Urinary Incontinence in US Women

A Population-Based Study

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Background: Urinary incontinence (UI) is a common disorder that is increasingly important as our population ages. Less is known about UI in younger women, and few large surveys have been able to determine risk factors by linking their data to patients’ medical findings.

Methods: We conducted a population-based, age-stratified postal survey of 6000 women aged between 30 and 90 years who were enrolled in a large health maintenance organization in Washington State.

Results: The response rate was 64% (n=3536) after exclusion criteria were applied. The population-based prevalence of UI was 45%. Prevalence increased with age, from 28% for 30- to 39-year-old women to 55% for 80- to 90-year-old women. Eighteen percent of respondents reported severe UI. The prevalence of severe UI also increased notably with age, from 8% for 30- to 39-year-old women to 33% for 80- to 90-year-old women. Older age, higher body mass index (BMI, calculated as weight in kilograms divided by the square of height in meters), greater medical comorbidity, current major depression, a history of hysterectomy, and parity increased the odds of having UI. Not being white and having had only cesarean deliveries decreased the odds of having UI. Major depression (odds ratio, 2.48; 95% confidence interval, 1.65-3.72) and obesity, defined as having a BMI of 30 or greater (odds ratio, 2.39; 95% confidence interval, 1.99-2.87), had the strongest association with UI. Among women with UI, age, BMI, medical comorbidity, current major depression, diabetes, a history of hysterectomy, and having had only cesarean deliveries were significantly associated with severe UI.

Conclusions: Urinary incontinence is highly prevalent in women across their adult life span, and its severity increases linearly with age. Age, BMI, race, medical comorbidity, current major depression, a history of hysterectomy, parity, and having only had cesarean deliveries are each independent factors significantly associated with the likelihood of having UI.

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tools. This study’s objectives were to determine the prevalence and severity of UI and the factors associated with this condition in a population-based sample of women aged between 30 and 90 years.

**STUDY POPULATION AND DESIGN**

The participants of this 2002 study were women enrolled at Group Health Cooperative (GHC), a health maintenance organization serving approximately 550,000 individuals in Washington State. A 15-page self-report form was mailed to 6000 women eligible for inclusion, ie, who were aged between 30 and 90 years. The survey contained questions about medical, surgical, obstetric, and gynecologic history; use of medications; bladder symptoms; depressive symptoms; functional status; QOL; and demographic characteristics. Exclusion criteria were our inability to locate the prospective participant or her death; disenrollment from GHC; paraplegia; mental or physical incapacity to complete a written questionnaire; and current urinary tract infection. The sample was stratified by decade of age, with oversampling of women in their younger decades to ensure a sufficient number of respondents with UI in each age group. An initial and 2 reminder questionnaires were sent. A $3 gift certificate to a local store was included in the initial mailing to encourage response. The sample was linked to longitudinal automated data, including inpatient and outpatient diagnoses, pharmacy purchases, and health care utilization in the year preceding questionnaire return. Automated data were available for respondents and nonrespondents. All participants provided informed consent and the study was approved by the GHC Human Subjects Committee.

**DEFINITION AND CHARACTERIZATION OF UI**

Frequency of urine loss was characterized as less than once per month, 1 to several times per month, 1 to several times per week, 1 or 2 times per day, or 3 or more times per day. The amount of urine lost was quantified as a few drops, a small amount, a moderate amount, or a large amount. Urinary incontinence was defined as leakage of any amount that occurred at least monthly. Stress UI symptoms were defined as leaking or losing urine during activities such as coughing, laughing, or walking. Urge UI symptoms were defined as leaking or losing urine associated with an urge to urinate so strong and sudden that the participant could not reach the toilet fast enough. Participants were classified as having mixed UI symptoms if they answered affirmatively to both stress and urge symptoms.

To characterize the degree of UI, we used the Sandvik Severity Index and aggregated responses into 2 amount levels (1, few drops/small amount and 2, moderate/large amount) and 4 frequency levels (1, less than monthly; 2, monthly; 3, weekly; and 4, daily). The index value (1-8) was calculated by multiplying the amount (2 levels) by the frequency (4 levels) of leakage, yielding categorical variables of mild (1-2), moderate (3-4), and severe (6-8). This widely used index has been validated against pad-weighing tests and in independent populations.

The study measured QOL using the Incontinence Quality of Life Instrument (I-QOL), a validated 22-item self-report measure for UI-specific QOL. The instrument yields a total score and 3 subscale scores for avoidance and limiting behaviors, psychosocial impacts, and social embarrassment. The severity of UI symptoms was measured by the Patient Incontinence Severity Assessment, a single self-report item asking individuals to rate their UI severity on a 3-point Likert scale ranging from 1 (mild) to 5 (severe). This item has been shown to correlate well with a physician assessment of UI severity and a validated severity index.

**ASSESSMENT OF MAJOR DEPRESSION AND DIABETES MELLITUS**

The Primary Care Evaluation of Mental Disorders (PRIME-MD), Patient Health Questionnaire 9-item (PHQ-9) was used to diagnose current major depression. The PHQ-9 major depression diagnosis has excellent agreement with diagnosis of major depression based on a structured interview. The criteria for major depression require the individual to have, for at least 2 weeks, 5 or more depressive symptoms present for more than half the days, with depressed mood or anhedonia as at least 1 of these symptoms.

The presence of diabetes mellitus was determined from GHC’s automated data by any of the following: taking a diabetic agent, fasting glucose level greater than 126 mg/dL (7.0 mmol/L) confirmed by a second out-of-range test result within 1 year, random glucose level greater than 200 mg/dL (11.1 mmol/L) confirmed by a second out-of-range test result within 1 year, or a hospital discharge diagnosis or 2 outpatient diagnoses of diabetes.

**OTHER COVARIATES**

The categorical variables of race, ethnicity, education, income, employment, smoking, alcohol use, and history of hysterectomy were assessed by self-report. Self-reported height and weight were used to calculate body mass index (BMI, as weight in kilograms divided by the square of height in meters). Two detailed questions on menstrual cycles and cessation of menses were used to determine menopausal status. Respondents were asked to list each childbirth, delivery type (vaginal or cesarean), whether a forceps or vacuum-assisted device was used, and infant birth weight. Delivery types were categorized by theoretical risk of pelvic floor injury as nonoperative vaginal deliveries only, cesarean deliveries only, history of any operative vaginal delivery (forceps or vacuum extraction), and other mixed/unknown delivery type. Parity (number of deliveries) and decade of age were used as continuous covariates in the logistic regression analyses.

The GHC automated pharmacy database was used to generate the RxRisk chronic disease score, a measure of medical comorbidity based on prescription drug use for the previous 12 months. Medical comorbidity was dichotomized according to the median split of the RxRisk score.

**STATISTICAL ANALYSIS**

All statistical analyses were performed using the SAS statistical package (version 8.2; SAS Institute, Inc, Cary, NC). Descriptive statistics were used to characterize the overall sample and individuals with and without UI. Prevalence rates of UI and UI severity subgroups were calculated for the study population according to decade of age. An age-weighted overall prevalence of UI was also calculated according to the age distribution of GHC’s total female population. Bivariate comparisons of variables by UI status were conducted using χ² tests for categorical variables and t tests for continuous variables. Bivariate comparisons of variables by UI severity (mild to moderate UI vs severe UI) were then conducted in the subset of women with UI. Using factors determined to be a priori and significant factors from the bivariate analyses, we created a series of
multivariate logistic regression models to predict odds of having UI for all women and odds of having severe UI for women with UI. In the subset of parous women, the same models were run with the addition of delivery type. Interaction effects were tested.

To assess potential response bias, we examined differences between survey respondents and nonrespondents using the automated database. We estimated the probability of being a respondent as a function of the following variables: age, RxRisk score, number of primary care visits in the past year, diagnosis of depression, and diagnosis of diabetes. We then used a weighted analysis with weights inversely proportional to the estimated probability of response, rescaled to sum to the observed sample size. In this type of analysis, persons with a low probability of responding are given a higher weight in the analysis to represent the larger number of nonrespondents with similar characteristics. We compared weighted and unweighted analyses to see if postsurvey adjustment for factors related to nonresponse resulted in meaningful differences in survey estimates. Differences in weighted and unweighted data were negligible; therefore, we report analyses based on observed data.

RESULTS

RESPONDENTS, PREVALENCE, AND CHARACTERISTICS OF UI

Reasons for ineligibility were death (n = 34), invalid address (n = 162), mental or physical inability to respond to the questionnaire (n = 151), disenrollment from GHC (n = 96), paralysis (n = 9), and current urinary tract infection (n = 17). Of the remaining 5531 potential participants, 3536 returned the questionnaire for a response rate of 64%.

The prevalence of UI (any leakage that occurs at least monthly) among respondents was 42%. After adjusting for oversampling the youngest age groups, the population-based prevalence was 45%. The prevalence of UI increased with age (28% for respondents aged between 30 and 39 years compared with 55% for those aged between 80 and 90 years) (Table 1). Among all respondents, 9% reported slight UI, 15% reported moderate UI, 18% reported severe UI, and 58% reported no UI. The prevalence of severe UI increased markedly with age, as only 8% of women aged between 30 and 39 years reported severe incontinence compared with 33% of those aged between 80 and 90 years (Figure).

Monthly episodes were reported by 44%, weekly episodes were reported by 30%, and daily episodes were reported by 26% of the women with UI. The median amount of urine lost was small (range, a few drops to a large amount). The mean ± SD duration of UI was 6.0 ± 7.2 years. Half of the incontinent women reported mixed symptoms while 13% reported symptoms of urge UI alone, 33% reported symptoms of stress UI alone, and 4% did not report their symptom type. The prevalence of stress UI symptoms decreased with age and the prevalence of urge and mixed UI symptoms increased with age (Table 1).

Incontinent women were older, had a higher BMI, and were more likely to be white, parous, and perimenopausal or postmenopausal (Table 2). They were more likely to have undergone a hysterectomy and had greater medical comorbidity, including major depression and diabetes. They had lower educational attainment, lower income, and were less likely to be currently employed. Their mean ± SD Patient Incontinence Severity Assessment symptom score was 2.0 ± 1.2 (range, 1.0-5.0). Their mean ± SD I-QOL score was 82.6 ± 17.6 (range, 6.8-100.0).
FACTORS ASSOCIATED WITH UI

In the final logistic regression model, older age, increasing BMI, increasing medical comorbidity, current major depression, a history of hysterectomy, and increasing parity were associated with increased odds of having UI whereas not being white was associated with decreased odds of having UI (Table 3). In the final logistic model in the subset of parous women, a history of cesarean deliveries only was associated with decreased odds of having UI (adjusted odds ratio [OR], 0.59; 95% confidence interval [CI], 0.43-0.82; P = .001) compared with having had nonoperative vaginal deliveries only. Diabetes, current smoking status, other delivery types, and interaction effects were not significantly associated with UI in the final logistic regression models.

Because severe UI has the largest QOL impact, a separate logistic regression was performed to determine factors associated with severe UI among women with UI (Table 4). Older age, obesity, medical comorbidity, major depression, diabetes, and a history of hysterectomy were associated with increased odds of having severe UI. In the final logistic model in the subset of parous women, having had cesarean deliveries only was associated with decreased odds of severe UI (adjusted OR, 0.47; 95% CI, 0.26-0.84; P = .01) compared with having had nonoperative vaginal deliveries only.

COMMENT

In this study, one quarter of the women between the ages of 30 and 39 years and one half of the women between the ages of 50 and 90 years reported experiencing urinary leakage at least monthly. The severity of UI increased linearly with age, as only 8% of women between the ages of 30 and 39 years reported severe UI compared with 33% of the eldest women (those aged 80-90 years). The largest proportion of women in this study reported mixed UI symp-
toms. Stress and mixed symptoms were roughly equivalent in women younger than 50 years, while mixed symptoms predominated in women older than 50 years. Increasing age, BMI, medical comorbidity, and parity; current major depression; and a history of hysterectomy were associated with increased odds of having UI whereas not being white and having had only cesarean deliveries (in parous women) were associated with decreased odds of having UI. Of these factors, major depression and obesity had the strongest association with UI. Among women with UI, these same 2 factors plus diabetes had the strongest association with severe UI.

Our prevalence rate of 45% is higher than that in the Norwegian study by Hannestad et al13 (25%) but lower than that in the British study by Swithinbank et al14 (69%), both of which surveyed women of a similarly broad age range. Since the detailed, multistep questions assessing UI in our study and the Norwegian study13 are similar, the reason for this difference is unclear. The Norwegian study population may be healthier and have fewer risk factors (such as obesity) than our US study population. Alternately, the recent direct-to-consumer advertising of UI treatments in the United States may have increased the general awareness that UI is a medical problem—rather than a normal condition of aging—in our study population. Our prevalence rate is lower than the rates found in studies that focused on older populations and included any leakage in a normal condition of aging—in our study population. Our prevalence rate is lower than the rates found in studies that focused on older populations and included any leakage in the past year as their definition of UI.9,11 Since leakage that occurs less than monthly has been associated with little bother,13 we chose at least monthly leakage as the cutoff for a definition of UI.

The linear increase in UI severity with age is similar to the pattern seen in the Norwegian study.13 Our finding of 13% severe UI in women aged between 40 and 49 years is similar to the recent finding by Sampselle et al9 of 10% severe UI in US women aged between 42 and 52 years using the same severity index. Our finding that one quarter of women aged between 60 and 69 years and up to one third of women aged between 80 and 90 years experience severe UI is alarming and indicates a need for increased detection and treatment of this condition.

The women in our study were most likely to report mixed UI symptoms. This differs from many reports that stress UI symptoms are most common,12,22 but is similar to one large French study where 49% of respondents reported mixed UI symptoms.12 Our high rate of mixed symptoms may again be related to direct-to-consumer advertising for overactive bladder and urge UI. Our results support that pure stress symptoms decrease with advancing age, and that pure urge symptoms and mixed symptoms increase with advancing age.13

The women in our study reported mild to moderate quality of life impairment from their UI. The mean ± SD I-QOL score of 82.6 ± 17.6 is 1 SD higher than the US I-QOL validation study in women enrolled in an incontinence treatment trial.1 The mean Patient Incontinence Severity Assessment score of 2.0 ± 1.2, reflecting a subjective impression of mild to moderate UI severity, is lower than the rating of moderate severity (3.1 ± 1.3) that we found in our tertiary care incontinence clinics.18 These differences seem appropriate given the community-based sample in the present population, which includes many of the participants who have not sought treatment for their UI.

Our study confirms the current evidence for increasing age,2,6,7,25 increasing BMI9,13,24,25 parity,2,9,12,26 and medical comorbidity6,27 as factors associated with UI. Our study contributes to the understanding that current major depression, a history of hysterectomy, and having had only cesarean deliveries are factors also associated with UI.

The strong association between current major depression and UI adds to recent studies using depression diagnostic tools, rather than symptom screening measures, which have found similar associations between major depression and UI.4,6,28 This distinction is important because it reveals that many women with UI have serious forms of depression that are often undiagnosed or undertreated. The link between major depression and UI may be bidirectional. Altered neurotransmitter function in depressed patients could affect the complex bladder innervation, leading to UI. Alternately, the embarrassment from urine loss may lead to progressive social isolation and subsequent depression over time.

Hysterectomy is thought to contribute to UI through the damage of pelvic nerves or urethral support structures.20-31 While several studies have shown higher rates of UI in women who underwent hysterectomy,2,12,27,32 other studies have not confirmed this association.22,33 The majority of studies were performed in European countries with hysterectomy prevalence rates of 5% to 15%, which are much lower than estimated US prevalence rates of up to 40%.34 The impact of hysterectomy on UI in a country where far more hysterectomies are performed may differ from that in counties where relatively few are performed. In our study the prevalence of hysterectomy in women aged between 30 and 90 years was 21%, and women who had undergone a hysterectomy were 33% more likely to have UI than women who had not.

Damage to innervation of the pelvic floor muscles has been implicated in the development of UI following vaginal delivery.35 Several recent studies examined the role of delivery type on UI prevalence, with emphasis on the possible protective role of cesarean deliveries.12,36 In our study, compared with nulliparous women, parous women were 17% more likely to have UI with each delivery.
Among parous women, having had only cesarean deliveries offered protection, with a 41% decrease in the odds of having UI compared with women who had only nonoperative vaginal deliveries.

The population-based sampling and links to automated medical data, which provide accurate assessment of comorbid medical conditions, are strengths of this study. We also addressed potential responder bias through a propensity analysis, showing that the results are representative of our population. The comprehensive data collected and the large number of participants allow for analysis of many potential risk factors. Most of our participants were white and not current smokers, however, and may thereby differ from other population samples. Another limitation of this and other large epidemiologic surveys is the cross-sectional design, which prevents determination of the causal relationships between UI and associated risk factors.

With the aging of our population and better treatments for UI, women must be encouraged not to think of UI as a normal and untreatable consequence of aging. Practitioners should query women of all ages about symptoms of this prevalent condition and offer treatment when detected. Special attention should be paid to increasing age, obesity, and current depression as potential factors associated with this condition.

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