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Urinary retention and catheter use among U.S. female Medicare beneficiaries: Prevalence and risk factors

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Abstract

AIMS—To identify the prevalence of and risk factors for urinary retention and catheterization among female Medicare beneficiaries.

METHODS—We identified women with a diagnosis of urinary retention in a 5% sample of Medicare claims in 2012. Women were categorized into three groups based on the occurrence and duration of urinary catheterization within a 1 year period: 1) no catheterization; 2) short-term catheterization (ie, one or more catheterizations in less than 30 days); and 3) chronic catheterization (catheterizations in multiple 30 day periods within 1 year). We then identified a group of age-matched controls without catheterization or a diagnosis of urinary retention in 2012. Clinical and demographic data were collected for each patient, and risk factors for retention and catheterization were compared across groups. We assessed factors associated with urinary retention using multivariable logistic regression.

RESULTS—We estimated the rate of retention to be 1532 per 100 000 U.S. female Medicare beneficiaries in 2012, with rates of short term and chronic catheterization estimated to be 160 and 108 per 100 000 women, respectively. Prior diagnoses of neurologic condition, urinary tract infection, and pelvic organ prolapse were positively associated with retention and catheterization in multivariable analyses.

CONCLUSIONS—We estimated the prevalence of urinary retention diagnoses among female Medicare beneficiaries to be 1532 per 100 000 women. Retention and catheterization were significantly associated with comorbid disease, with the strongest associations identified with a concomitant diagnosis of neurologic condition, UTI, and POP.

Keywords

lower urinary tract symptoms; pelvic organ prolapse; underactive bladder; urinary retention

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POTENTIAL CONFLICTS OF INTEREST

Dr. Dmochowski is a consultant for Allergan and Medtronic. Dr. Kaufman teaches courses for Medtronic and Boston Scientific.

SUPPORTING INFORMATION

Additional Supporting Information may be found online in the supporting information tab for this article.

1 INTRODUCTION

Urinary retention may result from bladder outlet obstruction (BOO), impaired bladder function, or both. BOO due to functional or anatomic causes has been identified in as few as 2.7% of women referred for urodynamics (UDS) from a general population.[1] In contrast, detrusor underactivity (DU) has been identified in 12–45%,[2] suggesting impaired detrusor function contributes more significantly than BOO to impaired bladder emptying in many women with retention and lower urinary tract symptoms (LUTS). Although elevated PVR can be an incidental finding, the burden of clinically significant urinary retention can include bladder catheterization, bothersome LUTS, incontinence, and/or urinary tract infections (UTIs); in some cases unrecognized retention can pose a risk to long term renal function.[2]

The incidence of acute urinary retention requiring hospitalization has been estimated to be only seven per 100 000 women per year across all ages.[3] However, to date, no studies have identified the population-wide prevalence of non-acute urinary retention in older women in the United States. Therefore, we sought to determine the prevalence of urinary retention and catheter use among female U.S. Medicare beneficiaries and associated risk factors.

2 MATERIALS AND METHODS

Our Institutional Review Board determined that this project met qualifications for exemption. We used administrative healthcare claims for a 5% sample of U.S. Medicare beneficiaries obtained from the Centers for Medicare and Medicaid Services in years 2011–2013. We initially identified female beneficiaries older than 65 years of age with at least one healthcare claim for services in 2012 associated with a diagnosis of urinary retention based on International Classification of Diseases-9th Edition (ICD-9) codes [atony of bladder (ICD 596.4), retention of urine (ICD 788.2×), retention of urine, unspecified (ICD 788.20), incomplete bladder emptying (ICD 788.21), other specified retention of urine (ICD 788.29), overflow incontinence (ICD 788.38)] (Supplemental Material). This dataset has the advantages of including a large population of older women, a broad sample reflective of the older U.S. population, and allowing for continuity in claims for individual subjects over time. We excluded women without continuous Medicare coverage during 2012 and at least 3 months of coverage prior to and 12 months following retention diagnosis. We then identified subgroups of women with additional claims documenting bladder or urinary catheterization based on common procedural terminology (CPT) and ICD-9 procedural codes. We categorized the cohort into three groups based on frequency and duration of catheterization in the 365 days following either the first retention diagnosis or catheter procedure code in 2012. Group one included women with a diagnosis of retention and no catheterization (ie, retention without catheterization). Group two included women with a diagnosis of retention who had undergone catheterization(s) within a single 30-day period (ie, retention with short-term catheterization). Group three included women with a diagnosis of retention with catheterization(s) in multiple 30-day periods (ie, retention with long-term catheterization). We also established a fourth group of age-matched controls without retention. Matching was based on age and race with exact 1:1 matching to all women with retention. Records from 2011 to 2013 were queried to provide run-in and follow-up data.

Additional clinical data related to comorbidities and procedures potentially associated with urinary retention were gathered on all patients using ICD-9 diagnostic and procedural codes, and CPT codes (Supplemental Material). Age and Charlson comorbidity index (CCI) were determined at the time of retention diagnosis based upon previously established criteria.[4] We categorized race/ethnicity into Caucasian, African-American, Hispanic, Asian, and other. Using all available data prior to the diagnosis of retention, we identified obesity, diabetes, cardiovascular disease, stroke, neurologic condition, and POP using ICD-9 and CPT codes in the outpatient, inpatient, and carrier files (Supplemental Material). A diagnosis of frailty was based on previously published criteria in a Medicare population.[5] We reviewed claims within 30 days of retention diagnosis for the presence of ICD-9 procedural or CPT codes consistent with radical pelvic, urologic pelvic, and stress urinary incontinence surgery. In addition, we reviewed all prior claims data for the presence of ICD-9 diagnosis codes for LUTS prior to retention diagnosis and CPT codes consistent with UDS testing.

2.1 Statistical analyses

We report number and proportion for categorical variables and mean and standard deviation for continuous variables. We performed Chi-square tests to assess for differences in proportions for categorical variables and Kruskal-Wallis tests to assess for differences in continuous variables across groups. Logistic regression analysis was used to assess odds of urinary retention compared to non-retention controls and odds of any catheterization relative to those without catheterization among beneficiaries with retention. Univari-able regression was performed for all variables; clinically relevant variables were included in the multivariable regression analyses. All analyses were performed with SAS 9.4 (SAS Institute Inc, Cary, NC). A two-sided *P*-value <0.05 was considered statistically significant.

3 RESULTS

Of 1 002 659 female beneficiaries in the 5% sample dataset in 2012, we identified 15 360 women meeting criteria for retention, a prevalence of 1532 per 100 000 (1.5%). Demographic and clinical data for this cohort are presented in Table 1. Twelve thousand six hundred and seventy nine (1265 per 100 000) women had retention without catheterization (Group 1), 1603 (160 per 100 000) retention with short-term catheterization only (Group 2), and 1078 (108 per 100 000) retention with long-term catheterization (Group 3). Relative to age-matched controls without retention, women with retention were more likely to have a diagnosis of all measured comorbid conditions. In the long-term catheterization group, 23.3% of women had a prior diagnosis of a neurologic condition, versus only 10.1% and 6.6% in the no catheter and short-term catheter groups, respectively ($P < 0.001$). A prior diagnosis of diabetes was more frequently present in women with retention (35.5%, 33.6%, and 38.7% in Groups 1, 2, and 3, respectively), however, diabetes was common in controls as well (31.4%). Diagnoses of UTI and POP were more frequently present in women with retention ($P < 0.001$ for both), with 74.3% and 22.6% of women in the long-term catheterization group having prior diagnoses of UTI and POP, respectively.

The most frequent ICD-9 diagnosis was retention of urine (ICD 788.2×), followed by retention of urine unspecified (ICD 788.20), and incomplete bladder emptying (ICD 788.21)

(Table 2). Among women with retention, a claim consistent with voiding LUTS was present prior to the diagnosis of retention in 4.6%, 4.9%, and 5.8% of women in the no catheterization, short-term catheterization, and long-term catheterization groups, respectively. A diagnosis of one or more storage LUTS was present in over 20% of all women with a diagnosis of retention, and diagnoses of stress urinary incontinence, urgency urinary incontinence, and mixed urinary incontinence were present in 3.8%, 4.6%, and 2.3%, respectively. 2.0% of women with a retention diagnosis had a prior UDS claim. Intermittent catheterization was the most frequent procedure for women in the short-term (54.5%) and long-term (57.2%) catheterization groups (Table 3).

Comorbid diagnosis, UTI, and POP were significantly associated with a diagnosis of retention in univariable analyses (Table 4). After multivariable adjustment, the presence of cardiovascular disease (adjusted odds ratio [AOR] 1.16, 95%CI 1.10–1.23), stroke (AOR 1.12, 95%CI 1.01–1.23), neurologic condition (AOR 2.79, 95%CI 2.48–3.15), frailty (AOR 1.67, 95%CI 1.57–1.77), UTI (AOR 3.48, 95% CI 3.27–3.63), and POP (AOR 5.37, 95%CI 4.77–6.04) remained significantly associated with increased odds of retention relative to controls. Diabetes was associated decreased odds of retention on adjusted analysis (AOR 0.78, 95%CI 0.73–0.83).

Table 5 summarizes the univariable and multivariable analyses of odds of catheterization (short-term, long-term, and any catheterization analyzed separately) relative to women with retention and no catheterization. Only POP was associated with significantly increased odds of short-term catheterization relative to women with retention without catheterization (AOR 1.75, 95%CI 1.51–2.02). Characteristics significantly associated with increased odds of long-term catheterization relative to retention without catheterization included: older age (AOR 1.015, 95%CI 1.006–1.024), diabetes (AOR 1.20, 95%CI 1.02–1.40), neurologic condition (AOR 2.73, 95%CI 2.33–3.20), prior UTI (AOR 1.89, 95%CI 1.63–2.18), and POP (AOR 2.45, 95%CI 2.09–2.87). Increased odds of any catheterization were significantly associated with older age (AOR 1.010, 95%CI 1.004–1.015) and diagnosis of a neurologic condition (AOR 1.42, 95%CI 1.25–1.62), prior UTI (AOR 1.24, 95%CI 1.14–1.36), and POP (AOR 2.02, 95%CI 1.80–2.26).

4 DISCUSSION

Our study is the first to examine the prevalence of urinary retention and bladder catheterization in female U.S. Medicare beneficiaries. We report a prevalence of retention of 1532 per 100 000 in the 5% sample of female U.S. Medicare beneficiaries in 2012, of whom approximately one in six underwent bladder catheterization of any duration. Older age, neurologic diagnosis, history of UTI, and POP were all associated to varying degrees with increased odds of catheterization. We also identified both voiding and storage LUTS as frequently present concomitant diagnoses.

There are few studies with which to compare our results. In the 1980s, Klarskov et al. identified 18 hospital admissions for acute urinary retention over 9 months among women at six different hospitals in Copenhagen, Denmark serving a population of 700 000 people.[3] From these data, the authors estimated an annual incidence of acute urinary retention in

women of seven per 100 000 per year. By design, Klarskov et al. identified the most extreme cases of retention, as all led to hospitalization. Our data suggest retention is more common, as we identified women with what is presumed to be clinically significant urinary retention (based on catheterization and/or the effort made by a provider to code for retention) in the inpatient and outpatient settings. Because retention and voiding LUTS tend to predominate in women both with and without retention, it is likely that retention is underdiagnosed, and, therefore, our study may underestimate the incidence of retention-associated clinical symptoms.

To this end, 20% of women of all ages reported “difficulty completely emptying” on a mailed population-based survey in Metro Detroit.[6] In addition, multiple studies have reported on the prevalence of elevated PVR in women, many of whom were asymptomatic. In the ambulatory setting, Huang et al.[7] identified PVR >100 mL in 11% and >200 mL in 5% of 987 women ages 55–75 screened as part of a two-year prospective Washington state Group Health Cooperative study. PVR >100 mL was associated with urinary frequency (OR 1.42) and PVR >200 mL with increased likelihood of urgency urinary incontinence (OR 1.50). Although 26.7% of women with PVR >200 mL reported no LUTS, 46.7% reported urge urinary incontinence, 44.4% reported stress urinary incontinence, 26.7% reported daytime frequency, and 37.8% reported nocturia, suggesting a high degree of variability in LUTS in women with elevated PVR. Furthermore, these data suggest that presence of predominant storage LUTS do not render concomitant urinary retention unlikely. The combination of both urge urinary incontinence and elevated PVR may reflect the presence of detrusor hyperactivity with impaired contractility, a common finding in elderly patients with incontinence.[8] In addition to its association with bothersome LUTS, incidentally detected elevated PVR has been associated with increased risk of UTI,[9] suggesting that even “asymptomatic” retention may be clinically relevant even if it goes undetected.

In addition to clinical symptoms, including both voiding and storage LUTS, certain clinical conditions may make the presence of urinary retention more likely. Lee et al.[10] identified increased prevalence of cardiovascular disease, diabetes, metastatic malignancy, and renal disease among older women referred for retention in the inpatient setting. In the present study, we similarly identified the presence of comorbid disease to be more prevalent among women with a retention diagnosis. Specifically, higher CCI score, cardiovascular disease, stroke, and frailty were associated with retention. However, the diagnoses with the strongest association with retention and catheterization were the presence of a neurologic condition, prior UTI, and POP.

Neurologic disease is frequently associated with lower urinary tract dysfunction, and urinary retention is a common manifestation of neurogenic bladder.[11] The incidence of frequent causes of neurogenic bladder such as spinal cord injury[12] and multiple sclerosis[13] may be increasing among older women. In the present study, nearly one-quarter of women diagnosed with urinary retention had a prior diagnosis of a neurologic condition versus only 2.6% of controls. The frequency of UTI in patients with neurogenic bladder, which has been estimated at 2.5 episodes per year,[14] is primarily due to incomplete bladder emptying and the need for catheterization,[15] a clinical scenario that predisposes many women even without underlying neurologic disease to UTI.[16]

The risk for UTI in older women may be elevated even in the absence of voiding dysfunction due to postmenopausal status and increased prevalence of diabetes.[17] To this end, a prior UTI diagnosis was present in nearly one-quarter of non-retention controls. However, the presence of a prior UTI diagnosis was especially high among women in retention (approximately 60%), and particularly among women requiring long-term catheterization, of whom nearly three-quarters had a prior UTI. Although causality cannot be implied based on study design, the association between catheter usage and UTI is well-established.[18]

Although limiting catheterization may not be possible in many patients, in a subset of older women a reversible cause of retention may be identified. In the present study, we found POP to be significantly associated with increased risk of retention and catheterization. Fitzgerald et al.[19] reported resolution of elevated PVR in 89% (31/35) of patients with grade 3 or 4 prolapse who underwent surgical correction. Similarly, pessary reduction of POP has been reported to result in resolution of elevated PVR in 75% of women with symptomatic POP,[20] suggesting a role for this conservative therapy in women who wish to avoid or cannot undergo surgery.

When not due to a reversible anatomic or functional cause, however, treatment options for retention remain limited. Underactive bladder (UAB) is an emerging clinical diagnosis characterized by a failure to empty primarily related to an inadequate bladder contraction rather than anatomic or functional BOO.[2] The etiology of impaired emptying in UAB is variable. Neurogenic dysfunction (afferent or efferent signaling), prolonged obstruction leading to myogenic failure, voiding dysfunction, ischemia, and/or aging may all contribute to the condition's underlying pathophysiology.[21–25] Given that the rate of BOO has generally been reported to be low in older women,[1] UAB may be an important contributor to urinary retention in our study population, however this is speculative. In a study of 99 women over 70 years of age undergoing UDS for LUTS, only 12 (12%) demonstrated DU.[24] However, DU was significantly associated with a diagnosis of urinary retention (75% vs 9%, $P = 0.0052$) and urethral catheter use (67% vs 10%, $P = 0.038$). Neurologic disease (30% vs 10%) and diabetes (27% vs 10%) were more frequently present in women with impaired detrusor function; however, the difference was not significant ($P > 0.05$ for both). Age ≥75 years was significantly associated with DU, consistent with an earlier study[25] that identified impaired detrusor contractility in 29 out of 77 (38%) incontinent institutionalized women with mean age 89 years.

Despite classically being linked to DU,[2] we did not identify an independent association between diabetes and urinary retention. The lack of association with diabetes may be related to the fact that claims-based data do not provide any detailed information on diabetes, such as the severity or chronicity, which are likely important factors contributing to DU. It also may be that diabetes is not a significant, independent cause for urinary retention in this population, which is our primary outcome measure. As discussed above, we do speculate that some women in our study have UAB, but this is not our outcome measure for the study. Therefore, associations for UAB or DU may not be entirely applicable. Further studies on the association with diabetes and lower urinary tract dysfunction are clearly needed.

The present study is the first to evaluate the prevalence of urinary retention and catheterization among female Medicare beneficiaries. As a population-wide study, it has broad applicability to older U.S. women. However, there are several limitations. Our study is subject to the inherent limitations of any administrative claims-based study, namely that there may be errors in coding for procedures and diagnosis (ie, misclassification bias). It is therefore likely that this study underestimates the true incidence of retention, particularly in those without a catheterization procedure code. There are likely many women who have bothersome LUTS contributed to by elevated PVR but who are coded based on symptoms without recognition of retention and/or presumed diagnosis of overactive bladder. Second, it is possible that in many cases a UTI claim was filed in the absence of true infection, as this scenario is frequently encountered in clinical practice, particularly in older women with LUTS. Third, catheterization is captured only when a procedure code is filed. This is unlikely to misrepresent women with chronic indwelling catheters changed at regular intervals, however, there may be women who had prior to the study period been successfully performing long-term intermittent catheterization who were misclassified as having incident retention without catheterization or short-term catheterization only. Furthermore, although no women had a retention claim in the run-in period, it is likely that a subset of both retention patients and controls may have been in retention prior to the study period. Therefore, the estimates in the study represent the likelihood that a woman will have a diagnosis of retention or undergo catheterization in a given year and may underestimate the total number of women in retention. Lastly, as a cross-sectional study, these data represent a snapshot in time, and the results do not address causality or consequences of retention and catheterization. In this heterogeneous study population, a claims-based dataset does not permit quantifying the degree of retention or associated bother or unambiguous identification of an underlying etiology, which must be speculated based on the presence or absence of associated catheterization and/or diagnosis codes. Future studies will be required to investigate population-wide outcomes for women with urinary retention.

5 CONCLUSIONS

Based on a 5% Medicare sample, we estimated the prevalence of urinary retention diagnoses among female beneficiaries to be 1532 per 100 000 women in 2012, of whom one in six underwent catheterization. Retention and catheterization were significantly associated with comorbid disease, with the strongest associations identified with a concomitant diagnosis of neurologic condition, UTI, and POP.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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TABLE 1

Characteristics of the study population

Category	No catheterization *n* = 12 679	Short-term catheterization *n* = 1603	Long-term catheterization *n* = 1078	No retention (control) *n*=15 360	*P*-value
Demographics and comorbidities					
Age, mean ± std dev	79.0 ± 7.9	78.9 ± 7.9	79.4 ± 7.8	79.0 ± 7.9	0.212
Race, *n* (%)					0.694
Caucasian	11 396 (89.9)	1438 (89.7)	980 (90.9)	13 814 (89.9)	
African-American	714 (5.6)	92 (5.7)	55 (5.1)	861 (5.6)	
Hispanic	193 (1.5)	25 (1.6)	18 (1.7)	236 (1.5)	
Asian	188 (1.5)	23 (1.4)	5 (0.5)	216 (1.4)	
Other	188 (1.5)	25 (1.6)	20 (1.9)	233 (1.5)	
Charlson comorbidity index, mean ± std dev	2.32 ± 2.14	2.07 ± 2.02	2.35 ± 2.14	1.57 ± 1.77	<0.001
Obesity, *n* (%)	1282 (10.1)	163 (10.2)	126 (11.7)	1203 (7.8)	<0.001
Diabetes, *n* (%)	4499 (35.5)	539 (33.6)	417 (38.7)	4829 (31.4)	<0.001
Cardiovascular disease, *n* (%)	5376 (42.4)	642 (40.1)	485 (45.0)	4688 (30.5)	<0.001
Stroke, *n* (%)	1524 (12.0)	158 (9.9)	117 (10.9)	930 (6.1)	<0.001
Neurologic condition, *n* (%)	1282 (10.1)	105 (6.6)	251 (23.3)	391 (2.6)	<0.001
Frail, *n* (%)	5462 (43.1)	606 (37.8)	434 (40.3)	3493 (22.7)	<0.001
Urologic history					
Urinary tract infection, *n* (%)	7447 (58.7)	912 (56.9)	801 (74.3)	3817 (24.9)	<0.001
Pelvic organ prolapse, *n* (%)	1318 (10.4)	280 (17.5)	242 (22.5)	385 (2.5)	<0.001

Category	No catheterization *n* = 12 679	Short-term catheterization *n* = 1603	Long-term catheterization *n* = 1078	No retention (control) *n*=15 360	*P*-value
Radical pelvic surgery,[a] *n* (%)	59 (0.5)	6 (0.4)	0 (0.0)	1 (0.0)	<0.001
Urologic pelvic surgery,[a] *n* (%)	6 (0.1)	2 (0.1)	2 (0.2)	0 (0.0)	<0.001
Stress urinary incontinence surgery,[a] *n* (%)	65 (0.5)	32 (2.0)	17 (1.6)	1 (0.0)	0.001

[a]In the 30 days prior to diagnosis of retention.

TABLE 2

Lower urinary tract symptoms and incontinence among women with retention

Category	No catheterization	Short-term catheterization	Long-term catheterization	*P*-value
Concomitant lower urinary tract symptoms				
Voiding lower urinary tract symptoms,[a] *n* (%)	579 (4.6)	79 (4.9)	63 (5.8)	0.146
Storage lower urinary tract symptoms,[b] *n* (%)	2646 (20.9)	400 (25.0)	230 (21.3)	<0.001
Incontinence,[c] *n* (%)				
Stress urinary incontinence	446 (3.5)	99 (6.2)	45 (4.2)	<0.001
Urgency urinary incontinence	558 (4.4)	84 (5.2)	60 (5.6)	0.085
Mixed urinary incontinence	280 (2.2)	42 (2.6)	31 (2.9)	0.247
Urinary retention ICD-9 Code				
Atony of bladder (596.4)	234 (1.9)	14 (0.9)	36 (3.3)	<0.001
Retention of urine (788.2×)	11188 (88.2)	1536 (95.4)	1029 (95.5)	<0.001
Retention of urine unspecified (788.20)	6935 (54.7)	902 (56.3)	612 (56.8)	0.237
Incomplete bladder emptying (788.21)	3867 (30.5)	588 (36.7)	398 (36.9)	<0.001
Other specified retention of urine (788.29)	462 (3.6)	64 (4.0)	34 (3.2)	0.524
Overflow incontinence (788.38)	203 (1.6)	6 (0.4)	11 (1.0)	<0.001

[a]Slowing of urinary stream (788.62), splitting of urinary stream (788.61), other abnormality of urinary stream (788.69), straining on urination (788.63), urinary hesitancy (788.64), urinary obstruction unspecified (599.60), urinary obstruction not elsewhere classified (599.69).

[b]Urgency urinary incontinence (788.31), hypertonicity of bladder (596.51), urinary frequency (788.41), urgency of urination (788.63), mixed incontinence (788.33), urinary incontinence unspecified (788.30).

[c]Stress urinary incontinence, stress incontinence female (625.6); urge incontinence, urge incontinence (788.31); mixed urinary incontinence, mixed urinary incontinence (788.33); overflow incontinence, overflow incontinence (788.38); other, incontinence without sensory awareness (788.34); functional incontinence (788.91); other urinary incontinence (788.39); urinary incontinence unspecified (788.30).

TABLE 3

Frequency of catheterization subtype

Type of catheterization	Short-term catheterization	Long-term catheterization	*P*-value
Intermittent catheterization, *n* (%)	874 (54.5)	617 (57.2)	0.166
Urethral foley, *n* (%)	755 (47.1)	476 (44.2)	0.134
Suprapubic catheter, *n* (%)	26 (1.6)	151 (14.0)	<0.001

TABLE 4

Regression analysis, odds of urinary retention diagnosis relative to controls

	OR (95%CI)	
	Univariate	**Multivariate**
Demographics and comorbidities		
Age	1.000(0.997–1.003)	0.987 (0.983–0.990)
Charlson comorbidity index	1.21 (1.20–1.23)	1.10 (1.08–1.12)
Race		
Caucasian (Ref)		
African-American	1.00 (0.91–1.10)	1.02 (0.91–1.14)
Hispanic	1.00 (0.83–1.20)	0.90 (0.74–1.11)
Asian	1.00 (0.83–1.21)	1.21 (0.99–1.49)
Other	1.00 (0.83–1.20)	1.07 (0.87–1.31)
Obesity	1.34 (1.24–1.45)	0.96 (0.87–1.05)
Diabetes	1.20 (1.15–1.26)	0.78 (0.73–0.83)
Cardiovascular disease	1.67 (1.60–1.75)	1.16 (1.10–1.23)
Stroke	2.06 (1.90–2.24)	1.12 (1.01–1.23)
Neurologic condition	4.57 (4.08–5.12)	2.79 (2.48–3.15)
Frail	2.49 (2.37–2.62)	1.67 (1.57–1.77)
Urologic history		
Urinary tract infection	4.47 (4.26–4.69)	3.45 (3.27–3.63)
Pelvic organ prolapse	5.29 (4.73–5.92)	5.37 (4.77–6.04)

TABLE 5

Regression analysis, odds of catheterization relative to women with retention without catheterization

	OR (95%CI)					
	Univariate			Multivariate		
	Short-term catheterization	Long-term catheterization	Any catheterization	Short-term catheterization	Long-term catheterization	Any catheterization
Demographics and Comorbidities						
Age	1.000 (0.993–1.006)	1.008 (1.000–1.016)	1.003 (0.998–1.008)	1.006 (0.999–1.013)	1.015 (1.006–1.024)	1.010 (1.004–1.015)
Charlson comorbidity index	0.94 (0.91–0.97)	1.01 (0.98–1.04)	0.97 (0.95–0.99)	0.96 (0.93–1.00)	0.97 (0.93–1.01)	0.97 (0.94–0.99)
Race						
Caucasian (Ref)						
African-American	1.02 (0.82–1.28)	0.90 (0.68–1.19)	0.97 (0.81–1.17)	1.09 (0.87–1.37)	0.96 (0.72–1.28)	1.05 (0.87–1.26)
Hispanic	1.03 (0.68–1.56)	1.09 (0.67–1.77)	1.05 (0.75–1.47)	1.09 (0.71–1.67)	1.02 (0.62–1.67)	1.06 (0.76–1.48)
Asian	0.97 (0.63–1.50)	0.31 (0.13–0.76)	0.70 (0.47–1.05)	1.01 (0.65–1.56)	0.33 (0.14–0.81)	0.75 (0.50–1.11)
Other	1.06 (0.69–1.61)	1.24 (0.78–1.97)	1.13 (0.81–1.57)	1.08 (0.71–1.66)	1.25 (0.78–2.01)	1.14 (0.82–1.59)
Obesity	1.01 (0.85–1.20)	1.18 (0.97–1.43)	1.07 (0.94–1.23)	1.12 (0.94–1.35)	1.18 (0.96–1.45)	1.15 (1.00–1.33)
Diabetes	0.92 (0.83–1.03)	1.15 (1.01–1.30)	1.01 (0.92–1.10)	1.04 (0.91–1.18)	1.20 (1.02–1.40)	1.10 (0.99–1.22)
Cardiovascular disease	0.91 (0.82–1.01)	1.11 (0.98–1.26)	0.99 (0.91–1.07)	1.00 (0.89–1.12)	1.12 (0.97–1.28)	1.04 (0.95–1.14)
Stroke	0.80 (0.67–0.95)	0.89 (0.73–1.09)	0.84 (0.73–0.96)	0.95 (0.79–1.15)	0.90 (0.73–1.12)	0.93 (0.80–1.07)
Neurologic condition	0.62 (0.51–0.77)	2.70 (2.32–3.14)	1.36 (1.20–1.54)	0.67 (0.54–0.82)	2.73 (2.33–3.20)	1.42 (1.25–1.62)
Frail	0.80 (0.72–0.89)	0.89 (0.78–1.01)	0.84 (0.77–0.91)	0.91 (0.81–1.03)	0.76 (0.66–0.88)	0.84 (0.76–0.93)
Urologic History						
Urinary tract infection	0.93 (0.84–1.03)	2.03 (1.76–2.34)	1.24 (1.14–1.36)	0.98 (0.88–1.09)	1.89 (1.63–2.18)	1.24 (1.14–1.36)
Pelvic organ prolapse	1.82 (1.58–2.10)	2.50 (2.14–2.91)	2.08 (1.87–2.33)	1.75 (1.51–2.02)	2.45 (2.09–2.87)	2.02 (1.80–2.26)