Factors Associated with Worsening and Improving Urinary Incontinence Across the Menopausal Transition

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Abstract

Objective—To evaluate whether the menopausal transition is associated with worsening of urinary incontinence symptoms over 6 years in mid-life women.

Methods—We analyzed data from 2415 women who reported monthly or more incontinence in self-administered questionnaires at baseline and during the first 6 annual follow-up visits (1995–2002) of the prospective cohort Study of Women's Health Across the Nation. We defined worsening as a reported increase and improving as a reported decrease in frequency of incontinence between annual visits. We classified the menopausal status of women not taking hormone therapy annually from reported menstrual bleeding patterns and hormone therapy use by interviewer questionnaire. We used Generalized Estimating Equations (GEE) methodology to evaluate factors associated with improving and worsening incontinence from year to year.

Results—Over 6 years, 14.7% of incontinent women reported worsening, 32.4% reported improvement, and 52.9% reported no change in the frequency of incontinence symptoms. Compared with pre-menopause, peri- and post menopause were not associated with worsening incontinence; for example, early peri-menopause was associated with improvement (OR 1.19; 95% CI 1.06, 1.35) and post-menopause reduced odds of worsening (OR 0.80; 95% CI 0.66, 0.95). Meanwhile, each pound of weight gain increased odds of worsening (OR 1.04; 95% CI 1.03, 1.05) and reduced odds of improving (OR 0.97; 95% CI 0.96, 0.98) incontinence.

Conclusion—In mid-life incontinent women, worsening of incontinence symptoms was not attributable to the menopausal transition. Modifiable factors such as weight gain account for worsening of incontinence during this life stage.

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INTRODUCTION

The natural history of urinary incontinence in mid-life women is not well described. Cross-sectional epidemiological studies have found a higher prevalence in women ages 45–55, an age range that coincides with the menopause transition(1). This incontinence prevalence increase in mid-life has been explained, in part, by the development of urogenital atrophy associated with estrogen loss around menopause(2). Yet progression through the menopause transition does not appear to increase the risk of developing incontinence(3). Other factors are important in the development of incontinence between 40 and 60: age, diabetes, obesity, and a high BMI(4).

Whether the transition from pre- to post-menopause affects existing incontinence, independent of other factors, is not known. There is little information about how change in factors over time, such as transition through the menopause stages or changes in weight and body distribution, can positively or negatively affect the severity of existing incontinence. Longitudinal studies are needed to provide insight into the natural history of this condition.

We aimed to evaluate factors associated with worsening and improving of incontinence symptoms in mid-life women during a period of 6 years. Specifically, we examined whether stage of the menopause transition and other factors that can vary over time such as changes in weight and waist to hip ratio (WHR) affected the frequency of reported incontinence symptoms. We investigated factors associated with worsening and improving incontinence between each year and over the entire 6 year period.

MATERIALS AND METHODS

This is an analysis of data from the baseline and first 6 annual follow-up visits (1995–2002) of women who reported incontinence during the Study of Women's Health Across the Nation (SWAN). SWAN is a multi-center, multi-ethnic, prospective study of mid-life women and the menopause transition(5). Seven clinical sites (Boston, Massachusetts; Chicago, Illinois, the Detroit area, Michigan; Los Angeles, California; Newark, New Jersey; Pittsburgh, Pennsylvania; and Oakland, California) identified 16,065 community-based women aged 40–55 years by random digit dialing, snowball, and/or list-based sampling and screened them for eligibility for the cohort study. From this large sample, each of the sites recruited about 450 women to include a Caucasian group and one designated minority group (African American at four sites, and Chinese, Japanese and Hispanics at one site each) for a total cohort of 3302 women. In SWAN, these minority groups were over-sampled to allow sufficient numbers for the planned analyses by group. Eligibility criteria for the SWAN cohort were age 42–52 years and self-identification as one of five racial/ethnic groups to be studied. The exclusion criteria were inability to speak English, Spanish, Japanese, or Cantonese, no menstrual period in greater than 3 months or hysterectomy and/or bilateral oophorectomy prior to enrollment, and the current use of oral contraceptives, estrogens, progestins, or luteinizing hormone agonists. SWAN was approved by Institutional Review Boards at all sites and all women gave informed consent.

Incontinence Outcomes

In a self-administered questionnaire at each annual follow-up visit, women were asked: "In the past year (or since your last study visit), have you ever leaked even a small amount of urine involuntarily?" Participants listed the frequency of their incontinence as "almost daily/ daily" (daily), "several days per week" (weekly), "less than one day per week" (monthly), "less than once a month" or "none." Because we consider incontinence occurring less than once a month not to be clinically significant and to have a higher misclassification rate, we

combined this category with "no incontinence" or to create the category of no regular incontinence.

We categorized type of incontinence as "stress" if participants reported leakage with "coughing, laughing, sneezing, jogging, jumping, with physical activity or picking up an object from the floor" or as "urge" if participants reported leakage "when you have the urge to void and can't reach the toilet fast enough." We defined prevalent incontinence as incontinence reported at baseline. First reports of incontinence at any of the 6 annual follow-up visits were considered to be incident incontinence.

We defined improving and worsening in incontinence in two ways. First, we evaluated change in incontinence reporting from year to year. Incontinence was considered improving if the frequency of incontinence decreased from one annual visit to the next, i.e.: from daily to weekly or less, from weekly to monthly or less, or from monthly to no regular incontinence. We considered incontinence worsening if the frequency of incontinence increased from one annual visit to the next, i.e.: from no regular incontinence (after a previous report of incontinence) to monthly or more, from monthly to weekly or more or from weekly to daily. We defined no change in incontinence as the same reported level of frequency from one annual visit to the next. Second, we evaluated change over the full 6 years of follow up in the following manner. From one year to the next, a change from less frequent incontinence to more frequent incontinence was assigned a numerical value of +1, a change from more frequent incontinence to less frequent incontinence a value of −1, and no change in frequency, a value of 0. We summed these values of change over the 6 years. Women whose scores were less than 0 were considered to have improved, those whose scores were greater than 0 were considered to have worsened, and those with a score of 0 were considered to have no change. A no change score could represent either consistent reporting of the same frequency of incontinence from year to year or variable reporting of frequency from year to year that summed to 0. We sub-divided this group into "no change with low reporting variance" and "no change with high reporting variance" respectively. Similarly, we determined the proportion of women who only worsened (ie: never reported improvement from year to year) and only improved (ie: never reported worsening from year to year) over the six years.

Main Time-Dependent Covariates

Our main independent variables in this analysis were menopause transition category and hormone use determined in the year previous to the reported change in incontinence frequency. We classified menopause status from questions assessing menstrual bleeding patterns on annual follow-up interview questionnaires. The definitions of natural menopause transition categories used by SWAN are as follows: *Pre-menopause*: less than three months of amenorrhea and no menstrual irregularities in the previous year; *Early Peri-menopause*: less than three months of amenorrhea and some menstrual irregularities in previous year; *Late Peri-menopause*: three to 11 months of amenorrhea; *Post-menopause*: 12 consecutive months of amenorrhea with no apparent medical cause. SWAN defined surgical menopause as hysterectomy (with or without oophorectomy) or bilateral oophorectomy.

Women who started using hormones in pre-, early peri- and late peri-menopause were considered to be hormone users with an unclassifiable menopausal status. We divided post- and surgical menopausal women into those using and not using hormone therapy when numbers in each category were sufficient for analysis. To account for change in menopausal status between years, we classified women as having transitioned from one menopausal stage to another, started using hormones, stopped using hormones, or as having no change in their status. Finally, from the baseline and year 6 menopause status we created categorical variables to reflect the change in status over the 6 years: from pre-/early peri-menopause to

pre-/early peri-menopause, to late peri-menopause, to post-menopause, to surgical menopause and to unclassifiable menopause status.

Weight and waist/hip ratio changes were also main variables of interest. Certified staff used calibrated scales and a stadiometer to measure height, weight, and waist and hip circumferences. We calculated baseline body mass index (BMI) as weight in kilograms/ (height in meters)^2 and waist to hip ratio (WHR) as waist circumference in centimeters/hip circumferences in centimeters. We defined weight gain from year to year as an increase in weight per pound; gain in WHR was an increase by 0.1 units.

Additional Covariates

Given that a woman's initial reported frequency of incontinence is likely to impact whether her incontinence improves or worsens, we controlled for this effect by treating frequency of incontinence at first report as an independent variable. Race and ethnicity were self-defined. We estimated socioeconomic status by level of difficulty paying for basics (food, heat and shelter). SWAN obtained self-reported diabetes, hypertension, fibroids, obstetrical history, smoking history and medication use, including hormone use by interview and general health status by the self-administered questionnaire. SWAN used an adaptation of the SF-36(6), the Center for Epidemiological Studies-Depression (CES-D) scale(7), and the Medical Outcomes Study (MOS) Social Support Survey(8) and Life Stressors and Social Resources Inventory (LISRES)(9). Life stressors were assessed with a scale derived from the Psychiatric Epidemiology Research Interview(10) and modified to include events particularly relevant for middle-aged women or for those living in low socioeconomic environments, involving job, family, financial, and illness/death events. Anxiety symptoms were measured by a summed score of days in the past two weeks in which certain symptoms were experienced (irritability, feeling tense or nervous, pounding or racing hear, feeling fear for no reason); anxious was defined by a score of 4 or more(11), For our time-dependent covariates, we evaluated whether new onset medical conditions and change in these scales and events from year to year were associated with change in incontinence frequency.

For data that were collected annually (for example, social support, depressive symptoms, and weight changes) we examined the degree of change for each variable over the 6 years by plotting their values. For those variables noted to change over time, we created summary variables describing the patterns of change. For example, we categorized weight gain and loss as a change of greater than 5% from baseline weight at year 6. For WHR, gain was defined as an increase of greater than 7.5% or loss more than 2.5% from baseline WHR. For variables whose change could be bi-directional, we accounted for variability in the change over time (for example, weight cycling) by entering the standard deviation of change over the 6 years into our models.

Missing Data

Drop outs included continent women who were deceased, discontinued the study, or could not be contacted for two or more consecutive visits. Incontinent women were retained in the analysis as long as they contributed data. When a woman was missing data on frequency and type of incontinence from one or two visits, we imputed values as follows. If one missing value occurred at baseline, we imputed the value from the subsequent visit. If the missing value occurred at year 6, we imputed the value at the previous visit. If the missing values were between concordant values, we imputed that concordant value. If one missing value occurred between two discordant values, we randomly assigned it the value of the previous or subsequent visit. If two missing values occurred in sequence between two discordant ones, we randomly assigned the missing values the previous and subsequent observed values. We did not impute for three or more missing data points. Overall, we imputed

incontinence frequency for 808 women at 1150 visits (5.0% of all visits) and incontinence type for 447 women at 572 visits (2.5% of all visits). When weight or WHR were missing for one or two visits, the values were imputed as the mean between the two known values (weight: 263 women at 394 visits, 1.7% of all visits; WHR: 257 women at 374 visits, 1.6% of all visits).

To assess the robustness of our results, we developed our main multivariable analyses with and without imputed values. Additionally, because we had a disproportionate and systematic loss to follow-up of the Caucasian and Hispanic women from the New Jersey site in year 6, we developed separate models with and without these participants. As the results of our models were similar, we present our final models with imputed data and with New Jersey year 6 data included.

Statistical Analysis

We checked each continuous covariate for normality by conducting either a Q-Q plot or a Lilliefors test, an adaptation of the Kolmogorov-Smirnov test. The social support score was the only covariate that violated the normality. Distributions of incontinence and other important variables for women who remained in (analysis cohort) and who dropped out of (drop-out cohort) our study were then compared using the t-test or Mann-Whitney-U statistic (in the case of social support) for continuous and chi-squared or proportional tests for categorical data.

After selecting candidate variables based on the literature and a priori hypotheses, we used multivariable analysis to examine which factors were associated with improving and worsening incontinence. To build our models, we used backward and forward stepwise processes entering variables based on our hypotheses or based on associations with the incontinence outcome at a p-value of 0.10 or less. We used SAS 9.1, SAS Institute Inc., Cary, NC, USA.

We used Generalized Estimating Equations (GEE), a methodology for dealing with repeated measures in longitudinal data, to evaluate factors associated with improving or worsening incontinence from year to year. The use of GEEs is based on a marginal modeling approach(12) for making inferences about the effects of independent variables on the outcomes. While this approach does not explicitly model correlation structure between repeated observations on the same woman, it accommodates the correlation. We developed models to compare the following: improving with worsening/no change in incontinence as the reference, worsening incontinence with improving/no change in incontinence as the reference. For women who reported only stress or urge incontinence at two or more visits, we developed models for improving and worsening stress or urge incontinence between those visits. Because our main objective was to evaluate the effect of menopausal status and change in status on incontinence independent of age, we forced these factors into our final models. Model stability was tested by respectively forcing in menopausal status, change in status and age without significant changes in the point estimates of the other variables. Estimated correlation matrices showed no significant co-linearity among our independent variables, including between menopausal status and age. We chose our final models based on the lowest QIC (quasi-likelihood under independence model criterion) and the related QICu statistic which indicate the best fit for GEE models(13, 14).

We also used regression modeling to evaluate factors associated with change in frequency of incontinence over the entire 6 year period using the 6-year summary outcomes and independent variables described above. We assumed that low variance in reporting no change in incontinence would be a stable reference group. We compared odds of high variance in reporting no change in incontinence, odds of improving with low variance no

change/worsening incontinence and odds of worsening with low variance no change/ improving incontinence.

RESULTS

Table 1 displays the baseline characteristics of the women in SWAN's inception cohort, of those incontinent women in our analysis (analysis cohort) and of those women who did not report incontinence before being lost to follow-up by the sixth annual visit (drop-out cohort). Women who remained in the study and never reported incontinence are not included in our analysis and are therefore not shown in this table. Women in our analysis cohort compared to the drop out cohort were less likely to be Hispanic, had less difficulty paying for basics, were more likely to have gone to college, had higher parity, had a higher BMI and were more likely to report anxiety symptoms at baseline.

Longitudinal patterns of incontinence

Of the 1493 women who reported monthly or more incontinence at baseline, 1396 (93.5%) contributed information to our analysis. For the 922 women who reported incident monthly or more incontinence, 834 (90.5%) contributed to our analysis. Overall, 14.7% of incontinent women reported worsening, 32.4% reported improvement, and 52.9% reported no change in the frequency of incontinence symptoms. Figure 1 displays the percentage of women with prevalent and incident incontinence that improved, worsened, and remained unchanged over the 6 years. A higher percentage of incontinence reported at baseline was unchanged while a higher percentage of incident incontinence worsened. Also shown is the distribution of incontinence reporting by type.

Change in the time dependent covariates over 6 years

Figure 2 provides the percentages of women who had remained pre or early peri-menopausal and who transitioned to early peri-, late peri-, post-, surgical or unclassifiable menopausal status by year 6. It also displays the percentages of women who gained, lost or maintained weight and waist/hip ratios by year 6.

Factors associated with improving incontinence from year to year

While few stages of the menopausal transition were statistically significantly associated with increased odds of improving incontinence, most of the estimated odds ratios for improving incontinence in early and late peri- and post-menopause were greater than 1.00 (Table 2). For women reporting any or stress incontinence, early peri-menopausal status was associated with improvement in incontinence symptoms. Consistent with this, though not statistically significant, the corresponding estimated odds ratio for urge incontinence also indicated improvement for this status. Advancing in menopausal status was significantly associated with increased odds of improvement for any incontinence, but not for stress and urge incontinence. However, the estimated odds ratios were identical for each of the three categories of incontinence (any, stress, urge) suggesting a consistent effect for stress and urge incontinence. The lack of statistical significance for the association between menopausal status and specific incontinence type likely reflects an insufficient sample size to detect such a departure from the null hypothesis. Hormone use, including either starting or stopping hormone therapy, in the previous year did not appear to be associated with improving incontinence in the subsequent year for any and stress incontinence. Meanwhile, starting hormones was associated with improvement in urge incontinence.

We found several factors that were associated with increased odds of reporting improvement in incontinence symptoms. When a woman's first report of incontinence frequency was daily or weekly, she was subsequently more likely to improve compared with a woman

whose first report of incontinence frequency was monthly. Women with no history of smoking were more likely to report improvement in any incontinence. On the other hand, weight gain and increased anxiety symptoms were associated with lower odds of improvement.

Factors associated with worsening incontinence from year to year

While few stages of the menopausal transition were statistically significantly associated with lower odds of worsening incontinence, the estimated odds ratios for early and late peri-and post-menopause were all less than 1.00 (Table 3). Compared to pre-menopausal women not using hormones, post-menopausal women not using hormones were less likely to report worsening incontinence. The odds ratios for any and urge incontinence were significantly reduced for post-menopausal women not using hormones, and the estimate for stress incontinence was consistent with these odds ratios. Similarly, the use of hormones in the pre-, early or late peri- menopause was also associated with a consistent pattern of estimated odds ratios less than 1.00.

Weight gain was associated with increased odds of worsening any, stress and urge incontinence, while an increase in WHR increased odds of worsening any and stress incontinence. A college degree or higher was associated with lower odds of worsening stress incontinence, while stressful life events increased odds of worsening any and stress incontinence. Hispanic ethnicity was associated with increased odds of worsening stress and urge incontinence. African American race and anxiety symptoms were significantly associated with higher odds of worsening of any and stress incontinence. Here again, the estimated odds ratios for the association between African American race and anxiety symptoms and worsening urge incontinence were in a consistent direction with those for any and stress incontinence but were not statistically significant.

Factors associated with patterns of change in incontinence over all 6 years

Of the 470 women who had no total change in their incontinence status over the 6 years, 54.7% reported mostly the same level of incontinence year to year (low reporting variance) while 45.3% reported different levels of frequency from year to year (high reporting variance). Women with a high variance in reporting the frequency of their incontinence were more likely to have a high baseline BMI (OR 1.02; 95% CI 1.00, 1.04), have more weight cycling (OR 1.07; 95% CI 1.00, 1.16) and to report anxiety symptoms at baseline (OR 1.57; 95% CI 1.11, 2.23).

For women who worsened or improved over the 6 years, 329 (40.0%) worsened without ever reporting improvement and 218 (29.4%) improved without ever reporting worsening. In our models assessing factors associated with improving and worsening incontinence over the entire 6 year period, we found no association with change in menopausal status. In these models, African Americans (OR 1.64, 95% CI 1.24, 2.19) had higher odds of worsening incontinence compared with Caucasians. Women who lost weight were less likely to report worsening incontinence (OR 0.63, 95% CI 0.41, 0.96) while women who weight cycled (OR 1.07, 95% CI 1.01, 1.14) were more likely to report worsening incontinence.

DISCUSSION

We found few statistically significant associations between natural menopause transition stage and change in the frequency of incontinence symptoms. Being in early peri-menopause was associated with improvement in any and stress incontinence, and being in post-menopause reduced odds of worsening for any and urge incontinence. Taken as a whole, the direction and internal consistency of our results suggest a weak positive effect of the

menopause transition on any, stress and urge incontinence. Early and late peri-and early post-menopause were associated with modestly increased odds of improvement and reduced odds of worsening incontinence compared to pre-menopause. While our statistical power was insufficient to confirm this observed modest positive effect, our results do not support the belief that worsening incontinence is attributable to the menopausal transition.

Women in pre-, early or late peri- menopause who started using hormones in the previous year were less likely to worsen in any incontinence symptoms with the same trend seen in stress and urge types. Previous longitudinal cohort studies(15)and randomized, controlled trials(16, 17) assessing the effects of hormone therapy on incontinence in post-menopausal women have found that hormone use worsens both stress and urge incontinence in postmenopausal women. The effects of exogenous estrogen in pre- and peri-menopausal women may be different than in post-menopausal women due different distributions of alpha and beta estrogen receptors, and thus actions of estrogen, in the urogenital tract before and after the final menstrual period(18). However, our finding of a negative association between hormone use in pre-, early and late peri-menopause and worsening incontinence is weak. We found no definitive pattern suggesting hormone use in these stages was associated with improved incontinence. Specifically using hormones before the final menstrual period did not appear to decrease the odds for worsening incontinence, and starting exogenous hormones at any stage was only associated with improvement in urge incontinence symptoms.

The majority of incontinent women in mid-life experience no change or improvement in their incontinence symptoms. We found few factors other than early peri-menopause to be significantly associated with improving incontinence only. Having never smoked appeared to increase odds of improving any incontinence. Good social support was associated with increased odds of improving and having a college education with lower odds of worsening stress incontinence. Women who have never smoked are less likely to have a chronic lung disease which has been associated with incontinence in some populations(19). While we could not account for the effect of treatment of incontinence in our models, women with social support and a better education are more likely to seek treatment and this may account for the positive effect on stress incontinence.

While a higher proportion of women with incident incontinence subsequently reported worsening of incontinence symptoms, overall only about 15% of incontinent mid-life women reported worsening. Our longitudinal analysis showed that weight gain from year to year and over 6 years was associated with both a reduction in odds of improvement and an increase in odds of worsening incontinence symptoms. An increase in WHR worsened any and stress incontinence. A high BMI and high waist circumference are factors associated with prevalent incontinence(4, 19); weight gain and increases in WHR have cogent biological explanations for worsening existing incontinence. For example, one theory is that increases in weight and WHR increase intra-abdominal pressure and thus pressure on the bladder and pelvic organ support structures.

African American women, Hispanic women and women reporting stressful life events were more likely to report worsening incontinence symptoms. African American women have been shown to be at higher risk for developing stress incontinence in mid-life for unclear reasons(4). Also unclear is the mechanism for a direct effect of stressful life events. While psychological stress could increase muscular tension, neurotransmitters or hormones that impact bladder and urethral function, stress may also increase behaviors that increase incontinence or increase the reporting of incontinence symptoms.

We found a few factors associated with both worsening and improving incontinence. Women whose first report of incontinence was daily or weekly were less likely to worsen and more likely to improve. This finding is, in part, due to constraints of our categorical incontinence frequency variables, that is, women who reported daily incontinence could not worsen by the categories of incontinence frequency used in SWAN. However, it is also possible that women with more severe or frequent incontinence are more likely to seek treatment and/or experiment with behavioral strategies such as decreasing fluid intake and increasing voiding frequency to reduce incontinence symptoms. While women whose anxiety scores increased from year to year were more likely to worsen and less likely to improve in their incontinence, women who developed anxiety over all 6 years were more likely to have a higher variability in their reporting of incontinence over the years of our study, that is, they were more likely to report both worsening and improving over time. Reporting of incontinence symptom frequency may increase or decrease with changes in parallel with anxiety symptoms.

Our study had a number of limitations. The SWAN cohort was not assembled specifically to evaluate incontinence. Loss to follow-up or missing data can introduce bias and is always an important problem in longitudinal studies. While over 90% of the incontinent women in this study contributed information towards our analysis, the differences between those in our analysis cohort and those who dropped out, limit the generalizability of our results. We attempted to evaluate both short term (year to year changes) and long term (change over all 6 years) worsening and improving in incontinence. The short term changes may represent reporting variance rather than true changes in incontinence frequency and have attempted to evaluate and control for this by including factors that could affect incontinence reporting in our models (such as social support) and by assessing the proportions of women whose incontinence reporting varied more from year to year. Our models for long term change identified few factors associated with either worsening or improving incontinence. Whether our method for summing change over time explains these limited results or whether fewer factors predict longer term change cannot be assessed. SWAN's definition of surgical menopause includes women who had a hysterectomy without reference to removal of ovaries. We do not have data between baseline and year 6 to evaluate longitudinally how treatment of incontinence contributed to improvement of incontinence symptoms in our cohort. . Finally, because the questions eliciting the frequency of incontinence did not quantify leakage by type, we had limited power to assess change in the frequency of each incontinence type over these 6 years.

Our study also had a number of important strengths. Six years of longitudinal data on incontinence in almost 2500 mid-life women is unique, and SWAN has provided an opportunity to evaluate incontinence in a racially/ethnically diverse, community-based cohort of women over time. Second, the same incontinence questions were asked on an annual basis. While self-report reflects the symptoms rather than the condition of stress and urge incontinence, the experience of incontinence is of more direct clinical and public health importance than the presence or absence of urodynamic abnormalities. The sensitivity and specificity of self-reported incontinence by type is estimated at 75–86% and 60–79% in validated questionnaires(20, 21). While the incontinence questions were not from validated questionnaires, they are similar to such currently validated questions and those that have been used widely in other epidemiological studies(19, 22).

While some women and clinicians have believed urinary incontinence to be a symptom attributable to the menopausal transition, our results suggest that the transition from pre- or early peri- to post-menopause has either no or possibly a weak positive effect on changes in the frequency of incontinence symptoms in mid-life women. Instead, other modifiable

factors such as weight gain and changes in weight distribution may account for any worsening in incontinence symptoms noted during this life stage.

Acknowledgments

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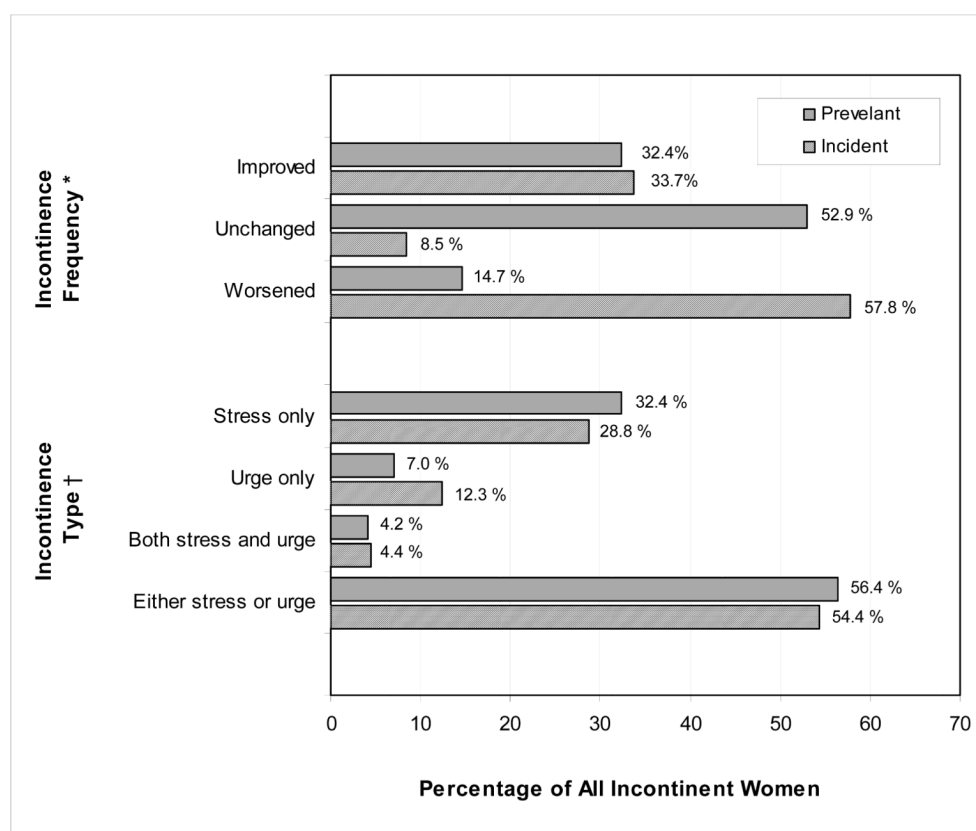
Figure 1.
* Change in reporting of incontinence over six years
† For women who report incontinence at two or more visits: stress only represents women who reported stress type only at every visit they reported incontinence; urge only represents women who reported urge type only at every visit they reported incontinence, both stress and urge represents those women who reported both types of incontinence at every visit they reported incontinence; either stress or urge represents women who inconsistently reported either type without a pattern at every visit they reported incontinence.
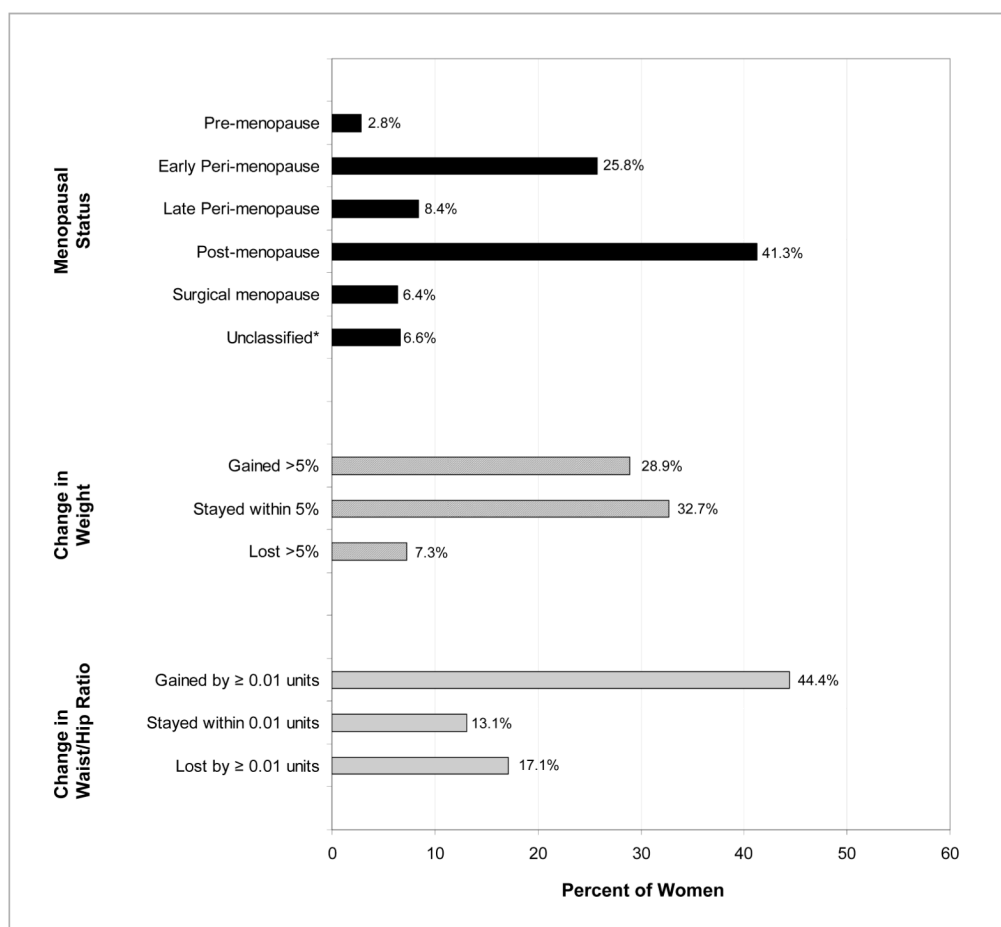
Figure 2.

Table 1

Baseline Characteristics and Differences Between Analysis and Drop-out Cohorts over Six Years

Baseline Characteristics	Baseline Cohort N = 3301		Analysis Cohort N = 2415		Drop out Cohort N=279		p-value*
Age (mean ± SD)	45.8	2.7	45.8	2.7	45.8	2.6	0.33
Race (N, %)							<0.01
Caucasian	1550	47.0	1238	51.3	91	32.6	
Black	934	28.3	657	27.2	100	35.8	
Chinese	250	7.6	168	7.	11	3.9	
Japanese	281	8.5	192	8.0	14	5.0	
Hispanic	286	8.7	160	6.6	63	22.6	
Menopausal status (N, %)							0.42
Pre-menopausal	1726	52.3	1245	51.6	148	53.0	
Early peri-menopausal	1498	45.4	1120	46.4	120	43.0	
Education (N, %)							<0.01
High school or less	819	24.8	544	22.5	106	38.0	
College or higher	2451	74.3	1851	76.6	170	60.9	
Marital status (N, %)							0.06
Single	439	13.3	316	13.1	36	12.9	
Married, living as	2148	65.1	1587	65.7	164	58.8	
Separated/Divorced/Widowed	660	20.0	479	19.8	71	25.4	
Social Support (mean, SD)	12.3	3.4	12.3	3.3	12.2	4.0	0.89†

Baseline Characteristics	Baseline Cohort N = 3301		Analysis Cohort N = 2415		Drop out Cohort N=279		p-value*
General Health Status (N, %)							0.21
Excellent	694	21.0	486	20.1	60	21.5	
Very good	1179	35.7	887	36.7	85	30.5	
Good	945	28.6	703	29.1	80	28.7	
Fair	368	11.1	262	10.8	40	14.3	
Poor	62	1.9	45	1.9	6	2.2	
Difficulty paying for basics (N, %)							<0.01
Not at all hard	1968	59.6	1445	59.8	137	49.1	
Somewhat hard	1005	30.4	746	30.9	100	35.8	
Very hard	306	9.3	212	8.8	39	14.0	
Body Mass Index (mean ± SD)	28.3	7.2	28.8	7.4	27.7	6.2	0.01
Waist-hip ratio (mean ± SD)	0.8	0.1	0.8	0.1	0.8	0.1	0.35
Parity (mean ± SD)	2.0	1.4	2.1	1.4	0.9	0.3	0.01
Smoking History (N, %)							0.16
Never smoked	1877	56.9	1341	55.5	141	50.5	
Current smoker	569	17.2	418	17.3	60	21.5	
Past smoker	825	25.0	638	26.4	72	25.8	
Medical Conditions (N, %)							
Diabetes	163	4.9	131	5.4	15	5.4	1.00**
Hypertension	642	19.4	493	20.4	57	20.4	1.00**

Baseline Characteristics	Baseline Cohort N = 3301		Analysis Cohort N = 2415		Drop out Cohort N=279		p-value*
Fibroids	670	20.3	512	21.2	45	16.1	0.05**
Depressive symptoms	804	24.4	610	25.3	72	25.8	0.93**
Anxiety symptoms	439	13.3	365	15.1	48	9.3	<0.01**
Incontinence Frequency (N, %)							
None	1806	54.7	921	38.1			
Monthly	997	30.2	997	41.3			
Weekly	321	9.7	321	13.3			
daily	175	5.3	175	7.2			
Incontinence Type (N, %)							
Stress	1012	30.7	957	39.6			
Urge	309	9.4	301	12.5			
Mixed	460	13.9	458	19.0			
Other	70	2.1	57	2.4			

Due to missing data, numbers may not add to column total and percentages may not add to 100%

Analysis cohort are those women who had or developed incontinence and contributed data to this analysis

Drop-out cohort are those women who did not develop incontinence before becoming lost to follow up. Women followed for all six years who never reported incontinence during the study are not included.

*
Comparison of Analysis Cohort and Drop-out Cohort only using the t-test for continuous and chi-squared test for categorical data.

†
Mann-Whitney-U test as data did not meet normality assumptions.

**
Proportional test

Table 2

Adjusted Odds Ratios for Factors Associated with Improving Incontinence by Type Among Incontinent Mid-life Women

Time-dependent Factors	Any Incontinence		Stress Only Incontinence		Urge Only Incontinence	
	OR	95% CI	OR	95% CI	OR	95% CI
Menopause Status in Previous Year						
Pre-menopause not using hormones	Ref		Ref		Ref	
Early peri-menopause not using hormones	**1.19**	**1.06,1.35**	**1.29**	**1.02,1.63**	1.37	0.90, 2.09
Late peri-menopause not using hormones	1.19	0.97,1.46	1.07	0.69, 1.66	1.73	0.96, 3.13
Post-menopause not using hormones	0.99	0.82,1.20	1.38	0.94, 2.00	1.22	0.68, 2.18
Surgical menopause not using hormones	0.86	0.60,1.22	0.29	0.08, 1.06	0.42	0.12, 1.50
Pre-, Early/Late peri-menopause using hormones	1.07	0.85, 1.36	0.89	0.56,1.40	1.62	0.77, 3.42
Post-menopause using hormones	1.13	0.51, 2.50				
Surgical menopause using hormones	2.08	0.98, 4.40				
Change in Menopause Status from Previous to Current Year						
No change in status	Ref		Ref		Ref	
Menopause status change, no hormone use	**1.14**	**1.00, 1.31**	1.14	0.89, 1.48	1.14	0.77, 1.70
Started using hormones	1.06	0.87, 1.30	1.12	0.76, 1.63	**1.80**	**1.00, 3.23**
Stopped using hormones	1.02	0.73, 1.44	0.87	0.45, 1.68	1.49	0.59, 3.76
Weight gain (per pound from previous year)	**0.97**	**0.96, 0.98**	**0.96**	**0.93, 0.99**		
Waist to hip ratio gain (per 0.1 from previous year)	0.32	0.10,1.08	0.35	0.04, 2.72	0.21	0.01, 7.37
Smoking in previous year						
Never	Ref				Ref	

	Any Incontinence		Stress Only Incontinence		Urge Only Incontinence	
	OR	95% CI	OR	95% CI	OR	95% CI
Time-dependent Factors						
Ever	**1.14**	**1.04, 1.25**			1.20	0.89, 1.62
Current	1.01	0.88, 1.16			0.58	0.33, 1.01
Social Support (per unit change from previous year)	1.01	0.99, 1.04	**1.05**	**1.01, 1.09**	0.97	0.91, 1.04
Stressful Life Events (per event in previous year)	**0.98**	**0.95, 1.00**	0.99	0.94, 1.03	1.06	0.99, 1.13
Developed Medical Conditions in Previous Year						
Diabetes	0.91	0.77, 1.07	0.75	0.50, 1.12	0.79	0.46, 1.34
Hypertension			0.94	0.76, 1.16		
Depressive symptoms (per unit change in score)					1.01	0.99, 1.03
Anxiety symptom (per unit change in score)	**0.96**	**0.94, 0.99**	**0.93**	**0.88, 0.97**	0.95	0.88, 1.03
Change in Health Status from Previous Year	0.95	0.88, 1.02	0.95	0.83, 1.08	0.92	0.75, 1.14
Baseline/Stable Factors						
Frequency at First Report of Incontinence						
Monthly	Ref		Ref		Ref	
Weekly	**1.45**	**1.31, 1.61**	**2.15**	**1.77, 2.62**	**2.43**	**1.76, 3.37**
Daily	**1.33**	**1.15, 1.55**	**3.24**	**2.35, 4.45**	**3.82**	**2.30, 6.37**
Age at baseline (per year)	1.00	0.98, 1.02	1.01	0.98, 1.04	1.01	0.96, 1.07
Race/ethnicity						
Caucasian	Ref		Ref		Ref	
African American	1.09	0.98, 1.22	0.90	0.69, 1.17	0.91	0.66, 1.26
Chinese	1.05	0.90, 1.23	0.76	0.56, 1.03	0.76	0.37, 1.57

Time-dependent Factors	Any Incontinence		Stress Only Incontinence		Urge Only Incontinence	
	OR	95% CI	OR	95% CI	OR	95% CI
Japanese	0.98	0.85,1.13	1.01	0.80, 1.28	1.20	0.65, 2.24
Hispanic	**1.28**	**1.04,1.58**	0.74	0.45, 1.22	0.43	0.09, 2.00
Education						
Less than college	Ref				Ref	
College or greater	0.97	0.93, 1.22			1.14	0.78, 1.68
Difficulty paying for basics						
Not very hard			Ref			
Very hard			1.30	0.90, 1.89		
Parity						
Nulliparous	Ref					
Parous	1.07	0.94, 1.22				
Marital Status						
Not married	Ref		Ref		Ref	
Married	0.96	0.88, 1.06	0.94	0.78, 1.14	1.33	0.99, 1.80
Symptom score (per unit)	1.00	0.99, 1.01	1.01	0.98, 1.03	1.01	0.98, 1.05
Baseline BMI (per unit increase)	0.99	0.99, 1.00	0.99	0.97, 1.00	**1.02**	**1.00, 1.04**
Fibroids at baseline	0.94	0.85, 1.04			0.89	0.63, 1.25

Reference group are those women who reported no change or worsening in their incontinence year to year

OR = Odds Ratio, CI = Confidence Interval, Ref = Reference

All variables with values for ORs and 95% CIs are included in each multiple logistic regression model; some variables in models by type could not be evaluated due to small numbers.

Table 3

Adjusted Odds Ratios for Factors Associated with Worsening Incontinence by Type Among Incontinent Mid-life Women

Time-dependent Factors	Any Incontinence		Stress Only Incontinence		Urge Only Incontinence	
	OR	95% CI	OR	95% CI	OR	95% CI
Menopause Status in Previous Year						
Pre-menopause not using hormones	Ref		Ref		Ref	
Early peri-menopause not using hormones	0.95	0.85, 1.07	0.94	0.77, 1.14	**0.63**	**0.46, 0.85**
Late peri-menopause not using hormones	0.86	0.70, 1.05	0.99	0.70, 1.40	0.74	0.47, 1.16
Post-menopause not using hormones	**0.80**	**0.66, 0.95**	0.82	0.59, 1.14	**0.57**	**0.37, 0.87**
Surgical menopause not using hormones	0.83	0.61, 1.15	1.36	0.74, 2.50	0.71	0.34, 1.47
Pre-, Early/Late peri-menopause using hormones	**0.75**	**0.60, 0.95**	0.73	0.51, 1.07	0.56	0.30, 1.04
Post-menopause using hormones	1.27	0.60, 2.75	2.93	0.51, 16.91	1.82	0.39, 8.57
Surgical menopause using hormones	1.33	0.61, 2.94	1.73	0.34, 8.73	0.42	0.07, 4.97
Change in Menopause Status from Previous to Current Year						
No change in status	Ref		Ref		Ref	
Menopause status change, no hormone use	0.95	0.84, 1.09	0.96	0.78, 1.19	0.84	0.62, 1.14
Started using hormones	0.93	0.76, 1.14	0.98	0.71, 1.33	0.57	0.33, 1.00
Stopped using hormones	0.85	0.60, 1.21	0.88	0.52, 1.49	0.67	0.28, 1.60
Weight gain (per pound from previous year)	**1.04**	**1.03, 1.05**	**1.05**	**1.03, 1.08**	**1.06**	**1.03, 1.09**
Waist to hip ratio gain (per 0.1 from previous year)	**4.31**	**1.25, 14.80**	**11.76**	**1.39, 99.32**	1.78	0.13, 25.20
Smoking in Previous Year						
Never	Ref				Ref	

	Any Incontinence		Stress Only Incontinence		Urge Only Incontinence	
	OR	95% CI	OR	95% CI	OR	95% CI
Time-dependent Factors						
Ever	0.98	0.90,1.08			0.91	0.71, 1.18
Current	0.96	0.84, 1.09			1.18	0.82. 1.71
Social support (per unit change from previous year)	1.00	0.98, 1.02				
Stressful Life Events (per event from previous year)	1.03	1.01, 1.05	1.03	1.00, 1.07	0.98	0.93, 1.03
Developed Medical Conditions in Previous Year						
Diabetes	1.04	0.89, 1.21			0.95	0.63, 1.45
Hypertension						
Depressive symptoms (per unit change in score)	1.00	0.99, 1.00	0.99	0.98, 1.00	1.00	0.99, 1.02
Anxiety symptoms (per unit change in score)	1.05	1.02, 1.08	1.05	1.01, 1.10	1.04	0.99, 1.11
Change in Health Status from Previous Year	1.03	0.96, 1.10	1.09	0.98, 1.22	1.07	0.92, 1.25
Baseline/Stable Factors						
Frequency at First Report of Incontinence						
Monthly	Ref		Ref		Ref	
Weekly	0.47	0.39, 0.56	0.39	0.26, 0.58	0.50	0.29, 0.86
Daily	0.86	0.78, 0.96	0.62	0.50, 0.78	0.68	0.50, 0.94
Age at baseline (per year)	1.01	0.99, 1.02	1.01	0.98, 1.04	1.01	0.96, 1.05
Race/ethnicity						
Caucasian	Ref		Ref		Ref	
African American	1.13	1.02, 1.26	1.49	1.18, 1.87	1.27	0.98, 1.65
Chinese	1.04	0.89, 1.20	1.25	0.97, 1.60	1.44	0.85, 2.43

Time-dependent Factors	Any Incontinence		Stress Only Incontinence		Urge Only Incontinence	
	OR	95% CI	OR	95% CI	OR	95% CI
Japanese	0.99	0.86, 1.13	0.93	0.74, 1.17	1.20	0.74, 1.96
Hispanic	1.09	0.89, 1.35	**2.44**	**1.63, 3.65**	**4.86**	**1.72, 13.74**
Education						
Less than college	Ref					
College or greater	0.94	0.85, 1.04	0.72	0.60, 0.88	0.93	0.68, 1.27
Difficulty paying for basics						
Not very hard					Ref	
Very hard					1.19	0.79, 1.81
Parity						
Nulliparous	Ref				Ref	
Parous	1.02	0.90, 1.17			1.38	0.97, 1.96
Marital Status						
Not married	Ref		Ref			
Married			0.89	0.75, 1.06		
Symptom score (per unit)	1.00	0.98, 1.01	0.99	0.97, 1.01	1.00	0.97, 1.03
Baseline BMI (per unit increase)	**1.01**	**1.00, 1.01**	1.01	0.99, 1.02	1.01	0.99, 1.02
Fibroids at baseline	0.91	0.83, 1.01	0.83	0.69, 1.02	0.95	0.73, 1.25

Reference group are those women who reported no change or improving in their incontinence year to year

OR = Odds Ratio, CI = Confidence Interval, Ref = Reference

All variables with values for ORs and 95% CIs are included in each multiple logistic regression model