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## Remission and progression of urinary incontinence among Asian, black, and white women in the United States

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### Abstract

**Background**—Growing evidence suggests that urinary incontinence prevalence and incidence in women vary by race. However, little is known regarding potential racial differences in remission and progression of incontinence, which would have meaningful implications for clinicians who treat incontinence.

**Objective**—To compare changes in incontinence frequency over two years among Asian, black, and white women with incontinence.

**Methods**—Participants in the Nurses' Health Study cohorts provided information on their race and incontinence frequency on mailed questionnaires. Prospective analyses over two years of follow-up included 57,900 women aged 37–79 years with at least monthly incontinence at baseline.

**Results**—Changes in incontinence frequency appeared to vary by race, even after adjusting for a large variety of risk factors for incontinence. Specifically, compared with white women, black women were more likely to report no incontinence at follow-up (14% remission in black women vs. 9% in white women). Asian women were more likely to report any decrease in incontinence frequency (40% improvement in Asian women vs. 31% in white women). Incontinence improvement was also more common in black versus white women in analyses restricted to older women, although reports of improvement were similar among black and white women aged 54 years and younger. Black women were less likely to report a higher frequency of incontinence at follow-up (30% progression in black women vs. 34% in white women), and this difference was borderline statistically significant.

**Conclusions**—Higher odds of incontinence remission in black women, and improvement in Asian American women, compared with white women, may account for some of the previously observed differences in incontinence prevalence across racial groups, and were independent of health and lifestyle factors. Although incontinence is a common condition in women of all races, clinicians should be aware that the natural history of incontinence may differ across racial groups.

### Keywords

urinary incontinence; race; epidemiology

## INTRODUCTION

Urinary incontinence (UI), defined by the International Continence Society as the complaint of involuntary loss of urine<sup>1</sup>, is a common condition, particularly in women. Among community-dwelling women, UI is at least twice as common as it is in men, with a

prevalence ranging from about 20% in women aged 45 years or younger to about 30% in women aged 80 years or older.<sup>2</sup> In nursing homes, the prevalence of UI is much higher, with estimates exceeding 70% for both women and men.<sup>2</sup>

The physical, psychosocial, and financial consequences of UI are substantial. For example, UI that is not managed appropriately may lead to rashes, skin infections, urinary tract infections, and pressure sores.<sup>3</sup> In addition, among older, community-dwelling women, urgency UI, which is associated with the need for frequent, urgent trips to the bathroom, has been related to an increased risk of falls and fractures.<sup>4</sup> Regarding the potential psychosocial impact, several studies have reported associations between UI and feelings of embarrassment and anxiety, as well as decreased participation in physical recreation and social activities.<sup>5</sup> Finally, the financial burden of managing incontinence – including the cost of absorbent pads, treatment of UI and its complications, and admission to institutions – is significant. One analysis estimated that a person with UI had over 2 times the annual expenditures per person per year than a person without UI, after controlling for a variety of factors such as age, sex, work status, and comorbid conditions.<sup>6</sup> In addition, Thom et al. observed a two-fold greater risk of nursing home admission among women with UI compared to those without UI.<sup>7</sup>

Yet, despite the high prevalence and wide-ranging consequences of UI, the burden of UI among women is often not recognized. Consistent with findings from general population studies, we found that a minority of women (38%) in the Nurses' Health Study II with incident incontinence at least weekly reported their urinary symptoms to a physician.<sup>8</sup>

Furthermore, much about the epidemiology of UI, including its natural history, is not well understood. In particular, there are anatomical and functional differences in the female pelvic floor between black and white women, suggesting that risks of pelvic floor dysfunction may vary by race.<sup>9–12</sup> In addition, growing evidence from mostly cross-sectional epidemiologic studies indicates that the burden of urinary incontinence differs across racial groups.<sup>13–18</sup> Specifically, several studies have reported a lower prevalence of UI in black and Asian women compared with white women.

However, prevalence is a function of both UI incidence and duration. While there is some initial evidence that race is related to UI incidence<sup>18,19</sup>, including data from our own study<sup>20</sup>, little is known regarding the relation between race and UI duration. Additional knowledge about rates of UI progression and remission across races might help clarify the factors underlying differences observed in cross-sectional prevalence studies and help to better understand the etiology of incontinence. Thus, we examined changes in UI frequency over two years among Asian, black, and white women with UI enrolled in two large, prospective cohort studies of female health professionals.

## METHODS

### Nurses' Health Studies

In 1976, the Nurses' Health Study (NHS) was initiated when 121,700 female registered nurses, aged 30–55 years, returned a mailed questionnaire about their medical history and health behaviors.<sup>21</sup> The Nurses' Health Study II (NHSII) began in 1989 when 116,430 female registered nurses, aged 25–42 years, returned a similar mailed questionnaire. Return of the questionnaire implied informed consent. Participants in both cohorts have provided updated health and lifestyle information on biennial questionnaires. During each questionnaire cycle, a full-length questionnaire is sent for initial mailings, after which an abbreviated version is sent to non-responders to maximize participation. Through the 2000 questionnaire cycle (baseline for this report on UI), the rate of follow-up was 94% in the

NHS and, in the NHSII, the rate of follow-up was 95%. Response to the urinary incontinence questions in particular was also high; in the two cohorts combined, 87% of women who reported incontinence at baseline provided information on incontinence frequency on the follow-up questionnaire. The Committee on the Use of Human Subjects in Research at the Brigham and Women's Hospital approved these studies.

### Study population

Questions about UI were included on the full-length questionnaires in 2000 and 2002 in the NHS and in 2001 and 2003 in the NHSII. NHS and NHSII participants who provided both baseline and follow-up information on UI were identical to the whole NHS and NHSII cohorts, respectively, in mean age (66 years in NHS for both groups, 46 years in NHSII), mean body mass index (BMI; 27 kg/m<sup>2</sup> in NHS and NHSII for both groups), and parity (5% nulliparous in NHS for both groups, 16% nulliparous in NHSII). In addition, the racial distribution was highly similar comparing those with UI data at baseline and follow-up to the whole cohort (96% vs. 92% white, respectively, in the NHS; 96% vs. 94% white, respectively, in the NHSII).

For these analyses, we focused on changes in UI frequency over two years (2000–2002 in the NHS and 2001–2003 in the NHSII) among Asian, black, and white women with self-reported UI, defined as leakage at least once per month, at baseline. Thus, we excluded women who reported no UI (NHS n=26,669; NHSII n=28,388) or very infrequent UI (i.e., UI occurring less than once per month: NHS n=25,307; NHSII n=20,169) at baseline. In addition, we excluded women with missing information on UI frequency at follow-up (NHS n=3,208; NHSII n=6,302). Finally, we excluded women with missing information on race or who did not self-identify as Asian, black, or white (NHS n=966; NHSII n=591). Thus, we included 27,847 NHS participants and 30,053 NHSII participants with prevalent UI in these analyses.

### Measurement of urinary incontinence

In both cohorts, women were asked on the baseline and follow-up questionnaire, “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, 2–3 times per month, about once per week, and almost every day. Among these nurses, response to this question was highly reproducible over several months in reliability testing.<sup>22</sup>

### Measurement of race

Participants were asked to indicate their race and ethnicity on the NHS and NHSII questionnaires. We classified women as Asian, black, or white if they marked their race as only Asian, only black or African American, or only white, respectively. Women of both Hispanic and non-Hispanic ethnicity were included within each racial category (less than 1% of women reported Hispanic ethnicity).

### Statistical analysis

To examine changes in UI frequency over two years across Asian, black, and white women with incontinence, we defined two groups at baseline: occasional UI (i.e., incontinence occurring 1–3 times per month) and frequent UI (i.e., incontinence occurring at least once per week). We then defined full remission for both groups as no UI at follow-up. In addition, “improvement” in UI was defined as either a decrease from frequent UI to occasional UI, UI less than once per month, or no leaking, or a decrease from occasional UI to UI less than once per month or no episodes of leakage over the 2-year period. Progression of UI was only

considered among women with occasional UI at baseline, and was defined as a change to frequent UI at follow-up.

We used descriptive statistics (mean, standard deviation [SD] or percentage) to evaluate the participants' self-reported demographic and health characteristics across racial groups within each cohort. These characteristics, which reflect participant status as of the 2000 questionnaire in the NHS and the 2001 questionnaire in the NHSII, were: age (years), BMI ( $\text{kg}/\text{m}^2$ ), physical activity (metabolic equivalent hours per week), parity, history of hysterectomy, menopausal status, postmenopausal hormone use, cigarette smoking, diabetes, high blood pressure, major neurologic disease (defined as a history of stroke, multiple sclerosis, or Parkinson's disease), functional limitation (defined as a significant limitation in climbing a flight of stairs, walking 1 block, bathing, or dressing), and use of medications (including thiazides, furosemide, calcium channel blockers, and angiotensin-converting enzyme inhibitors) that may worsen UI.

In unadjusted analyses, we used two-sample tests for binomial proportions to compare the proportion of Asian or black women to the proportion of white women reporting UI remission, improvement, or progression. Additionally, to assess whether associations between race and change in UI could be explained by health and lifestyle differences between races, we used multivariable logistic regression to calculate multivariable-adjusted odds ratios (ORs) and 95% confidence intervals (CIs) for each outcome (remission, improvement, and progression) according to race. All multivariable models included terms for the demographic and health status variables listed above. We excluded women missing information on parity ( $n=939$ ) or body mass index ( $n=252$ ) from the multivariable analyses because these are particularly important potential confounding factors.

We present data combining the two cohorts, as well as separately for each cohort. Before combining data, we assessed whether there were significant differences in findings across the cohorts. Specifically, interactions between race and cohort were tested using an interaction term in the logistic regression models. We found a significant interaction between race and cohort only for UI improvement comparing black to white women; therefore, we do not present the combined data for this comparison. Analyses in the combined cohorts were adjusted for study cohort in addition to the variables described above. All data were analyzed using SAS 9.1 (SAS Institute Inc, Cary, NC).

## RESULTS

### Characteristics of the study population

At study baseline, in 2000, NHS participants were aged 54–79 years and in 2001, NHSII participants were aged 37–54 years. At baseline, black women tended to have more risk factors for incontinence, including a higher mean BMI and a higher prevalence of hysterectomy, diabetes, and high blood pressure compared to the Asian or white women (Table 1). Asian women were least likely to be current smokers or use diuretics. White women were most likely to be parous and had a lower prevalence of diabetes than the other groups.

### Race and UI remission

Overall, Asian and black women were more likely to report UI remission over two years than white women (Table 2). When comparing the younger women in the NHSII to the older women in the NHS, we found that the proportion of women reporting UI remission decreased by 79%, from 14% to 3%, with aging. However, in both younger and older groups, black women had a higher likelihood of remission than white women. For older Asian women, the rate of remission was comparable to that for older white women in the

NHS (3% vs. 4%, respectively;  $p=0.50$ ), but in younger women in NHSII, Asian women had significantly higher remission rates than white women (20% vs. 14%, respectively;  $p<0.01$ ).

We created a statistical model, including a wide variety of lifestyle and health variables, to determine if any of these factors might explain the racial differences in UI remission. After adjusting for potential confounding factors, the odds ratio for UI remission comparing black to white women became somewhat stronger, and black women were 73% more likely to experience remission (fully adjusted OR 1.73, 95% CI 1.31–2.28). Similarly, after considering health and lifestyle differences in the racial groups, remission also was slightly higher comparing Asian to white women (fully adjusted OR 1.34, 95% CI 0.99–1.80,  $p=0.06$ ). Thus, these findings indicate that risk factors difference did not completely explain differences in UI remission across races.

### Race and UI improvement

Similar to the findings for UI remission, Asian and black women were more likely than white women to report UI improvement, defined as any decrease in UI frequency over two years (Table 2). In addition, considering the two cohorts separately, the percentage of older women in the NHS reporting UI improvement (20%) was approximately one-half of the percentage of younger NHSII participants reporting improvement (42%). However, among the older participants, compared with the rate of improvement in white women (20%), rates were similar in Asian women (22%,  $p=0.46$ ) and higher in black women (34%,  $p<0.001$ ). In contrast, in the younger women, improvement was similar in black and white women (43% vs. 41%, respectively;  $p=0.53$ ) and higher in Asian versus white women (52% vs. 41%, respectively;  $p<0.001$ ).

We also did not find that health and lifestyle differences across the racial groups could explain our findings. Among all women, the odds of UI improvement were significantly higher in Asian compared with white women by 33% (multivariable-adjusted OR 1.33, 95% CI 1.08–1.64), independent of health or lifestyle difference. Because the results comparing black and white women were significantly different between cohorts, we examined this association in cohort-specific analyses only. Among the older NHS participants, after taking risk factor differences into account, the odds of improvement remained significantly higher in black women (OR 2.22, 95% CI 1.65–3.00). In contrast, the odds of improvement in black and white women were not significantly different among the younger NHSII participants (fully adjusted OR 1.19, 95% CI 0.93–1.52), indicating that the higher rate of improvement in younger black than white women was largely explained by risk factor differences across the racial groups.

### Race and UI progression

Finally, we examined the proportion of women with occasional UI at baseline who reported frequent UI two years later (Table 2). Overall, there were no significant differences in the proportions of women with UI progression among Asian, black, and white women. However, specifically for the older women, incontinence progression was more likely compared with the younger NHSII participants (42% vs. 26%), and UI progression was less common in black versus white women (32% vs. 42%, respectively;  $p=0.03$ ), and comparable in Asian and white women (42% in both groups,  $p=0.94$ ).

In the combined cohorts, after adjusting for health and lifestyle factors, the odds of incontinence progression were similar in Asian and white women (OR 1.05, 95% CI 0.77–1.42). However, the odds of UI progression were 23% lower in black versus white women (OR 0.77, 95% CI 0.57–1.04), and this difference was borderline statistically significant ( $p=0.09$ ).

## DISCUSSION

Although there was some heterogeneity in results between older and younger women, changes in UI frequency over two years generally varied by race – independent of any differences in health and lifestyle factors related to UI across the racial groups. Specifically, incontinence remission was more common in black women and any incontinence improvement was more common in Asian women versus white women. In addition, among older women, black women were more likely to report any improvement of incontinence than white women. Interestingly, proportions with UI progression appeared fairly similar across Asian, black, and white women, although when considering risk factor differences across races, progression also was lower in black compared with white women.

In general, previous studies of the natural history of UI in largely white populations have reported stable or increasing incontinence frequency over time for the majority of women with incontinence, but there is spontaneous improvement or remission of symptoms for a small, but significant, proportion of women,<sup>8,19,23–27</sup> which may occur in the absence of treatment. For example, Samuelsson et al. observed a mean annual remission rate of 6% among 90 women with incontinence followed for 5 years, none of whom had sought treatment for UI.<sup>25</sup> We also observed this overall pattern among the Asian, black, and white women in our study, although we did not specifically exclude those who had sought treatment.

Basic biologic studies have found differences in pelvic floor anatomy and function between black and white women that are consistent with our finding of more remission of UI in black versus white women. For example, Hoyte et al. found a higher mean levator ani volume, a longer mean distance between the levator and pubic symphysis, and a wider mean pubic arch angle in 12 black women compared with 10 white women, possibly indicating more protection against injury during childbirth in black women.<sup>9</sup> In addition, there is evidence of a smaller pelvic floor cross-sectional area<sup>10</sup> and higher urethral closure pressure<sup>11,12</sup> in black versus white women. Together, these findings suggest that, in general, the ability to recover from insults to the pelvic floor may differ between black and white women. Little is known regarding potential differences in the pelvic floor between Asian and white women, and studies are needed to explore whether anatomical or functional differences might explain the higher odds of UI improvement we observed in Asian versus white women.

Several cross-sectional studies have found differences in UI prevalence by race. For example, studies have reported UI prevalence proportions that were 50–70% lower in black versus white women<sup>13–15,17</sup> and 30–40% lower in Asian versus white women<sup>15–17</sup>. More limited research also indicates that the incidence of UI is lower in black and Asian women<sup>18–20</sup>.

Longitudinal data on potential racial differences in UI progression and remission are scarce. However, in a prospective study of 11,591 women aged 50 years and older in the Health and Retirement Study (HRS), Komesu et al. generally observed higher rates of UI remission and improvement in black women compared with white women, consistent with our findings.<sup>19</sup> For example, among women aged 50–79 years, over four years, average annual UI remission rates ranged from 10–13% in black women compared with 8–9% in white women and average annual improvement of severe incontinence (defined as UI >15 days/month) ranged from 11–20% in black women compared with 11–14% in white women. Among the NHS participants (aged 54–79 years), average annual remission rates were 3% in black women and 1.5% in white women and average annual improvement from frequent UI was 14% in black women and 10% in white women. It is unclear why remission was less common in our study than in the HRS; however, in the HRS, the annual rate was averaged

from four years of follow-up rather than two in our study, allowing more time for incontinence resolution.

In contrast to our findings, two studies did not observe differences in UI improvement across races after adjusting for potential confounding factors.<sup>19,26</sup> For example, among 2,415 women aged 42–52 years in the SWAN study, the likelihood of decreasing incontinence frequency over 6 years was virtually identical in Chinese women and in Japanese women compared with white women.<sup>26</sup> However, the observation of similar odds of improvement in black versus white women in SWAN is consistent with our finding among the younger NHSII participants. Nonetheless, additional data are clearly needed to try to elucidate the findings across the small number of existing studies.

Regarding progression of incontinence, findings from previous studies have been mixed. In the SWAN study, incontinence worsening was not significantly different in Chinese or Japanese women compared with white women, consistent with our findings.<sup>26</sup> There was also relatively little difference in progression for black versus white women, although in contrast to our results, worsening UI appeared somewhat more common in black women. In the HRS, the multivariable-adjusted odds of progression, defined as UI incidence or worsening of existing UI, were 43% lower in black versus white women.<sup>19</sup> UI progression was similarly lower in black compared with white women in our study. Again, an explanation for the inconsistent findings among these few studies on UI progression is unclear and additional prospective studies are needed to further explore potential differences in changes in UI across races.

Several limitations of our study should be considered. First, UI frequency was self-reported and, thus, rates of change in UI frequency may be subject to error. However, several studies<sup>28,29</sup>, including our own<sup>22</sup>, have found reasonable short-term reproducibility of UI frequency reports. Moreover, we combined categories of UI frequency (e.g., occasional incontinence combined 1 leaking episode per month and 2–3 episodes per month), to reduce misclassification of the exact number of leaking episodes.

Second, because over 90% of NHS and NHSII participants are white, some measurements of changes in UI in Asian and black women were limited by small numbers, and should be interpreted with caution. Nonetheless, the total number of black women in our cohort was 120% higher than the total number of black women in the HRS<sup>19</sup>, and just 26% lower than the total number of black women in SWAN<sup>26</sup>. Also, because we did not collect information on Asian ethnicity, our findings for Asian women are not directly comparable to those for Chinese and Japanese women in SWAN.

Finally, we did not collect information on treatment for UI among women who reported incontinence on the baseline questionnaire. Thus, we could not determine the impact of treatment on estimates of UI remission and improvement. However, data indicate that a minority of women with UI seek treatment and that treatment-seeking does not appear to vary significantly by race.<sup>30–32</sup> In addition, in our cohorts of health professionals with equivalent access to health care and healthcare knowledge, any potential racial differences in treatment-seeking would likely be minimized. Thus, it does not seem likely that lack of data on treatment meaningfully affected our ability to compare changes in UI frequency across races.

In conclusion, over two years of follow-up, Asian and black women with UI were generally more likely to experience remission or improvement of their urinary symptoms than white women and these differences could not largely be explained by a variety of health and lifestyle factors. Thus, clinicians should be aware that, while UI affects women of all racial backgrounds, the natural history of the condition may differ in women of different races. In

addition, since data indicate that women of different races are similarly unlikely to seek treatment for incontinence<sup>30</sup>, clinicians should be encouraged to initiate discussions about UI so that their patients can take advantage of available behavioral, pharmacologic, and surgical therapies.<sup>33</sup>

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Table 1

Characteristics of study participants reporting at least monthly urinary incontinence in 2000 (NHS) or 2001 (NHSII)<sup>a</sup>

Variable	NHS			NHSII		
	Asian (n=164)	Black (n=204)	White (n=27,479)	Asian (n=244)	Black (n=282)	White (n=29,527)
Age, years	67.2 (6.3)	67.6 (6.6)	66.6 (7.1)	46.6 (4.5)	47.4 (4.1)	46.7 (4.6)
Body mass index, kg/m <sup>2</sup> <sup>b</sup>	24.4 (3.9)	30.1 (6.2)	27.6 (5.7)	24.1 (4.0)	31.3 (8.3)	28.0 (6.8)
Physical activity, MET-hrs/wk	18.3 (17.8)	13.4 (13.3)	16.4 (15.1)	17.6 (19.5)	17.3 (18.7)	19.4 (19.0)
Parity						
0	10 (6.1)	13 (6.4)	1,321 (4.8)	48 (19.7)	61 (21.6)	4,673 (15.8)
1-2	67 (40.9)	106 (52.0)	9,043 (32.9)	140 (57.4)	143 (50.7)	16,076 (54.5)
3+	85 (51.8)	79 (38.7)	16,750 (61.0)	50 (20.5)	72 (25.5)	8,224 (27.9)
Missing	2 (1.2)	6 (2.9)	365 (1.3)	6 (2.5)	6 (2.1)	554 (1.9)
Hysterectomy	72 (43.9)	118 (57.8)	13,000 (47.3)	31 (12.7)	93 (33.0)	5,937 (20.1)
Premenopausal	0 (0.0)	1 (0.5)	298 (1.1)	176 (72.1)	183 (64.9)	20,127 (68.2)
Postmenopausal hormone use <sup>c</sup>						
Never	23 (14.0)	49 (24.1)	5,174 (19.0)	17 (25.0)	15 (15.2)	1,453 (15.5)
Past	49 (29.9)	62 (30.5)	7,321 (26.9)	5 (7.4)	16 (16.2)	1,732 (18.4)
Current	89 (54.3)	71 (35.0)	13,474 (49.6)	40 (58.8)	58 (58.6)	5,985 (63.7)
Missing	3 (1.8)	21 (10.3)	1,212 (4.5)	6 (8.8)	10 (10.1)	230 (2.5)
Cigarette smoking						
Never	106 (64.6)	105 (51.5)	12,186 (44.4)	208 (85.3)	192 (68.1)	18,891 (64.0)
Past	56 (34.2)	89 (43.6)	13,152 (47.9)	27 (11.1)	63 (22.3)	8,088 (27.4)
Current	2 (1.2)	10 (4.9)	2,141 (7.8)	9 (3.7)	27 (9.6)	2,548 (8.6)
Diabetes	18 (11.0)	32 (15.7)	2,768 (10.1)	10 (4.1)	19 (6.7)	1,019 (3.5)
High blood pressure	87 (53.1)	155 (76.0)	14,668 (53.4)	64 (26.2)	128 (45.4)	6,214 (21.1)
Major neurologic disease <sup>d</sup>	5 (3.1)	7 (3.4)	1,044 (3.8)	0 (0.0)	6 (2.1)	652 (2.2)
Functional limitations	8 (4.9)	21 (10.3)	2,528 (9.2)	4 (1.6)	17 (6.0)	968 (3.3)
Medication use <sup>e</sup>	50 (30.5)	97 (47.6)	9,041 (32.9)	23 (9.4)	82 (29.1)	3,578 (12.1)

MET, metabolic equivalent

<sup>a</sup>Values are mean (SD) or no. (%)

<sup>b</sup> BMI is missing for 70 women in the NHS (1 black, 68 white) and 198 women in the NHSII (1 Asian, 182 white)

<sup>c</sup> Calculated among postmenopausal women only

<sup>d</sup> Major neurologic disease includes stroke, multiple sclerosis, and Parkinson's disease

<sup>e</sup> Medications that may worsen UI, including thiazides, furosemide, calcium channel blockers, and angiotensin-converting enzyme inhibitors

**Table 2**

Remission, improvement, and progression of urinary incontinence over 2 years among Asian, black, and white women in the NHS and the NHSII

Change in incontinence frequency	White	Asian	Black
<b>Remission</b>			
Combined cohorts			
Cases/Total at risk	4,999/57,006	55/408	67/486
%	9%	13%	14%
P-value <sup>a</sup>	Reference group	<0.001	<0.001
NHS			
Cases/Total at risk	910/27,479	7/164	13/204
%	3%	4%	6%
P-value <sup>a</sup>	Reference group	0.50	0.02
NHSII			
Cases/Total at risk	4,089/29,527	48/244	54/282
%	14%	20%	19%
P-value <sup>a</sup>	Reference group	0.01	0.01
<b>Improvement</b>			
Combined cohorts			
Cases/Total at risk	17,622/57,006	163/408	192/486
%	31%	40%	<i>b</i>
P-value <sup>a</sup>	Reference group	<0.001	<i>b</i>
NHS			
Cases/Total at risk	5,399/27,479	36/164	70/204
%	20%	22%	34%
P-value <sup>a</sup>	Reference group	0.46	<0.001
NHSII			
Cases/Total at risk	12,223/29,527	127/244	122/282
%	41%	52%	43%
P-value <sup>a</sup>	Reference group	<0.001	0.53
<b>Progression</b>			
Combined cohorts			
Cases/Total at risk	8,508/24,731	63/204	64/216
%	34%	31%	30%
P-value <sup>a</sup>	Reference group	0.29	0.14
NHS			
Cases/Total at risk	5,447/12,826	37/88	33/103
%	42%	42%	32%
P-value <sup>a</sup>	Reference group	0.94	0.03
NHSII			
Cases/Total at risk	3,061/11,905	26/116	31/113

Change in incontinence frequency	White	Asian	Black
%	26%	22%	27%
P-value <sup>a</sup>	Reference group	0.42	0.68

Remission is defined as no incontinence at follow-up; improvement is defined as any decrease in incontinence frequency between baseline and follow-up; progression is defined as an increase from incontinence 1–3 times per month at baseline to incontinence at least once per week at follow-up.

<sup>a</sup>P-values were calculated using two-sample tests for binomial proportions comparing proportions of black vs. white women and proportions of Asian vs. white women meeting each case definition.

<sup>b</sup>Results are not presented for the combined cohorts due to a significant difference in results between cohorts.