American Journal of Epidemiology
Vol. 167, No. 4
DOI: 10.1093/aje/kwm356
Advance Access publication January 7, 2008

Original Contribution

Prevalence of and Risk Factors for Urine Leakage in a Racially and Ethnically Diverse Population of Adults

The Boston Area Community Health (BACH) Survey

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Received for publication July 14, 2006; accepted for publication May 31, 2007.

Most epidemiologic studies of urine leakage in the United States report on women and White populations. In this study, the authors determined the prevalence of urine leakage across genders and racial/ethnic groups in a population-based sample of 5,506 adults aged 30–79 years and identified factors related to leakage within genders and racial/ethnic groups. The prevalence of weekly urine leakage was 8% overall, 10.4% in women, and 5.3% in men. White women (11.7%) were more likely than Black (9.4%) and Hispanic (7.3%) women to report weekly leakage and to report stress-type (35.4% vs. 9.4% and 14.5%, respectively) and urge-type (13.4% vs. 3.3% and 10.8%, respectively) leakage. Rates and leakage types for men did not vary by race/ethnicity. For women, central obesity, asthma, and arthritis increased the odds of weekly leakage. For men, the odds of leakage increased for Blacks and Whites at ages 50 and 60 years, respectively, and for Hispanics of higher social class. For both genders, various comorbid conditions, including heart disease, asthma, and depression, increased the odds of leakage in varying racial/ethnic groups. The authors conclude that types of and risk factors for urine leakage vary by gender and racial/ethnic group.

prevalence; urinary incontinence

Abbreviations: BACH, Boston Area Community Health; NHANES III, Third National Health and Nutrition Examination Survey.

Editor's note: *An invited commentary on this article appears on page 400, and the authors' response appears on page 404.*

Concern about the psychosocial and economic burden of involuntary urine leakage fuels the need for a more complete understanding of the scope of this health problem in the US population, which is becoming increasingly diverse. Available data on both men and women have established involuntary urine leakage as a health problem that differs by gender in prevalence, type, age distribution, and etiology (1). In the few studies that have compared urine leakage in one or more racial/ethnic groups, investigators have reported that differences across groups warrant further investigation (2–9). However, most comparative studies have been limited to women and clinical samples, and relatively little is known about racial/ethnic differences in men.

Our objectives in this study were 1) to determine the prevalence of urine leakage across genders and racial/ethnic groups in a population-based sample of adults aged 30–79 years and 2) to investigate risk factors for urine leakage within genders and racial/ethnic groups. The analysis focused on rates of and risk factors for urine leakage experienced at least weekly. This level of frequency has high

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clinical relevance, is likely to be associated with bother, help-seeking, and reduced quality of life, and is more relevant for estimating the relevant burden on the health care system (10, 11).

MATERIALS AND METHODS

Study design

Data were derived from the Boston Area Community Health (BACH) Survey, an epidemiologic survey conducted in a population-based random sample of Black, Hispanic, and White men and women aged 30–79 years in Boston, Massachusetts.

Sample

The goal of the study's multistage, stratified cluster sample design was to obtain equal numbers of subjects in each of 24 design cells, defined by age (30–39, 40–49, 50–59, or 60–79 years), gender, and race/ethnicity (Black, Hispanic, or White). The city of Boston was stratified into 12 strata using four geographic areas and three racial/ethnic groups. The strata were formed by grouping the city's planning districts according to three levels of minority density (i.e., low minority density (primarily White), high Black density ($\geq$25 percent Black), and high Hispanic density ($\geq$30 percent Hispanic)). Census blocks were randomly sampled from 4,266 blocks in the city by stratum, such that approximately 10 percent of low-minority-density blocks, 15 percent of high-density Black blocks, and 75 percent of high-density Hispanic blocks were selected. The overall contact rate was 66 percent, with little variation across minority sampling blocks.

Screening was conducted at the household level and then the individual level, with a goal of obtaining approximately equal numbers of Black, White, and Hispanic respondents in the four age categories by gender. Individuals were eligible for the BACH Survey if a member of the randomly selected household aged 30–79 years, of a race/ethnicity and gender compatible with the household's sampling code, was competent to sign an informed consent form and could speak English or Spanish well enough to complete the interview. A total of 5,506 study participants were recruited from April 2002 through June 2005. Participants included 3,205 women and 2,301 men; by race/ethnicity, there were 1,770 Blacks, 1,877 Hispanics, and 1,859 Whites. Interviews were completed with 63.3 percent of the screener-identified eligible persons from the selected households. A detailed description of the sampling design and study methods is provided elsewhere (12).

Measures

Data were obtained during a 2-hour, in-person interview, generally conducted in the subject's home (13). All protocols and informed consent procedures were approved by the institutional review board of the New England Research Institutes (Watertown, Massachusetts). Wherever possible, the questions and scales were selected from instruments with acceptable validity and reliability.

Symptoms of urine leakage were measured with the following question:

> ''Many people complain that they leak urine (wet themselves) or have accidents. In the last 12 months, have you leaked even a small amount of urine?''

Frequency of urine leakage was coded as weekly (''one or more times per week'' or ''every day'') or less frequently (''one or more times per month'' or ''less than once per month''). Type of urine leakage was based on responses to the following questions:

> ''During the last 7 days, how many times did you accidentally leak urine:
> *a*. when you were performing some physical activity such as coughing, sneezing, lifting, or exercise?
> *b*. when you had the strong feeling that you needed to empty your bladder but you couldn't get to the toilet fast enough?
> *c*. without any particular physical activity or warning?''

Frequency responses of $\geq$1 to question (*a*) only were defined as stress-type leakage, to question (*b*) only as urge-type leakage, to both questions (*a*) and (*b*) as mixed-type leakage, and to question (*c*) only as other type of leakage. Frequency responses of zero to all three questions were also classified as other type of leakage.

Potential risk factors for urine leakage consisted of sociodemographic and behavioral factors and comorbid health conditions. Sociodemographic and behavioral risk factors included age; socioeconomic status, as measured by an index (range, 25.0–77.3) that combines education and income (14) (categorized such that one fourth of the BACH sample was lower class, one half was middle class, and one fourth was upper class); body weight/obesity (waist circumference, hip circumference, and measured height and weight for calculation of body mass index (weight (kg)/height $(m)^2$)); smoking (never, former, or current smoking); alcohol use (defined as in the Third National Health and Nutrition Examination Survey (NHANES III)); and physical activity level (low, moderate, or high), measured by means of the Physical Activity Scale for the Elderly (15). Self-reported comorbidity included diabetes mellitus, heart disease (angina, history of myocardial infarction, or coronary artery bypass or angioplasty), congestive heart failure, cardiac arrhythmia (irregular heartbeat or arrhythmia requiring a pacemaker or heart rhythm disturbance), hyperlipidemia, hypertension, arthritis/rheumatism, and asthma. Depression was measured using an abbreviated version of the Center for Epidemiologic Studies Depression Scale (16). For women, we included a composite menopause/hormone-use measure, according to the method of Kaufert et al. (17), that consisted of the following mutually exclusive categories: menopausal status (pre-, peri-, or postmenopausal) without hormone use, prior hysterectomy (surgically induced menopause) with hormone use, prior hysterectomy without hormone use, and current hormone use, including separate categories of hormone replacement therapy, birth control, raloxifene hydrochloric acid, and progesterone only. Hormones were identified through a medication audit with subsequent

TABLE 1. Prevalence of weekly urine leakage by race/ethnicity and gender, Boston Area Community Health Survey, 2002–2006

	Weekly urinary leakage (%)*				*p* value
	All participants	Blacks	Hispanics	Whites	
	$n = 5,506$	$n = 1,780$	$n = 1,858$	$n = 1,868$	
Both genders	8.0	7.5	5.7	8.7	0.0902
	$n = 2,301$	$n = 700$	$n = 766$	$n = 835$	
Men	5.3	5.0	3.9	5.7	0.5141
Age group (years)					
30–39	1.8	1.1	2.8	1.8	0.6124
40–49	5.2	2.5	5.2	6.6	0.2302
50–59	7.0	8.2	5.5	6.7	0.7795
60–79	10.6	13.5	2.4	10.4	0.0046
p value	0.0007	0.0010	0.6337	0.0307	
Type of urine leakage					
Stress	9.8	7.2	10.1	10.8	0.2337
Urge	16.1	28.3	26.4	10.3	
Mixed	15.0	25.1	14.3	11.5	
Other	59.0	39.4	49.2	67.5	
Duration of urine leakage (years)					
<1	30.4	36.6	26.3	28.8	0.8342
1–5	30.0	23.8	43.1	30.4	
>5	39.6	39.6	30.6	40.8	
	$n = 3,205$	$n = 1,070$	$n = 1,111$	$n = 1,024$	
Women	10.4	9.4	7.3	11.7	0.1400
Age group (years)					
30–39	6.3	5.2	1.0	8.7	0.0160
40–49	9.2	10.7	15.1	6.6	0.1930
50–59	12.6	11.0	9.2	14.2	0.3491
60–79	15.6	12.8	9.3	17.4	0.1584
p value	0.0041	0.3127	0.0009	0.0081	
Type of incontinence					
Stress	26.4	9.4	14.5	35.4	0.0030
Urge	10.4	3.3	10.8	13.4	
Mixed	56.7	82.1	68.7	44.2	
Other	6.4	5.1	6.0	7.0	
Duration of incontinence (years)					
<1	24.8	30.8	17.1	23.4	0.7266
1–5	34.4	32.9	40.5	34.2	
>5	40.8	36.3	42.4	42.4	

* All percentages are weighted.

coding. Finally, on the basis of prior results (18), reproductive history was limited to any vaginal delivery (yes/no).

Data analysis

Multiple logistic regression analyses were used to determine significant correlates of weekly urine leakage. To identify risk factors by gender and racial/ethnic group, we constructed separate models ($n = 8$) for each gender and then for each racial/ethnic group within each gender. Exact *p* values are presented to allow readers to use their preferred significance level when considering multiple comparisons.

Because of the two-stage cluster sampling design, it was necessary to weight observations inversely proportionally to the probability of selection into the study (19, 20). Weights were further poststratified to the Boston population

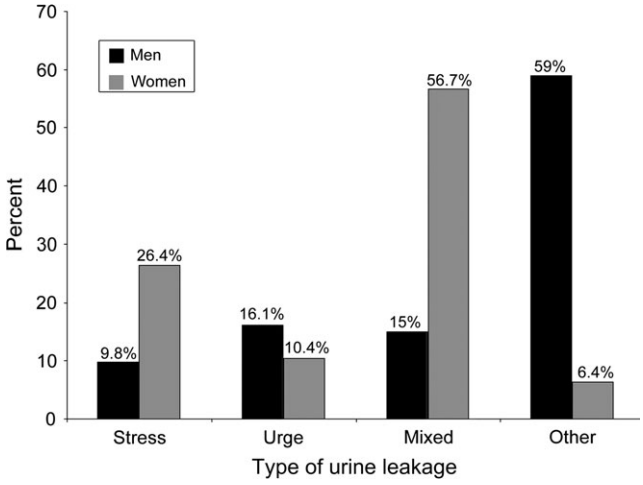

FIGURE 1. Type of urine leakage, by gender, Boston Area Community Health Survey, 2002–2006.

according to the 2000 US Census. SAS, version 9.1 (SAS Institute, Inc., Cary, North Carolina), was used to generate missing values by multiple imputation (21, 22). With the exception of income (6 percent), fewer than 0.5 percent of data were missing. Five multiple imputations were performed by gender and race/ethnicity, using all relevant variables. SUDAAN, version 9.0.1 (Research Triangle Institute, Research Triangle Park, North Carolina), was used to conduct weighted analyses.

RESULTS

Prevalence of weekly urine leakage

The overall prevalence of weekly urine leakage was 8 percent. Women were twice as likely as men (10.4 percent vs. 5.3 percent) to report weekly urine leakage across all racial/ethnic groups (table 1). For both genders, prevalence was highest among Whites and lowest among Hispanics. Prevalence rates among Blacks of both genders were closer to the rates for Whites than to the rates for Hispanics.

Characteristics of urine leakage

Women were more likely to report symptoms characterized as mixed stress- and urge-type leakage (figure 1). Men most frequently reported urine leakage that could not be characterized as stress-, urge-, or mixed-type leakage. There were significant racial/ethnic differences in type of leakage for women but not for men. The rate of stress-type leakage for White women (35.4 percent) was almost four times higher than that for Black women (9.4 percent) and 2.5 times higher than that for Hispanic women (14.5 percent). Mixed-type leakage was most frequently reported by Black (82.1 percent) and Hispanic (68.7 percent) women and less often by White women (44.2 percent). Urge-type symptoms were least common among Black women (3.3 percent), with similar rates among Hispanic (10.8 percent) and White (13.4 percent) women. In contrast to men (59 percent), type of urine leakage was much less likely to be characterized as ''other'' by women (6.4 percent).

Duration of urine leakage was similar for men and women and did not differ by racial/ethnic group. Approximately 40 percent of men and women with weekly leakage reported experiencing it for more than 5 years.

Risk factors for weekly urine leakage

Table 2 reports results from the eight logistic regression models identifying risk factors for weekly urine leakage by gender and for each racial/ethnic group within-gender.

Sociodemographic and behavioral risk factors. The odds of weekly urine leakage varied by racial/ethnic group only for women. White women had twice the odds of reported weekly urine leakage as Black and Hispanic women after adjustment for other covariates. The odds of weekly leakage increased with age for Hispanic women and for Black and White men. In Hispanic women, the greatest odds (odds ratio > 18) occurred at ages 40–49 years and 60–79 years, with a slight decrease at ages 50–59 years. In men, the largest increase occurred after age 50 years in Black men and after age 60 years in White men. Socioeconomic status was related to leakage only for upper-class Hispanic men (odds ratio $= 7$). Smoking status, alcohol use, and physical activity level were not related to weekly leakage for men or women. Waist circumference was a risk factor for leakage in women, with the odds of weekly leakage increasing by 15 percent with each 10-cm increase. The odds of leakage increased 43 percent for Hispanic women with each 10-cm increase, with similar trends for White women (13 percent increase) and Black women (16 percent increase).

Comorbidity risk factors. Various cardiovascular diseases increased the odds of leakage in both men and women. Heart disease was associated with over a fourfold increase in the odds of leakage among White men, whereas among women, the odds of leakage were increased 2.5-fold in Black women with heart disease and in Hispanic women with hyperlipidemia. Men and women with asthma had twice the odds of leakage, with higher odds of leakage in White men and women. The odds of leakage doubled for Black and White women with arthritis and increased four- to sixfold for Hispanic and White men and Black women with depression. The odds of leakage were not increased substantially for men or women with diabetes, with the exception of Hispanic men, for whom the odds of leakage were doubled.

Of the menopausal and hormone status factors considered for women, the odds of weekly leakage were twice as high (although not statistically significant) in women using hormone replacement therapy and women taking hormones after a hysterectomy as in women who were premenopausal. For Black and White women taking hormones after hysterectomy, these odds increased fourfold. Overall, the odds ratios for peri- and postmenopausal status, as well as surgically induced menopause with or without hormone replacement therapy, indicated that the odds of urine leakage were increased two- to fourfold in White women, although the

TABLE 2. Risk factors for weekly urine leakage by race/ethnicity and gender, Boston Area Community Health Survey, 2002–2006*

	All participants			Blacks			Hispanics			Whites		
	OR†	95% CI†	*p* value	OR	95% CI	*p* value	OR	95% CI	*p* value	OR	95% CI	*p* value
						Men						
Race/ethnicity			0.9967									
Black	1.02	0.53, 2.01										
Hispanic	1.04	0.37, 2.96										
White	1.00	Reference										
Sociodemographic and behavioral factors												
Age group (years)			0.0016			0.0084			0.1978			0.0204
30–39	1.00	Reference		1.00	Reference		1.00	Reference		1.00	Reference	
40–49	3.12	0.87, 11.17		1.67	0.35, 7.89		1.67	0.53, 5.25		4.90	0.76, 31.53	
50–59	4.30	1.39, 13.33		5.90	1.52, 22.90		3.44	0.91, 12.97		4.19	0.72, 24.35	
60–79	8.57	2.51, 29.27		6.97	1.77, 27.44		2.81	0.82, 17.74		12.67	2.16, 74.42	
Socioeconomic status			0.1011			0.7745			<0.0001			0.2402
Lower class	0.50	0.24, 1.02		1.06	0.46, 2.48		0.26	0.06, 1.06		0.32	0.09, 1.22	
Middle class	1.00	Reference		1.00	Reference		1.00	Reference		1.00	Reference	
Upper class	1.19	0.53, 2.64		0.59	0.12, 2.90		6.87	1.36, 34.76		1.00	0.39, 2.55	
Smoking status			0.0916			0.4039			0.1765			0.1538
Never smoker	1.00	Reference		1.00	Reference		1.00	Reference		1.00	Reference	
Former smoker	0.54	0.24, 1.20		1.28	0.43, 3.79		0.22	0.03, 1.51		0.35	0.10, 1.14	
Current smoker	0.99	0.46, 2.12		1.83	0.74, 4.56		0.81	0.12, 5.32		0.68	0.24, 1.93	
Alcohol consumption (drinks/day)			0.3707			0.4899			0.0877			0.4959
0	1.00	Reference		1.00	Reference		1.00	Reference		1.00	Reference	
<1	1.11	0.58, 2.13		1.46	0.62, 3.44		0.45	0.09, 2.17		0.92	0.32, 2.64	
≥1	1.68	0.80, 3.52		0.84	0.34, 2.10		4.31	0.80, 23.17		1.73	0.58, 5.15	
Physical activity			0.4233			0.9501			0.2541			0.7337
Low	1.00	Reference		1.00	Reference		1.00	Reference		1.00	Reference	
Moderate	0.66	0.36, 1.24		0.88	0.38, 2.04		0.82	0.21, 3.19		0.81	0.35, 1.87	
High	0.76	0.34, 1.67		0.89	0.31, 2.55		0.25	0.04, 1.39		1.73	0.58, 5.15	
Waist circumference (per 10-cm increase)	1.00	0.80, 1.24	0.9793	1.22	0.97, 1.55	0.0924	0.88	0.53, 1.47	0.6261	0.90	0.66, 1.24	0.5181
Comorbid conditions												
Diabetes mellitus	1.11	0.55, 2.24	0.7788	1.43	0.63, 3.24	0.3959	1.98	0.33, 11.91	0.4567	0.67	0.18, 2.51	0.5513
Heart disease	2.04	1.00, 4.16	0.0492	1.30	0.58, 2.95	0.5264	0.52	0.08, 3.59	0.5078	4.26	1.30, 13.97	0.0170
Congestive heart failure	0.64	0.15, 2.76	0.5502	—‡			—			—		
Cardiac arrhythmia	0.92	0.45, 1.89	0.8126	1.97	0.72, 5.38	0.1834	0.21	0.02, 2.05	0.1812	0.59	0.21, 1.68	0.3205
Hypertension	0.62	0.36, 1.06	0.0785	1.07	0.40, 2.85	0.8870	0.42	0.07, 2.42	0.3309	0.53	0.22, 1.29	0.1608
Hyperlipidemia	1.44	0.84, 2.47	0.1895	1.13	0.49, 2.60	0.7806	0.46	0.10, 2.07	0.3128	1.66	0.74, 3.73	0.2158
Asthma	2.66	1.17, 6.06	0.0201	1.57	0.59, 4.16	0.3658	2.93	0.63, 13.70	0.1710	3.65	1.14, 11.68	0.0292
Arthritis/rheumatism	1.03	0.61, 1.72	0.9210	1.86	0.81, 4.28	0.1435	0.38	0.09, 1.56	0.1772	0.67	0.31, 1.44	0.2993
Depression	3.53	1.93, 6.46	<0.0001	2.07	0.73, 5.84	0.1684	5.51	1.43, 21.19	0.0131	6.63	3.32, 13.26	<0.0001
						Women						
Race/ethnicity			0.0035									
Black	0.51	0.32, 0.80										
Hispanic	0.46	0.22, 0.94										
White	1.00	Reference										

Sociodemographic and behavioral factors												
Age group (years)			0.9650			0.7942			<0.0001			0.6621
30–39	1.00	Reference		1.00	Reference		1.00	Reference		1.00	Reference	
40–49	1.13	0.56, 2.28		1.30	0.39, 4.29		18.97	5.90, 61.01		0.56	0.23, 1.40	
50–59	1.03	0.43, 2.45		1.79	0.52, 6.17		13.98	3.85, 50.85		0.59	0.18, 2.00	
60–79	1.05	0.40, 2.78		1.41	0.34, 5.87		18.34	3.86, 87.07		0.56	0.16, 1.90	
Socioeconomic status			0.9183			0.2947			0.0813			0.6372
Lower class	1.09	0.66, 1.78		1.56	0.73, 3.32		0.64	0.32, 1.28		0.77	0.35, 1.68	
Middle class	1.00	Reference		1.00	Reference		1.00	Reference		1.00	Reference	
Upper class	1.10	0.64, 1.91		0.58	0.16, 2.05		0.09	0.01, 0.77		1.14	0.62, 2.10	
Smoking status			0.6683			0.3945			0.6379			0.8567
Never smoker	1.00	Reference		1.00	Reference		1.00	Reference		1.00	Reference	
Former smoker	0.82	0.50, 1.32		0.65	0.30, 1.42		1.47	0.64, 3.41		0.88	0.48, 1.61	
Current smoker	1.00	0.59, 1.70		1.09	0.38, 3.09		1.15	0.46, 2.89		0.83	0.41, 1.68	
Alcohol consumption (drinks/day)			0.6090			0.5723			0.2191			0.9102
0	1.00	Reference		1.00	Reference		1.00	Reference		1.00	Reference	
<1	1.01	0.63, 1.61		0.67	0.26, 1.71		1.76	0.86, 3.62		0.89	0.50, 1.58	
≥1	1.34	0.73, 2.44		1.12	0.36, 3.45		2.48	0.58, 10.64		1.01	0.48	2.15
Physical activity			0.6645			0.0687			0.3563			0.7180
Low	1.00	Reference		1.00	Reference		1.00	Reference		1.00	Reference	
Moderate	1.02	0.65, 1.59		2.55	1.13, 5.76		1.01	0.48, 2.10		0.78	0.42, 1.43	
High	0.78	0.41, 1.49		1.41	0.44, 4.47		0.27	0.04, 1.81		0.81	0.36, 1.81	
Waist circumference (per 10-cm increase)	1.15	1.01, 1.31	0.0344	1.16	0.91, 1.48	0.2320	1.43	1.14, 1.78	0.0017	1.13	0.95, 1.34	0.1788
Comorbid conditions												
Diabetes mellitus	1.17	0.73, 1.88	0.5148	1.10	0.52, 2.30	0.8057	0.80	0.38, 1.67	0.5509	0.97	0.41, 2.28	0.9431
Heart disease	1.19	0.73, 1.94	0.4818	2.52	1.15, 5.53	0.0211	1.72	0.54, 5.50	0.3616	0.88	0.39, 1.99	0.7634
Congestive heart failure	1.08	0.38, 3.10	0.8811	2.12	0.39, 11.45	0.3837	0.28	0.02, 4.06	0.3491	1.27	0.22, 7.19	0.7873
Cardiac arrhythmia	1.38	0.84, 2.27	0.1984	1.91	0.93, 3.91	0.0763	0.59	0.20, 1.73	0.3349	0.93	0.42, 2.06	0.8596
Hypertension	1.25	0.74, 2.12	0.4060	0.73	0.38, 1.40	0.3439	0.61	0.24, 1.51	0.2826	1.66	0.81, 3.39	0.1643
Hyperlipidemia	1.21	0.83, 1.76	0.3211	1.63	0.80, 3.31	0.1753	2.53	1.40, 4.58	0.0022	1.07	0.63, 1.80	0.8050
Asthma	1.83	1.12, 3.00	0.0165	0.97	0.44, 2.15	0.9363	0.79	0.38, 1.64	0.5310	2.52	1.31, 4.84	0.0060
Arthritis/rheumatism	1.86	1.15, 3.00	0.0119	2.06	1.03, 4.14	0.0411	0.85	0.42, 1.73	0.6561	2.41	1.18, 4.94	0.0170
Depression	1.42	0.87, 2.31	0.1584	3.77	1.91, 7.46	0.0001	0.50	0.24, 1.05	0.0688	0.96	0.45, 2.07	0.9222
Menopausal/hormone-use status			0.3741			0.2944			0.4190			0.5639
Premenopausal	1.00	Reference		1.00	Reference		1.00	Reference		1.00	Reference	
Perimenopausal	1.77	0.78, 4.01		1.56	0.41, 5.93		0.79	0.29, 2.16		2.74	0.82, 9.13	
Postmenopausal	1.13	0.43, 2.93		1.09	0.27, 4.41		0.34	0.11, 1.10		1.94	0.49, 7.77	
Menopausal status undetermined	1.57	0.40, 6.19		0.74	0.11, 4.79		0.54	0.07, 4.32		3.50	0.64, 19.17	
Hysterectomy without hormones	1.06	0.42, 2.67		0.87	0.22, 3.47		1.11	0.39, 3.18		2.32	0.61, 8.85	
Hysterectomy with hormones	2.38	0.83, 6.85		4.28	0.51, 35.84		0.92	0.16, 5.18		3.86	0.64, 23.32	
Hormone replacement therapy	2.15	0.53, 8.74		0.17	0.01, 2.39		1.12	0.22, 5.81		1.16	0.30, 4.53	
Birth control	0.60	0.15, 2.29		—§			—			—		
Raloxifene hydrochloric acid	1.04	0.12, 8.82		—			—			—		
Progesterone only	2.37	0.38, 14.80		—			—			—		
Vaginal birth	1.92	1.21, 3.04	0.0061	1.31	0.62, 2.74	0.4768	1.37	0.57, 3.32	0.4849	2.22	1.23, 4.03	0.0090

* Results from eight logistic regression models calculating adjusted odds ratios and 95% confidence intervals.
† OR, odds ratio; CI, confidence interval.
‡ Because of small numbers of cases, the odds associated with this factor by race/ethnicity were not estimated.
§ Because of multicollinearity, the odds associated with this factor by race/ethnicity were not estimated.

odds ratios were not statistically significant. The same trends were not apparent for Black and Hispanic women. Finally, having at least one vaginal delivery was associated with increased odds of leakage, with the odds being doubled in White women.

DISCUSSION

To our knowledge, the BACH Survey is the first large, population-based study to calculate rates and risk factors for urine leakage in men and women of a wide age range in three racial/ethnic groups. In contrast to most prior studies, data are reported here for both men and women in each of these groups. We found significant differences in both prevalence of and risk factors for urine leakage by gender and by race/ethnicity within each gender.

While different definitions of incontinence and different populations pose challenges to direct comparisons of incontinence prevalence across studies, the prevalence of weekly urine leakage for White men and women here was similar to that reported for other population-based samples (23–25). The prevalence of weekly urine leakage for women was higher in NHANES III, as previously reported (26), and from our own analysis of NHANES III data than in the BACH sample, but prevalences for men were more similar.

The racial/ethnic differences in leakage prevalence found in the BACH Survey are similar to differences reported in NHANES III. Other US studies reporting higher rates in different groups had samples drawn from large managed-care populations (2, 27), in contrast to the BACH sample, which was community-based. Women in all three racial/ethnic groups were twice as likely as men to report urine leakage. For both genders, rates of weekly leakage were highest for Whites, followed by Blacks, and were lowest for Hispanics. Similar racial/ethnic differences in rates have been reported for women (28–30), but these data now show this to be true for men. Thom et al.'s (11) finding of the highest prevalence in Hispanic women could be related to differences in the age of the study population, definitions of urine leakage, or composition of the ethnic group. Hispanics in the BACH sample were predominantly from Puerto Rico (34 percent), the Dominican Republic (24 percent), and Central (16 percent) and South (13 percent) America, whereas Hispanics in Thom et al.'s sample were predominantly Mexican (11). To our knowledge, no study to date has investigated rates of urine leakage among all Hispanic subgroups to inform interpretation of this difference. Finally, this difference in prevalence among Hispanics, particularly the lower prevalence of weekly leakage at older ages for both men and women, could be related to cultural factors, namely willingness to report what is considered a sensitive and private matter. Considering language as an indicator of acculturation, Hispanic men who completed the BACH interview in Spanish were less likely to report urine leakage than those who completed the interview in English, before and after adjustment for age. This may also explain the finding of a higher prevalence of leakage among Hispanic men with higher socioeconomic status, as these men were more likely to complete the interview in English. However, this was not true for Hispanic women, and it does not explain the decline in prevalence of weekly leakage after age 50 years.

In contrast to the higher frequency of stress-type leakage reported in large European studies (25, 31), the majority of women in this study reported mixed-type symptoms. This might be explained by the lack of racial heterogeneity in the European studies, as these rates of stress-type leakage across racial/ethnic groups are consistent with previous reports (5, 9, 32). However, reporting differences across racial/ethnic groups may explain the higher rate of mixed-type leakage among Black women. Correlation of symptoms with results of physical examinations and urodynamic studies are required to confirm the validity of this finding. Sandvik et al. (33) compared symptoms with the results of urodynamic evaluation and found a reduction in the rate of mixed-type leakage and an increase in the rate of stress-type leakage, concluding that mixed incontinence may be overreported in epidemiologic surveys. Finally, the discrepancy might be related to differing definitions of incontinence types. For example, stress or urge incontinence can be defined as having *only* symptoms of that type or having *predominantly* symptoms of that type. Mixed incontinence can be defined as having any combination of stress and urge symptoms or more strictly as having equal proportions of symptoms.

Although clinical evaluation might change the distribution of types of leakage, the racial/ethnic differences in types of leakage remain. These differences are supported by results of urodynamic studies comparing White women with Hispanic women (34), Black women (35), and Asian women (36). These studies report fundamental differences in bladder function, which might explain such racial/ethnic differences. Similar studies have not been conducted among men. The results of the BACH Survey provide additional evidence in support of these types of studies to explain group differences in rates or types of urine leakage.

In the BACH Survey, type of leakage could not be categorized for the majority of men as it was for women. While these men reported leaking urine, almost one fifth of them (18 percent) reported leaking only drops of urine and also reported postvoid dribbling. The International Continence Society (37) defines dribbling as a voiding symptom, which is distinguished from urinary incontinence as a storage symptom. However, due to the wording of these questions, it was not possible to distinguish the reported dribbling as a voiding problem versus a storage problem. Postvoid dribbling was equally common in men whose leakage could be categorized. Therefore, these cases were considered ''other'' and were included in calculating the prevalence of urine leakage. While this may have caused slight overestimation of the prevalence, it is important to note that this pattern was observed across all three racial/ethnic groups, although it was more prevalent for White males.

We analyzed a wider range of potential risk factors than other investigators and consequently identified risk factors, particularly comorbid conditions, not previously reported. Various cardiovascular diseases were related to urine leakage but with differences by gender and racial/ethnic group. Differences in an associated cardiovascular disease risk that varies by gender, as was seen in this study, might be

explained by pelvic ischemia that exacerbates bladder dysfunction from obstruction due to benign prostatic hyperplasia (38, 39). If myocardial infarction is a marker for more severe peripheral vascular disease as opposed to merely hyperlipidemia, then the resulting pelvic ischemia, which has been implicated in the pathophysiology of detrusor overactivity and the incomplete bladder emptying due to benign prostatic hyperplasia, might explain why the association is limited to men. As for an association between cardiac arrhythmia and incontinence, one might postulate lifestyle and dietary links, including caffeine intake, in addition to ischemic heart disease.

The relation between asthma and increased odds of urine leakage could be related to chronic coughing or sneezing that raises intraabdominal pressure and causes damage to the pelvic floor in White women, who are more at risk than Black women for pelvic prolapse. Finally, when we controlled for all other factors, the odds of leakage were higher in Blacks and in White women with arthritis or rheumatism. This association, previously reported in women (40), is attributed to inability to access a toilet in a timely manner (41, 42). Treatments for some forms of arthritis may trigger detrusor overactivity and cause incontinence in both men and women.

Body mass index is a frequently cited risk factor for urine leakage (1, 7, 10, 27, 29, 43–45). The BACH Survey collected data on body mass index as well as measures of central obesity (waist and hip circumference). In line with recent debate regarding the optimal measure of obesity (46), we assessed the explanatory value of each measure in relation to urine leakage. Waist circumference appears to be more sensitive than body mass index in explaining the association between obesity and urine leakage. Abdominal girth is probably an indirect measure of intraabdominal pressure that may influence the pelvic floor or raise intravesical pressures in women, which in turn triggers detrusor overactivity underlying urge incontinence.

As Connolly et al. (18) have reported, obstetric risk factors for urine leakage that have been found in other studies were not observed for women in this sample. However, having any vaginal delivery doubled the odds of leakage for White women. The results of two clinical trials showed that hormone replacement therapy increased the severity or risk of urinary incontinence (47–49). In this representative sample, use of hormone therapy after natural or surgically induced menopause was related to increased odds of weekly leakage, a finding that was most apparent in White women.

Depression as an independent risk factor for urine leakage has been found by other investigators (3, 4, 27, 28, 40, 50), but gender and racial/ethnic differences have not been previously reported. Depressive symptoms were more strongly associated with weekly urine leakage in men than in women, specifically among White and Hispanic men and Black women. These cross-sectional data obviously do not allow assessment of causality, and this link may be bidirectional (27). Urine leakage could lead to depression, or the altered neurotransmitter function associated with depression could affect the complex bladder innervation, leading to incontinence. Regardless of causality, a large number of men and women who have untreated or undertreated depression also experience frequent urine leakage.

The area sample of the BACH Survey raises questions about the generalizability of these findings to other populations. We have compared overall findings from this study with data from large-scale national studies (NHANES III, the National Health Interview Survey, and the Behavioral Risk Factor Surveillance System), and with appropriate adjustments most of the findings are generalizable, with the possible exception of data for Hispanics. Hispanics in the BACH Survey were primarily from Latin America and the Caribbean, in contrast to the 58 percent of Hispanics nationally who are from Mexico.

The BACH Survey is a study of self-reported symptoms using valid and reliable questions about urine leakage (51, 52). However, reliance on self-reports introduces the possibility of reporting error. In a sample including minorities, a possible source of reporting error is the influence of acculturation. The low rate of urine leakage among older Hispanics, at least the men, might have resulted from underreporting related to cultural taboos about disclosing problems considered personal in nature.

In conclusion, findings from this ethnically diverse sample identified important gender and racial/ethnic differences in the symptom types and risk factors for urine leakage. Follow-up at 5 years will allow us to investigate the natural history (progression or remission) of symptoms over time, temporal relations, and causality for urine leakage in this highly diverse population.

ACKNOWLEDGMENTS

This research was funded by grant DK56842 from the National Institute of Diabetes and Digestive and Kidney Diseases.

Conflict of interest: none declared.

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