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ORIGINAL ARTICLE

Caffeine and urinary incontinence in US women

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Abstract
Introduction and hypothesis The goal of this study was to characterize associations between caffeine consumption and severity of urinary incontinence (UI) in US women. We hypothesized that moderate and high caffeine intake would be associated with UI in US women when controlling for other factors associated with UI.
Methods US women participated in the 2005–2006 and 2007–2008 National Health and Nutrition Examination Survey (NHANES), a cross-sectional, nationally representative survey. Using the Incontinence Severity Index, UI was categorized as "any" and "moderate/severe". Types of UI included stress, urge, mixed, and other. Food diaries were completed, and average water (grams/day), total dietary moisture (grams/day), and caffeine (milligrams/day) intake were calculated into quartiles. Stepwise logistic regression models were constructed adjusting for sociodemographics, chronic diseases, body mass index, self-rated health, depression, physical activity, alcohol use, dietary water and moisture intake, and reproductive factors.
Results From the 4,309 nonpregnant women (aged ≥20 years) who had complete UI and dietary data, UI prevalence for any UI was 41.0 % and 16.5 % for moderate/severe UI, with stress UI the most common type (36.6 %). Women consumed a mean caffeine intake of 126.7 mg/day. After adjusting for multiple factors, caffeine intake in the highest quartile (≥204 mg/day) was associated with any UI [prevalence odds ratio (POR) 1.47, 95 % confidence interval (CI) 1.07–2.01], but not moderate/severe UI (POR 1.42, 95 % CI 0.98–2.07). Type of UI (stress, urgency, mixed) was not associated with caffeine intake.
Conclusions Caffeine intake ≥204 mg/day was associated with any UI but not with moderate/severe UI in US women.

Keywords Urinary incontinence · Caffeine intake · Women

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Introduction

Urinary Incontinence (UI) is a prevalent condition in women, with significant negative impact on quality of life (QoL) and overall health. UI prevalence estimates vary considerably according to the definition used but among community-dwelling women ranges from 10 % to 40 % [1–4]. Caffeine is consumed more than any other stimulant drug in the world. The amount of caffeine in fluid varies considerably, with coffee containing from 95 to 206 mg/8-oz cup, tea from 14 to 120 mg/8-oz cup, and carbonated beverages as high as 55 mg/12-oz serving [5]. Most Americans consume caffeine, and it is reported that approximately 80 % of women drink caffeine-containing beverages daily [6]. The consumption of high-energy drinks with large amounts of caffeine (50–505 mg/serving) is also on the rise in the US

population [7]. Caffeine may have a diuretic effect in some adults and also may affect the bladder by increasing detrusor pressure and promoting detrusor muscle excitability [8–11]. Epidemiologic and clinical cohort studies demonstrated mixed results regarding the relationship between UI and caffeine and fluid intake in women [12–16]. Two large epidemiologic studies found conflicting conclusions on whether caffeine impacts incontinence [17, 18]. Little robust evidence exists on caffeine and fluid management strategies. One randomized trial found a reduction in urinary urgency and frequency with caffeine reduction, whereas others found that reducing excess fluid intake is beneficial [19, 20].

Given the existing data, we hypothesized that moderate and high caffeine intake would be associated with UI in US women when controlling for other factors associated with UI. We sought to further investigate the association between caffeine intake and UI in an age- and racially representative sample of community-dwelling women in the US.

Materials and methods

We used publically available data from the 2005–2006 and 2007–2008 National Health and Nutritional Examination Surveys (NHANES) for this analysis. NHANES data are cross-sectional surveys of the nationally representative, non-institutionalized US population that are sampled biannually using a complex, stratified, multistage, probability cluster design. The National Center for Health Statistics Ethics Review Board and the University of Alabama at Birmingham Institutional Review Board approved the protocol. NHANES participants were interviewed in their homes and then underwent standardized physical examination, including measured height and weight, and then further questioning in a mobile examination center (MEC). Questions regarding UI were assessed using the Computer-Assisted Personal Interviews (CAPI) methodology. To define UI, we analyzed data from the validated two-item Incontinence Severity Index (ISI), which measures incontinence volume and frequency. Responses are used to obtain a severity score ranging from 1 to 12, with an ISI score≥3 categorized as moderate/severe UI [21]. Moderate/severe UI corresponds to at least weekly leakage or monthly leakage of volumes more than just drops. The question: "During the past 12 months, have you leaked or lost control of even a small amount of urine with activity like coughing, lifting, or exercise"? defined stress UI (SUI). Urge UI (UUI) was defined based on the question: " During the past 12 months, have you leaked or lost control of even a small amount of urine with an urge or pressure to urinate and you couldn't get to the toilet fast enough"? In women who responded negatively to these questions, a positive response to the question: "During the past 12 months, have you leaked or lost control of even a small amount of urine during non-physical activities"? defined "other" incontinence. Positive responses to both SUI and UUI questions defined mixed UI (MUI).

A multiple-pass dietary recall method, developed and validated by the US Department of Agriculture, was used to record dietary data [22]. Participants took part in two 24-h dietary recall periods. The first 24-hour recall was done during the initial CAPI and the second 3–10 days later by telephone. From these data, we reported averaged caffeine consumption (milligrams/day); water intake (grams/day), consisting of tap, bottled, plain or carbonated, sweetened or unsweetened; and total moisture (grams/day) consisting of all moisture present in foods and beverages [22]. Caffeine intake was categorized into quartiles based on distribution of intake, with lower (0–27 mg/day), lower middle (28–95 mg/day), upper middle (96–204 mg/day), and upper (>204 mg/day) quartiles. We analyzed the upper quartile and the upper tenth percentile (≥348 mg/day) for association with UI. Caffeine intake was calculated from fluid (coffee, tea, and soda) and from food sources (chocolate) [22]. Water intake was divided into quartiles, with high intake defined by the upper quartile. Total dietary moisture (from both foods and beverages) was categorized into quartiles, and the upper quartile for moisture defined high intake. Alcohol intake was obtained through the alcohol-use questionnaire and was dichotomized as "never drank alcohol" and "prior or current alcohol consumption."

Women self-reported their race/ethnicity, and age was categorized in 10-year increments. Body mass index (BMI) (kg/m^2) was categorized as <25.0 (underweight/normal weight), 25.0–29.9 (overweight), and ≥30.0 (obese). Education was categorized as up to a high school education (including a General Education Development or equivalent) or more than high school. The poverty income ratio (an indicator of socioeconomic status that uses the ratio of income to the family's poverty threshold set by the US Census Bureau) was categorized as <1 (below the poverty threshold), 1–2 (1–2x the poverty threshold), and >2 (2x the poverty threshold).

Chronic disease data were ascertained through the questions: "Has a doctor or other health professional told you that you had [diseases]"? Chronic diseases included: arthritis, stroke, emphysema, chronic bronchitis, asthma, coronary heart disease, angina, myocardial infarction, hypertension, and diabetes mellitus. Diabetes also included taking insulin and/or diabetic pills. The definition of hypertension included diagnosis and/or antihypertensive medication consumption. The cumulative number of chronic diseases was categorized as 0, 1, 2, and ≥3. Self-rated general health status was defined by the question: "Would you say that in general your health is excellent, very good, good, fair, or poor"? Responses to this

question were aggregated into two categories: excellent and very good or good, versus fair or poor. Depression was assessed using the validated Patient Health Questionnaire-9 (PHQ-9), which yields scores from 0 to 27, with scores ≥10 used to define major depression [23].

From the NHANES reproductive health questions, vaginal deliveries, hormone therapy use, and prior hysterectomy were included. Vaginal births were categorized as none, 1–2, 3–4, or ≥4 and had a missing data rate of 25 %. Hormone therapy use was ascertained with the question: "Have you ever used female hormones such as estrogen and progesterone"? Data on having a prior hysterectomy had a missing rate of 28 %; therefore, women who reported having a period in the prior 12 months were also categorized as not having had a hysterectomy. Vaginal bulging was defined by the question: "Do you experience bulging or something falling out that you can see or feel in the vaginal area"? from the Pelvic Floor Distress Inventory [24].

Vigorous physical activity was defined by separate questions from the 2005 to 2006 cycle and the 2007 to 2008 cycle. The question used from 2005 to 2006 inquired about "any" vigorous activities over the past 30 days for at least 10 min that "caused heavy sweating, or large increases in breathing or heart rate." Questions from the 2007–2008 cycle inquired about "vigorous-intensity activity that causes large increases in breathing or heart rate," either at work or during leisure time. Any positive responses to these questions defined vigorous physical activity. Negative responses to all questions defined not participating in any vigorous physical activity.

All statistical analyses were calculated using STATA 8.2 (STATA Corp. College Station, TX, USA), which incorporates design effect, appropriate sample weights, and stratification and clustering of the complex NHANES sample design [25]. Pearson's X^2 test assessed the association between UI outcomes and demographic and medical characteristics, with prevalence estimates and 95 % confidence intervals (CI). Estimates with relative standard errors (SE) >30 % were identified as statistically unreliable. Multivariable logistic regression models were constructed using variables in a stepwise fashion with sociodemographic variables in step 2 (age, race/ethnicity, education, poverty status), comorbidity and BMI (step 3), self-rated health and depression (step 4), alcohol intake (step 5), total fluid and moisture intake (step 6), hysterectomy and the use of hormone replacement therapy (step 7), and vaginal deliveries (step 8). Given the decrease in the sample size by 25 % (n=1,552) by including women who had missing data on vaginal deliveries, this variable was included individually in the multivariable models. Prevalence odds ratios (POR) and 95 % CIs were reported, with the level of statistical significance set at $p<0.05$.

Results

A total of 10,914 NHANES participants ≥20 years were interviewed in their homes and then underwent standardized physical examination, including measured height and weight, followed by further questioning in a mobile examination center (MEC). Women with missing data on UI or dietary recall for caffeine and water intake (n=915/5,617, 16.2 %) compared with women without missing data were more likely to be ≥80 years of age (14.9 % vs. 4.6 %, p= 0.002) and have less than a high school education (27.6 % vs. 16.8 %, $p<0.05$). For our study, after excluding men (n= 5,297), we excluded women who were pregnant at the time of the interview (n=393), women with incomplete UI data (n=745), and women with incomplete caffeine intake data (n=170) A total of 4,309 women were assessed in the final analytic data set.

UI prevalence was 41.0 % (95 % CI 38.9–43.2) for any UI and 16.5 % (95 % CI 15.0–18.1) for moderate/severe UI. In addition, 36.6 % (95 % CI 33.8–39.5) of women reported SUI, 17.0 % (95 % CI 15.2–18.9) UUI, 25.5 % (95 % CI 23.6–27.4) MUI, and 7.8 % (95 % CI 6.7–9.1) other UI. In univariate analyses, UI was significantly associated ($p<$ 0.05) with several factors, including age, race/ethnicity, less education, low poverty–income ratio, obesity, fair/poor self-rated health, major depression, diabetes, more chronic diseases, vigorous physical activity, alcohol use, use of hormone replacement therapy, history of hysterectomy, increasing number of vaginal deliveries (0 vs. 1, 2, 3, and ≥4) and reporting a vaginal bulge (Table 1). The prevalence of UI increased in the population by quartile of caffeine intake (p for trend <0.001, Fig. 1), with the prevalence of any UI ranging from 34 % in the lower quartile to 49 % in the upper quartile.

Mean caffeine intake was 127 mg/day (range 0–2,715 mg/day). Women with UI were more likely to consume higher rates of caffeine than women without UI (178 vs. 143 mg/day, respectively, for women with any UI; 180 vs. 153 mg/day, respectively, for women with moderate/severe UI, $p<0.001$ for both comparisons). In the univariate analyses (Table 2), caffeine intake in the upper quartile (≥204 mg/day) was associated with any UI ($p<0.001$) and moderate/severe UI ($p=0.005$). Caffeine intake in the top tenth percentile of intake (≥348 mg/day),was significantly associated with a higher prevalence of any UI ($p=0.008$),but not with moderate/severe UI ($p=0.23$). Water intake in the upper quartile (≥1,304 ml per day) was associated with a lower prevalence of moderate/severe UI ($p<0.001$), but not with any UI. Total moisture in the upper quartile (≥3,319 g/day) was associated with any UI ($p=0.001$) but was not with moderate/severe UI (Table 2).

In the multivariable models (Table 3), caffeine intake in the highest quartile (>204 mg/day) was associated with any

Table 1 Prevalence rates of any and moderate/severe urinary incontinence (UI) among women ≥20 years in the US National Health and Nutrition Examination Surveys (NHANES) 2005–2006 and 2007–2008

Variable	No.[a]	Any UI prevalence,[b] % (95 % CI)	*P* value	No.[a]	Moderate/severe UI prevalence,[b] % (95 % CI)	*P* value
Age, years	4,309		<0.001	4,309		<0.001
20–29	798	17.0 (14.1–20.4)		798	3.8 (2.5–5.6)	
30–39	711	30.4 (26.3– 34.9)		711	10.3 (8.1–12.9)	
40–49	736	45.5 (41.0–50.1)		736	14.2 (11.4–17.6)	
50–59	622	54.5 (48.8–60.2)		622	21.9 (18.0–26.4)	
60–69	700	52.4 (46.8–57.9)		700	23.7 (19.1–28.9)	
70–79	474	48.4 (43.3–53.5)		474	28.7 (23.8–34.2)	
80+	268	51.7 (44.1–59.2)		268	34.7 (28.8–41.4)	
Race/ethnicity	4,309		<0.001	4,309		0.157
Hispanic–Mexican American	794	39.1 (36.3–42.0)		794	16.5 (14.1–19.1)	
Hispanic–other	341	33.1 (27.2–39.5)		341	14.2 (10.6–18.9)	
Non-Hispanic white	2,108	43.5 (41.1–46.0)		2,108	17.2 (15.5–19.1)	
Non-Hispanic black	906	31.1 (27.9–34.5)		906	13.1 (11.2–15.3)	
Other–Including multiracial	160	36.2 (28.9–44.3)		160	15.5 (9.6–24.2)	
Education	4,306		0.547	4,306		<0.001
< High school	1,140	40.8 (37.8–44.0)		1,140	21.5 (19.0–24.2)	
High school or GED	1,038	42.2 (38.0–46.6)		1,038	17.1 (14.8–19.7)	
>High school	2,128	40.6 (38.9–43.1)		2,128	14.9 (13.0–16.9)	
Family poverty income ratio	4,309		0.042	4,309		<0.001
<2	1,847	38.4 (35.7–41.1)		1,847	19.0 (17.3–20.8)	
≥2	2,462	42.3 (39.6–45.0)		2,462	15.4 (13.8–17.1)	
Body mass index, kg/m^2	4,281		<0.001	4,281		<0.001
<25.0	1,319	30.4 (27.3–33.7)		1,319	10.3 (8.3–12.9)	
25.0–29.9	1,244	42.4 (37.9–47.1)		1,244	17.9 (15.2–20.9)	
>30.0	1,718	50.5 (46.8–54.1)		1,718	21.6 (18.4–25.0)	
Self-rated health	4,309		<0.001	4,309		<0.001
Excellent/very good/good	3,304	39.4 (37.1–41.8)		3,304	14.7 (13.0–16.5)	
Fair/poor	1,005	48.9 (44.4–53.5)		1,005	25.6 (22.0–29.6)	
Major depression	4,290		<0.001	4,290		<0.001
Depression screen <10	3,863	39.9 (37.8–42.0)		3,863	15.1 (13.7–16.9)	
Depression screen≥10	427	52.7 (46.7–58.7)		427	31.0 (26.3–36.2)	
Ever used female hormones	4,292		<0.001	4,292		<0.001
No	3,283	36.6 (34.1–39.1)		3,283	12.9 (11.5–14.5)	
Yes	1,009	53.7 (49.5–57.8)		1,009	26.6 (23.0–30.6)	
Vaginal deliveries	2,494		<0.001	2,494		<0.001
0	618	35.8 (31.5–40.3)		618	10.9 (8.3–14.0)	
1–2	688	39.5 (34.2–45.0)		688	12.6 (10.0–15.8)	
3–4	897	45.9 (41.4–50.4)		897	17.9 (15.6–20.5)	
≥5	291	53.7 (47.7–59.6)		291	28.1 (24.5–36.3)	
Hysterectomy	4,304		<0.001	4,304		<0.001
No	3,298	37.7 (35.5–40.0)		3,298	13.2 (12.0–14.5)	
Yes	1,006	53.1 (48.4–57.7)		1,006	28.5 (24.9–32.4)	
Vaginal bulging	4,241		<0.001	4,241		<0.001
No	4,100	40.1 (37.9–42.3)		4,100	15.7 (14.2–17.3)	
Yes	141	68.6 (55.1–79.6)		141	43.3 (34.1–53.0)	
Number of chronic diseases	4,250		<0.001	4,250		<0.001
0	1,702	32.5 (29.2–36.0)		1,702	9.5 (7.7–11.6)	

Table 1 (continued)

Variable	No.[a]	Any UI prevalence,[b] % (95% CI)	*P* value	No.[a]	Moderate/severe UI prevalence,[b] % (95% CI)	*P* value
1	1,145	39.6 (35.4–43.8)		1,145	15.5 (12.2–19.5)	
2	754	49.9 (45.3–54.5)		754	22.7 (20.0–25.6)	
3	414	55.0 (48.5–61.4)		414	28.8 (23.9–34.3)	
≥4	235	63.0 (53.8–71.4)		235	36.8 (29.1–45.3)	
Diabetes	4,309		0.001	4,309		<0.001
No	3,842	40.0 (38.0–42.1)		3,842	15.3 (13.8–17.0)	
Yes	465	52.8 (45.1–60.4)		465	30.5 (25.1–36.6)	
Vigorous physical activity	4,309		0.002	4309		0.003
No	3,233	80.1 (74.9–84.5)		3,233	73.7 (70.6–76.5)	
Yes	1,076	19.9 (15.5– 25.1)		1,076	26.3 (23.5–29.4)	
Alcohol intake	4,307		0.042	4,307		<0.001
No	2,495	62.2 (57.9–66.3)		2,495	55.4 (50.4–60.3)	
Yes	1,812	37.8 (33.7–42.1)		1,812	44.6 (39.7–49.6)	

[a] Total number of women responding for the category or condition under study (denominator), excluding those with missing data

[b] Weighted prevalence rates reported

UI (POR 1.47, 95 % CI 1.07–2.07) after controlling for significant factors (age, race/ethnicity, poverty-income ratio, BMI, self-rated health status, major depression, chronic diseases, alcohol use, water intake, total dietary moisture intake, reproductive factors including vaginal deliveries). However, the odds ratio (OR) for caffeine intake in the top quartile, and moderate/severe UI was not significant when vaginal deliveries were included in the model (POR 1.42, 95 % CI 0.98–2.07). When examining the top 10th percentile for caffeine intake, no associations were seen for any UI (POR 1.23, 95 % CI 0.70–2.12) or moderate/severe UI (POR 0.90, 95 % CI 0.43–1.87) when vaginal deliveries

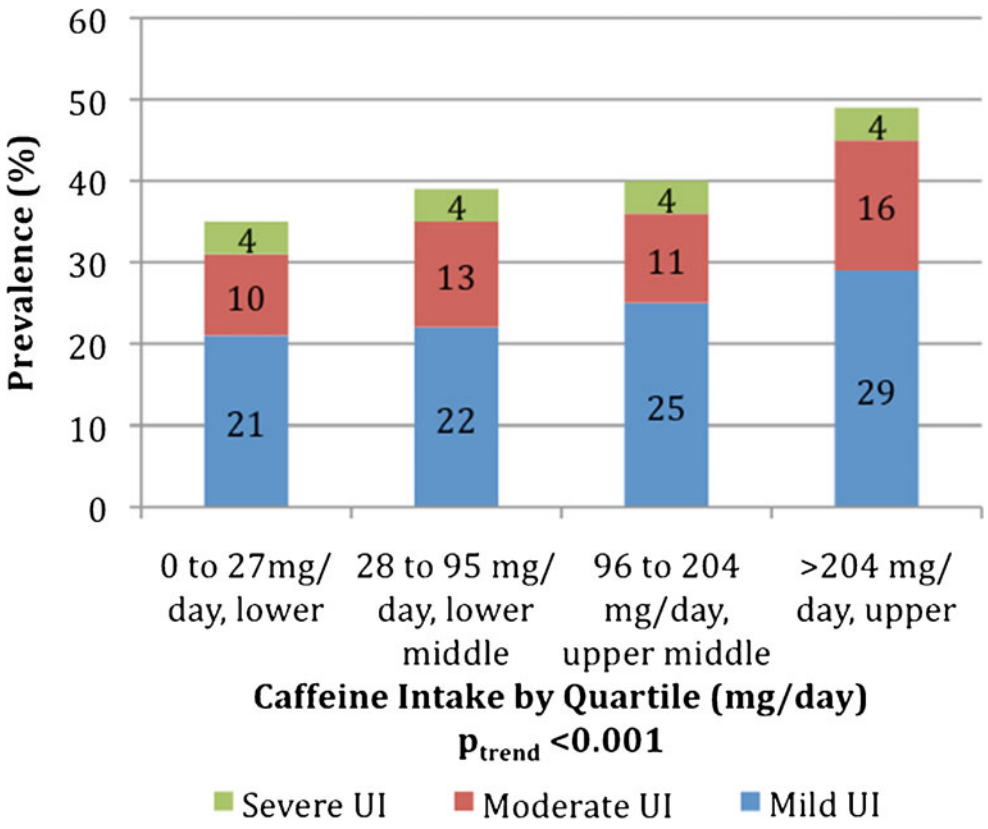

Fig. 1 Prevalence of urinary incontinence and severity by caffeine quartiles in US women; data from the National Health and Nutrition Examination Surveys (NHANES) 2005–2006 and 2007–2008

Table 2 Univariate analysis for total moisture, water, and caffeine intake according to urinary incontinence (UI) severity among women ≥20 years in the US National Health and Nutrition Examination Surveys (NHANES) 2005–2006 and 2007–2008

Variable	No.[a]	Any UI prevalence[b] % (95 % CI)	*P* value	No.[a]	Moderate/severe UI prevalence[b] % (95 % CI)	*P* value
Total moisture intake in upper quartile (>3,319 g/day)	4,309		0.002	4,309		0.253
No	2,577	26.3 (23.8–28.9)		3,486	17.1 (15.5–18.8)	
Yes	1,732	21.5 (19.1–24.2)		823	14.6 (11.3–18.7)	
Water intake in upper quartile (≥1,304 g/day)	4,309		0.455	4,309		<0.001
No	3,166	41.4 (38.9–44.0)		3,166	18.0 (16.4–19.6)	
Yes	1,143	40.0 (36.8–43.3)		1,143	12.9 (10.7–15.4)	
Caffeine intake upper quartile (≥204 mg/day)	4,309		<0.001	4,309		0.005
No	3,412	37.8 (35.9–39.8)		3,412	15.2 (13.6–16.9)	
Yes	897	49.4 (45.0–53.7)		897	19.9 (17.0–23.1)	
Caffeine intake top 10th percentile (≥348 mg/day)	4,309		0.008	4,309		0.234
No	3,974	39.7 (37.6–41.8)		3,974	16.2 (14.7–17.8)	
Yes	335	51.7 (43.3–60.0)		335	19.1 (16.5–31.4)	

*C*I confidence interval

[a] Total number of women responding for the category or condition under study (denominator), excluding those with missing data

[b] Weighted prevalence rates reported

were included in the model. Caffeine intake was not associated ($p>0.05$) in a separate multivariable analysis according to UI type (stress, urge, mixed, other).

Discussion

Results from the 2005–2006 and 2007–2008 NHANES indicated that among a representative sample of US women ≥20 years, the prevalence of any UI was associated with caffeine intake ≥204 mg/day (POR 1.42, 95 % CI 1.07–2.07), even after controlling for other UI risk factors, including water and total moisture intake. When evaluating the severity of UI symptoms, no relationship with moderate/severe UI and caffeine intake was found. Types of UI (stress, urge, mixed) were not associated with moderate or high caffeine intake when controlling for other UI risk factors.

Previous cross-sectional studies reported conflicting findings regarding the relationship of caffeine intake and UI [12–15]. Two large epidemiologic studies reported opposing conclusions about the relationship of caffeine and UI. Dalosso et al. found no association between tea or coffee consumption and stress UI or overactive bladder symptoms in the 39,603 male and female participants in the Leicestershire Marlene Reid Centre (MRC) Incontinence Study in the UK [17]. More recently, Jura et al. reported data from the Nurses' Health Study characterizing measured caffeine intake and the presence of UI [18]. Their conclusion that high caffeine intake (>450 mg/day) was associated [relative risk (RR) 1.3, 95 % CI 1.0–1.8] with frequent UI and UUI (RR 1.42, 95 % CI 1.04–1.95) is similar to our findings that caffeine intake ≥204 mg/day is associated any UI (OR 1.47, 95 % CI 1.07–2.01). We observed a similar trend in the association of caffeine intake with moderate/severe UI, but it did not reach statistical significance in the final multivariable model (POR 1.42, 95 % CI 0.98–2.07). This is likely due to the 42 % reduction in sample size when vaginal delivery is added to the model and results in an increase in POR but a widening of the 95 % CI (Table 3). Without vaginal deliveries in the model, caffeine intake was associated with moderate/severe UI (POR 1.40, 95 % CI 1.10–1.75). The study by Jura et al. was limited by the lack of ethnic diversity (95 % white) and failure to control for multiple factors known to affect continence (alcohol use, prior hysterectomy, presence of pelvic organ prolapse, number of chronic diseases, depression). Furthermore, their assessment of fluid intake only included fluid obtained from beverages, without data provided about total fluid intake including moisture in foods. Others previously demonstrated that up to 18 % of total moisture intake comes from sources other than beverages [26]. Recent data from the Swedish Twins Registry showed no association between coffee and tea consumption and UI in twins, but it did not account for other sources of caffeine or total fluid intake [16]. In the multivariable model for moderate/severe UI, we found that women with high water intake were less likely to have UI (data not shown in Table 2, POR 0.71, 95 % CI 0.55–0.91).

Table 3 Unadjusted and adjusted stepwise multivariate models for caffeine intake at the 75th percentile (≥204 mg/day)

	Cases	Any UI[a] POR (95 % CI)	Moderate/severe UI[a] POR (95 % CI)
Step 1: Unadjusted	4,309	1.60 (1.34–1.91)	1.38 (1.11–1.73)
Step 2: Sociodemographics (age, race, education, poverty status)	4,306	1.54 (1.30–1.84)	1.41 (1.15–1.73)
Step 3: Comorbidity and BMI	4,220	1.60 (1.34–1.92)	1.43 (1.15–1.80)
Step 4: Depression and self-rated health	4,205	1.59 (1.33–1.90)	1.43 (1.14–1.79)
Step 5: Vigorous physical activity	4,205	1.59 (1.34–1.90)	1.44 (1.14–1.81)
Step 6: Alcohol use	4,204	1.60 (1.36–1.91)	1.48 (1.18–1.87)
Step 7: Water and total moisture intake from food and fluid	4,204	1.54 (1.28–1.86)	1.43 (1.13–1.80)
Step 8: Hysterectomy, hormone replacement therapy	4,186	1.53 (1.27–1.84)	1.40 (1.10–1.75)
Step 9: Vaginal deliveries	2,423	1.47 (1.07–2.01)	1.42 (0.98–2.07)

UI urinary incontinence, *POR* prevalence odds ratio, *CI* confidence interval

[a] Separate logistic regression models created for any UI" and moderate/severe UI

Furthermore, no association was seen with UI and total moisture intake. Due to the cross-sectional design of this study, we were unable to imply causation. An explanation for this finding may be that women with UI symptoms may reduce fluid intake rather than because increased fluid intake reduces incontinence. However, one small trial evaluating behavioral therapy for UI treatment and that included increasing fluid intake in women with low fluid intake showed reduced UI episodes and amount of urine loss [27].

Based on our findings, moderation of caffeine intake remains a reasonable part of the multicomponent treatment approach to UI, but more adequately powered, randomized, controlled trials are needed. Caffeine has been found to have a diuretic effect and may also have an effect on smooth muscle contractions in the bladder. In one case–control study, high caffeine intake (>400 mg/day) was associated with detrusor instability on cystometric evaluation [12]. Bryant et al. found a 35 % reduction in voids per day and 61 % reduction in occasions of urgency symptoms after 1 month of caffeine reduction in a randomized controlled trial [19]. Caffeine reduction may be more important for women with UI who consume higher daily levels of caffeine (>200 mg/day, which roughly equates to one to two 8-oz cups of coffee or three to four 8-oz glasses or cups of tea or soda daily) than women who consume lower caffeine levels. Prospective studies, including randomized trials of caffeine reduction for UI, are needed to guide clinical practice.

Our study is strengthened by the large sample size with a representative population of US women specifically designed to oversample women in specific racial/ethnic and age groups. Also, a validated measure for UI was used to determine the presence and severity of UI symptoms, which enabled us to use two UI definitions (any vs. moderate/severe UI). The validated dietary recall methodology from NHANES that allows measurement of moisture intake from foods is another strength of this study [22]. Finding an association between caffeine intake and UI after controlling for factors such as age, race, BMI, moisture intake, alcohol use, hysterectomy, and vaginal deliveries, which are recognized risk factors for incontinence, strengthens our conclusions as well. A limitation of NHANES data is that it is cross-sectional in design; therefore, although an association between UI and moderate caffeine intake was noted, we are unable to imply causation. Furthermore, our analysis was dependent on self-reported symptoms of UI and caffeine intake. Questions for UI type were not validated, and data was not analyzed according to UI type/severity. We also were not able to account for the type of caffeine consumed or the timing of caffeine or fluid consumption.

Conclusions

Our findings support the association of higher caffeine intake (≥204 mg/day, the amount in one 8-oz cup of coffee per day) and UI. A decrease in caffeine intake should be discussed in women with any UI.

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Conflicts of interest None

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