Published in final edited form as:

Am J Obstet Gynecol. 2012 June ; 206(6): 502.e1–502.e8. doi:10.1016/j.ajog.2012.04.016.

Urinary Incontinence, Depression and Post-traumatic Stress Disorder in Women Veterans

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Abstract

Objective—To study associations between urinary incontinence (UI) symptoms, depression and post-traumatic stress disorder (PTSD) in women veterans.

Study Design—This cross-sectional study enrolled women 20 to 52 years of age registered at two Midwestern U.S. Veterans Affairs Medical Centers or outlying clinics within five years preceding study interview. Participants completed a computer-assisted telephone interview assessing urogynecologic, medical and mental health. Multivariable analyses studied independent associations between stress and urgency UI and depression and PTSD.

Results—968 women mean age 38.7 ± 8.7 years were included. 191 (19.7%) reported urgency/mixed UI and 183 (18.9%) stress UI. PTSD (OR [95%CI] = 1.8 [1.0, 3.1]) but not depression (OR [95%CI] = 1.2 [0.73, 2.0]) was associated with urgency/mixed UI. Stress UI was not associated with PTSD or depression.

Conclusion—In women veterans, urgency/mixed UI was associated with PTSD but not depression.

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Disclosure: None of the authors have a conflict of interest.

Presented at the 29th Annual Meeting of the American Urogynecologic Society, Chicago, IL, September 4–6, 2008.

Disclaimer: The views expressed in this article are those of the authors and do not necessarily reflect the position or policy of the Department of Veterans Affairs or the United States government.

Keywords

Depression; Post-traumatic Stress Disorder; Urinary incontinence, Stress; Urinary incontinence, Urgency; Veterans, Women

Introduction

Psychological distress, anxiety and depressive symptoms have been linked to urinary incontinence (UI) in both clinic-based studies^{1,2} and larger epidemiologic studies of middle-aged and older adults.^{3,4} In particular, some studies have demonstrated associations between urgency UI (but not stress UI) and depression and anxiety^{1,4}, leading to hypotheses that these conditions and urgency UI may share common neuropharmacological pathways.^{1,5,6}

Mental health disorders, including depression and PTSD (an anxiety disorder that develops in response to a traumatic experience), are particularly prevalent in veteran populations.⁷ However, UI and associated risk factors have not been well-studied in women veterans, and previous studies examining associations between anxiety disorders and UI have not focused on PTSD.^{4,8} The objective of this study was to measure the 12-month period prevalence of UI symptoms in reproductive-aged women veterans and to study associations between stress and urgency UI symptoms and psychological symptoms, especially those related to depression and PTSD.

Materials and Methods

This paper describes a prospectively-planned secondary analysis from a cross-sectional study of reproductive-aged women veterans who registered for health care or other veteran services through the Iowa City or Des Moines VA Medical Centers or outlying clinics during the 5 years preceding study interviews (performed July 2006-September 2008). The study's primary aim was to determine if the odds of gynecologic disorders (especially cervical cytological abnormalities and cervical cancer) were greater for sexually assaulted women veterans in comparison to non-assaulted peers.⁹ This study was approved by the University of Iowa Institutional Review Board and the Iowa City VA Research and Development Committee. All participants signed an informed consent document.

Adult women veterans 52 years of age were identified using the VistA System (Veterans health Information Systems & Technology Architecture) and recruited via mail and telephone. Women older than 52 years were not recruited and those aware of an *in utero* diethylstilbesterol exposure or currently receiving immunosuppressant therapy were excluded, related to the aims of the primary study. Eligible women who agreed to participate completed a computer-assisted telephone interview (CATI) administered by a trained female interviewer. Data collection included multiple validated instruments and items intended to screen for a history of sexual violence as well as urogynecologic, medical and mental health disorders.

We identified UI symptoms using three standardized epidemiologic items previously used in other large epidemiologic studies.¹⁰⁻¹² These items queried whether UI symptoms occurred during the past 12 months, including stress UI (urinary leakage "with an activity like coughing, lifting or exercise"), urgency UI (leakage "with an urge or pressure to urinate and you couldn't get to the toilet fast enough") and "other" UI (leakage "without an activity like coughing, lifting or exercise OR an urge to urinate") symptoms. Subjects who reported one or more types of UI were asked to quantify the UI frequency (separately for each type) as "every day", "a few times a week", "a few times a month" or "a few times a year".

Participants reporting UI symptoms were also asked how much the leakage bothered them, from “not at all” to “greatly”.

We assessed current depression and PTSD with validated diagnostic instruments based on *Diagnostic and Statistical Manual of Mental Disorders-4th edition* (DSM-IV) criteria. Depression was defined using the Composite International Diagnostic Interview- Short Form for Major Depression (CIDI-SF), which identifies depressive symptoms occurring during the past 12 months.¹³ The diagnosis of depression requires 1) depressed mood or anhedonia, for most of each day for most of a 2-week period, and 2) the presence of at least 4 other symptoms. CIDI-SF depression diagnoses have a sensitivity of 90% and specificity of 94% compared to the full-length CIDI.

Post-traumatic stress disorder was identified using the self-report Posttraumatic Symptom Scale (PSS-I), shown to have excellent sensitivity (88%) and specificity (96%) to structured clinical interview (SCID) diagnoses of PTSD.¹⁴ The assessment of lifetime traumatic events was augmented with combat-related traumatic exposures (for those who had served in combat). Follow-up questions regarding duration of symptoms and the effects of symptoms on daily functioning were also asked. Diagnosis of PTSD was determined (according to DSM-IV Criteria) if participants identified a traumatic exposure; endorsed at least 1 intrusive recollection, 3 avoidance actions and 2 hyper-arousal symptoms; acknowledged symptom duration lasting more than 1 month; and had symptoms that interfered with daily functioning. Both the CIDI-SF and PSS-I have been successfully administered in previous studies using telephone interviews.^{15,16}

Sexual violence exposures were assessed using detailed questions developed from the National Violence Against Women Survey (NVAWS), the National Women’s Study (NWS), and a survey of rape in Iowa.^{17,18} Women were asked a minimum of 5 questions that focused on whether they had experienced different types of assault throughout their lifetime. Sexual assault was defined as any act occurring without a women’s consent involving the use or threat of force, and including completed sexual penetration of the vagina, mouth, or rectum.¹⁹

Generic health-related quality of life (QOL) was assessed using the Short Form, 12-Item General Health Survey (SF-12).²⁰ Participants were asked to self-report height and weight, and provided information about other health behaviors and risks such as smoking, caffeine intake, exercise, and drug and alcohol use. Participants were also asked whether they had taken any medication during the past 6 months for anxiety or depression. A history of head injury was assessed by asking, “Have you ever had a head injury, skull fracture or concussion?” Additional information collected included: demographics, military service details, past reproductive history and medical diagnoses.

Stress and urgency UI were defined as the presence of stress and urgency UI symptoms (respectively) that occurred a “few times monthly” or more often. Women who met criteria for both stress and urgency UI were classified as having mixed UI. Because the urgency UI group was small, the urgency and mixed UI groups were combined for all analyses. Risk factors, associated conditions and other characteristics were compared between women with urgency/mixed UI and women with no UI symptoms, and similar comparisons were made in women with stress UI to the no UI group. Women with minimal UI symptoms (occurring “a few times a year” only) were not included in the comparative analyses.

Bivariable comparisons were performed using Pearson’s Chi-squared or Fisher’s exact tests for categorical variables and the Student t test for continuous variables. Multivariable logistic regression analyses were performed, again among women with urgency/mixed UI and no UI and among women with stress UI and no UI. The dependent variable in each

model was urgency/mixed UI or stress UI. Categorization of the independent variables was examined during bivariable analysis, and best function forms were applied to the fitted multivariable models.

Several preliminary models for each dependent variable were initially created, each including related independent variables (demographic, general health/health risk, reproductive health, and mental health variables). Variables associated with the dependent outcomes in the bivariable analyses (at $P < 0.2$) were included in preliminary models. Those that remained associated with the dependent outcomes (at $P < 0.1$) in the preliminary models in addition to the primary independent variables (depression and PTSD) were included in the final models. Variables that became non-significant when placed in the final models were removed if no significant changes were noted in the estimates for the other variables after removing them. Odds ratios with 95% confidence intervals for each of the significant risk factors were computed from the fitted models. One-way interaction terms for sexual assault, depression and PTSD were created and tested in the final model-building process, but these were not significant and were left out of the final models.

Statistical analyses were performed using SAS 9.1 (SAS Institute, Inc.; Cary, North Carolina). Associations were considered significant at a $P < 0.05$ level.

Results

Of 1670 women contacted, 1,055 (63%) agreed to participate and 1,004 completed data collection (17 were ineligible, 21 could not be reached by telephone and 13 were unable to complete the interview). Those who refused participation were similar to participants in age, self-reported general health and number of gynecologic health care visits in the past year.⁹ The average study interview length was 1 hour and 16 minutes, and 89% were completed in a single call. After excluding 36 participants with current or recent pregnancy, 968 were included in this analysis.

The mean ($\pm$ SD) age was 38.7 ± 8.7 years (range 20–52) and body mass index (BMI) 28.2 ± 6.1 kg/m². Median parity was 2 (0–6). Most (60.1%) had served in active regular military duty, 11.7% were Reserve or National Guard, and 28.2% reported both service types. The average length of active duty was 5.4 ± 5.0 years. Thirty six percent reported currently smoking, and 32% reported some type of chronic medical problem, most frequently diabetes (3.9%) and hypertension (5.4%). Past sexual assault was reported by 495 (51.1%) of the women veterans, with 329 (34.0%) reporting more than one past assault.

Depression and PTSD were common, occurring in 301 (31%) and 242 (25%) women, respectively. Fifteen percent met criteria for both depression and PTSD. Overall, 448 (46.3%) reported taking a medication for anxiety or depression during the past 6 months, including 81% of those with depression and 73% of those with PTSD.

Urinary incontinence symptoms were common (Table 1) and bothersome. Stress and/or urgency UI occurred at least “a few times a month” in 374 women (38.6%) during the past year. One hundred thirty-two women (13.6%), 99 (10.2%) and 108 (11.2%) reported they were “somewhat,” “very much,” and “greatly” bothered, respectively, by their urinary leakage.

Characteristics of women with no UI, stress UI and urgency/mixed UI are presented in Table 2. In bivariable analyses, compared to women with no UI, women with stress UI and women with urgency/mixed UI were older, more often married, less likely to be a student and more likely to be unemployed. Women with stress UI and those with urgency/mixed UI (compared to women with no UI) were also heavier, more likely to report chronic medical

problems, more parous, more often menopausal and were more likely to have had hysterectomy and a history of urinary tract infection.

Other variables differed in their associations with urgency/mixed UI and with stress UI. In bivariable analyses, women with urgency/mixed UI more often smoked, exercised less, and more often reported a history of head injury. A history of sexual assault and depression were each more common in women with either stress UI or urgency/mixed UI. In contrast, PTSD was identified more often in women with urgency/mixed UI compared to women with no UI (37% vs. 20%), but not in women with stress UI only (25%). Both women with urgency/mixed UI and those with stress UI were more likely to report taking a medication for anxiety or depression in the past 6 months than were women with no UI.

The higher rates of mental health disorders in the urgency/mixed UI group were reflected in lower mental health related QOL (SF-12 mental component scores 44.6 ± 9.0 vs. 47.2 ± 7.8 for urgency/mixed vs. no UI, $p=0.003$; $p=0.001$). SF-12 mental component scores were similar in the stress UI and no UI groups ($p=0.57$). SF-12 physical component scores were also lower in women with urgency/mixed UI (39.9 ± 6.9 vs. 42.0 ± 6.7 , $p=0.001$) and stress UI (40.7 ± 7.3 vs. 42.0 ± 6.7 , $p=0.04$), both compared to women with no UI.

Tables 3 and 4 present the multivariable analyses results. Depression and PTSD were not independently associated with stress UI (Table 3). Variables independently associated with stress UI included age, BMI, race, parity, a history of chronic medical problems and a history of sexual assault. In contrast, PTSD was independently associated with urgency/mixed UI, but depression was not (Table 4). Other variables independently associated with urgency/mixed UI included age, BMI, race, exercise, parity, a history of UTI and a history of sexual assault.

Comment

Our study demonstrates that UI symptoms are prevalent and bothersome in young and middle-aged women veterans. We also found that mental health symptoms and poorer mental health-related QOL are associated particularly with urgency/mixed UI, but not stress UI. Interestingly, we found PTSD was independently associated with urgency/mixed UI. Depression was more common in women with urgency/mixed UI and stress UI, but after controlling for other variables, depression was not independently associated with UI symptoms.

Strengths of this study include its large sample size and the careful characterization of current depression and PTSD symptoms using validated diagnostic instruments. Our results also provide important data on UI and UI risk factors in younger and middle aged women and in women veterans, an increasingly relevant study population as women now comprise 14% of the US Armed Forces.²¹ However, we acknowledge limitations to our results as well. Research diagnoses using epidemiologic instruments are not equivalent to diagnoses obtained from full structured diagnostic interview or clinical evaluation. Additionally, our findings are limited by cross-sectional study design and a lack of information about possible mental health and UI treatment effects on reported symptoms. Our results may not be generalizable to other women, in particular older women who were not included in this study. Notably, rates of PTSD in the general population would be expected to be lower than we observed in this group of women veterans.

In several past cross-sectional studies, largely in middle-aged and older adults, depression and anxiety were associated with UI.^{3,22–24} People with UI, and especially UI with functional impact, were more likely to experience psychological distress and anxiety disorder than those without UI.^{8,25} In a few studies, depression was particularly associated

with urgency UI (rather than stress UI).^{1,22} Our findings reproduced this UI type-specific association with mental health conditions, but with PTSD rather than depression. This emphasizes the importance of considering other mental health disorders when studying associations between depression and urinary symptoms.

Depression and PTSD are recognized as serious and often co-morbid mental health conditions, increasingly common in veterans and resulting in decreased QOL and functional impairment.^{7,26} Military women and women veterans may be at particularly high risk for PTSD, not only related to duty-related trauma such as combat, but also because of high rates of pre-military trauma and sexual and nonsexual assaultive violence in the military.^{27–29} Similarly, we found high rates of past sexual violence in this female veteran population, and a history of sexual assault was independently associated with urgency/mixed and stress UI compared to women veterans without UI symptoms.

Several past clinic- and community-based studies^{30–32} and one recent study in women veterans³³ also reported an association between sexual abuse and lower urinary tract symptoms, particularly overactive bladder and urgency incontinence. A German clinic-based study found prior physical and/or sexual abuse more common in women with overactive bladder (frequency, urgency and/or urgency incontinence) compared to women without UI, and among women reporting past abuse, those with urinary symptoms were more likely to have suffered more than once from abuse and to report lasting influence from the abuse.³¹ Similarly, UI in our population was associated with a more severe history of assault (as measured using numbers of past assaults).

Multiple mechanisms may underlie associations between UI and mental health conditions. Some have proposed that the functional and social impairment caused by UI mediates the association between UI and depression.²⁵ Results from a large longitudinal study support this theory, as baseline urgency UI predicted incident depression one year later, but baseline depression did not predict incident urgency UI.⁴ However, a second longitudinal study in older women found the opposite: major depression predicted onset of UI, but incontinence did not predict onset of depression.⁶ These differences may result from different methods of ascertaining UI and depression, but may also reflect a multifactorial association between these conditions.

Other investigators have theorized that psychological symptoms and urgency UI share a common biological pathway. A common neuropharmacological basis could be related to reduced serotonin, described in some forms of depression as well as bladder muscle activity.¹ Supporting this theory is the fact that duloxetine, a balanced serotonin and norepinephrine reuptake inhibitor, effectively treats major depression as well as stress UI and urgency UI.^{34–36} Alterations in corticotropin-releasing factor (CRF), linked to depression and anxiety as well as acute and chronic stress states, may also alter bladder function.^{5,37,38}

Dysregulation of the serotonergic system and the hypothalamic-pituitary-adrenal axis have also been implicated in the neurobiological basis of PTSD. Studies suggest that alterations in serotonin and adrenal hormones may contribute to psychological symptoms and neuropsychological deficits in PTSD patients.³⁹ The effect of acute and chronic stress on complex neural circuits and neurochemical components, such as CRF, may also explain the association between prior sexual assault and urinary symptoms.⁴⁰ However, the relationship between these neurobiological mechanisms and behavior is extremely complex. Although biological mechanisms may underlie links between prior sexual assault and PTSD and urinary symptoms, they almost certainly interact with and are affected by other social, environmental and individual mechanisms.⁴¹

Lastly, the association between sexual assault (and other traumas) and UI may be mediated by PTSD, as has been proposed to explain associations between other physical health outcomes and PTSD.⁴¹ However, we found prior sexual assault was more common in women with stress UI, while PTSD was not; again suggesting other mechanisms may be involved.

Immediate clinical implications from this work may include the importance of screening for UI in women veterans during primary health care visits, given the high prevalence of UI symptoms in this group. Also, clinicians caring for women with urgency UI should be aware of associations between mental health problems (especially PTSD) and urgency UI and consider screening or referral for mental health symptoms in these patients. Finally, our data suggest prior sexual assault is common in women with UI, and clinicians should consider this when performing invasive gynecologic or urologic examinations, which may be more difficult for women with past sexual trauma to tolerate.

In conclusion, unlike women veterans with stress UI (only), those with urgency/mixed UI are more likely to have PTSD and poorer mental health-related QOL than women veterans with no UI. After controlling for other variables, PTSD remains independently associated with urgency/mixed UI symptoms. These findings emphasize the need for additional research to better understand the complex associations between UI and psychological symptoms and the neurobiological basis of urgency UI.

Acknowledgments

Funding/Acknowledgements:

This material is based on work funded by the Department of Veterans Affairs, Veterans Health Administration, Office of Research and Development, Health Services Research and Development Service (NRI 04-194 (AS)) with additional support provided by the National Institutes of Child Health and Human Development (K23 HD047654 (CB)).

References

1. Zorn BH, Montgomery H, Pieper K, Gray M, Steers WD. Urinary incontinence and depression. *J Urol.* 1999; 162:82–84. [PubMed: 10379745]
2. Lagro-Janssen AL, Debruyne FM, Van Weel C. Psychological aspects of female urinary incontinence in general practice. *Br J Urol.* 1992; 70:499–502. [PubMed: 1467853]
3. Nygaard I, Turvey C, Burns TL, Crischilles E, Wallace R. Urinary incontinence and depression in middle-aged United States women. *Obstet Gynecol.* 2003; 101:149–156. [PubMed: 12517660]
4. Perry S, McGrother CW, Turner K. An investigation of the relationship between anxiety and depression and urge incontinence in women: development of a psychological model. *Br J Health Psychol.* 2006; 11:463–482. [PubMed: 16870056]
5. Klausner AP, Steers WD. Corticotropin releasing factor: a mediator of emotional influences on bladder function. *J Urol.* 2004; 172:2570–2573. [PubMed: 15538210]
6. Melville JL, Fan M-Y, Rau H, Nygaard IE, Katon WJ. Major depression and urinary incontinence in women: temporal associations in an epidemiologic sample. *American Journal of Obstetrics and Gynecology.* 2009; 201 490.e1–e7.
7. Milliken CS, Auchterlonie JL, Hoge CW. Longitudinal Assessment of Mental Health Problems Among Active and Reserve Component Soldiers Returning From the Iraq War. *JAMA.* 2007; 298:2141–2148. [PubMed: 18000197]
8. Bogner HR, Gallo JJ, Swartz KL, Ford DE. Anxiety disorders and disability secondary to urinary incontinence among adults over age 50. *Int J Psychiatry Med.* 2002; 32:141–154. [PubMed: 12269595]
9. Sadler AG, Mengeling MA, Syrop CH, Torner JC, Booth BM. Lifetime Sexual Assault and Cervical Cytologic Abnormalities Among Military Women. *J Women's Health.* 2011; 20:1693–1701.

10. Sandvik H, Hunskaar S, Vanvik A, Bratt H, Seim A, Hermstad R. Diagnostic classification of female urinary incontinence: an epidemiological survey corrected for validity. *J Clin Epidemiol.* 1995; 48:339–343. [PubMed: 7897455]
11. Hannestad YS, Rortveit G, Sandvik H, Hunskaar S. A community-based epidemiological survey of female urinary incontinence: the Norwegian EPINCONT study. *Epidemiology of Incontinence in the County of Nord-Trøndelag. J Clin Epidemiol.* 2000; 53:1150–1157. [PubMed: 11106889]
12. Brown JS, Vittinghoff E, Lin F, Nyberg LM, Kusek JW, Kanaya AM. Prevalence and risk factors for urinary incontinence in women with type 2 diabetes and impaired fasting glucose: findings from the National Health and Nutrition Examination Survey (NHANES) 2001–2002. *Diabetes Care.* 2006; 29:1307–1312. [PubMed: 16732013]
13. Kessler R, Andrews G, Mroczek D, Ustun B, Wittchen HU. The World Health Organization Composite International Diagnostic Interview short-form (CIDI-SF). *International Journal of Methods in Psychiatric Research.* 1998; 7:171–185.
14. Foa EB, Riggs DS, Dancu CV, Rothbaum BO. Reliability and validity of a brief instrument for assessing post-traumatic stress disorder. *J Trauma Stress.* 1993; 6:459–473.
15. Brewin CR, Andrews B, Rose S, Kirk M. Acute stress disorder and posttraumatic stress disorder in victims of violent crime. *Am J Psychiatry.* 1999; 156:360–366. [PubMed: 10080549]
16. Patten SB. Major Depression Prevalence in Calgary. *Canadian Journal of Psychiatry.* 2000; 45:923.
17. Resnick HS, Kilpatrick DG, Dansky BS, Saunders BE, Best CL. Prevalence of civilian trauma and posttraumatic stress disorder in a representative national sample of women. *J Consult Clin Psychol.* 1993; 61:984–991. [PubMed: 8113499]
18. Kilpatrick, DG.; Ruggiero, KJ. Rape In Iowa: A Report to the State. National Violence Against Women Prevention Research Center; 2004.
19. Gynecologists. ACOG. Educational bulletin: Sexual assault. *ACOG Educ Bull.* 1997; 242:756–762.
20. Ware J Jr, Kosinski M, Keller SD. A 12-Item Short-Form Health Survey: construction of scales and preliminary tests of reliability and validity. *Med Care.* 1996; 34:220–233. [PubMed: 8628042]
21. Women's Research and Education Institute. [Accessed October 24, 2011]
http://www.wrei.org/MilitaryWomen_Reports.htm.
22. Milsom I, Abrams P, Cardozo L, Roberts RG, Thuroff J, Wein AJ. How widespread are the symptoms of an overactive bladder and how are they managed? A population-based prevalence study. *BJU International.* 2001; 87:760–766. [PubMed: 11412210]
23. Bogner HR, Gallo JJ, Sammel MD, Ford DE, Armenian HK, Eaton WW. Urinary incontinence and psychological distress in community-dwelling older adults. *J Am Geriatr Soc.* 2002; 50:489–495. [PubMed: 11943045]
24. van der Vaart CH, Roovers JP, de Leeuw JR, Heintz AP. Association between urogenital symptoms and depression in community-dwelling women aged 20 to 70 years. *Urology.* 2007; 69:691–696. [PubMed: 17445653]
25. Bogner HR, Gallo JJ. Urinary incontinence, condition-specific functional loss, and psychological distress. *J Am Geriatr Soc.* 2002; 50:1311. [PubMed: 12133035]
26. Seal KH, Bertenthal D, Miner CR, Sen S, Marmar C. Bringing the war back home: mental health disorders among 103,788 US veterans returning from Iraq and Afghanistan seen at Department of Veterans Affairs facilities. *Arch Intern Med.* 2007; 167:476–482. [PubMed: 17353495]
27. Fontana A, Rosenheck R. Duty-related and sexual stress in the etiology of PTSD among women veterans who seek treatment. *Psychiatr Serv.* 1998; 49:658–662. [PubMed: 9603572]
28. Hankin CS, Skinner KM, Sullivan LM, Miller DR, Frayne S, Tripp TJ. Prevalence of depressive and alcohol abuse symptoms among women VA outpatients who report experiencing sexual assault while in the military. *J Trauma Stress.* 1999; 12:601–612. [PubMed: 10646179]
29. Sadler AG, Booth BM, Nielson D, Doebbeling BN. Health-related consequences of physical and sexual violence: women in the military. *Obstet Gynecol.* 2000; 96:473–480. [PubMed: 10960645]
30. Davila GW, Bernier F, Franco J, Kopka SL. Bladder Dysfunction in Sexual Abuse Survivors. *The Journal of Urology.* 2003; 170:476–479. [PubMed: 12853803]

31. Jundt K, Scheer I, Schiessl B, Pohl K, Haertl K, Peschers UM. Physical and sexual abuse in patients with overactive bladder: is there an association? *Int Urogynecol J Pelvic Floor Dysfunct*. 2007; 18:449–453. [PubMed: 16917674]
32. Link CL, Lutfey KE, Steers WD, McKinlay JB. Is Abuse Causally Related to Urologic Symptoms? Results from the Boston Area Community Health (BACH) Survey. *European Urology*. 2007; 52:397–406. [PubMed: 17383083]
33. Klausner AP, Ibanez D, King AB, et al. The Influence of Psychiatric Comorbidities and Sexual Trauma on Lower Urinary Tract Symptoms in Female Veterans. *The Journal of Urology*. 2009; 182:2785. [PubMed: 19850303]
34. Mariappan P, Alhasso A, Ballantyne Z, Grant A, N'Dow J. Duloxetine, a Serotonin and Noradrenaline Reuptake Inhibitor (SNRI) for the Treatment of Stress Urinary Incontinence: A Systematic Review. *European Urology*. 2007; 51:67. [PubMed: 17014950]
35. Steers WD, Herschorn S, Kreder KJ, et al. Duloxetine compared with placebo for treating women with symptoms of overactive bladder. *BJU Int*. 2007; 100:337–345. [PubMed: 17511767]
36. Thor KB, Kirby M, Viktrup L. Serotonin and noradrenaline involvement in urinary incontinence, depression and pain: scientific basis for overlapping clinical efficacy from a single drug, duloxetine. *International Journal of Clinical Practice*. 2007; 61:1349–1355. [PubMed: 17608681]
37. Arborelius L, Owens MJ, Plotsky PM, Nemeroff CB. The role of corticotropin-releasing factor in depression and anxiety disorders. *J Endocrinol*. 1999; 160:1–12. [PubMed: 9854171]
38. Klausner AP, Streng T, Na YG, et al. The role of corticotropin releasing factor and its antagonist, astressin, on micturition in the rat. *Auton Neurosci*. 2005; 123:26–35. [PubMed: 16256445]
39. Southwick, S.; Rasmusson, A.; Barron, J.; Arnsten, A. Neurobiological and Neurocognitive Alterations in PTSD. In: Vasterling, J.; Brewin, C., editors. *Neuropsychology of PTSD: Biological, Cognitive and Clinical Perspectives*. New York: The Guilford Press; 2005. p. 27-58.
40. Link CL, Lutfey KE, Steers WD, McKinlay JB. Is abuse causally related to urologic symptoms? Results from the Boston Area Community Health (BACH) Survey. *Eur Urol*. 2007; 52:397–406. [PubMed: 17383083]
41. Schnurr, PP.; Green, BL. *Trauma and Health: Physical Health Consequences of Exposure to Extreme Stress*. Washington, D.C.: American Psychological Association; 2004.

Table 1

Urinary incontinence types and frequency (n=9 68).

	N (%)	“Few times a month”	“Few times a week”	“Every day”
Stress UI [*]	183 (18.9)	101 (10.4)	59 (6.1)	23 (2.4)
Mixed UI [†]	157 (16.2)	25 (2.6)	57 (5.9)	75 (7.7)
Urgency UI [‡]	34 (3.5)	22 (2.3)	8 (0.8)	4 (0.4)
Other UI [§]	13 (1.3)			
Minimal UI ^{**}	245 (25.3)			
No UI	334 (34.5)			
Missing data	2 (0.2)			
Total	968 (100.0)			

UI- urinary incontinence; percentages do not add exactly to 100 because of rounding.

^{*} UI with activity, occurring at least “a few times a month”

[†] UI with activity and with urge to urinate, both occurring at least “a few times a month”

[‡] UI with urge to urinate, occurring at least “a few times a month”

[§] UI without activity or urge to urinate, occurring at least “a few times a month”

^{**} UI symptoms occurring “a few times a year” only

Table 2

Characteristics of women veterans with no UI, stress UI and urgency/mixed UI

Population Characteristics	No UI (n=334)	Stress UI (n=183)	Urgency/Mixed UI (n=191)	p-value*
DEMOGRAPHICS				
Age (y)				<0.0001
45	74 (22.2)	65 (35.5)	96 (50.3)	
40-44	48 (14.4)	43 (23.5)	42 (22.0)	
30-39	95 (28.4)	53 (29.0)	39 (20.4)	
<30	117 (35.0)	22 (12.0)	14 (7.3)	
Race				0.06
Non-white	42 (12.6)	15 (8.2)	12 (6.3)	
White	255 (76.4)	154 (84.2)	153 (80.1)	
Multi-race	37 (11.1)	14 (7.7)	26 (13.6)	
Education				0.52
High School/GED completion	53 (15.9)	29 (15.9)	33 (17.3)	
Some college/technical training	180 (53.9)	99 (54.1)	112 (58.6)	
College completed or greater	101 (30.2)	55 (30.1)	46 (24.1)	
Employment				<0.0001
Employed	161 (48.2)	88 (48.1)	94 (49.2)	
Retired	4 (1.2)	3 (1.7)	17 (8.9)	
Student	108 (32.3)	41 (22.4)	25 (13.1)	
Unemployed	61 (18.3)	51 (27.9)	55 (28.8)	
Marital status				<0.0001
Single	101 (30.2)	31 (17.0)	24 (12.6)	
Divorced	104 (31.1)	56 (30.6)	75 (39.3)	
Married	129 (38.7)	96 (52.5)	92 (48.2)	
Combat or war zone exposure	108 (32.3)	55 (30.1)	40 (20.9)	0.005
GENERAL HEALTH/RISKS				
Body mass index (kg/m ²)	26.6 ± 5.3	28.8 ± 5.9	30.6 ± 7.2	<0.0001

Population Characteristics	No UI (n=334)	Stress UI (n=183)	p-value*	Urgency/Mixed UI (n=191)	p-value*
Exercise (min per week)			0.10		0.0002
0-59	118 (35.4)	81 (45.0)		95 (49.7)	
60-120	88 (26.4)	38 (21.1)		55 (28.8)	
>120	127 (38.1)	61 (33.9)		41 (21.5)	
Caffeine (# beverages/day)	2.4 ± 2.8	82.6 ± 2.8	0.47	3.2 ± 3.9	0.03
Chronic medical problem(s) (yes/no)	76 (22.8)	70 (38.3)	0.0002	75 (39.3)	<0.0001
Head injury	97 (29.0)	59 (32.2)	0.45	86 (45.0)	0.0002
Currently smoke	106 (31.7)	58 (31.7)	0.99	80 (41.9)	0.02
REPRODUCTIVE HEALTH					
Parity			<0.0001		<0.0001
0	163 (48.8)	44 (24.0)		47 (24.6)	
1	65 (19.5)	40 (21.9)		38 (19.9)	
2	73 (21.9)	57 (31.2)		56 (29.3)	
3	33 (9.9)	42 (23.0)		50 (26.2)	
Menopause	66 (20.1)	49 (28.3)	0.04	77 (41.9)	<0.0001
Hysterectomy	36 (10.8)	35 (19.1)	0.008	59 (30.9)	<0.0001
History of UTI	143 (42.9)	100 (54.6)	0.01	142 (74.4)	<0.0001
MENTAL HEALTH/RISKS					
History of sexual assault	134 (40.1)	98 (53.6)	0.003	123 (64.4)	<0.0001
Number of sexual assaults			0.0003		<0.0001
None	200 (59.8)	85 (46.5)		68 (35.6)	
Single assault	61 (18.3)	28 (15.3)		27 (14.1)	
>1 assault	73 (21.9)	70 (38.3)		96 (50.3)	
Medication use for depression or anxiety in last 6 months	115 (34.4)	94 (51.4)	0.0002	119 (62.3)	<0.0001
Depression	79 (23.7)	60 (32.8)	0.03	83 (43.5)	<0.0001
PTSD	68 (20.4)	45 (24.6)	0.27	71 (37.2)	<0.0001

Data presented as N (%) or mean ± standard deviation. UI- Urinary incontinence

* p-values indicate comparison with "No UI" group using Pearson's Chi-squared, Fisher's exact or Student t test.

Table 3

Associations with stress urinary incontinence symptoms (only) compared to no urinary incontinence symptoms from logistic regression analyses.

	Adjusted OR (95%CI)	p-value
Depression	1.3 (0.78, 2.1)	0.33
PTSD	1.2 (0.70, 2.0)	0.55
Age(y)		
45	2.3 (1.2, 4.4)	0.03
40–44	2.5 (1.3, 4.9)	
30–39	1.8 (0.99, 3.4)	
<30	1.0 (Ref)	
BMI (kg/m ²)	1.3 (1.1, 1.5) *	0.007
Race		
Non-white	0.44 (0.22, 0.88)	0.03
Multi-race	0.58 (0.29, 1.2)	
White	1.0 (Ref)	
Chronic medical problem(s) (yes/no)	1.6 (1.0, 2.5)	0.05
Parity		
3	3.8 (2.0, 7.2)	<0.001
2	2.4 (1.4, 4.2)	
1	2.1 (1.2, 3.7)	
0	1.0 (Ref)	
Sexual Assault		
2 prior assaults	1.8 (1.2, 2.9)	0.01
1 prior assault	0.85 (0.48, 1.5)	
None	1.0 (Ref)	

OR - Odds ratio, CI - Confidence interval, PTSD- Post-traumatic stress disorder, Ref-Reference category, BMI- Body mass index

*
OR for each 5 unit increase in BMI

Table 4

Associations with urgency/mixed urinary incontinence compared to no urinary incontinence symptoms from logistic regression analyses.

	Adjusted OR (95%CI)	p-value
Depression	1.2 (0.73, 2.0)	0.46
PTSD	1.8 (1.0, 3.1)	0.04
Age(y)		
45	4.1 (2.0, 8.3)	<0.001
40–44	3.5 (1.6, 7.6)	
30–39	1.5 (0.68, 3.1)	
<30	1.0 (Ref)	
BMI (kg/m ²)	1.4 (1.1, 1.7) *	<0.001
Race		
Non-white	0.33 (0.15, 0.74)	0.02
Multi-race	1.2 (0.59, 2.2)	
White	1.0 (Ref)	
Exercise (min/week)		
121	0.56 (0.33, 0.97)	0.02
60–120	1.3 (0.72, 2.2)	
0–59	1.0 (Ref)	
Parity		
3	4.1 (2.1, 8.2)	0.001
2	1.8 (1.0, 3.3)	
1	1.7 (0.93, 3.2)	
0	1.0 (Ref)	
History of UTI	3.2 (2.0, 5.1)	<0.001
Sexual Assault		
2 prior assaults	2.0 (1.2, 3.4)	0.002
1 prior assault	0.69 (0.36, 1.3)	
None	1.0 (Ref)	

OR - Odds ratio, PTSD- Post-traumatic stress disorder, Ref- Reference category, BMI- Body mass index, UTI- urinary tract infection,

*

OR for each 5 unit increase in BMI