Published in final edited form as:

J Urol. 2016 October ; 196(4): 1190–1195. doi:10.1016/j.juro.2016.04.084.

Mixed Incontinence Masked as Stress Induced Urgency Urinary Incontinence

Vatché A Minassian, MD, MPH¹, Xiaowei S Yan, PHD², James Pitcavage, MSPH³, and Walter F Stewart, PhD, MPH²

¹ Brigham and Women's Hospital, Boston, MA

² Sutter Health System, CA

³ Geisinger Health System, Danville, PA

Abstract

OBJECTIVE—To understand variation in expression and the temporal relation of bladder control episodes among women with mixed urinary incontinence (MUI).

METHODS—A random sample of women 40 years with MUI from the General Longitudinal Overactive Bladder Evaluation – UI was recruited into a digital daily diary study using a smart phone application. When a bladder control event occurred, women were instructed to answer episode specific questions. Episodes were defined as urgency, UI with and UI without urgency. Women and episodes were compared by type of activity preceding each episode. UI episodes were further defined as stress UI (SUI), urgency UI (UUI), stress induced UUI, and other. Chi-square and Wilcoxon tests were used for categorical and continuous variables, respectively.

RESULTS—A total of 35 of 40 women (mean age = 65.5) provided complete 30-day diary data. Of the 950 bladder control episodes reported, 25% were urgency only, 55% were UI with urgency, and 19% were UI without urgency. Of the UI episodes without urgency, 82% occurred after a stress activity (e.g., coughing or sneezing). Notably, a stress activity also occurred just before 52.5% of the UUI episodes, $P < 0.001$. Twenty-four (69%) reported at least one episode of stress induced UUI which was the most prevalent UI subtype episode (29%) followed by UUI (27%) and SUI (16%). Mean number of daily episodes ranged between 1 and 2 across all groups.

CONCLUSION—Women with MUI express a heterogeneous set of bladder control episodes with stress induced UUI being the dominant type.

Keywords

urinary incontinence; stress; urgency and mixed urinary incontinence; survey

Correspondence: Vatché A. Minassian, MD, Director of Urogynecology, Department of OB/GYN, 75 Francis Street, ASB1 3 -Room 073, Boston, MA 02115, Phone: (617) 732-4838, Fax: (617) 732-6116, vminassian@partners.org.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

INTRODUCTION

Mixed urinary incontinence (MUI), the most common type of UI in older women, is a heterogeneous disorder.¹⁻⁵ Prevalence of MUI is considerably more common than expected if SUI and UUI are assumed to be independent of each other.⁶ This epidemiologic feature indicates that in a majority of women with MUI, SUI and UUI co-occur because of a common cause or some other means of interaction. Co-occurrence by chance is likely to be uncommon.

The higher than expected prevalence of MUI could be due to SUI and UUI episodes occurring at separate times but linked by a common predisposing factor.⁷⁻¹¹ Factors that provoke either subtype may be causally distinct (e.g., common cold versus excess caffeine intake) but correlated within individuals. This explanation is most relevant in women where SUI and UUI co-occur by chance. Alternatively, exogenous (e.g., excess weight) or situational factors (e.g., stress) may mediate co-occurrence and increase risk of both SUI and UUI episodes.^{12,13} Finally, SUI episodes may provoke UUI episodes, given that these disorders give rise to mechanical and neuro-muscular mechanisms of action proximal to each other.⁶

Understanding temporal occurrence of SUI and UUI episodes would offer important etiologic clues about MUI.^{14, 15} We used a daily digital diary to better understand variation in expression of MUI and the relation among bladder control episodes that women experience.

METHODS

We conducted a digital daily diary study in a sample of 40 women with MUI from the Generalized Longitudinal Overactive Bladder Evaluation – Urinary Incontinence (GLOBE-UI).^{16,17} We briefly describe the original study and the methods for the diary study. The Geisinger Health System IRB approved the study.

Source Population and GLOBE-UI Cohort

Diary study participants were selected from the 8,497 GLOBE-UI women, 40 years of age or older, from primary care practices in central and northeastern Pennsylvania. Participants completed the Bladder Health Survey (BHS). Details of the BHS survey method are described elsewhere.¹⁸ The BHS includes lifetime, 6- months and 4-weeks questions on the occurrence of urgency, UI, SUI and UUI. The BHS has proven reliability and clinical validity.¹⁸

Women in the diary study met criteria for active SUI and UUI symptoms in the previous six months. As part of the original clinical validation study, 15 of the 35 participants were previously clinically assessed with a structured protocol, diagnosed by a Urogynecologist, including urodynamics. Fourteen of the 15 women had confirmed mixed UI, and one had UUI. Women with prior anti-incontinence surgery or medical treatment for overactive bladder were excluded. SUI was defined if someone reported having UI about half the time

or more to at least one of two stress UI questions.¹⁸ UUI was defined if someone reported having UI about half the time or more to at least one of two UUI questions.¹⁸

Selection and Recruitment of Diary Study Participants

Nine hundred and twenty women met inclusion criteria for active SUI and active UUI. Women were sampled from 8 strata defined by different levels of SUI and UUI. An initial letter was sent to women to notify them about the study, and they were later called to assess interest to participate in the study. Recruitment stopped after obtaining verbal consent from 5 women in each of the 8 strata, for a total of 40 women.

Diary Data Collection Protocol

Questions in the digital diary were motivated by traditional bladder control symptoms and by a large epidemiologic longitudinal study that suggested variants of urine loss events that did not fit the traditional constructs. Questions were mostly derived from the BHS that has been shown to have highly reliable questions and that has been clinically validated.¹⁸ The daily diary study was conducted using a smart phone application developed by the Survey Research Center, Pennsylvania State University. Participants were scheduled for a group or home-visit training. A help line number was provided for questions.

Digital diary questions were organized into three sections (Table 1). When a bladder control event occurred, women were instructed to click the “Event” tag showing a sequence of questions about the event nature including what preceded the event, urine loss amount (if any), and the participant's psychological state during the event. Next, participants were instructed to click the “Evening” tag at bedtime to answer questions about frequency, UI episodes and pads used, fluid intake (including caffeine), and an overall rating of stress for the day. Section 3 was triggered by clicking the “Morning” tag and answering questions about nocturia. Date and time of day were automatically logged for any diary transaction.

Analysis

Analyses were completed using the 30-day digital diaries and the BHS survey data including: age, BMI, parity, marital status, education, smoking, alcohol status, history of diabetes, UI subtype scores, duration of time with UI, UDI-6, IIQ-7, and the Sandvik score. These data were used to compare diary study participants to the source population of GLOBE UI participants. Chi-square and Wilcoxon sign tests were used for categorical continuous variables, respectively. All analyses were conducted using SAS (version 9.4, SAS institute, Inc, Cary, NC).

We were interested in answering the following key questions. First, in the moments before a bladder control episode, what was a woman's experience? Three types of episodes were defined: a.) Urgency only; b.) UI with urgency; and c.) UI without urgency. We compared the type of activity just preceding the occurrence of each of these episodes. We also compared mean volume of UI and mood of participants at the time of each episode.

The second question was whether there was variation in the frequency of the different episodes. Hence, we estimated total number of episodes, overall and by subtype, and the

mean number of days with at least one episode. We also generated mean frequency measures of overall and daily bladder control episodes. Here, we used answers to the bladder control event questions (top section of table 1) to further classify UI episodes into the following subtypes: (1) SUI – “Just leaked urine” *and* at least one of the following activities: [“I coughed, sneezed or laughed” or “I pushed or lifted something” or “Standing and jumping” or “Walking or running”]; (2) UUI – [“Just leaked urine” or “Had a sudden urge to urinate and leaked urine”] *and* at least one of the following: [“I felt a sudden strong feeling to urinate” or “laying down or sitting” or “washing dishes or hearing / using running water”]; (3) Stress induced UUI - “Had a sudden urge to urinate and leaked urine” *and* at least one of the following: [“I coughed, sneezed or laughed” or “I pushed or lifted something” or “Standing and jumping” or “Walking or running”]; (4) Unknown or other UI - “Just leaked urine” *and* “Other” or “no answer” (Table 1).

Finally, we compared voiding characteristics and daily fluid intake (including caffeine) by days with stress induced UUI episodes, days without stress induced UUI but with urgency or UUI, days with SUI only, and days without any UI episode.

RESULTS

Of the 40 women, 35 provided complete and valid data, two completed only 14 and 17 days of the diary, respectively, and three decided not to participate after enrolling. Details on participants and non-participants are summarized in Table 2. Diary participants were less likely to have an SUI score of 5+ and were more likely to have had UI for a longer time period. Although survey participants (versus non-participants) had a higher UDI-6 bother score (69 versus 57, $P=0.02$), they reported similar IIQ-7 scores (27 versus 25, $P=0.65$) (Table 2).

The 35 women reported 950 bladder control episodes over 30 days, of which 25% were urgency only, 55% were UI with urgency, and 19% were UI without urgency (Table 3). Women who reported UI with no urgency (82%) were more likely to have had a preceding stress related event compared to those who reported UI with urgency (52.5%, $p<0.01$). For example, 40% of UI episodes without urgency were associated with coughing or sneezing, 15% with standing or jumping, and 27% with walking or running. Even for UUI episodes, 35% occurred just after coughing or sneezing, 8% with standing or jumping, and 10% with walking or running, $P<0.01$. Conversely, episodes of urgency with or without UI were more likely to occur with the sitting position, on the way to the bathroom, or with the sound of running water (Table 3).

Volume of urine loss was not significantly different ($P=0.11$) between UI episodes with versus without urgency. UI with urgency episodes (32%) occurred more often than UI without urgency (18%) when patients were distracted. However, UI episodes without urgency were significantly ($P<0.001$) more likely than UI episodes with urgency to be associated with feelings of excitement, stress and anxiety (19% versus 13%) and feelings of frustration, annoyance and being upset (13% versus 8%) (Table 3).

Mean number of total daily episodes (1-2) were similar for all UI subtypes. The mean number of days having at least one bladder control episode was 5.2 days for urgency and UUI, 4.1 days for stress induced UUI, 2.9 days for SUI, and 0.8 days for other UI (Table 4). Stress induced UUI was the most common UI event, accounting for 29% of all UI events. This was followed by UUI (27%) and SUI (16%) (Table 4). Four women reported SUI and UUI episodes during the 30 day period that appeared to occur independent of each other; none of these women had stress induced UUI events. In contrast, 24 women had at least one stress induced UUI episode; three women had UUI episodes only; two had SUI episodes only; and two had other (or unknown) type of UI episodes.

There was no difference in the mean fluid intake volume (32-38 ounces) between days with or without UI episodes, irrespective of type. Caffeine intake was more likely on days without UI episodes which also were associated with lower frequency and nocturia rates. For instance, 7 or more daily voids were highest for days with stress induced UUI (20%) followed by days with urgency or UUI (14%) then SUI (13%) and lastly days without any UI episode (9%), $P=0.007$ (Table 5).

DISCUSSION

MUI is defined as the co-occurrence of SUI and UUI¹⁹ without specifying how events co-occur. We undertook our study to better understand the nature of UI episodes in women with MUI. UI episodes within and among women with MUI were heterogeneous, where the dominant episode has not been previously characterized. We described this episode as stress induced UUI, where UI with urgency immediately follows a stress event. Notably, a minority of women who met MUI criteria reported episodes of SUI and UUI occurring independent of each other.

Others have tried to better characterize MUI by comparing survey data to clinical and urodynamics findings. Terminology such as stress predominant or urgency predominant MUI have been used.^{5,20-22} However, MUI continues to be poorly understood. Brubaker has cast doubt into the utility of the term MUI in outcomes research arguing that current definitions are inadequate, and until a “standard operational definition is available”, MUI may best be categorized by its component SUI and UUI severity levels.⁵

Findings from our study bring us closer to the “operational definition” for MUI. We propose that the subtype of stress induced UUI may offer a potential explanation for why SUI prevalence decreases after 50 and why MUI prevalence increases. Epidemiologically, SUI alone is uncommon at an older age, as it mostly co-occurs with UUI.^{1,20,23} Moreover, the observed prevalence of MUI is much higher than expected assuming that SUI and UUI are independent.⁶ Hence, one hypothesis for the relatively high prevalence of MUI is that the stress induced UUI phenotype is a progressive or advanced MUI stage, difficult for a woman to distinguish SUI from a UUI.¹⁴

Alternatively, prolonged presence of one type of UI may increase risk of onset of the other type. Here, a dominant UI variant may begin with SUI progressing from a normal state to one where stressors (e.g., parity and weight) impair pelvic floor function resulting in

increased vulnerability to UI episodes.²⁴ Persistent exposure to stressors may trigger secondary processes that increase SUI episodes and sensitize neuromuscular response leading to urgency episodes that later trigger UUI episodes with a stress event.²⁵ Here, a stress activity in the context of a weakened pelvic floor, may have a higher likelihood of causing UI with an urgency event. Additionally, trauma or age related deterioration of sphincter support may be associated with a lower threshold for an urgency episode to result in UI.²⁶

We also hypothesize that progression towards a more severe UI state may be mediated by factors facilitating a positive feedback loop between SUI and UUI. Evidence for other chronic episodic conditions indicates that in susceptible individuals, peripheral and central nervous systems mitigate progression through behavioral and cognitive-psychological pathways.^{13,27,28} We propose that an analogous process may mediate progression of UI towards MUI and eventually toward an end-stage of chronic persistent daily symptoms, where SUI and UUI are coupled and indistinguishable.

Interestingly, although volume of UI did not differ between episodes with or without urgency, mood and psychological state differed. Being distracted was more likely to be associated with UI and urgency suggesting that conscious control and timed toileting may help mitigate these episodes; in contrast, being stressed or excited was more associated with UI and no urgency suggesting that pelvic floor strengthening may be helpful in controlling those episodes. Since the majority of our cohort had multiple bladder control symptoms, advocating a combination of behavioral changes may be of benefit. Although fluid intake volume had no effect on type of episode, two or more caffeinated beverages were more common when UI was absent, likely reflecting an adaptive behavior whereby women avoid caffeine on days with UI episodes.

Limitations to our study include the small size of the cohort; however, this was primarily a descriptive and exploratory pilot phone diary study designed to study novel questions and generate hypotheses. Although the phone diary was not validated, we worked with experts in experience sampling using digital applications and with in depth knowledge on how to assess symptom experience. It is important for future larger studies to validate the phone diary clinically to better understand temporal relations between SUI and UUI, including insensible UI episodes not associated with either urgency or stress events. Our cohort included women over the age of 40. Symptoms experienced will differ from younger women with bladder control problems and should be extrapolated with caution.

Understanding the temporal occurrence of SUI and UUI episodes offer important insights into disease state and pathogenesis leading to more effective and targeted prevention and treatment options. Women with mixed UI experience a heterogeneous set of bladder control events with stress induced UUI being the most common variant. We speculate that the first line mixed UI treatment is to address the SUI component preferentially. This may result in significant improvement of the UUI component as well. This digital diary study offers a glimpse into bladder control episodes and associated events as they unfold in real-time in women over the age of 40 with MUI.

Acknowledgments

Financial Support Disclosure: This research was funded by a grant from the National Institute of Health, grant #R01DK082551

Key of Definitions for Abbreviations

MUI	Mixed urinary incontinence
SUI	Stress UI
UII	Urgency UI
GLOBE-UI	Generalized Longitudinal Overactive Bladder Evaluation – Urinary Incontinence
BHS	Bladder Health Survey

REFERENCES

1. Hannestad YS, Rortveit G, Sandvik H, et al. A community-based epidemiological survey of female urinary incontinence:: The Norwegian EPINCONT Study. *J Clin Epidemiol*. 2000; 53:1150. [PubMed: 11106889]
2. Hunskaar S, Burgio K, Diokno A, et al. Epidemiology and natural history of urinary incontinence in women. *Urology*. 2003; 62:16. [PubMed: 14550833]
3. Melville JL, Katon W, Delaney K, et al. Urinary incontinence in US women: a population-based study. *Arch Intern Med*. 2005; 165:537. [PubMed: 15767530]
4. Minassian VA, Stewart WF, Wood CG. Urinary Incontinence in Women: Variation in Prevalence Estimates and Risk Factors. *Obstet Gynecol*. 2008; 2:324. [PubMed: 18238969]
5. Brubaker L, Stoddard A, Richter H, et al. Mixed incontinence: comparing definitions in women having stress incontinence surgery. *Neurourol Urodyn*. 2009; 28:268. [PubMed: 19274758]
6. Minassian VA, Stewart WF, Hirsch AG. Why do stress and urge incontinence co-occur much more often than expected? *Int Urogynecol J Pelvic Floor Dysfunct*. 2008; 19:1429–1440. [PubMed: 18528608]
7. Dallosso HM, McGrother CW, Matthews RJ, et al. The association of diet and other lifestyle factors with overactive bladder and stress incontinence: a longitudinal study in women. *BJU Int*. 2003; 92:69. [PubMed: 12823386]
8. Hannestad YS, Rortveit G, Daltveit AK, et al. Are smoking and other lifestyle factors associated with female urinary incontinence? The Norwegian EPINCONT Study. *BJOG*. 2003; 110:247. [PubMed: 12628262]
9. Cummings JM, Rodning CB. Urinary stress incontinence among obese women: review of pathophysiology therapy. *International Urogynecology Journal*. 2000; 11:41.
10. Teleman PM, Lidfeldt J, Nerbrand C, et al. Overactive bladder: prevalence, risk factors and relation to stress incontinence in middle-aged women. *BJOG*. 2004; 111:600. [PubMed: 15198789]
11. Brown JS, Grady D, Ouslander JG, et al. Prevalence of urinary incontinence and associated risk factors in postmenopausal women. Heart & Estrogen/Progestin Replacement Study (HERS) Research Group. *Obstet Gynecol*. 1999; 94:66. [PubMed: 10389720]
12. Wing RR, West DS, Grady D, et al. Effect of weight loss on urinary incontinence in overweight and obese women: results at 12 and 18 months. *J Urol*. 2010; 184:1005. [PubMed: 20643425]
13. Smith JA, Decalmer S, Kelsall A, et al. Acoustic Cough - Reflex Association in chronic cough: Potential triggers and mechanisms. *Gastroenterology*. 2010; 139:754. [PubMed: 20600028]
14. Bump RC, Norton PA, Zinner NR, et al. Mixed urinary incontinence symptoms: urodynamic findings, incontinence severity, and treatment response. *Obstet Gynecol*. 2003; 102:76. [PubMed: 12850610]

15. Thom D. Variation in estimates of urinary incontinence prevalence in the community: effects of differences in definition, population characteristics, and study type. *J Am Geriatr Soc.* 1998; 46:473. [PubMed: 9560071]
16. Stewart WF, Minassian VA, Hirsch AG, et al. Predictors of variability in urinary incontinence and overactive bladder symptoms. *Neurourology & Urodynamics.* 2010; 29:328. [PubMed: 19693956]
17. Hirsch AG, Minassian VA, Dilley A, et al. Parity is not associated with urgency with or without urinary incontinence. *Int Urogynecol J Pelvic Floor Dysfunct.* 2010; 21:1095.
18. Minassian VA, Yan XS, Sun H, et al. Clinical validation of the Bladder Health Survey for urinary incontinence in a population sample of women. *Int Urogynecol J.* 2016; 27:453–61. [PubMed: 26386565]
19. Haylen BT, de Ridder D, Freeman RM, et al. An International Urogynecological Association (UGA)/International Continence Society (ICS) joint report on the terminology for female pelvic floor dysfunction. *Neurourol Urodyn.* 2010; 29:4. [PubMed: 19941278]
20. Sandvik H, Hunskaar S, Vanvik A, et al. Diagnostic classification of female urinary incontinence: an epidemiological survey corrected for validity. *J Clin Epidemiol.* 1995; 48:339. [PubMed: 7897455]
21. Digesu GA, Salvatore S, Fernando R, et al. Mixed urinary symptoms: What are the urodynamic findings? *Neurourol Urodyn.* 2008; 27:372. [PubMed: 17943988]
22. Brubaker L, Lukacz ES, Burgio K, et al. Mixed incontinence: comparing definitions in non-surgical patients. *Neurourol Urodyn.* 2011; 30:47. [PubMed: 21181960]
23. Herzog AR, Fultz NH. Prevalence and incidence of urinary incontinence in community-dwelling populations. *J Am Geriatr Soc.* 1990; 38:273. [PubMed: 2179368]
24. Nygaard IE, Heit M. Stress urinary incontinence. *Obstet Gynecol.* 2004; 104:607. [PubMed: 15339776]
25. Petros PE, Ulmsten UI. An integral theory of female urinary incontinence. Experimental and clinical considerations. *Acta Obstet Gynecol Scand.* 1990; 153:7.
26. Petros PEP. Mixed urinary incontinence—time to uncouple urgency from stress? *International urogynecology journal.* 2011; 22:919. [PubMed: 21614442]
27. Nazif O, Teichman JM, Gebhart GF. Neural upregulation in interstitial cystitis. *Urology.* 2007; 69:24. [PubMed: 17462476]
28. Woolf CJ. Central sensitization: Implications for the diagnosis and treatment of pain. *Pain.* 2011; 152:S2. [PubMed: 20961685]

Table 1

Daily Diary Question Sets and Response Options

Questions Asked	Response Options
Section 1: Bladder Control Event	
A. What just happened? [/]	1 = Had a sudden urge to urinate but did not leak 2 = Just leaked urine 3 = Had a sudden urge to urinate and leaked urine
B. What happened right before the above event? (check all that apply) [/]	1 = I coughed, sneezed, or laughed 2 = I pushed or lifted something 3 = I felt a sudden strong feeling to urinate 4 = Laying down or sitting 5 = Standing or jumping 6 = Walking or running 7 = Washing dishes or hearing, using running water 8 = Other
C. How much did you leak? (if no leak, question not shown)	1 = A few drops 2 = More than a few drops, but not a lot 3 = A lot
D. How were you feeling just before you leaked?	1 = Stressed or anxious 2 = Frustrated or annoyed 3 = Distracted 4 = Relaxed 5 = Excited 6 = Upset 7 = Other
Section 2: Evening Survey	
E. How many times total did you urinate today?	1 = 3-4 times 2 = 5-6 times 3 = 7-10 times 4 = More than 10 times
F. How many times did you leak today?	1 = None 2 = Once 3 = Twice 4 = 3-4 times 5 = 5 or more times
G. How many 8oz servings of liquids did you have today?	Give a keyboard for them to indicate the number of servings (water, coffee, tea and other liquids)
H. Did you have two or more caffeinated drinks today?	0 = No 1 = Yes
I. How many pads to absorb urine did you go through today?	1 = None 2 = One 3 = Two 4 = Three or four 5 = Five or more
J. How stressful was your day?	0-10 scale (where 0 is "no stress at all" and 10 is as stressful as it can be)
Section 3: Morning Survey	
K. Did you leak in bed last night?	0 = No 1 = Yes
L. How many times did you wake up during the night to urinate?	Give a keyboard for them to indicate the number of times they urinated

[/] Questions A and B were used to define bladder control events as follows: Urgency (A=1; B=any answer) ; Stress urinary incontinence (A=2; B=1,2,5, or 6); Urgency urinary incontinence (A=2; B=3,4, or 7); Urgency urinary incontinence (A=3; B=3,4,7,8, or no answer); Stress induced urgency urinary incontinence (A=3; B=1,2,5, or 6); Unknown or other (A=2; B=8, or no answer)

Table 2

Comparison of women who met criteria for mixed urinary incontinence and who participated in the smart phone diary study versus women who did not participate

Variable	Category	Smart Phone survey Participants (N = 35)	Non-participant (N = 885)	P-value
Age (40+)	Mean (SD)	65.5 (10.1)	66.1 (11.5)	0.74
BMI (kg/m ²) N (%)	<25	9 (25.7)	149 (16.8)	0.28
	25-29.99	5 (14.3)	226 (25.5)	
	30-34.99	7 (20.0)	206 (23.3)	
	35+	14 (40.0)	304 (34.4)	
Parity N (%)	0	6 (17.1)	104 (11.7)	0.54
	1	3 (8.6)	110 (12.4)	
	2+	26 (74.3)	671 (75.8)	
Marital status N (%)	Married	25 (71.4)	525 (59.3)	0.49
	Widowed	2 (5.7)	154 (17.4)	
	Separated or divorced	6 (17.1)	157 (17.7)	
	Never married	2 (5.7)	49 (5.5)	
Education N (%)	High school or less	20 (57.1)	501 (56.6)	0.96
	Some college	10 (28.6)	242 (27.3)	
	College grad or more	5 (14.3)	142 (16.1)	
Smoking N (%)	Never/missing	22 (62.8)	465 (52.5)	0.24
	Past	6 (17.1)	271 (30.6)	
	Current	7 (20.0)	149 (16.9)	
Alcohol N (%)	Yes	11 (31.4)	299 (33.8)	0.62
Diabetes N (%)	Yes	8 (22.9)	200 (22.6)	0.97
Stress UI score (0-8) N (%)	0-1	9 (25.7)	225 (25.3)	0.01
	2	16 (45.7)	204 (23.1)	
	3-4	6 (17.1)	204 (23.1)	
	5-8	4 (11.4)	252 (28.5)	
Urgency UI score (0-8) N (%)	0-1	-	-	0.37
	2	9 (25.7)	299 (33.8)	
	3-4	11 (31.4)	304 (34.5)	
	5-8	15 (42.9)	282 (31.9)	
Sandvik severity score N (%)	Mild	7 (20.0)	189 (21.4)	0.58
	Moderate	17 (48.6)	456 (51.5)	
	Severe	11 (31.4)	240 (27.1)	
UI duration (yrs) N (%)	0-5	11 (31.4)	455 (51.4)	0.04
	6+	24 (68.6)	430 (48.6)	
UDI-6 score at baseline	Mean (std)	69.2 (21.3)	56.6 (30.5)	0.02
IIQ-7 score at baseline	Mean (std)	27.0 (23.0)	24.7 (28.7)	0.65

Table 3

Summary of bladder control episodes across all women with a valid response in the 30-day period

Diary Question	Category	Type of Episode (Column Percents)			P-value ¹
		Urgency + no UI (n = 236)	UI + urgency (n = 532)	UI + no urgency (n = 182)	
What just happened before the event?	Cough/sneeze	17.4%	35.0%	39.6%	< 0.001
	Standing/jumping	14.4%	7.9%	15.4%	
	Walking/running	19.1%	9.6%	26.9%	
	Laying down/sitting	23.7%	19.0%	7.7%	
	On the way to the bathroom	10.2%	20.3%	0%	
	Washing dishes/running water	4.2%	3.2%	0%	
	Other	9.3%	5.1%	9.9%	
	Unknown	1.7%	0%	0.6%	
	TOTAL	100%	100%	100%	
Volume of urine loss	A few drops		30.5%	30.4%	< 0.11
	> than a few drops		29.0%	21.6%	
	A lot		40.6%	48.1%	
	TOTAL		100%	100%	
Feeling	Relaxed	36.9%	41.0%	37.4%	< 0.001
	Distracted	22.0%	32.0%	18.1%	
	Excited, stressed, anxious	28.4%	12.8%	19.2%	
	Frustrated, annoyed, upset	6.4%	8.3%	13.2%	
	Other + Unknown	6.4%	6.0%	12.1%	
	TOTAL	100%	100%	100%	

¹P-value for chi-square test of differences in percent distribution by type of episode

Table 4

Summary statistics on daily bladder control episodes by type of episode, among women who completed the 30-day digital diary

Type of Bladder Control Episode	Percent of total Episodes ¹ (%) (N = 950)	Percent of total UI Episodes (N = 714)	Mean (SE) days out of 30 days with at least one episode	Mean (SE) ² episodes/day on days with at least one episode
Urgency	24.8%		5.2 (6.6)	1.3 (0.7)
Stress UI	15.7%	20.9%	2.9 (4.9)	1.5 (0.9)
Urgency UI	26.6%	35.4%	5.2 (5.6)	1.4 (1.1)
Stress Induced Urgency UI	29.3%	39.1%	4.1 (5.7)	2.0 (2.1)
Other ³	3.5%	4.6%	0.8 (2.6)	1.1 (0.4)
All Episodes¹	100%	100%	12.6 (9.8)	2.3 (2.0)

¹ Episodes include urgency, stress UI, urgency UI, or stress induced urgency UI

² These means are only for days where women had at least one episode

³ UI episode but type is unknown

Table 5

Comparison of fluid intake, urinary frequency and nocturia for days with or without bladder control episodes¹

Variable	Level	Days with Stress Induced UI (N =142 ²)	Days without Stress Induced UI but with,		Days without any UI Episode (N =688 ²)	P-Value ³
			Urgency or UI (N =132 ²)	SUI only (N =86 ²)		
Fluid Intake (oz)	Mean (std)	33.0 (20.3)	31.6 (20.0)	37.8 (19.2)	32.3 (20.7)	0.54
Caffeine (2 or more per day)	Yes (%)	33.8	39.4	36.1	46.2	0.02
Daytime Frequency (# of voids)	3-4 (%)	41.6	42.4	55.8	50.2	0.007
	5-6 (%)	38.7	43.9	31.4	40.6	
	7+ (%)	19.7	13.6	12.8	9.3	
Nocturia (# of voids / night)	Mean (std)	2.0 (0.9)	2.0 (1.0)	2.0 (1.0)	1.7 (0.9)	< 0.001

¹Episodes include urgency, stress UI, urgency UI, or stress induced urgency UI

²Among 1050 (35*30) person days, two days with missing fluid intake, caffeine, frequency and nocturia

³P-value is obtained by chi-square test for categorical variables, and Wilcoxon test for continuous variables