Published in final edited form as:

BJU Int. 2010 October ; 106(8): 1170–1175. doi:10.1111/j.1464-410X.2010.09321.x.

Menopausal transition and the risk of urinary incontinence: results from a British prospective cohort

Gita D. Mishra, Linda Cardozo*, and Diana Kuh

MRC unit for Lifelong Health and Ageing, University College and Royal Free Medical School

*Kings College London, London, UK

Abstract

OBJECTIVE—To investigate the effect of menopausal transition and age on symptoms of urinary incontinence in midlife.

SUBJECTS AND METHODS—The study included a nationally representative cohort of 1211 women followed up since their birth in 1946 and annually from 48–54 years; their menopausal transition status and symptoms of stress, urge, and severe urinary incontinence (UI) at 7 consecutive years from ages 48–54 were assessed.

RESULTS—From Generalized Estimating Equations, women who became perimenopausal ('pre-peri') or those experiencing perimenopause for >1 year ('peri-peri') were more likely to have symptoms of stress UI than were postmenopausal women; the odds ratio (95% confidence interval) was; pre-peri 1.39 (1.11–1.73); and peri-peri 1.39 (1.4–1.71). Menopausal transition status was not associated with urge or severe UI. These relationships were not explained by age, childhood enuresis, reproductive factors, previous health status, body mass index and educational qualifications.

CONCLUSION—This study is unique in being able to disentangle the effects of age, menopausal transitions, and other life-long risk factors on UI. Menopausal transition was only related to stress UI, while increasing age was related to both stress and urge UI. This study suggests that there are both shared and distinct aetiological pathways leading to each type of UI.

Keywords

menopause; stress incontinence; urge incontinence; severe incontinence

INTRODUCTION

The effect of severe urinary incontinence (UI) might have a significant effect on women's lives [1], but even mild UI can affect daily life in subtle but noticeable ways. UI is commonly experienced during midlife among women [2,3]. The prevalence of stress UI peaks during the perimenopausal years (age 45–49 years), and for urge UI it increases with age [2,3]. From our previous findings, using prospective data from the Medical Research Council National Survey of Health and Development (NSHD) cohort, just under half of the

© 2010 THE AUTHORS © 2010 BJU INTERNATIONAL

Correspondence: Gita Mishra, MRC Unit for Lifelong Health and Ageing – Epidemiology and Public Health, 33 Bedford Place, London WC1B 5J UK. g.mishra@nshd.mrc.ac.uk.

Ethical approval: North Thames Multicentre Research Ethics Committee.

CONFLICT OF INTEREST

None declared.

women reported the symptom of stress incontinence (46–49%) when aged 48–54 years, while there was a slight increase evident in the percentage experiencing urge UI, from 22% at 48 years to 25% at age 54 years [4].

Primarily from cross-sectional studies and short-term cohort studies, a wide range of adult social, behavioural, and biological risk factors has been associated with women's UI and the risk factors varied by type of UI [5]. Previous longitudinal research from the NSHD found that across adult life, a higher body mass index (BMI) for women was linked with subsequent symptoms of stress and severe UI in midlife; those who were overweight or obese since early in adult life more than doubled their risk of severe UI [4]. In addition to these adult factors, childhood factors, in particular childhood enuresis, can also have a long-term effect on the incidence of UI in later life [6].

Although from a clinical perspective it has long been assumed that urinary symptoms are an integral part of menopausal transition, the relationship between menopausal transition and UI, independent of the effects of age, remains unclear [7,8]. Epidemiological evidence comparing mostly postmenopausal with premenopausal women has been mixed, with associations varying according to frequency, volume, and type of UI [6,9–11]. More recently, results from the Study of Women Across the Nation (SWAN), one of the few longitudinal studies, found that neither a worsening nor an improvement in the symptoms of UI were associated with menopausal transition [12]. The high prevalence of UI during midlife might be due to urogenital atrophy and decreased collagen support that accompanies lower oestrogen levels during menopause. Given the biological plausibility of the effects on menopause on UI, detailed longitudinal studies are required to distinguish the effects of menopause on UI from those of age or other potential risk factors or confounders.

Using prospective data from the NSHD, in the present study we investigated the effect of menopausal transition and age on symptoms of different clinical types of UI (stress and urge) and the severity of UI across midlife, while taking into account childhood enuresis, reproductive factors, previous health status, BMI and educational qualifications.

SUBJECTS AND METHODS

The NSHD is a nationally representative sample of 2547 women and 2815 men followed up regularly since their birth in March 1946 [13,14]. From 1993 (when cohort members were aged 47 years) to 2000, a postal questionnaire to collect information on health symptoms, the menopause, and change in life circumstances was sent annually to the 1778 (70%) women with whom there was then contact [15]. Of the original cohort, 6% had died, 12% had refused to take part at earlier follow-ups, 9% lived abroad and were no longer in contact with the study, and 3% could not be traced. Non-responders were sent questionnaires for two consecutive years.

This report particularly draws on data collected annually from ages 48–54 years, when the participants reported on the symptoms of urge and stress UI. During this time 1525 of the 1778 women (86%) completed at least one questionnaire. Of these women, 1025 (67.2%) completed all seven questionnaires. Compared to these 1025 women, women who did not respond to any of the questionnaires were more likely to have no formal qualifications (42% vs 31%), to have more frequent visits to the GP at age 43 years (38% vs 31%), and to have a BMI of $>30 \text{ kg/m}^2$ at age 43 years (18% vs 10%). Ethical approval for this study was given by the North Thames Multicentre Research Committee.

Each year women who replied positively to the question 'Do you ever lose any urine when you cough, sneeze, laugh, run, or exercise?' were classified as having the symptoms of stress UI. Those who replied positively both to the question 'Do you ever have an urgent and

strong desire to pass urine which is difficult to control?’ and to the follow-up question ‘Do you ever lose any urine before you reach the toilet?’ were classified as having the symptoms of urgency and urge UI (hereafter referred to as urge UI). Severe UI was defined as involuntary loss occurring twice a month or more over the previous year and the reported loss of more than a few drops of urine [6].

Menopausal status was assessed from the annual postal questionnaire and was defined on the basis of self-reporting of regularity of menstrual bleeding as premenopausal (still had periods and reported no change in regularity), perimenopausal (3–12 months of amenorrhoea or irregular periods in the preceding year), and postmenopausal (amenorrhoea for 12 months) [16]. Women who had undergone hysterectomy or whose menopausal status could not be determined because they were on hormone-replacement therapy (HRT) were classified into two separate groups. The eight menopausal transition categories in two consecutive years were defined as: ‘pre-pre’ (premenopausal for 12 months); ‘pre-peri’ (premenopausal then perimenopausal in the following year); ‘pre/peri-post’ (pre- or perimenopausal then postmenopausal in the following year); ‘peri-peri’ (perimenopausal for 12 months); ‘post-post’ (postmenopausal); ‘pre/peri-HRT’ (pre- or perimenopausal followed by taking HRT in the following year); ‘HRT-HRT’ (on HRT for 1 year); ‘pre/peri/hyst-hyst’ (pre- or perimenopausal and since has had a hysterectomy or has had a hysterectomy for 1 year) [17,18].

Other risk factors included in the analysis that were shown previously to be associated with UI were: childhood enuresis, parity, mode of delivery, and physical and mental health [5,6]. Childhood enuresis was defined from maternal reports of bedwetting ‘occasionally’ or at least ‘several nights a week’ or wetting ‘sometimes’ during the day when study members were 6 years old. Information on the birth of children was updated at each adult survey (the last one occurring at age 53 years). In addition, at age 49 years women were asked to recall the number of Caesarean deliveries.

When cohort members were 43 years old, women with a history of kidney or bladder infections were identified from answers to a list of health problems completed by research nurses during a home visit. Health care use was indicated by the number of GP consultations in the previous year, classified as no more than two visits, or three or more visits.

Psychological symptoms occurring in the months before the age 36-year home visit were assessed using the Present State Examination (PSE), a measure of anxiety and depression [19]. Total scores were categorized as no symptoms, low symptoms (score of 1–4), and high symptoms (score of 5) [20]. Educational qualifications achieved by age 26 years were grouped into degree level or equivalent, advanced secondary (‘A’-levels or equivalent, usually attained at 18 years), lower secondary level qualifications (‘O’-levels or equivalent, usually attained at 16 years), and no qualifications.

Chi-squared analysis was used to test the associations between each of the reproductive, behavioural and biological risk factors and the symptoms of stress, urge and severe UI at age 54 years. Repeated-measures analyses of data on UI from ages 48–54 years were conducted by using Generalized Estimating Equations (GEE) [21] for binary data and with the logit link function in PROC GENMOD in SAS [22]. These were used to determine the relationships between the time-dependent menopausal transition status and symptoms of stress UI, adjusting for age, childhood enuresis, reproductive factors, and behavioural factors. These procedures were repeated for symptoms of urge and severe UI.

RESULTS

Figure 1 shows the percentage of women in the selected menopausal transition categories with stress UI by age. Although there was an increase in the percentage of women with stress UI in all menopausal transition groups, postmenopausal women tended to have a lower prevalence throughout the seven years, while the 'pre-peri' or 'peri-peri' group had a higher percentage of women with stress UI (postmenopausal women, mean for women with UI 38%; pre-peri, 52%; peri-peri, 54%) More specifically, at age 54 years, women who had been perimenopausal for 12 months (peri-peri) had the highest prevalence of stress UI (63%), while postmenopausal women (post-post) had the lowest (43%).

There was no difference in the percentage who had urge or severe UI by menopausal transition status. By contrast, childhood enuresis and psychological symptoms were positively associated with symptoms of urge and severe UI. Of the women with childhood enuresis, >40% had urge UI and ≈25% reported severe UI, while the values for women with no enuresis were 25% and 10%, respectively (Table 1).

In all, 843 women provided complete information on menopausal transition status and all relevant risk factors/confounders collected across the life course. Using the repeat measures of UI, women who became perimenopausal (pre-peri) or those experiencing perimenopause for >1 year (peri-peri) were more likely to have symptoms of stress UI than were postmenopausal women (Table 2). Stress UI was also associated with age, a history of urinary or kidney infection, genital prolapse, higher BMI, higher educational qualifications, and more frequent visits to the GP. Women who had their first child over the age of 30 years, by vaginal deliveries, were 2.7 times more likely to have stress UI than those who had no children (Table 2). Urge UI was related to age, childhood enuresis, higher BMI, more frequent GP visits, and poor psychological health. Severe UI was associated with childhood enuresis, higher BMI, and more frequent GP visits (Table 2).

DISCUSSION

The NSHD is unique among longitudinal studies in being able to disentangle the effects of menopausal transition, ageing, and other lifelong risk factors on UI. For women in midlife, menopausal transition status was associated with stress UI but not with urge or severe UI. Instead, urge UI was strongly associated with age, childhood enuresis, and poorer mental health, as indicated by higher psychological symptoms.

Few other longitudinal studies have examined UI in midlife; from the SWAN study, menopause had only weak positive effects on the changes in the frequency of UI symptoms in midlife [12]. However, the relationships between menopausal transition status and the prevalence of UI were not reported. The Melbourne Women's Midlife Health project was another longitudinal study of women that investigated UI, but was limited by a small sample size and because different types of UI were only distinguished in the final year. Although analytical methods for repeated-measures data were not used, their cross-sectional analysis failed to detect effects of either age or menopausal transition [11].

The main new results from the NSHD for natural menopausal transition concern the high level of reported symptoms of stress UI in women who were premenopausal then perimenopausal in the following year, or women who had been perimenopausal for 12 months. It might be that women going through the perimenopause also had a range of other symptoms, such as vasomotor symptoms [23-25], and they might be more sensitive to other changes in their body and over-report the experience of UI symptoms. Alternatively, despite their symptoms, postmenopausal women might have found a strategy to manage their

symptoms. We found no evidence of a relationship for women in the other categories of menopausal transition with the experience of UI symptoms.

Our study does not support the hypothesis that urge UI is related to oestrogen deficiency, but provides evidence that it increases steadily with age [26]. Instead, the study confirms our previous finding from cross-sectional data that childhood enuresis was associated with urge and severe UI [6]. Childhood enuresis can be physical or psychological in origin [6]. For instance, women with detrusor instability commonly report childhood enuresis [27] and studies have shown that bladder instability is more common in children with diurnal enuresis than nocturnal enuresis [28]. It has also been suggested that urge UI in some adults represents an inadequacy in the neurological reflex mechanisms [29]. For urge UI this relationship was independent of psychological symptoms before the onset of menopause, suggesting that urge UI, childhood enuresis and psychological symptoms might have a common causal factor. The established risk factors of higher BMI [2,4,6,12,30,31] and more frequent visits to the GP [6] were associated with stress, urge and severe UI.

The main strengths of our study are the size and representativeness of the sample, its high response rate, and the wide-ranging prospective and longitudinal data available. The same incontinence questions were asked on an annual basis between ages 48–54 years and permitted classification of UI symptoms by clinical type (stress and urge) and severity. The definition of women with severe UI captures most (60%) of women with both stress and urge symptoms. Although the prevalence of UI in women peaks in midlife (at age 50–54 years) [2,3] the study does not provide prospective information on the age of its onset. Self-reported information on UI reflects symptoms rather than the diagnosis urodynamic abnormalities; nevertheless these have direct clinical consequences, as such an experience might prompt the decision to seek medical help and intervention.

In conclusion, the findings indicate that menopausal transition is only related to stress UI, with the highest incidence of symptoms reported by women who have been perimenopausal for 1 year. By contrast, age, childhood enuresis and greater psychological symptoms are strongly associated with urge UI. More frequent GP visits and a higher BMI are risk factors for all three types of UI. This suggests that there are both shared and distinct causal pathways through life leading to each type of UI.

There are public health implications; when advising women during menopausal transition, health professionals should be aware that half of women who become perimenopausal or women who have been perimenopausal for 12 months, might have stress UI, and that this is likely to decline for postmenopausal women. For complaints of urge UI, health professionals should instead consider the psychological health of the women and childhood enuresis, alongside established risk factors of a higher BMI and more frequent GP visits.

Acknowledgments

G.D.M. and D.K. designed the research; L.C. contributed to analytical strategy and interpreted the results; G.D.M. analysed data and wrote the paper. All authors read and approved the final manuscript.

Funding: The Wellcome Trust Grant provided financial support for GM. The Medical Research Council provided funding for the National Survey of Health and Development and financial support for DK.

Abbreviations

UI	urinary incontinence
NSHD	National Survey of Health and Development

BMI	body mass index
SWAN	Study of Women Across the Nation
HRT	hormone-replacement therapy
PSE	Present State Examination
GEE	Generalized Estimating Equation

REFERENCES

1. van der Vaart CH, de Leeuw JR, Roovers JP, Heintz AP. The effect of urinary incontinence and overactive bladder symptoms on quality of life in young women. *BJU Int*. 2002; 90:544–9. [PubMed: 12230614]
2. Hannestad YS, Rortveit G, Daltveit AK, Hunskaar S. Are smoking and other lifestyle factors associated with female urinary incontinence? The Norwegian EPINCONT Study. *BJOG*. 2003; 110:247–54. [PubMed: 12628262]
3. Nihira MA, Henderson N. Epidemiology of urinary incontinence in women. *Curr Womens Health Report*. 2003; 3:340–7.
4. Mishra GD, Hardy R, Cardozo L, Kuh D. Body weight through adult life and risk of urinary incontinence in middle-aged women: results from a British prospective cohort. *Int J Obes (Lond)*. 2008; 32:1415–22. [PubMed: 18626483]
5. Holroyd-Leduc JM, Straus SE. Management of urinary incontinence in women: scientific review. *JAMA*. 2004; 291:986–95. [PubMed: 14982915]
6. Kuh D, Cardozo L, Hardy R. Urinary incontinence in middle aged women. childhood enuresis and other lifetime risk factors in a British prospective cohort. *J Epidemiol Community Health*. 1999; 53:453–8. [PubMed: 10562862]
7. Hunskaar, S.; Burgio, KL.; Diokno, AC., et al. Epidemiology and natural history of urinary incontinence. In: Abrams, P.; Cardozo, L.; Khoury, S.; Wein, A., editors. *Incontinence*. Health Publication Limited; Plymouth: 2002. p. 165–201.
8. Cardozo L, Lose G, McClish D, Versi E, de Koning GH. A systematic review of estrogens for recurrent urinary tract infections: third report of the hormones and urogenital therapy (HUT) committee. *Int Urogynecol J Pelvic Floor Dysfunct*. 2001; 12:15–20. [PubMed: 11294525]
9. Chen YC, Chen GD, Hu SW, Lin TL, Lin LY. Is the occurrence of storage and voiding dysfunction affected by menopausal transition or associated with the normal aging process? *Menopause*. 2003; 10:203–8. [PubMed: 12792290]
10. Fultz NH, Herzog AR. Prevalence of urinary incontinence in middle-aged and older women: a survey-based methodological experiment. *J Aging Health*. 2000; 12:459–69. [PubMed: 11503727]
11. Sherburn M, Guthrie JR, Dudley EC, O'Connell HE, Dennerstein L. Is incontinence associated with menopause? *Obstet Gynecol*. 2001; 98:628–33. [PubMed: 11576579]
12. Waetjen LE, Feng WY, Ye J, et al. Factors associated with worsening and improving urinary incontinence across the menopausal transition. *Obstet Gynecol*. 2008; 111:667–77. [PubMed: 18310370]
13. Wadsworth ME, Butterworth SL, Hardy RJ, et al. The life course prospective design: an example of benefits and problems associated with study longevity. *Soc Sci Med*. 2003; 57:2193–205. [PubMed: 14512249]
14. Wadsworth M, Kuh D, Richards M, Hardy R. Cohort Profile. The 1946 National Birth Cohort (MRC National Survey of Health and Development). *Int J Epidemiol*. 2006; 35:49–54. [PubMed: 16204333]
15. Kuh D, Hardy R. Women's health in midlife: findings from a British birth cohort study. *J Br Menopause Soc*. 2003; 9:55–60. [PubMed: 12844426]
16. McKinlay SM, Brambilla DJ, Posner JG. The normal menopause transition. *Maturitas*. 1992; 14:103–15. [PubMed: 1565019]

17. Mishra G, Kuh D. Perceived change in quality of life during the menopause. *Soc Sci Med.* 2006; 62:93–102. [PubMed: 15990213]
18. Mishra G, Kuh D. Sexual functioning throughout menopause. the perceptions of women in a British cohort. *Menopause.* 2006; 13:880–90. [PubMed: 17003739]
19. Wing, JK.; Cooper, JE.; Sartorius, N. Present State Examination. Cambridge University Press; London: 1974.
20. Kuh D, Hardy R, Rodgers B, Wadsworth ME. Lifetime risk factors for women's psychological distress in midlife. *Soc Sci Med.* 2002; 55:1957–73. [PubMed: 12406464]
21. Twisk, JWR. Applied Longitudinal Data Analysis for Epidemiology. Cambridge University Press; Cambridge: 2003.
22. SAS. SAS/STAT User's Guide, Version 8. SAS Institute Inc; Cary NC: 1999.
23. Deecher DC, Dorries K. Understanding the pathophysiology of vasomotor symptoms (hot flushes and night sweats) that occur in perimenopause, menopause, and postmenopause life stages. *Arch Womens Ment Health.* 2007; 10:247–57. [PubMed: 18074100]
24. Brown WJ, Mishra GD, Dobson A. Changes in physical symptoms during the menopause transition. *Int J Behav Med.* 2002; 9:53–67. [PubMed: 12112996]
25. Hardy R, Kuh D. Change in psychological and vasomotor symptom reporting during the menopause. *Soc Sci Med.* 2002; 55:1975–88. [PubMed: 12406465]
26. Botlero R, Davis SR, Urquhart DM, Shortreed S, Bell RJ. Age-specific prevalence of, and factors associated with, different types of urinary incontinence in community-dwelling Australian women assessed with a validated questionnaire. *Maturitas.* 2009; 62:134–9. [PubMed: 19181467]
27. Moore KH, Richmond DH, Parys BT. Sex distribution of adult idiopathic detrusor instability in relation to childhood bedwetting. *Br J Urol.* 1991; 68:479–82. [PubMed: 1747721]
28. Mayo ME, Burns MW. Urodynamic studies in children who wet. *Br J Urol.* 1990; 65:641–5. [PubMed: 2372679]
29. Yarnell JW, Voyle GJ, Sweetnam PM, Milbank J, Richards CJ, Stephenson TP. Factors associated with urinary incontinence in women. *J Epidemiol Community Health.* 1982; 36:58–63. [PubMed: 7069357]
30. Bortolotti A, Bernardini B, Colli E, et al. Prevalence and risk factors for urinary incontinence in Italy. *Eur Urol.* 2000; 37:30–5. [PubMed: 10671782]
31. Dwyer PL, Lee ET, Hay DM. Obesity and urinary incontinence in women. *Br J Obstet Gynaecol.* 1988; 95:91–6. [PubMed: 3342213]

FIG. 1.

The percentage of 843 women in each menopausal transition category with stress UI, by age; for parsimony, only a few categories were selected for illustrative purposes

TABLE 1

The percentage of 1211* women at age 54 years reporting stress symptoms, urge symptoms, severe incontinence, according to the various characteristics

Characteristic (N)	Stress symptoms	P	Urge symptoms	P	Severe UI	P
All women	49.9		25.6		11.1	
Menopausal transition status (53-54 years)		0.02		0.7		0.6
pre-pre (26)	50.0		23.1		7.7	
pre-peri (27)	59.3		37.0		7.4	
peri-peri (79)	63.3		32.9		11.5	
pre/peri-post (70)	57.1		27.1		11.4	
post-post (425)	42.8		25.4		9.7	
pre/peri/hyst-hyst (251)	52.2		25.5		14.7	
pre/peri-HRT (24)	54.2		20.8		8.3	
HRT-HRT (176)	50.6		24.4		9.1	
Childhood factors						
Enuresis (6 years)		0.6		0.003		<0.001
No (1055)	49.4		24.5		10.1	
Yes (41)	53.3		44.4		26.7	
Urinary or kidney infection (15-43 years)		0.03		0.03		0.9
No (883)	48.4		24.9		11.0	
Yes (239)	56.1		31.8		11.3	
Reproductive factors						
Ever diagnosed genital prolapse		0.04		0.05		0.2
No (1025)	49.5		25.1		10.2	
Yes (60)	63.3		36.7		15.0	
Number of children		0.04		0.4		0.04
None (141)	39.7		26.2		9.2	
1 (136)	55.2		30.2		11.0	
2 (520)	51.0		26.2		12.3	
3 (241)	49.0		24.1		7.5	
4 (85)	60.0		24.7		19.1	
Childbirth characteristics		0.02		0.3		0.1
No children (145)	39.3		24.8		9.0	
Age at first birth < 30 years and vaginal deliveries (805)	50.9		25.3		10.2	
30 years and all Caesarean (27)	55.6		29.6		7.4	
>30 years and all vaginal (63)	60.3		36.5		15.9	
>30 years and all Caesarean (17)	64.7		35.3		17.7	
Menopausal status (54 years)		0.01		0.5		0.3
Premenopausal (43)	62.8		18.6		9.3	
Perimenopausal (132)	59.9		31.1		10.7	
Postmenopausal (542)	45.4		25.1		10.5	
Hysterectomy (258)	51.9		25.6		14.7	

Characteristic (N)	Stress symptoms	<i>P</i>	Urge symptoms	<i>P</i>	Severe UI	<i>P</i>
HRT (222)	50.0		24.3		9.0	
Lifestyle factors						
BMI, kg/m ² at 43 years		0.008		0.16		<0.001
<20 (74)	47.3		29.7		9.5	
20-25 (627)	46.3		24.7		8.8	
25-30 (283)	54.4		26.2		10.3	
>30 (130)	60.8		33.9		23.9	
Educational qualifications		0.002		0.04		0.001
Degree (72)	61.1		30.6		8.5	
A levels (287)	53.7		27.9		7.0	
O levels (315)	51.8		27.3		10.5	
Less than O levels (99)	50.5		23.2		18.2	
None (366)	44.3		22.4		14.4	
Previous health (age 43 years)						
GP consultations in 12 months		0.002		0.08		<0.001
No more than two (771)	46.7		23.7		8.2	
Three or more (363)	56.5		28.7		16.6	
Psychological symptoms (PSE) (age 36 years)		0.7		0.05		0.05
No symptoms (436)	50.5		25.0		10.1	
Low: score of 1-4 (339)	47.8		22.4		9.2	
High: 5 (310)	52.3		31.9		14.9	

*
n varies due to missing values.

TABLE 2

Fully adjusted odd ratios (adjusted for all the variables listed) and 95% CI from repeated-measure analysis (GEEs), for the symptoms of stress, urge and severe UI (843 women who provided annual data from age 48-54 years)

Characteristics	Stress symptoms	P	Urge symptoms	P	Severe UI	P
Menopausal transition status		0.005		0.07		0.4
post-post	R		R		R	
pre-pre	1.27 (0.98, 1.63)		0.76 (0.57, 1.01)		0.55 (0.33, 0.93)	
preperi	1.39 (1.11, 1.73)		0.8 (0.61, 1.04)		0.8 (0.5, 1.28)	
peri-peri	1.39 (1.14, 1.71)		1.18 (0.94, 1.49)		0.91 (0.62, 1.35)	
pre/peri-post	1.19 (0.98, 1.46)		0.94 (0.76, 1.17)		0.92 (0.61, 1.38)	
pre/peri/hyst-hyst	0.94 (0.68, 1.31)		0.89 (0.62, 1.27)		0.76 (0.43, 1.34)	
pre/peri-HRT	1.2 (0.92, 1.57)		0.96 (0.69, 1.34)		0.81 (0.48, 1.36)	
HRT-HRT	1.13 (0.9, 1.42)		0.9 (0.68, 1.21)		0.89 (0.58, 1.38)	
Age	1.02 (0.99, 1.05)	0.06	1.03 (1, 1.06)	0.04	1.02 (0.97, 1.08)	0.4
Enuresis (6 years)		0.4		0.02		0.05
No	R		R		R	
Yes	1.44 (0.79, 2.62)		2.61 (1.31, 5.21)		2.84 (1.33, 6.06)	
Urinary or kidney infection (15-43 years)		0.03		0.16		0.4
No	R		R		R	
Yes	1.36 (1.02, 1.81)		1.26 (0.92, 1.72)		1.18 (0.78, 1.78)	
Reproductive factors						
Ever diagnosed genital prolapse		0.04		0.18		0.15
No	R		R		R	
Yes	1.73 (1.1, 2.73)		1.4 (0.86, 2.28)		1.69 (0.91, 3.15)	
Childbirth characteristics		0.006		0.8		0.37
No children	R		R		R	
Age at first birth						
30 and all vaginal	1.51 (1.05, 2.18)		1.08 (0.7, 1.69)		1.56 (0.92, 2.64)	
30 and all Caesarean	1.77 (1.01, 3.1)		1 (0.53, 1.86)		1.46 (0.66, 3.21)	
>30 and all vaginal	2.69 (1.54, 4.68)		1.35 (0.7, 2.62)		2.28 (0.97, 5.38)	
>30 y and all Caesarean	1.64 (0.73, 3.64)		0.91 (0.34, 2.48)		1.86 (0.51, 6.86)	
Lifestyle factors						
BMI (at 43 years)	1.05 (1.02, 1.08)	<0.001	1.04 (1.01, 1.07)	0.02	1.06 (1.03, 1.1)	0.003
Educational qualifications		<0.001		0.6		0.07
None	P		P		P	
Less than 0 level	1.29 (0.8, 2.08)		1.08 (0.64, 1.82)		1.34 (0.73, 2.46)	
0 level	1.57 (1.17, 2.11)		1.17 (0.82, 1.66)		1.01 (0.66, 1.55)	
A levels	1.66 (1.22, 2.25)		1.21 (0.86, 1.72)		0.54 (0.32, 0.93)	
Degree	1.58 (0.96, 2.58)		1.55 (0.89, 2.69)		0.78 (0.34, 1.81)	
Previous health (at 43 years)						
GP consultations in 12 months		<0.001		0.004		<0.001
No more than twice	R		R		R	

Characteristics	Stress symptoms	P	Urge symptoms	P	Severe UI	P
Three or more times	1.59 (1.24, 2.05)		1.53 (1.15, 2.03)		2.28 (1.57, 3.3)	
Psychological symptoms, PSE		0.17		0.04		0.1
No symptoms	R		R		R	
Low (score of 1–4)	0.77 (0.59, 1.02)		0.89 (0.65, 1.22)		0.86 (0.55, 1.35)	
High (5)	0.96 (0.72, 1.27)		1.34 (0.97, 1.84)		1.37 (0.9, 2.09)	