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ORIGINAL ARTICLE

Risk factors for urinary incontinence among postmenopausal Mexican women

Mary K. Townsend[1] · **Martín Lajous**[2,3,4] · **Raúl Hernán Medina-Campos**[5] · **Andres Catzin-Kuhlmann**[6] · **Ruy López-Ridaura**[2] · **Megan S. Rice**[7]

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Abstract
Introduction and hypothesis Previous studies of racial/ethnic variation in urinary incontinence (UI) suggest that population-specific studies of UI risk factors are needed to develop appropriate public health recommendations. We assessed UI risk factors among postmenopausal Mexican women enrolled in the Mexican Teachers' Cohort.
Methods We conducted a cross-sectional study among 15,296 postmenopausal women who completed the 2008 questionnaire. UI cases were women who reported experiencing UI during menopause. Self-reported potential UI risk factors included age, reproductive variables, smoking status, adiposity, and several health conditions. We estimated multivariate-adjusted odds ratios (ORs) and 95 % confidence intervals (CIs) for UI using multivariable logistic regression.
Results Among these postmenopausal women, the prevalence of UI was 14 %. Odds of UI were higher among women with ≥4 children vs nulliparous women (OR 1.43, 95 % CI 1.04–1.96) or body mass index (BMI) ≥30 vs <22 kg/m^2 (OR 2.00, 95 % CI: 1.55–2.57). Age at first birth <20 vs 20–24 years, past or current vs never smoking, larger waist-to-hip ratio, and history of asthma, high blood pressure, or diabetes were also associated with higher odds of UI (OR 1.2–1.3). We found a trend of lower odds of UI with older age.
Conclusions Our data suggest that information about UI and UI prevention strategies might be particularly useful for Mexican postmenopausal women with 4 or more children or higher BMI. Further studies with longitudinal UI data, in addition to data on UI severity and subtype, are needed to provide more specific information about UI risk factors to Mexican women.

Keywords Adult · Cross-sectional studies · Epidemiology · Female · Risk factors · Urinary incontinence

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✉ Martín Lajous
mlajous@insp.mx

[1] Channing Division of Network Medicine, Department of Medicine, Brigham and Women's Hospital and Harvard Medical School, Boston, MA, USA

[2] Center for Population Health Research, National Institute of Public Health, 7ª Cerrada Fray Pedro de Gante # 50, Mexico City, Cuernavaca 14000, Mexico

[3] Department of Global Health and Population, Harvard T.H. Chan School of Public Health, Boston, MA, USA

[4] Center for Research in Epidemiology and Population Health, National Institute for Health and Medical Research (INSERM), Center for Research in Epidemiology and Population Health, U1018 Research Unit, Villejuif, France

[5] National Institute of Geriatrics, Mexico City, Mexico

[6] Department of Medicine, National Institute of Medical Sciences and Nutrition Salvador Zubirán, Mexico City, Mexico

[7] Clinical and Translational Epidemiology Unit, Department of Medicine, Massachusetts General Hospital, Boston, MA, USA

Introduction

Urinary incontinence (UI) is a common condition among women of all ages [1]. UI may have a substantial negative impact on the quality of life and cause anxiety, depression, and reduced participation in social activities [2]. In addition, women with UI are burdened by the economic costs of managing their condition, including costs of extra laundry and absorbent pads [3].

Epidemiological studies of UI have focused mainly on women in the United States and Europe [4]. However, several previous studies have observed variation in UI prevalence by race or ethnicity [5], suggesting that studies of UI risk factors across diverse populations of women, who may have different risk factor distributions, might be important in developing appropriate, population-specific public health recommendations.

Data on UI among Mexican women are scarce. Of the limited studies that have focused on Mexican [6–11] or Mexican–American women [12–15], few enrolled more than 650 participants [6, 13, 14] or women younger than 60 years of age [6, 11, 13]. In addition, most of these studies did not include multivariate-adjusted analyses of UI risk factors and did not assess associations with potentially important reproductive variables, such as age at first birth and hormonal contraceptive use, or early life adiposity. This study aimed to assess multivariate-adjusted associations between several reproductive, body size, and health variables and history of UI among 15,296 postmenopausal Mexican women aged 30 to 82 in the Mexican Teachers' Cohort (MTC or ESMaestras).

Materials and methods

Study population

The MTC has been described elsewhere [16]. Briefly, the MTC began in 2006 when 27,979 female public school teachers, aged 35 years or older and residing in two Mexican states (Jalisco and Veracruz), responded to a baseline questionnaire. The cohort was expanded in 2008 when 87,336 additional women, aged 25 years or older and living in 10 Mexican states, responded to a similar questionnaire. In the 2008 questionnaire, women were asked about UI at menopause. Thus, we restricted these analyses to 17,472 women who reported in the 2008 questionnaire that their periods had ceased for more than 12 months owing to a natural menopause or a oophorectomy. In addition, because more than 90 % of female MTC participants have reached the menopause by age 51, we also included women who reported menopause for other reasons (i.e., chemotherapy or radiation) or with unknown menopausal status, who were older than 51 years in 2008. After excluding 2,176 women who were missing information on parity or body mass index (BMI), which are established UI risk factors [17], our final analytic population included 15,296 postmenopausal women. Informed consent was obtained from all participants and the study was approved by the human research committee at the National Institute of Public Health in Mexico.

Urinary incontinence

The 2008 questionnaire contained a variety of items about participants' health, medical history, and lifestyle. Urinary incontinence was assessed as part of a series of items focusing on menopausal status and menopausal symptoms. Women were presented with a list of nine symptoms commonly present in postmenopausal women, including urinary incontinence ("*incontinencia urinaria*"), and asked to mark which of the symptoms they experienced at menopause while not using any hormones ("*¿Cuáles sintomas tuvo o tiene en la menopausia? (cuando aún no utilizaba alguna hormona)*"). Participants were told that they could mark one or more symptoms. We defined UI cases as postmenopausal women who marked UI as one of their symptoms.

Risk factors

Information on potential UI risk factors was collected in the 2008 questionnaire. Each participant provided her date of birth and indicated whether she owned various items (landline telephone, mobile telephone, car, computer, vacuum cleaner, microwave oven, or internet access) in addition to whether she or her parents spoke an indigenous language. The questionnaire included several items on reproductive history, including the number of births and age at each birth, the use of hormonal contraception (oral medications, patches, or injections), age at menopause, the reason why periods ceased (natural, oophorectomy, hysterectomy, radiation, or chemotherapy), and the use of postmenopausal hormone therapy during the menopausal transition. In addition, women provided information on their body size at different ages. Specifically, the questionnaire included a diagram of nine different silhouettes (i.e., somatotypes) with increasing degrees of body fatness [18]. Women were asked to select the silhouette that best represented their body size before menarche. Reasonable validity of the recalled somatotype compared with BMI measured at age 10 was demonstrated in a study of older women in another population (Pearson's $r = 0.65$) [19]. We used women's self-reported current height, weight at age 18, and current weight to calculate their BMI at age 18 and current BMI [weight (kg)/height (m^2)]. Women were also given instructions on how to measure their waist and hip circumferences using a measuring tape that was mailed with the questionnaire. Strong correlations between self-reported and measured BMI ($r = 0.89$), waist circumference ($r = 0.78$), and hip circumference ($r = 0.83$) were observed among a subset of 3,756 MTC participants [16]. In addition, women provided information on cigarette smoking history and medical history, including diagnoses of diabetes, asthma, high blood pressure, stroke, multiple sclerosis, and Parkinson's disease.

Statistical analysis

We estimated odds ratios (ORs) and 95 % confidence intervals (CIs) for UI at menopause according to each potential risk factor using multivariate logistic regression analysis. For each risk factor of interest, analyses were restricted to women with nonmissing data on that risk factor. To examine the impact of adjusting for different sets of covariates on the ORs, we ran four sequential models for each risk factor. Model 1 was adjusted for age (<50, 50–52, 53–54, 55–56, 57–59, ≥60 years). Model 2 was adjusted for age, parity (nulliparous, 1 child, 2 children, 3 children, ≥4 children), age at first birth (<20, 20–24, 25–29, ≥30, unknown), smoking (never, past, current, unknown), age at menopause (<40, 40–44, 45–49, ≥50, unknown), and postmenopausal hormone therapy use (never, ever, unknown). Model 3 was adjusted for BMI at age 18 (<18.5, 18.5–20.9, 21–24.9, ≥25 kg/m^2, unknown), current BMI (<22, 22–24.9, 25–29.9, ≥30 kg/m^2), and waist-to-hip ratio (quartile 1, quartile 2, quartile 3, quartile 4, unknown) in addition to the variables in model 2. Model 4 was adjusted for asthma, high blood pressure, diabetes, and neurological disease (defined as history of stroke, multiple sclerosis, or Parkinson's disease) in addition to the variables in model 3. Further adjustment for the reason why periods ceased, ownership of various items, and speaking an indigenous language did not alter results and therefore were not retained in the analysis. In a sensitivity analysis, we restricted the study population to women who reported a natural menopause (n = 12,488). We considered p values less than 0.05 to be statistically significant. Analyses were conducted using SAS, version 9.4 (SAS Institute, Cary, NC, USA).

Results

The analytic population included 15,296 postmenopausal women ranging in age from 30 to 82 years; 60 % were aged 50 to 59 years (Table 1). Among these women, 2,115 (14 %) reported a history of UI at menopause. Women who reported UI were more likely to have delivered four or more children (27 % vs 22 %), to have ever used hormonal contraceptives (53 % vs 46 %) or to have ever used postmenopausal hormone therapy (37 % vs 32 %), and to have a BMI ≥30 kg/m^2 (39 % vs 28 %) or a waist-to-hip ratio ≥0.82 (80 % vs 74 %). High blood pressure (32 % vs 25 %) and neurological disease (0.8 % vs 0.4 %) were also more common in women with a history of UI at menopause. The unadjusted distributions of current age, age at first birth, age at natural menopause, smoking status, somatotype before menarche, BMI at age 18, and history of asthma and diabetes were similar in women who did and in those who did not report UI at menopause.

In multivariate adjusted analyses (Table 2), older age was associated with lower odds of UI (p trend <0.01). Among

Table 1 Distribution of age, reproductive, and lifestyle factors according to urinary incontinence status among 15,296 postmenopausal women in the Mexican Teachers' Cohort (2008)[a]

Characteristic	Urinary incontinence (n = 2,115)	No urinary incontinence (n = 13,181)
Age (years)		
<50	659 (31)	4,095 (31)
50–52	543 (26)	3,153 (24)
53–54	376 (18)	2,067 (16)
55–56	229 (11)	1,412 (11)
57–59	187 (9)	1,286 (10)
≥60	121 (6)	1,168 (9)
Parity		
Nulliparous	203 (10)	1,824 (14)
1 child	195 (9)	1,549 (12)
2 children	510 (24)	3,376 (26)
3 children	626 (30)	3,583 (27)
≥4 children	581 (27)	2,849 (22)
Age at first birth (years)[b]		
<20	243 (13)	1,105 (10)
20–24	760 (41)	4,225 (39)
25–29	535 (29)	3,474 (32)
≥30	311 (17)	2,080 (19)
Hormonal contraceptive use		
Never	927 (47)	6,466 (54)
Ever	1,034 (53)	5,566 (46)
Age at natural menopause (years)		
<40	109 (7)	724 (8)
40–44	290 (19)	1,890 (20)
45–49	691 (46)	4,143 (45)
>50	417 (28)	2,488 (27)
Postmenopausal HT use		
Never	1,297 (63)	8,563 (68)
Ever	747 (37)	4,011 (32)
Smoking status		
Never	1,421 (70)	9,321 (74)
Past	385 (19)	1,931 (15)
Current	234 (11)	1,293 (10)
Somatotype before menarche		
1	922 (45)	5,625 (44)
2	444 (22)	2,824 (22)
3	345 (17)	2,256 (18)
≥4	343 (17)	1,956 (15)
BMI at age 18 (kg/m^2)		
<18.5	349 (18)	2,230 (19)
18.5–20.9	672 (34)	4,502 (38)
21–24.9	760 (39)	4,314 (36)
≥25	170 (9)	823 (7)
Current BMI (kg/m^2)		
<22	78 (4)	796 (6)

Table 1 (continued)

Characteristic	Urinary incontinence (n = 2,115)	No urinary incontinence (n = 13,181)
22–24.9	329 (16)	2,761 (21)
25–29.9	891 (42)	5,886 (45)
≥30	817 (39)	3,738 (28)
Waist-to-hip ratio		
Quartile 1 (<0.82)	385 (20)	2,974 (26)
Quartile 2 (0.82 to <0.86)	481 (26)	2,911 (25)
Quartile 3 (0.86 to <0.91)	502 (27)	2,883 (25)
Quartile 4 (≥0.91)	511 (27)	2,853 (25)
Asthma	143 (7)	661 (5)
High blood pressure	667 (32)	3,272 (25)
Diabetes	296 (14)	1,354 (10)
Neurological disease[c]	16 (0.8)	52 (0.4)

BMI body mass index, *HT* hormone therapy

[a] Numbers in the table are *n* (%). Percentages may not total 100 % because of rounding. Women for whom data were missing on each variable: age at first birth (n = 536), hormonal contraceptive use (n = 1,303), age at natural menopause (n = 2,839 missing menopause type or age; n = 1,705 did not have natural menopause), postmenopausal HT use (n = 678), smoking status (n = 711), somatotype before menarche (n = 581), BMI at age 18 (n = 1,476), waist-to-hip ratio (n = 1,796)

[b] Percentages were calculated among parous women

[c] Neurological disease was defined as a history of stroke, multiple sclerosis, or Parkinson's disease

women aged ≥60, the odds of UI were 44 % lower compared with women aged <50 years in the fully adjusted model (OR = 0.56, 95 % CI: 0.45–0.70).

Women with ≥4 children had significantly higher odds of UI than nulliparous women (OR = 1.43, 95 % CI: 1.04–1.96; p for trend <0.01). Older age at first birth was associated with significantly lower odds of UI in the age-adjusted model (p value for linear trend <0.01), but not after adjusting for other covariates (p value for linear trend = 0.06). Nonetheless, in the fully adjusted model, the odds of UI were 18 % higher among women with age at first birth <20 years vs 20–24 years (OR = 1.18, 95 % CI: 1.00–1.38).

Ever use of postmenopausal hormone therapy (OR = 1.26, 95 % CI: 1.14–1.39) and cigarette smoking (OR = 1.23, 95 % CI: 1.09–1.39 for past smoking; OR = 1.18, 95 % CI 1.01–1.37 for current smoking) were associated with higher odds of UI. Ever use of hormonal contraception and age at natural menopause were not statistically significantly associated with UI in fully adjusted models.

We examined the associations of several measures of adiposity over the life course with UI. Somatotype before menarche was not associated with UI in the model adjusted for age and reproductive variables (p trend = 0.53). After adjusting for potential intermediate variables (BMI at age 18, current BMI, and waist-to-hip ratio), there was a trend toward lower odds of UI with a higher somatotype before menarche (p trend = 0.02). However, the OR comparing the highest vs lowest category of somatotype before menarche was not statistically significant (OR = 0.88, 95 % CI: 0.75–1.03). Higher BMI at age 18 was associated with modestly higher odds of UI after adjusting for age and reproductive variables (p trend <0.01), but the association attenuated and became nonsignificant after adjusting for current BMI (p trend = 0.50). Higher current BMI and waist-to-hip ratio were associated with higher odds of UI in all models. After adjusting for BMI at age 18 (model 3), ORs for UI were 1.40 (95 % CI: 1.10–1.80) for 25–29 kg/m^2 and 2.00 (95 % CI: 1.55–2.57) for ≥30 kg/m^2 vs <22 kg/m^2. These ORs attenuated slightly after adjusting for potential intermediate variables in model 4, such as high blood pressure and diabetes. Women whose waist-to-hip ratio was in quartiles 2 to 4 vs quartile 1 had approximately 20 % higher odds of UI in the fully adjusted model.

In age-adjusted models, all four medical conditions (asthma, high blood pressure, diabetes, and neurological disease) were associated with higher odds of UI (ORs = 1.38–1.99). In the fully adjusted model, statistically significant associations remained for asthma (OR = 1.26, 95 % CI: 1.04–1.52), high blood pressure (OR = 1.24, 95 % CI: 1.11–1.37), and diabetes (OR = 1.24, 95 % CI: 1.08–1.43). Although neurological disease had the largest OR point estimate (OR = 1.74), the confidence interval was wide (95 % CI: 0.98–3.08) because of the small number of women diagnosed with a neurological condition.

We repeated the analyses after restricting the study population to women who reported natural menopause. Results generally were similar to those reported above (Supplementary Table 1). However, unlike in the primary analysis, somatotype before menarche was not associated with odds of UI at menopause in any of the models (p trend ≥0.17). In addition, the associations of BMI 25–29.9 vs <22 kg/m^2 and history of asthma with higher odds of UI were not statistically significant in the fully adjusted model.

Discussion

Among these postmenopausal women, we observed several variables associated with UI in multivariate-adjusted analyses. A history of UI at menopause was more common among women with 4 or more children, younger age at first birth, and a higher BMI or waist-to-hip ratio, and among women with a history of postmenopausal hormone therapy use, smoking, high blood pressure, and diabetes. Younger postmenopausal women were more likely to report a history of UI at menopause than older women.

Table 2 Age and multivariate-adjusted odds ratios and 95 % confidence intervals for the association between age/reproductive/lifestyle factors and urinary incontinence in 15,296 postmenopausal women in the Mexican Teachers' Cohort (2008)[a]

	Cases/noncases	Model 1	Model 2	Model 3	Model 4
Age (years)					
<50	659/4,095	1.00	1.00	1.00	1.00
50–52	543/3,153	1.07 (0.95, 1.21)	1.00 (0.88, 1.14)	1.00 (0.87, 1.14)	0.99 (0.86, 1.13)
53–54	376/2,067	1.13 (0.99, 1.30)	1.03 (0.88, 1.20)	1.02 (0.88, 1.19)	0.99 (0.85, 1.16)
55–56	229/1,412	1.01 (0.86, 1.19)	0.90 (0.75, 1.07)	0.89 (0.75, 1.07)	0.87 (0.73, 1.04)
57–59	187/1,286	0.90 (0.76, 1.08)	0.82 (0.68, 0.99)	0.81 (0.67, 0.98)	0.78 (0.64, 0.94)
≥60	121/1,168	0.64 (0.52, 0.79)	0.59 (0.48, 0.73)	0.59 (0.48, 0.74)	0.56 (0.45, 0.70)
p trend		<0.01	<0.01	<0.01	<0.01
Parity					
Nulliparous	203/1,824	1.00	1.00	1.00	1.00
1 child	195/1,549	1.11 (0.91, 1.37)	0.92 (0.66, 1.29)	0.94 (0.67, 1.32)	0.93 (0.66, 1.30)
2 children	510/3,376	1.33 (1.12, 1.58)	1.09 (0.80, 1.49)	1.11 (0.81, 1.51)	1.09 (0.79, 1.49)
3 children	626/3,583	1.54 (1.30, 1.82)	1.25 (0.92, 1.71)	1.25 (0.91, 1.70)	1.22 (0.90, 1.67)
≥4 children	581/2,849	1.84 (1.55, 2.19)	1.48 (1.08, 2.02)	1.45 (1.06, 1.99)	1.43 (1.04, 1.96)
p trend		<0.01	<0.01	<0.01	<0.01
Age at first birth (years)					
<20	243/1,105	1.22 (1.04, 1.44)	1.18 (1.00, 1.38)	1.18 (1.00, 1.38)	1.18 (1.00, 1.38)
20–24	760/4,225	1.00	1.00	1.00	1.00
25–29	535/3,474	0.86 (0.76, 0.97)	0.92 (0.81, 1.04)	0.93 (0.82, 1.05)	0.93 (0.82, 1.05)
≥30	311/2,080	0.84 (0.73, 0.97)	0.99 (0.84, 1.15)	0.98 (0.84, 1.15)	0.98 (0.84, 1.15)
p trend		<0.01	0.05	0.06	0.06
Hormonal contraception use					
Never	927/6,466	1.00	1.00	1.00	1.00
Ever	1,034/5,566	1.10 (1.02, 1.18)	1.07 (0.99, 1.15)	1.07 (0.99, 1.15)	1.06 (0.99, 1.15)
Age at natural menopause (years)					
<40	109/724	0.91 (0.73, 1.13)	0.89 (0.71, 1.11)	0.84 (0.67, 1.06)	0.84 (0.67, 1.05)
40–44	290/1,890	0.92 (0.79, 1.08)	0.92 (0.79, 1.07)	0.90 (0.77, 1.05)	0.90 (0.77, 1.05)
45–49	691/4,143	1.00	1.00	1.00	1.00
≥50	417/2,488	1.05 (0.91, 1.22)	1.05 (0.91, 1.22)	1.06 (0.91, 1.23)	1.06 (0.92, 1.23)
p trend		0.14	0.10	0.10	0.09
Postmenopausal HT use					
Never	1,297/8,563	1.00	1.00	1.00	1.00
Ever	747/4,011	1.24 (1.12, 1.36)	1.23 (1.12, 1.36)	1.26 (1.14, 1.40)	1.26 (1.14, 1.39)
Smoking status					
Never	1,421/9,321	1.00	1.00	1.00	1.00
Past	385/1,931	1.30 (1.15, 1.47)	1.28 (1.14, 1.45)	1.24 (1.10, 1.41)	1.23 (1.09, 1.39)
Current	234/1,293	1.16 (1.00, 1.35)	1.14 (0.98, 1.33)	1.16 (1.00, 1.35)	1.18 (1.01, 1.37)
Somatotype before menarche					
1	922/5,625	1.00	1.00	1.00	1.00
2	444/2,824	0.97 (0.86, 1.09)	0.97 (0.86, 1.10)	0.93 (0.82, 1.06)	0.93 (0.82, 1.06)
3	345/2,256	0.94 (0.82, 1.07)	0.94 (0.82, 1.08)	0.84 (0.73, 0.97)	0.84 (0.73, 0.97)
≥4	343/1,956	1.07 (0.94, 1.22)	1.09 (0.95, 1.25)	0.88 (0.75, 1.03)	0.88 (0.75, 1.02)
p trend		0.69	0.53	0.02	0.02
BMI at age 18 (kg/m^2)					
<18.5	349/2,230	1.00	1.00	1.00	1.00
18.5–20.9	672/4,502	0.95 (0.83, 1.10)	0.95 (0.82, 1.09)	0.90 (0.78, 1.04)	0.90 (0.78, 1.04)
21–24.9	760/4,314	1.13 (0.99, 1.30)	1.12 (0.98, 1.29)	0.98 (0.85, 1.13)	0.96 (0.84, 1.11)
≥25	170/823	1.31 (1.07, 1.60)	1.35 (1.11, 1.66)	1.06 (0.86, 1.30)	1.03 (0.83, 1.27)

Table 2 (continued)

	Cases/noncases	Model 1	Model 2	Model 3	Model 4
p trend		<0.01	<0.01	0.50	0.71
Current BMI (kg/m^2)					
<22	78/796	1.00	1.00	1.00	1.00
22–24.9	329/2,761	1.21 (0.94, 1.57)	1.17 (0.90, 1.52)	1.15 (0.88, 1.49)	1.14 (0.88, 1.48)
25–29.9	891/5,886	1.54 (1.21, 1.97)	1.47 (1.16, 1.88)	1.40 (1.10, 1.80)	1.37 (1.07, 1.75)
≥30	817/3,738	2.23 (1.75, 2.85)	2.15 (1.68, 2.75)	2.00 (1.55, 2.57)	1.87 (1.45, 2.41)
p trend		<0.01	<0.01	<0.01	<0.01
Waist-to-hip ratio					
Quartile 1 (<0.82)	385/2,974	1.00	1.00	1.00	1.00
Quartile 2 (0.82 to <0.86)	481/2,911	1.27 (1.10, 1.46)	1.26 (1.09, 1.45)	1.21 (1.04, 1.39)	1.19 (1.03, 1.37)
Quartile 3 (0.86 to <0.91)	502/2,883	1.33 (1.15, 1.54)	1.33 (1.15, 1.53)	1.25 (1.08, 1.44)	1.22 (1.05, 1.41)
Quartile 4 (≥0.91)	511/2,853	1.38 (1.19, 1.59)	1.39 (1.20, 1.60)	1.25 (1.08, 1.44)	1.20 (1.04, 1.39)
p trend		<0.01	<0.01	<0.01	0.02
Asthma	143/661	1.38 (1.14, 1.66)	1.33 (1.10, 1.61)	1.28 (1.06, 1.55)	1.26 (1.04, 1.52)
High blood pressure	667/3,272	1.44 (1.30, 1.59)	1.41 (1.28, 1.57)	1.28 (1.15, 1.42)	1.24 (1.11, 1.37)
Diabetes	296/1,354	1.44 (1.26, 1.65)	1.42 (1.24, 1.63)	1.30 (1.13, 1.50)	1.24 (1.08, 1.43)
Neurological disease[b]	16/52	1.99 (1.13, 3.49)	2.01 (1.14, 3.54)	1.92 (1.09, 3.40)	1.74 (0.98, 3.08)

[a] Model 1: adjusted for age (<50, 50–52, 53–54, 55–56, 57–59, ≥60); model 2: model 1 and additionally adjusted for parity (nulliparous, 1 child, 2 children, 3 children, ≥4 children), age at first birth (<20, 20–24, 25–29, ≥30, missing), smoking (never, past, current, missing), age at menopause (<40, 40–44, 45–49, ≥50, missing), and postmenopausal HT use (never, past, current, missing); model 3: model 2 additionally adjusted for BMI at age 18 (<18.5, 18.5–20.9, 21–24.9, ≥25, missing), current BMI (<22, 22–24.9, 25–29.9, ≥30), and waist-to-hip ratio (quartile 1, quartile 2, quartile 3, quartile 4, missing); model 4: model 3 additionally adjusted for asthma, high blood pressure, diabetes, and neurological disease

[b] Neurological disease is defined as a history of stroke, multiple sclerosis, or Parkinson's disease

Our finding of a 14 % prevalence of UI among these women should be interpreted cautiously. The MTC was not designed as a UI study and, therefore, the 2008 questionnaire did not include a validated question to assess UI symptoms. Participants were asked about UI in the context of menopausal symptoms, such as hot flashes and difficulty sleeping, and the medical term "urinary incontinence" was used, rather than language typically used in validated UI items (e.g., "leak urine"). Together, these issues may have led to the underreporting of UI. However, in a study of 1,307 women, aged 25–54 years, living in Sonora, Mexico, and a study of 628 women aged ≥70 years in the Mexican Study of Nutritional and Psychosocial Markers of Frailty, the prevalence of UI was about 20 %, similar to our study [6, 7]. In contrast, among studies of Mexican–American women, prevalence estimates have been highly variable, ranging from 15 % among women aged ≥65 years in the Hispanic Established Population for the Epidemiologic Study of the Elderly (HEPESE) to 47 % among women aged ≥20 years in the National Health and Nutrition Examination Survey (NHANES) [13, 14]. Clearly, additional studies with validated Spanish language questions about UI are needed to better quantify UI prevalence among middle-aged and older Mexican women.

Older age is an established risk factor for UI [17]. Therefore, our finding of decreasing odds of UI with older age is somewhat unexpected. However, our observation is consistent with a previous study that found a peak in UI prevalence at age 50, followed by a decline between ages 50 and 60, and second peak among older adults [1]. Alternatively, our finding may reflect the item used to assess UI, which asked about UI occurring at menopause, rather than current symptoms.

Childbirth may increase UI risk by causing damage to the connective tissue support structures and nerves in the pelvic floor [17]. We found a significant linear trend of higher odds of UI with higher parity and significantly higher odds of UI among women with at least four children compared with nulliparous women. Similarly, among 1,307 women in Sonora, Mexico aged 25–54, the odds of UI were higher in parous vs nulliparous women (OR 1.78, 95 % CI 0.84–3.78) [6]. Also, a study of 1,589 Mexican–American women aged 65 years and older in the HEPESE found a higher mean number of children among women with UI compared with continent women (5.2 vs 4.5 children, $p = 0.01$) [14]. To our knowledge, no studies of Mexican or Mexican–American women have examined the relation between age at first birth and risk of UI. We found 18 % (0–38 %) higher odds of UI among women with age at first birth <20 vs 20–24 years, after adjusting for parity and other covariates. Similarly, in a multi-ethnic population of 1,521 women aged 40–69 years in Northern California,

Thom et al. observed 47 % (95 % CI 11 %–54 %) higher odds of UI among those with age at first birth <23 vs ≥23 years [20].

Current and past use of postmenopausal hormone therapy has been associated with increased UI risk in several clinical trials [17]. The underlying mechanism for this association is not clear, but may reflect increases in collagen turnover related to the use of exogenous hormones [21]. Consistent with these findings, we observed higher odds of UI among ever vs never users of postmenopausal hormone therapy. In contrast, previous studies of oral contraceptive use and UI have had mixed results, with studies reporting null [22, 23], positive [24], and inverse associations [25]. We found no evidence of an association between hormonal contraception use and history of UI at menopause in our study.

Previous studies have generally observed a higher risk for UI among cigarette smokers. For example, among 1,589 Mexican–American women in the HEPESE, 41 % of women with UI vs 25 % of continent women had smoked at least 100 cigarettes in their lifetime ($p < 0.01$) [14]. Among 1,307 women in northern Mexico, smoking was not associated with prevalent UI; however, current smoking was associated with greater odds of severe UI among women with incontinence (OR 2.54, 95 % CI 1.21–5.84) [6]. We observed moderately higher odds of UI among past or current vs never smokers. Smoking may increase UI risk indirectly (e.g., smoker's cough leading to urethral sphincter dysfunction) or directly (e.g., smoking-related reductions in collagen synthesis leading to weakened pelvic support structures) [26].

Higher BMI and abdominal adiposity are established UI risk factors [17]. Obesity is hypothesized to increase UI risk by increasing pressure in the abdomen and bladder, which may lead to chronic strain and weakening of the pelvic floor structures [17]. We found higher odds of UI among women whose current BMI was 25–29 or ≥30 kg/m^2 and among women with a higher waist-to-hip ratio. Similarly, among women in northern Mexico, odds ratios for UI were 1.54 (95 % CI 1.01–2.35) among those with a BMI of 25–29 kg/m^2 and 1.61 (95 % CI 1.06–2.45) among those with BMI ≥30 kg/m^2 [6]. Few data exist on the relation between body size throughout the life course and UI in later life [27]. Our analyses, which simultaneously considered somatotype before menarche, BMI at age 18, and current BMI, suggested that current BMI might be a more important factor in later life UI than body size in young adulthood or childhood. Interestingly, higher somatotype before menarche was associated with lower odds of UI after adjusting for intermediate body size (i.e., BMI at age 18 and current BMI). However, it is possible that we did not adjust for all common causes of intermediate BMI and UI, and thus we cannot exclude the potential effect of bias on this association. Therefore, this association should be interpreted cautiously. Additional studies with data on body size in childhood, adolescence, and throughout adulthood are needed to better understand the impact of life-course BMI on UI.

Several mechanisms may explain the associations between neurological disease/diabetes/high blood pressure and higher UI risk. For example, these conditions may damage the microvasculature and nerves in the pelvic floor. Also, lower urinary tract infections, which are more common in women with diabetes, may irritate the bladder and lead to urgency UI. Diuretic therapy for high blood pressure may promote UI by causing higher urine output. In addition, chronic cough associated with asthma may increase the risk of stress incontinence. Similar to our findings, in the HEPESE the prevalence of diabetes was higher in Mexican–American women with vs without UI (30 % vs 22 %, $p = 0.01$) [14]. Also, in the Mexican Health and Aging Study, there was a suggestion of a higher prevalence of UI among adults with vs without hypertension (7.5 % vs 5.9 %, $p = 0.08$) [28].

The limitations of this study should be considered. First, the MTC questionnaire did not include a validated item for assessing UI. As participants were asked about urinary incontinence at menopause rather than about their current symptoms, some women who developed UI after menopause may not have reported it (possibly contributing to our finding of lower odds of UI among older women). Thus, as discussed earlier, the estimation of UI prevalence in this study should be interpreted cautiously. However, misclassification of UI was likely nondifferential according to most of the risk factors examined in our study (besides age). In addition, the MTC did not collect details about UI symptoms such as frequency, typical quantity of urine leaked, or subtype (i.e., stress, urgency, or mixed UI). However, our study is the largest to collect data on UI among Mexican women and one of the few [6] to conduct multivariate-adjusted analyses, which is important for understanding independent associations between risk factors and UI. Finally, as all of the MTC participants are public school teachers, the distribution of some characteristics in this population are not representative of the underlying female population of Mexico. For example, women in the MTC have an educational level that is above average in Mexico (88 % have education beyond high school). In addition, MTC participants are more likely to be married (70 % vs 58 %) and have a higher average age at first birth (25.2 vs 20.8 years) than women in the general population [29]. However, we conducted multivariate-adjusted analyses to address the unique confounding structure among these women.

In summary, our findings suggest that information about UI, though important for all Mexican postmenopausal women, may be especially useful for women with four or more children or higher BMI. Given the high prevalence of obesity among Mexican women [30], the association of BMI with UI is of particular public health concern. Further prospective studies with data on UI severity, subtype, and impact on quality of life are needed to provide more specific information about UI risk factors and burden to Mexican women and clinicians.

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Compliance with ethical standards

Conflicts of interest None.

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