Evaluation of Parturition and Other Reproductive Variables as Risk Factors for Urinary Incontinence in Later Life

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***Objective*: To assess specific parturition and reproductive variables as potential risk factors for urinary incontinence in later life.**

***Methods*: A mail survey was conducted with a random sample of 1922 women members of a large health maintenance organization. Multivariate analysis was used to estimate the independent association between parturition factors, hysterectomy, hormone use, and incontinence.**

***Results*: Completed surveys were returned by 939 women (49%), 682 of whom reported at least one episode of incontinence in the past 12 months or ever having been treated for incontinence. On univariate analysis, women with incontinence were more likely to be white and heavier and to have had a hysterectomy before age 45, at least one live birth, a postdate (at least 42 weeks' gestation) birth, a labor lasting longer than 24 hours, and exposure to oxytocin. The risk of incontinence increased significantly with the number of exposures to oxytocin. In a multivariate model including age, there was a significant association between incontinence and white race (odds ratio [OR] 1.8, 95% confidence interval [CI] 1.2, 2.8), body mass (OR for fourth quartile 3.0, 95% CI 1.8, 5.0), estrogen replacement (OR 1.9, 95% CI 1.3, 2.8) and oxytocin (OR 1.9, 95% CI 1.0, 3.6). Parity was also associated with incontinence ($P < .05$).**

***Conclusion*: This study supports previous findings of a positive association between urinary incontinence and body mass, parity, and use of estrogen. In addition, we found a significant independent association between exposure to oxytocin during labor and incontinence in later life. (Obstet Gynecol 1997;90:983–9. © 1997 by The American College of Obstetricians and Gynecologists.)**

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Urinary incontinence is an important, though often unrecognized, health problem for older adults. The prevalence of daily urinary incontinence has been estimated at between 5% and 14% in US women age 60 years and older.[1] The direct medical cost of urinary incontinence in the United States has been estimated at more than $16 billion per year.[2] Urinary incontinence is an important cause of nursing-home admissions[3] and has been associated with a loss of independence[4] and quality of life.[5]

Pregnancy and parturition have been associated with the onset of urinary incontinence. The putative physiologic basis for the association between perineal trauma during parturition and postpartum incontinence includes pudendal and other pelvic nerve damage due to stretching or compression and overstretching of the pelvic floor musculature.[6,7] Urinary incontinence in the immediate postpartum period has been associated with several specific potential risk factors that occur during delivery, including type of delivery (with cesarean delivery being protective),[8] use of forceps,[9] episiotomy[9] and pudendal anesthesia (Schuessler B, Hesse U, Dimpfl T, Anthuber C. Epidural anaesthesia and avoidance of postpartum stress urinary incontinence [letter]. Lancet 1988;1:762). These studies generally have not used multivariate analysis to estimate independent associations between reproductive variables that often are correlated with each other.

Women who develop incontinence in the immediate postpartum period usually regain continence in the next 3–6 months.[8,10] However, it has been suggested that continence function regained in the 1st postpartum year subsequently may decline, due to additional trauma (eg, additional births), the effects of aging, or the loss of endogenous hormonal stimulation following menopause.[11] In support of this model, among 14 women with perineal nerve damage following vaginal

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delivery there was progression of perineal denervation at 5 years.[7]

Despite the association between birth trauma and postpartum incontinence and the potential for an increase in the risk of incontinence over time, no studies could be located, either in MEDLINE or the Scientific Citation Index, that examined the association between specific parturition factors and incontinence in later life. The reported relationship between parturition and incontinence in later life has been limited essentially to parity, which has been associated with an increased risk of incontinence, particularly stress incontinence, in most studies that examined this association.[12–14] For these reasons, the current study was undertaken to investigate potential reproductive risk factors, parturition variables, for urinary incontinence in women age 60 years and older, using a cross-sectional survey and multivariate modeling.

Materials and Methods

The study was conducted by mail survey of a random sample of women age 60 years and older who were members of Kaiser Permanente Medical Care Plan of Northern California. Kaiser is a large, prepaid group practice whose members make up approximately 30% of the population in the geographic area served, and its members generally are representative of the underlying population, except with respect to income, for which the very poor and the very wealthy are somewhat underrepresented by members.[15] Sample size calculations indicated that a study of 1000 subjects would have 80% power to detect differences, by continence status, for conditions with a prevalence of at least 10%, assuming the true relative risk was at least 1.6 and the prevalence of incontinence was 40%. A sample twice the desired study size was generated by first enumerating all women members age 60 years and older on January 1, 1994, from the complete Kaiser current membership file, assigning a computer-generated random number to each member, ordering members by random number, and selecting the first 2000.

Between April 1994 and November 1994, questionnaires were mailed to all 2000 women. Of these 2000 women, two were found to be ineligible due to errors in the membership files, 24 had died, and 52 had moved out of the area. Of the remaining 1922 women, 1436 (74.7%) completed the initial section of the survey indicating the presence or absence of urinary incontinence, and 939 (48.9%) completed the entire survey. Subjects who returned the completed survey were similar to those who did not with respect to age (69.6 versus 70.2 years). Subjects who indicated they had incontinence in the initial section were more likely to complete the entire survey than subjects indicating no incontinence (73.4% versus 50.7%). The survey asked detailed questions about reproductive history, including age of menarche and menopause, pregnancies, childbirths, lactation, gynecologic surgeries, hormone use, general health, and demographics. In addition, women reporting incontinence were requested to complete a questionnaire asking detailed questions regarding their incontinence.

Incontinent subjects ($n = 682$) were women who reported at least one episode of incontinence in the past 12 months or ever having been treated for incontinence. Women who denied ever having had incontinence were used as the comparison group ($n = 251$). The six women (0.6%) who reported having been incontinent, but not in the past 12 months, and who denied ever being treated for incontinence, were excluded from the analysis. The clinical type of incontinence was defined by combining answers to questions, based on accepted terminology for clinical urge incontinence, stress incontinence, and mixed incontinence, similar to previous investigators.[16] Specifically, subjects who answered that their incontinence was triggered by one or more activities associated with increased intra-abdominal pressure, with leakage usually occurring immediately and without a sense of urgency, were considered to have stress incontinence. Subjects who reported that they experienced a sense of urgency prior to the incontinence were classified as having urge incontinence. Those with both types were considered to have mixed incontinence. Remaining subjects with continence were labeled "other."

Initial analyses examined the univariate relationship between the variables of interest and continence status. χ^2 and t tests were used to assess the significance of the associations. Multivariate logistic regression was then applied to estimate the association between each potential risk factor and incontinence adjusted for other variables. All variables associated with urinary incontinence in the univariate analysis at a significance level of $P \leq .1$ were evaluated using multivariate modeling. Logistic regression was used to estimate the risk of urinary incontinence associated with each variable of interest, expressed as an odds ratio (OR).[17] Additional analyses examined subgroups of stress, urge, and mixed incontinence, and incontinence with onset before or after menopause, defined a priori. Data were missing for fewer than 5% of subjects for all nonparturition variables except age at last menstrual period (9%). The following percentages of data were missing for parturition variables: perineal tears requiring stitches (11%), use of epidural anesthesia (19%), use of oxytocin (27%), episiotomy (20%), use of forceps (23%), time spent pushing (47%), and use of a vacuum extractor (49%).

These last two variables were not included in the analysis due to the large proportion of missing data.

Results

Characteristics of study subjects are presented in Table 1. They were predominately white, with the remainder being approximately evenly divided among black, Asian, Hispanic, and other. More than half had attended college or a technical school. About a third had had a hysterectomy, just over a quarter had ever used oral contraceptives, and just over 60% had used estrogen replacement therapy. Although the majority of women in the study met the study definition for incontinence, only slightly more than 12% reported daily incontinence.

As shown in Table 2, the most common clinical types of incontinence were urge and mixed, with stress incontinence being less common. The distribution by type of incontinence did not differ significantly by race, although black women reported proportionally more urge incontinence. For example, among white women with incontinence, the proportions of urge, mixed, and stress incontinence were 32%, 32%, and 24%, respectively, whereas among black women the proportions were 45%, 23%, and 20%, respectively.

Women with and without incontinence were similar with respect to mean age (69.6 versus 69.6 years), education (60% versus 54% having attended college), and general health (51% versus 54% reporting excellent or very good). Incontinent women were significantly more likely to be white and to have a greater mean body mass index (Table 3). Women with incontinence did not differ from continent women in mean age of menarche (12.9 versus 12.9 years) or natural menopause (50.1 versus 49.6 years), but did report more pregnancies and births and were more likely to have had a hysterectomy before age 45. Prior use of oral contraceptives did not differ significantly by continence status, but use of estrogen replacement was more common among incontinent women.

Table 1. Characteristics of the Study Subjects

Characteristic	*n*	(%)	Mean (± SD)
Married	517	(56.2)	
White	705	(76.9)	
College or technical school	532	(58.2)	
Age (y)			69.6 ± 7.0
Body mass index (kg/m^2)			25.6 ± 5.1
General health good or excellent	466	(52.0)	
One or more live births	799	(87.5)	
Hysterectomy	311	(34.3)	
Ever used oral contraceptives	241	(26.5)	
Ever use estrogen replacement	550	(61.5)	
Daily incontinence	115	(12.3)	

SD = standard deviation.
Percentages refer to the proportion of subjects who answered the questions; denominators differ due to missing data.

Table 2. Characteristics of Women With Urinary Incontinence

Characteristic	*n*	(%)	Mean (SD)
Frequency of incontinence*			
Less than once per month	134	(19.8)	
Monthly	224	(33.0)	
Weekly	205	(30.2)	
Daily	115	(17.0)	
Type of incontinence			
Stress	159	(23.3)	
Urge	224	(32.8)	
Mixed	222	(32.5)	
Other	78	(11.4)	
Age first incontinent (y)			58.7 ± 14.8

SD = standard deviation.
Percentages refer to the proportion of subjects who answered the questions; denominators differ due to missing data.
* Monthly refers to at least once per month but less than once per week. Weekly refers to at least once per week but less than once a day.

Parturition factors were examined for 791 women with a least one live vaginal birth. At least one postdate pregnancy (at least 42 weeks) was reported by 15% of women with incontinence, compared with 9% of continent women. There was no difference by reported use of epidural anesthesia or lacerations requiring sutures. Women with incontinence were more likely to report having had a forceps delivery or an episiotomy, but this difference was not statistically significant. Only prolonged labor and use of oxytocin were significantly associated with incontinence. There was a significant dose-response for oxytocin ($P < .001$). For a single reported exposure to oxytocin, the OR was 1.85 (95% confidence interval [CI] 1.04, 3.31) and for two exposures the OR was 3.07 (95% CI 1.01, 9.31). Only 11 women reported three or more exposures to oxytocin; all were incontinent ($P < .05$).

Multivariate modeling was used to further analyze the associations between those variables associated with urinary incontinence at a significance of $P < .1$. The results of two models are presented in Table 4. The first (nonparturition) model shows the adjusted associations for all these variables for age, race, body mass index (BMI), parity, hysterectomy before age 45, and use of estrogen replacement at any time, among all subjects. The second (parturition) model includes the three parturition variables associated with urinary incontinence in the univariate analyses. By necessity, this model was restricted to the 799 subjects with at least one birth. The associations estimated for the nonparturition variables were essentially the same in both mod-

Table 3. Univariate Analysis of Variables Potentially Associated With Urinary Incontinence

Characteristic	Incontinent subjects (n = 682)		Continent subjects (n = 251)		
	n	(%)	n	(%)	P
Demographics and general variables					
Race					
White	538	(80.2)	167	(67.6)	
Hispanic	35	(5.2)	15	(6.1)	
Black	45	(6.7)	24	(9.7)	
Asian	31	(4.6)	21	(8.5)	
Other	22	(3.3)	20	(8.1)	<.05
Body mass index (kg/m^2)					
<23	189	(28.9)	115	(46.9)	
23 to <27	226	(34.5)	87	(35.5)	
27+	240	(36.6)	43	(17.6)	<.001
Reproductive					
Number of live births					
0	75	(11.2)	39	(16.0)	
1	75	(11.2)	33	(13.2)	
2+	520	(77.6)	171	(70.8)	
Hysterectomy <45 y	143	(25.4)	33	(15.9)	<.05
Hysterectomy ≥45 y	79	(15.8)	30	(14.6)	.70
Hormone use					
Ever used oral contraceptives	186	(27.9)	55	(22.6)	.13
Ever used estrogen replacement	430	(65.4)	120	(50.4)	<.01
Parturition variables (parous women only)					
Ever gestational age ≥42 wk	88	(15.2)	17	(8.7)	<.05
Cesarean delivery only	16	(2.7)	9	(4.5)	.22
Any labor >24 h	103	(20.3)	22	(12.4)	<.05
Ever oxytocin	126	(24.9)	22	(12.7)	<.001
Ever epidural anesthesia	197	(35.2)	69	(35.9)	.85
Ever forceps	251	(47.0)	78	(42.6)	.30
Ever episiotomy	426	(76.5)	136	(70.8)	.12
Ever tears needing stitches	342	(63.3)	116	(61.1)	.58

Percentages refer to the proportion of subjects who answered the questions; denominators differ due to missing data.

els; therefore the associations from nonparturition model are reported for the nonparturition variables. After adjustment for age, BMI, race, parity, hysterectomy, and estrogen replacement, an association with urinary incontinence was found for subjects who were white, had a greater BMI, greater parity, and who had ever used estrogen. The association between estrogen and incontinence appeared to be greater in those subjects who reported no hysterectomy. In the nonparturition model the adjusted OR was 2.15 (95% CI 1.43, 3.22) among women who reported never having had a hysterectomy and 1.11 (95% CI 0.51, 2.42) among women who reported having had hysterectomies (P = .15 for interaction). The association between hysterectomy and incontinence was significant after adjustment for all variables except use of estrogen replacement (OR 1.79, 95% CI 1.15, 2.77) but became nonsignificant after adjustment for estrogen (OR 1.41, 95% CI 0.89, 2.23). Of the three parturition variables associated with incontinence in the univariate analysis, only oxytocin remained after adjustment for the remaining variables (OR 1.93, 95% CI 1.02, 3.62). Adding variables weakly associated with incontinence, including education, oral contraceptive use, average gestational age, or episiotomy, did not alter these associations.

Those variables also were assessed as potential risk factors for stress incontinence only. The associations were found to be essentially similar as with all incontinence. In addition, because of the possibility that the risk of incontinence may be determined disproportionally by the first birth, compared with subsequent births, the association between parturition exposures in the first birth and incontinence was examined separately, and we found no substantial difference in the associations. There were also no substantial differences in the associations between incontinence and the parturition exposures when analysis was limited to women with daily incontinence.

Table 4. Multivariate Analysis of the Association Between Potential Risk Factors and Urinary Incontinence

Characteristic	Nonparturition model OR (95% CI)	Parturition model OR (95% CI)
White	1.84 (1.24, 2.75)	1.73 (1.02, 2.91)
Body mass index (kg/m^2)		
1st quartile (<22.1)	Referent	Referent
2nd quartile (22.1 to <24.8)	1.34 (0.84, 2.12)	1.12 (0.62, 2.00)
3rd quartile (24.8 to <28.1)	2.00 (1.25, 3.21)	1.63 (0.91, 2.95)
4th quartile (28.1+)	2.98* (1.78, 5.01)	2.67* (1.37, 5.20)
Parity (referent group = 0)		
0	Referent	
1	0.94 (0.48, 1.85)	Referent
2	1.03 (0.58, 1.82)	1.05 (0.51, 2.13)
3	1.38 (0.76, 2.51)	1.37 (0.66, 2.86)
4+	1.58* (0.87, 2.85)	1.54* (0.87, 2.74)
Hysterectomy <45 y	1.41 (0.89, 2.23)	1.54 (0.87, 2.74)
Ever used estrogen replacement therapy	1.92 (1.33, 2.76)	1.78 (1.13, 2.80)
Any gestational age ≥42 wk		1.22 (0.62, 2.39)
Any labor >24 h		0.95 (0.51, 1.77)
Ever oxytocin		1.93 (1.02, 3.62)

OR = odds ratio; CI = confidence interval.

Nonparturition model: age (continuous), race (white/other); body mass index, parity, hysterectomy < age 45, ever estrogen replacement.

Parturition model (limited to women with at least one birth): age (continuous), race (white/other), body mass index, parity, hysterectomy < age 45, ever estrogen replacement, ever gestational age >42 weeks, ever labor >24 hours, ever oxytocin.

* Test for trend significant at P < .05.

Discussion

Using MEDLINE to search the literature published since 1980 with the key word "incontinence" coupled with specific parturition terms and the Scientific Citation Index to locate articles that cited references on the association between birth trauma and postpartum incontinence, we were unable to locate any previous reports examining the association between specific parturition variables and urinary incontinence in later life. The relationships between parturition variables and incontinence found in the current study generally are consistent with previous studies[7,8,18] of parturition variables and postpartum incontinence, with the exception of the association with exposure to oxytocin.

The positive association between exposure to oxytocin and incontinence was one of the strongest associations found in the study and persisted after adjustment for age, BMI, race, parity, hysterectomy, gestational age, estrogen replacement, and other parturition variables. This association was somewhat surprising and will need to be replicated in future studies to be established. No previous studies could be located that examined the association between oxytocin and incontinence. Although there may be some unknown biologic effect of oxytocin on the urinary system, it is more likely that any causal association is the result of oxytocin's mechanical effects on labor and delivery. It could be that augmented or induced labor creates greater mechanical forces on the perineum, resulting in greater stretching of pudendal and other nerves as well as the pelvic floor musculature. It also may be true that oxytocin was used in higher doses with less intensive monitoring in the decades during which these subjects gave birth,[19] and any association may be less strong in the current period. Nonetheless, the strength of this finding and its persistence despite adjusting for multiple variables indicate that it may be a fruitful area for future study.

Prolonged labor was associated with incontinence in the study, though the association was no longer significant after adjustment for other variables. Length of second stage has been associated with postpartum incontinence in a previous study.[8] In one study,[18] prolonged labor was more common among women with postpartum stress incontinence, though the difference was not statistically significant. A significant association between episiotomy and/or third- and fourth-degree perineal tears and postpartum incontinence has also been reported in a study of 140 women[18] and a positive, though not significant association in another study of 350 women.[9] The current study found a positive but nonsignificant association between incontinence and episiotomy but not between incontinence and perineal tears requiring stitches. It is possible that many of the tears reported were second-degree tears, which could dilute any association between incontinence and third- or fourth-degree tears. Forceps delivery has been associated with an increased risk of perineal tears and of pudendal nerve damage and was positively, though not significantly, associated with postpartum urinary incontinence in a previous study.[9] In the current study, the slight positive association between incontinence and use of forceps disappeared after adjustment for other variables.

The univariate association between hysterectomy and incontinence in later life found in the study has been reported from previous population-based epidemiologic studies.[14,20,21] The unadjusted association between hysterectomy and incontinence from these studies, expressed as ORs, ranged from 1.3[14] to 2.1,[21] similar to the unadjusted association found in the current study (1.5). The one previous study[20] that reported an adjusted association (for age, parity, obesity, and medical illness) found an OR of 1.4. In the current study, most of the association between incontinence and hysterectomy was due to the association with hysterectomy before age 45. This may relate to the length of time since hysterectomy.

The association between estrogen use and incontinence found in the study may reflect the use of estrogen to treat incontinence. However, the majority (73%) of women with incontinence taking estrogen reported beginning estrogen before their first episode of incontinence, suggesting that the association was not simply a result of estrogen being used to treat incontinence. Two previous epidemiologic studies[20,21] have shown an increased prevalence of incontinence in women taking estrogen similar to the association found in our study. We could not identify any plausible mechanism by which estrogen use would be expected to cause urinary incontinence or why this association would be stronger in women without hysterectomy. It is possible that the association between estrogen use and subsequent incontinence is the result of a third factor causally related to estrogen use and incontinence but not measured in the study.

The association between parity and incontinence was expected, paralleling the findings from numerous other studies.[12–14] In our data, there was a nearly linear relationship between number of live births and risk of incontinence, at least up to four or more births, in contrast to a previous study,[20] which suggests that most of the association is with the first birth. The association found between incontinence and elevated BMI in the current study is consistent with previous reports.[20,22] The association found between incontinence and race, with incontinence being more common among white women compared with other women, has not been

reported previously, perhaps because previous population-based studies generally have been limited to white women. This difference may reflect a true difference in incontinence prevalence by race or may be the result of a differential response rate by race between continent and incontinent women in the current study. Among incontinent women, race did not appear to be related to the type of incontinence, with the possible exception of more urge incontinence among black women. This finding is similar to a study[23] that examined 200 women, referred for urogynecologic evaluation, that found white women reported urge incontinence 28% of the time compared with 56% of the time for black women. We found that the use of oral contraceptives was not associated with incontinence (OR 1.0), as did the researchers in the one previous study[14] on this topic.

The current study was limited in that it relied on women's own recall of events around the time of parturition. Such recall is limited by time since the event and may have been further attenuated by the use of sedation near the time of delivery. However, self-report among older women has been shown to correlate well with medical record documentation for such variables as height (r = .87), weight (r = .89), hysterectomy (percent agreement = .98), and age at hysterectomy (r = .95).[24] Recall several years after parturition also has been shown to correlate well with the medical record for gestational age (r = .84), parity (r = .999), use of forceps (percent agreement = .94) and cesarean delivery (percent agreement = 1.0).[25] Recall in the month following birth is excellent for episiotomy (percent agreement = .94) and perineal tears (percent agreement = .89).[26] It also seems unlikely that recall for parturition variables would be substantially biased by the presence of current incontinence. To the extent that recall is poor without being differentially worse for continent women compared with women with incontinence, the effect would be to bias an association toward the null hypothesis of no association, making the results more conservative. An additional limitation is that the data set did not include the variables of birth weight or cephalopelvic disproportion. Birth weight and cephalopelvic disproportion would be expected to act via perineal trauma, and the current analyses did control for prolonged labor, multiple measures of perineal trauma, and gestational age, which strongly correlates with birth weight. Three previous studies[15–17] found no significant association between birth weight and postpartum incontinence. Finally, the response rate of 49% leaves open the possibility that a differential response by women with one or more of the exposures of interest could have led to a biased estimate for the association between incontinence and that exposure.

The current study confirms previous findings of a positive association between incontinence and BMI, prior hysterectomy, parity, and use of estrogen. Multivariate analyses of parturition variables suggest that oxytocin may be an important, previously unrecognized risk factor for incontinence in later life. Further studies, preferably using medical records to supplement recall, would be helpful in evaluating this and other potential reproductive, hormonal, and parturition risk factors for incontinence in later life. Identification of such associations may lead to the reduction of incontinence through the modification of potential risk factors.

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