgency & 'Rarely/Don't Know' to Stress

MUI= Answered 'Most/Some of the time' to Stress & 'Most/Some of the time' to Urgency

Uncategorized= 'Rarely/Don't Know' to Urgency and Stress

Prevalence Definitions:

UI= # with UI / # with UI information

UUI= # with UUI / # with UI information

SUI= # with SUI / # with UI information

MUI= # with MUI / # with UI information

Uncategorized = # with Uncategorized/ # with UI information

Two year Cumulative Incidence Definitions:

UI=# with UI at 2 year follow-up/# without UI at baseline.

UI subtype= # with a specific UI subtype (UUI, SUI, MUI, Uncategorized) at 2 year follow-up /# without UI at baseline

Two Year Cumulative Remission Definitions:

UI=# with UI at baseline whose UI resolved at 2 year follow-up

UI Subtype=# with a specific UI subtype (UUI, SUI, MUI, Uncategorized) at baseline without UI at 2 year follow-up

Figure 1. Diagram of Urinary Incontinence and Incontinence Subtype Definitions

Figure 2. Urinary Incontinence Status: Transitions from Baseline to 2 year Follow-up

Transitions from incontinence status at baseline to 2 year follow-up (2004–6, 2006–8, 2008–10)

UI status at baseline: No UI, UUI (Pure UUI without other subtypes), SUI (Pure SUI without other subtypes). 2 Year follow-up: Percentages of patients in each subtype at follow-up (years 2006, 2008 & 2010) are expressed as a range encompassing results for each of the years

Figure 3. History Predicts Occurrence of Urinary Incontinence Subtypes

X-Axis represents OR for incidence of UI subtype in 2010

Y-Axis represents UI subtypes (SUI, UUI and MUI) and UI subtype history. “Distant”

history=UI subtype present in only 2004, “Recent” history=UI subtype present in only 2006,

“Repetitive” history=UI subtype present in both 2004 & 2006.

Table 1

Population Characteristics

Variables	Prevalence Population 2004 ^a (N=10,572) ^b	Prevalence Population 2006 ^a (N=9,717) ^b	Prevalence Population 2008 ^a (N=8,991) ^b	Prevalence Population 2010 ^a (N=7,908) ^b	Incidence Population 2004–2006 ^a (N=9545) ^b	Incidence Population 2006–2008 ^a (N=8826) ^b	Incidence Population 2008–2010 ^a (N=7842) ^b
Decade Life							
6 th : 50–<60 years	37.6% (2654)	33.8% (2009)	25.5% (1383)	18.1% (771)	38.2% (2439)	34.6% (1877)	26.6% (1263)
7 th : 60–<70 years	27.3% (3541)	30.1% (3234)	35.6% (2955)	40.7% (2652)	28.1% (3296)	30.9% (3013)	36.7% (2684)
8 th : 70–<80 years	21.2% (2606)	21.1% (2714)	22.6% (2880)	24.0% (2870)	21.3% (2392)	21.3% (2504)	22.5% (2553)
9 th : 80–<90 years	12.0% (1491)	12.7% (1456)	13.7% (1443)	14.3% (1301)	11.0% (1236)	11.5% (1219)	12.4% (1153)
10 th : 90	1.9% (280)	2.2% (304)	2.7% (330)	3.0% (314)	1.3% (182)	1.7% (213)	1.7% (189)
Median age years (95% CI) ^c	63.0 (62.6–63.4)	63.7 (63.3–64.1)	65.1 (64.7–65.4)	66.5 (66.1–66.9)	62.6 (62.3–63.0)	63.3 (63.0–63.7)	64.5 (64.1–64.8)
Ethnicity							
White	80.7% (7783)	81.2% (7181)	80.9% (6591)	80.7% (5776)	81.2% (7081)	81.4% (7193)	81.2% (5776)
Black	10.6% (1669)	10.2% (1527)	10.2% (1432)	10.4% (1272)	10.5% (1487)	10.0% (1528)	10.1% (1237)
Hispanic	6.6% (944)	6.6% (849)	6.8% (818)	6.8% (718)	6.4% (825)	6.7% (852)	6.7% (698)
Other	2.0% (176)	2.0% (160)	2.0% (150)	2.1% (142)	1.9% (152)	1.9% (160)	2.0% (131)
Functional Limitations							
None	27.1% (2557)	25.7% (2161)	25.5% (2018)	28.4% (1943)	27.4% (2348)	26.3% (2024)	26.3% (1834)
1	15.7% (1631)	14.9% (1401)	15.1% (1258)	14.3% (1119)	16.3% (1533)	15.4% (1316)	15.5% (1131)
2	12.1% (1284)	12.3% (1249)	11.6% (1087)	12.0% (929)	12.3% (1183)	12.5% (1159)	12.1% (991)
3	10.2% (1152)	9.5% (992)	10.9% (1011)	9.0% (776)	10.2% (1040)	9.6% (904)	11.0% (897)
9	1.0% (111)	1.5% (162)	1.3% (130)	1.7% (144)	.9% (95)	1.3% (134)	1.2% (109)
Median # (95% CI) ^c	1.11 (1.07–1.15)	1.8 (1.6–1.9)	1.8 (1.7–2.0)	1.7 (1.5–1.9)	1.6 (1.4–1.9)	1.7 (1.6–1.8)	1.7 (1.6–1.9)
# Medical Comorbidities							
0	18.3% (1595)	15.9% (1182)	14.2% (970)	11.9% (716)	18.4% (1448)	16.2% (1095)	14.4% (860)
1	28.8% (2855)	27.7% (2463)	26.1% (2140)	25.5% (1785)	29.2% (2610)	28.3% (2291)	26.6% (1909)

Variables	Prevalence Population 2004 ^a (N=10,572) ^b	Prevalence Population 2006 ^a (N=9,717) ^b	Prevalence Population 2008 ^a (N=8,991) ^b	Prevalence Population 2010 ^a (N=7,908) ^b	Incidence Population 2004-2006 ^a (N=9545) ^b	Incidence Population 2006-2008 ^a (N=8826) ^b	Incidence Population 2008-2010 ^a (N=7842) ^b
2	26.8% (2993)	27.5% (2830)	28.4% (2668)	28.3% (2348)	27.0% (2745)	28.0% (2620)	29.0% (2387)
3	26.1% (3129)	28.9% (3242)	31.3% (3213)	34.3% (3059)	25.4% (2742)	27.5% (2820)	30.1% (2686)
Median # (95% CI)	1.7 (1.5-1.9)	1.2 (1.2-1.3)	1.3 (1.3-1.4)	1.4 (1.4-1.5)	1.1 (1.0-1.1)	1.20 (1.15-1.24)	1.3 (1.3-1.4)
BMI (kg/m²)							
<25	38.1% (3861)	36.2% (3417)	34.6% (3082)	34.8% (2762)	37.0% (3374)	35.0% (2985)	33.3% (2571)
25 to <30	32.3% (3374)	32.1% (3113)	33.1% (2932)	32.1% (2500)	32.8% (3101)	32.6% (2883)	33.3% (2587)
30 to <35	17.7% (1874)	19.1% (1805)	18.9% (1673)	20.0% (1525)	18.1% (1732)	19.6% (1680)	19.4% (1508)
35	11.8% (1221)	12.5% (1190)	13.4% (1138)	13.2% (979)	12.1% (1135)	12.7% (1100)	13.9% (1035)
Median BMI (95% CI) ^d	26.6 (26.5-26.7)	26.9 (26.7-27.2)	27.3 (27.1-27.5)	27.3 (27.2-27.5)	26.8 (26.6-27.1)	27.1 (26.9-27.4)	27.4 (27.3-27.6)

^a Percentages (%) report weight adjusted proportions and % sums which do not equal 100 are due to rounding of percentages. Numbers in parentheses () report unweighted raw data.

^b N in each category may not equal total number of subjects due to missing data. Missing data was < 1% for all categories except BMI with <3% missing data

^c Medians are weight adjusted (95% CI of the median)

Table 3

Overall & Age Stratified Two Year Cumulative Incidence of UI and UI Subtype

Decade Year	6 th :50-<60 yrs Weighted % (unweighted proportions)	7 th :60-<70 yrs Weighted % (unweighted proportions)	8 th :70-<80 yrs Weighted % (unweighted proportions)	9 th :80-<90 yrs Weighted % (unweighted proportions)	10 th : 90 Weighted % (unweighted proportions)	Overall Incidence Weighted % (unweighted proportions)
2004-06						
Total UI	8.7% (186/2093)	11.7% (306/2678)	13.9% (246/1858)	19.6% (172/909)	23.1% (26/116)	11.8% (936/7654)
UII	1.7% (41/2093)	3.1% (83/2678)	4.3% (73/1858)	6.5% (55/909)	9.0% (10/116)	3.2% (262/7654)
SUI	3.2% (61/2093)	3.2% (84/2678)	3.2% (54/1858)	2.9% (24/909)	3.1% (3/116)	3.2% (226/7654)
MUI	2.1% (52/2093)	3.6% (97/2678)	3.8% (70/1858)	6.9% (60/909)	7.4% (9/116)	3.4% (288/7654)
Uncategorized	1.6% (32/2093)	1.8% (42/2678)	2.7% (49/1858)	3.4% (33/909)	3.6% (4/116)	2.1% (160/7654)
2006-08						
Total UI	8.5% (131/1584)	12.3% (296/2370)	15.5% (293/1936)	20.8% (175/861)	35.0% (45/138)	12.8% (940/6889)
UII	1.5% (22/1584)	2.9% (74/2370)	5.2% (95/1936)	7.2% (59/861)	9.5% (12/138)	3.4% (262/6889)
SUI	3.3% (47/1584)	3.8% (87/2370)	2.9% (55/1936)	3.4% (26/861)	2.5% (4/138)	3.4% (219/6889)
MUI	2.4% (42/1584)	3.3% (81/2370)	4.2% (85/1936)	5.6% (52/861)	17.1% (22/138)	3.6% (282/6889)
Uncategorized	1.3% (20/1584)	2.4% (54/2370)	3.2% (58/1936)	4.6% (38/861)	6.0% (7/138)	2.4% (177/6889)
2008-10						
Total UI	10.0% (98/1047)	12.4% (250/2068)	13.5% (242/1882)	22.3% (169/792)	28.7% (30/114)	13.3% (789/5903)
UII	2.4% (28/1047)	3.3% (65/2068)	3.4% (57/1882)	4.2% (35/792)	3.5% (4/114)	3.2% (189/5903)
SUI	3.6% (33/1047)	3.5% (68/2068)	3.6% (60/1882)	2.8% (21/792)	5.4% (7/114)	3.5% (189/5903)
MUI	2.6% (23/1047)	2.5% (55/2068)	3.2% (63/1882)	8.0% (61/792)	9.1% (8/114)	3.4% (210/5903)

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Decade Year	6 th :50- yrs Weighted % (unweighted proportions)	7 th :60- yrs Weighted % (unweighted proportions)	8 th :70- yrs Weighted % (unweighted proportions)	9 th :80- yrs Weighted % (unweighted proportions)	10 th : 90 yrs Weighted % (unweighted proportions)	Overall Incidence Weighted % (unweighted proportions)
Uncategorized	1.3% (14/1047)	3.2% (62/2068)	3.3% (62/1882)	7.3% (52/792)	10.6% (11/114)	3.2% (201/5903)

Table 4
Two Year Cumulative Remission of UI and UI Subtypes; Overall & Age-Stratified Results

Decade Years	6 th ; 50-<60 yr Weighted % (unweighted proportions)	7 th ; 60-<70 yr Weighted % (unweighted proportions)	8 th ; 70-<80 yr Weighted % (unweighted proportions)	9 th ; 80-<90 yr Weighted % (unweighted proportions)	10 th ; 90 Weighted % (unweighted proportions)	Overall Remission Weighted % (unweighted proportions)
2004-06						
Total UI	37.4% (132/346)	34.1% (213/618)	35.1% (192/534)	32.2% (102/327)	19.4% (13/66)	34.6% (652/1891)
UII	45.5% (18/45)	36.5% (48/128)	36.8% (49/131)	36.7% (32/99)	21.9% (4/21)	37.6% (151/424)
SUI	30.8% (43/127)	35.2% (66/196)	46.1% (56/121)	34.8% (22/60)	---	35.3% (187/510)
MUI	34.6% (45/130)	25.8% (62/223)	24.7% (54/213)	23.3% (28/120)	16% (6/31)	27.4% (195/717)
Uncategorized	55.3% (26/44)	51.0% (37/71)	44.3% (33/69)	41.0% (20/48)	40.9% (3/8)	48.7% (119/240)
2006-08						
Total UI	30.4% (93/293)	31.9% (204/643)	31.1% (173/568)	30.9% (112/358)	28.3% (21/75)	31.0% (603/1937)
UII	41.6% (26/58)	30.9% (44/145)	33.0% (44/143)	37.6% (43/111)	34.3% (9/26)	35.1% (166/483)
SUI	27.6% (32/107)	41.4% (74/191)	35.2% (52/140)	32.4% (17/56)	41.3% (3/8)	34.4% (178/502)
MUI	21.0% (20/95)	25.7% (65/238)	19.5% (40/197)	22.8% (34/145)	16.3% (6/34)	22.3% (165/709)
Uncategorized	46.8% (15/33)	26.4% (21/69)	46.3% (37/88)	39.4% (18/46)	44.4% (3/7)	40.1% (94/243)
2008-10						
Total UI	32.3% (71/216)	27.9% (177/616)	32.8% (232/671)	28.5% (103/361)	28.4% (24/75)	30.1% (607/1939)
UII	24.4% (8/30)	31.4% (43/139)	33.1% (64/188)	40.7% (44/109)	37.7% (7/21)	33.3% (166/487)
SUI	35.4% (27/77)	25.3% (49/184)	37.0% (58/143)	32.1% (20/61)	18.4% (2/8)	31.1% (156/473)
MUI	31.0% (28/86)	19.3% (49/221)	23.5% (59/237)	15.7% (23/139)	21.5% (10/36)	22.3% (169/719)

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Decade Years	6 th : 50-<60 yr Weighted % (unweighted proportions)	7 th : 60-<70 yr Weighted % (unweighted proportions)	8 th : 70-<80 yr Weighted % (unweighted proportions)	9 th : 80-<90 yr Weighted % (unweighted proportions)	10 th : 90 Weighted % (unweighted proportions)	Overall Remission Weighted % (unweighted proportions)
Uncategorized	36.5% (8/23)	51.5% (36/72)	47.6% (51/103)	31.9% (16/52)	40.6% (5/10)	44.0% (116/260)