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Factors associated with persistent urinary incontinence

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Abstract

Objective—Many women with urinary incontinence (UI) have symptoms that continue over many years; however, virtually nothing is known about factors that are associated with persistent UI.

Study design—We studied 36,843 participants of the Nurses' Health Study, aged 54–79 years at baseline for the UI study, who provided UI information on biennial questionnaires from 2000 to 2008; follow up in the Nurses' Health Study is 90%. In total, 18,347 women had "persistent UI," defined as urine leakage ≥1/month reported on all five biennial questionnaires during this eight-year period; 18,496 women had no UI during this period. Using multivariable-adjusted logistic regression, we estimated odds ratios (OR) of persistent UI versus no UI across various demographic, lifestyle, and health-related factors, which were derived from reports in 2000.

Results—Increasing age group, white race, greater parity, greater BMI, and lower physical activity levels were each associated with greater odds of persistent UI, as were several health-related factors (i.e., stroke, type 2 diabetes, and hysterectomy). Associations with persistent UI were particularly strong for increasing age group (p-trend<0.0001; OR=2.75, 95% CI=2.54–2.98 comparing women aged ≥75 vs. <60 years) and greater BMI (p-trend<0.0001; OR=3.14, 95% CI=2.95–3.33 comparing women with BMI ≥30 vs. <25 kg/m^2); moreover, black women had much lower odds of persistent UI compared to white women (OR=0.27, 95% CI=0.21–0.34).

Conclusions—Factors associated with persistent UI were generally consistent with those identified in previous studies of UI over shorter time periods; however, older age, white race, and obesity were particularly strongly related to persistent UI.

Keywords

epidemiology; risk factors; urinary incontinence; women

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INTRODUCTION

Urinary incontinence (UI) is a common condition among women, which can lead to substantial reductions in quality of life for affected individuals. In addition, UI is responsible for increased financial burdens on individuals as well as the healthcare system[1, 2]. Numerous epidemiologic studies have identified factors associated with prevalent and incident UI, and have offered insight into the etiology of this condition and suggested possible strategies for mitigating UI[3, 4]. However, previous epidemiologic research has focused largely on UI assessment at one or two points in time, including analyses in the Nurses' Health Study, despite clinical observations indicating that UI is a complex, dynamic condition[5, 6]. Longitudinal studies involving a larger number of repeated UI assessments over time have begun to yield important information regarding the natural history of UI[7–9], although there is still relatively little known about specific risk factors for UI that persists over many years. Thus, we evaluated factors associated with persistent UI over eight years of follow up among women participating in the Nurses' Health Study—in whom we have collected UI information on repeated biennial questionnaires.

MATERIALS AND METHODS

Study population

The Nurses' Health Study was initiated in 1976, when 121,700 female nurses, aged 30 to 55 years, responded to a mailed questionnaire on their medical history and lifestyle; this information is updated with similar questionnaires every two years. Questions about urinary incontinence were included on the questionnaires in 2000, 2002, 2004, 2006, and 2008; to date, the follow-up rate is approximately 90%. The Institutional Review Board of Brigham and Women's Hospital approved this study, and informed consent was implied by return of the questionnaires.

Measurement of urinary incontinence

On the biennial questionnaires from 2000–2008, participants were asked, "During the last 12 months, how often have you leaked or lost control of your urine?" Response options were never, less than once per month, once per month, 2 to 3 times per month, about once per week, and almost every day. A reliability study among a subgroup of the nurses demonstrated high reproducibility of responses to this question[10]. Cases were classified as 'any UI' if women reported leaking urine at least once per month, and as 'frequent UI' if women reported leaking at least once per week. UI cases were classified as 'persistent' if women reported UI on all questionnaires from 2000 to 2008; these cases were the focus of the analyses presented here.

Measurement of exposures

The biennial questionnaires included information on a wide variety of demographic, health, and lifestyle factors, including age, race, height and weight, reproductive history, alcohol intake, smoking, physical activity, post-menopausal hormone use, vascular conditions, and hysterectomy. Participants reported their race and ethnicity on the 2004 questionnaire, and we classified women as white, black, or Asian if they identified with one of these racial groups. Height was reported on the initial questionnaire, and weight, number of births, smoking habits, postmenopausal hormone use, and hysterectomy status were reported on most of the biennial questionnaires. Information on physical activity was collected in 1986, 1988, 1992, and every two years thereafter; specifically, participants reported the number of hours spent on various leisure activities (e.g. walking, running) during the past year, and total energy expenditure was calculated in metabolic-equivalent (MET)-hours per week,

which has been previously described in detail[11]. In addition, participants reported diagnoses of stroke, myocardial infarction, and type 2 diabetes on biennial questionnaires.

Population for analysis

Of the original 121,700 NHS participants, 108,673 were alive at UI baseline (i.e., return date of the 2000 questionnaire) and 84,013 of those women responded to UI questions on that questionnaire. Among participants with baseline information on UI, we included 75,515 women in our analyses who answered UI questions on at least two additional questionnaires during the period 2002–2008 (i.e., 90% of those who answered UI questions at baseline). Seventy-seven percent of women in our analytic sample (n=58,260) provided UI information on all five questionnaires from 2000 through 2008; for women missing UI information on one or two follow-up questionnaires, we imputed their UI status from the most recent report (all findings were nearly identical in alternate analyses using only women with complete information on all five questionnaires).

For these analyses of persistent UI, we included two groups of participants: 18,347 women who reported UI consistently on biennial questionnaires from 2000–2008, and 18,496 women who reported having no UI on any of these questionnaires. For analyses of persistent 'frequent UI', we included 7,843 women who reported frequent UI consistently on questionnaires during 2000–2008, and the 18,496 women who reported no UI on these questionnaires.

Statistical analysis

To evaluate factors related to persistent UI, we used multivariable-adjusted logistic regression to estimate odds ratios for 'any UI' and 'frequent UI' versus no UI during follow up across categories of the following variables: age (<60, 60–64, 65–69, 70–74, ≥75), race (white, black, Asian), body-mass index (BMI) (<25, 25–29.9, ≥30 kg/m^2), parity (0, 1–2, ≥3 births), alcohol intake (none, 1–14, ≥15 g/day), smoking status (never, past, current), physical activity (MET-hours/week in tertiles), postmenopausal hormone use (never, past, current), history of stroke (yes, no), history of myocardial infarction (yes, no), history of type 2 diabetes (yes, no), and prior hysterectomy (yes, no). The status of these factors was determined based on the participant's report at baseline (i.e., on the 2000 questionnaire), except that physical activity was defined using an average of all available reports through baseline to represent long-term physical activity. We calculated 95% confidence intervals (CI) for all estimates, and evaluated linear tests of trend for ordinal variables.

In secondary analyses, we examined the association between BMI and persistent UI after excluding women who were underweight (i.e., BMI ≤18.5 kg/m^2).

RESULTS

Table 1 shows age-adjusted characteristics of our study population at the initial UI assessment in 2000, separately for women with persistent UI vs. no UI during the study period. Compared to women with no UI, women with persistent UI were older, slightly more parous, and more likely to report current use of postmenopausal hormones and prior hysterectomy. In addition, women with persistent UI, on average, had higher BMI and lower physical activity levels compared to women without UI.

In multivariable models adjusting simultaneously for all factors that we examined in relation to UI, we found multiple demographic, lifestyle, and health-related factors that were independently associated with persistent UI (Table 2). For demographic factors, increasing age was highly associated with increasing odds of persistent UI (p-trend<0.0001); for example, women ≥75 years of age had three times higher odds of persistent UI than women

<60 years (OR=2.75, 95% CI=2.54–2.98). This association was stronger when we considered frequent UI, such that women aged ≥75 years had nearly four times the odds of persistent frequent UI compared to those <60 years of age (p-trend<0.0001; OR=3.56, 95% CI=3.21–3.96). Parity was also related to modestly greater odds of persistent UI (OR=1.58, 95% CI=1.44–1.74 comparing women with ≥3 births vs. no births) and persistent frequent UI (OR=1.82, 95% CI=1.59–2.07 for the same comparison). In contrast, non-white women had substantially lower odds of persistent UI, especially black women (OR=0.27, 95% CI=0.21–0.34) although reduced odds were apparent for Asian women as well (OR=0.69, 95% CI=0.51–0.92) compared to white women. Similar associations were found between race and persistent frequent UI (OR=0.30, 95% CI=0.22–0.41 for black vs. white women, and OR=0.64, 95% CI=0.42–0.98 for Asian vs. white women).

When we considered lifestyle factors, BMI was strongly related to persistent UI (p-trend<0.0001); in particular, women with BMI ≥30 kg/m^2 had three times higher odds of persistent UI (OR=3.14, 95% CI=2.95–3.33) compared to women with BMI <25 kg/m^2. Again, this association was even stronger for persistent frequent UI (p-trend<0.0001), such that women with BMI ≥30 kg/m^2 had four times the odds of persistent frequent UI compared to women with <25 kg/m^2 (OR=4.12, 95% CI=3.82–4.45). In addition, postmenopausal hormone use was associated with increased odds of persistent UI (OR=2.06, 95% CI=1.95–2.18 comparing current vs. never users), which was similar to the association between postmenopausal hormone use and persistent frequent UI (OR=1.90, 95% CI=1.77–2.04 for current vs. never users). On the contrary, higher physical activity levels were related to decreased odds of persistent UI (p<0.0001; OR=0.73, 95% CI=0.69–0.77 comparing the highest vs. lowest tertiles) and persistent frequent UI (p<0.0001; OR=0.71, 95% CI=0.66–0.76 when extreme tertiles were compared).

Finally, several health-related factors were related to persistent UI, including a history of stroke (OR=1.56, 95% CI=1.29–1.89), type 2 diabetes (OR=1.36, 95% CI=1.24–1.48), and prior hysterectomy (OR=1.35, 95% CI=1.29–1.41). These associations were very similar for persistent frequent UI in relation to stroke (OR=1.69, 95% CI=1.35–2.12), type 2 diabetes (OR=1.42, 95% CI=1.27–1.58), and hysterectomy (OR=1.42, 95% CI=1.34–1.51).

Secondary analyses excluding 528 underweight women produced results that were nearly identical to those of our main analyses.

COMMENT

In this large cohort of women aged 54–79 years, we found associations of demographic, lifestyle, and health-related factors with persistent UI. Of interest, our study demonstrated that most known risk factors for UI prevalence and incidence were also related to persistent UI. Nonetheless, advancing age, white race, and obesity were very strong factors associated with persistent UI; since most women do not ask their health care providers about UI, these risk factors might indicate women whom providers might target to initiate conversations about UI prevention and treatment.

To our knowledge, this is the first epidemiologic study to explore factors associated with persistent UI. In previous studies of UI over shorter time periods, including the Nurses' Health Study, increasing age, white race, greater BMI, greater parity, postmenopausal hormone use, type 2 diabetes, and lower physical activity levels have been related to incident UI[12–19]. In addition, history of stroke and prior hysterectomy have been found to be risk factors for UI development[12, 15]. Smoking is one previously-identified risk factor for incident UI that was not related to persistent UI in our analyses here, although prior studies have produced conflicting evidence on the association between smoking and UI[5]; thus, it is difficult to conclude that smoking may be related only to more sporadic and not to persistent

UI. Overall, these similarities indicate that mechanisms underlying short-term as well as longer-term UI are likely parallel; perhaps other factors, such as genetics or gene-environment interactions, determine persistence of UI. Certainly, research addressing these issues is needed, including research in our own cohort and others to evaluate factors that might be associated with less persistent UI.

A major strength of our study is the multiple, repeated measurements of UI over time, which is unique and allowed us to specifically consider persistent UI. There are limitations to this study as well. First, UI information was self reported which may have led to some random misclassification of UI at each assessment. However, we have established high reliability of self-reported incontinence symptoms among these women, and other studies have demonstrated the high validity of self-reported incontinence compared to clinical assessment. In addition, random misclassification is probably less likely to have affected these analyses of persistent UI because we compared extreme phenotypes (i.e., no UI vs. persistent UI over time); thus, large amounts of misreporting would have been required to influence these results. Furthermore, self-reported UI assessment often captures less severe symptoms in addition to bothersome symptoms that typically lead women to seek treatment from their health care provider; thus, our study population probably includes a broader range of UI severity than if we had employed physician-diagnosed UI assessment. Nonetheless, it is important to understand UI in the community, and potentially identify women who could benefit from conversations with their health care provider regarding UI. Moreover, our assessment of UI symptoms via mailed questionnaires compared to telephone or face-to-face interviews also helps to reduce embarrassment that might otherwise cause underreporting of UI among these women; our repeated UI assessments utilizing the same instrument over time add to the validity of our persistent UI classification as well. Second, exposure information was determined using self-reported information. Yet, our participants are health professionals with substantial knowledge about health-related issues, which suggests that their reporting is likely highly accurate. Indeed, self-reported information on multiple factors considered in our analyses has been well validated in this cohort previously. Third, our study population is relatively homogenous, consisting of nurses who were predominantly white. The status of these women as health professionals helps to ensure accurate reporting of health and lifestyle characteristics, although it could limit the generalizability of our results; still, there is no specific reason to think that factors associated with persistent UI would differ for nurses vs. other women. Furthermore, in previous research on UI in this cohort, we have consistently found that UI prevalence, incidence, and risk factors are similar to those identified in other populations. The racial distribution is also limited in this cohort, with 98% of women being white. Although we were able to identify strong associations between race and persistent UI, we did not have the ability to specifically assess whether factors associated with UI differ by race; thus, more research is needed among racial minorities. Finally, we studied women with existing UI at baseline, and therefore it is possible that observed associations might have been influenced by reverse causation (i.e., the associations could be due to the presence of UI causing alterations in health and lifestyle factors). However, many factors that we examined were determined over many years prior to UI baseline in this cohort (e.g., race, health status, physical activity) and would not be subject to reverse causation. Nonetheless, results should be interpreted with caution, and future analyses after longer follow up will permit an adequate number of incident cases of persistent UI to conduct a prospective study of risk factors.

In conclusion, we observed associations of multiple demographic, lifestyle, and health-related factors with persistent UI in older women; specifically, increasing age, white race, and obesity were strong factors related to persistent UI. These findings provide the first insight into the profile of women with persistent UI.

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TABLE 1

Age and age-adjusted characteristics of participants in the Nurses' Health Study at initial urinary incontinence assessment in 2000, according to UI status

	Women with persistent UI [1] (n=18,347)	Women with no UI [1] (n=18,496)
Age, in years, %		
<60	19	27
60–64	20	23
65–69	22	21
70–74	22	17
≥75	17	12
Race, %		
White	99	97
Black	1	2
Asian	<1	1
Body-mass index, in kg/m^2,%		
<25	35	53
25–29.9	35	33
≥30	30	14
Parity, %		
0 births	5	7
1–2 births	34	37
≥3 births	61	56
Median alcohol intake, in g/day [2]	0.9 (0–5.8)	1.5 (0–6.7)
Smoking status, %		
Never	45	46
Past	46	43
Current	9	11
Median physical activity, in MET-hrs/wk [2]	12.0 (6.0–21.4)	14.8 (7.6–25.9)
Post-menopausal hormone use, %		
Never	20	32
Past	22	25
Current	58	43
History of stroke, %	2	1
History of myocardial infarction, %	4	3
History of type 2 diabetes, %	9	5
Had a hysterectomy, %	46	34

[1] Percentages of non-missing values.

[2] Denotes interquartile range.

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TABLE 2

Odds ratios of persistent UI over eight years, according to possible associated factors in the Nurses' Health Study [1,2]

	UI at least monthly		UI at least weekly	
Age (years)	**Cases**	**OR (95% CI)**	**Cases**	**OR (95% CI)**
<60	3,473	1.00 (ref)	1,313	1.00 (ref)
60–64	3,703	1.26 (1.18–1.35)	1,577	1.45 (1.33–1.60)
65–69	4,126	1.66 (1.55–1.78)	1,756	1.93 (1.76–2.12)
70–74	3,949	2.14 (1.99–2.30)	1,762	2.60 (2.36–2.87)
≥75	3,096	2.75 (2.54–2.98)	1,435	3.56 (3.21–3.96)
		p-trend<0.0001		p-trend<0.0001
Race				
White	17,787	1.00 (ref)	7,597	1.00 (ref)
Black	105	0.27 (0.21–0.34)	53	0.30 (0.22–0.41)
Asian	77	0.69 (0.51–0.92)	28	0.64 (0.42–0.98)
Body-mass index (kg/m^2)				
<25	6,595	1.00 (ref)	2,456	1.00 (ref)
25–29	6,394	1.58 (1.50–1.66)	2,716	1.80 (1.68–1.92)
≥30	5,358	3.14 (2.95–3.33)	2,671	4.12 (3.82–4.45)
		p-trend<0.0001		p-trend<0.0001
Parity				
0 births	878	1.00 (ref)	338	1.00 (ref)
1–2 births	6,005	1.32 (1.20–1.46)	2,493	1.47 (1.28–1.68)
≥3 births	11,464	1.58 (1.44–1.74)	5,012	1.82 (1.59–2.07)
Alcohol intake, g/d				
None	7,706	1.00 (ref)	3,502	1.00 (ref)
1–14	8,553	1.03 (0.99–1.08)	3,482	0.94 (0.89–0.99)
≥15	1,523	1.12 (1.03–1.21)	583	0.96 (0.87–1.06)
Smoking status				
Never	8,305	1.00 (ref)	3,466	1.00 (ref)
Past	8,534	1.06 (1.01–1.11)	3,721	1.12 (1.05–1.19)

	UI at least monthly		UI at least weekly	
Age (years)	**Cases**	**OR (95% CI)**	**Cases**	**OR (95% CI)**
Current	1,508	0.93 (0.86–1.01)	656	1.03 (0.92–1.14)
Physical activity (in tertiles of MET-hrs/wk)				
Low (<7.6)	5,894	1.00 (ref)	2,670	1.00 (ref)
Medium (7.6–17.9)	6,517	0.86 (0.81–0.90)	2,798	0.85 (0.80–0.90)
High (≥18.0)	5,864	0.73 (0.69–0.77)	2,341	0.71 (0.66–0.76)
		p-trend<0.0001		p-trend<0.0001
Postmenopausal hormone use				
Never	3,595	1.00 (ref)	1,484	1.00 (ref)
Past	3,887	1.27 (1.20–1.36)	1,727	1.29 (1.19–1.39)
Current	9,684	2.06 (1.95–2.18)	4,095	1.90 (1.77–2.04)
History of stroke	352	1.56 (1.29–1.89)	175	1.69 (1.35–2.12)
History of myocardial infarction	681	1.01 (0.89–1.14)	321	1.03 (0.88–1.20)
History of type 2 diabetes	1,625	1.36 (1.24–1.48)	794	1.42 (1.27–1.58)
Had a hysterectomy	8,600	1.35 (1.29–1.41)	3,853	1.42 (1.34–1.51)

[1] All statistical analyses were performed using multivariable-adjusted logistic regression.

[2] All estimates are mutually adjusted for covariates listed in the table.