

## ORIGINAL ARTICLE

# Urinary Incontinence after Vaginal Delivery or Cesarean Section

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## ABSTRACT

**BACKGROUND**

From the Epidemiology of Incontinence in the County of Nord-Trøndelag (EPINCONT) study (G.R., A.K.D., Y.S.H., S.H.); the Section for General Practice (G.R., Y.S.H., S.H.) and the Section for Preventive Medicine (A.K.D.), Department of Public Health and Primary Health Care, University of Bergen; and the Medical Birth Registry of Norway (A.K.D.) — all in Bergen, Norway. Address reprint requests to Dr. Rortveit at the Section for General Practice, University of Bergen, Ulriksdal 8c, N-5009 Bergen, Norway, or at guri.rortveit@isf.uib.no.

It is uncertain whether women who deliver by cesarean section have an increased risk of urinary incontinence as compared with nulliparous women and whether women who deliver vaginally have an even higher risk.

**METHODS**

We studied 15,307 women enrolled in the Epidemiology of Incontinence in the County of Nord-Trøndelag (EPINCONT) study, which involved a community-based cohort. The data base for this study was linked to data from the Medical Birth Registry of Norway. We included women who answered questions related to urinary incontinence, were younger than 65 years of age, and had had no deliveries, cesarean sections only, or vaginal deliveries only.

**RESULTS**

The prevalence of any incontinence was 10.1 percent in the nulliparous group; age-standardized prevalences were 15.9 percent in the cesarean-section group and 21.0 percent in the vaginal-delivery group. Corresponding figures for moderate or severe incontinence were 3.7 percent, 6.2 percent, and 8.7 percent, respectively; figures for stress incontinence were 4.7 percent, 6.9 percent, and 12.2 percent, respectively; figures for urge incontinence were 1.6 percent, 2.2 percent, and 1.8 percent, respectively; and figures for mixed-type incontinence were 3.1 percent, 5.3 percent, and 6.1 percent, respectively. As compared with nulliparous women, women who had cesarean sections had an adjusted odds ratio for any incontinence of 1.5 (95 percent confidence interval, 1.2 to 1.9) and an adjusted odds ratio for moderate or severe incontinence of 1.4 (95 percent confidence interval, 1.0 to 2.1). Only stress and mixed-type incontinence were significantly associated with cesarean sections. The adjusted odds ratio for any incontinence associated with vaginal deliveries as compared with cesarean sections was 1.7 (95 percent confidence interval, 1.3 to 2.1), and the adjusted odds ratio for moderate or severe incontinence was 2.2 (95 percent confidence interval, 1.5 to 3.1). Only stress incontinence (adjusted odds ratio, 2.4; 95 percent confidence interval, 1.7 to 3.2) was associated with the mode of delivery.

**CONCLUSIONS**

The risk of urinary incontinence is higher among women who have had cesarean sections than among nulliparous women and is even higher among women who have had vaginal deliveries. However, these findings should not be used to justify an increase in the use of cesarean sections.

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**C**HILDBEARING IS AN ESTABLISHED risk factor for urinary incontinence among young and middle-aged women.<sup>1-4</sup> It has been suggested that vaginal delivery is the main contributing factor, possibly because of damage to important muscle tissue or nerves. However, pregnancy itself may cause mechanical changes, hormonal changes, or both that can lead to urinary incontinence. Results of epidemiologic<sup>5-8</sup> and pathophysiological<sup>9,10</sup> studies assessing the relation between the mode of delivery and incontinence have been inconclusive. A methodologic problem in many studies is the relatively small number of participants, who are sometimes drawn from selected populations. We studied women in the Norwegian Epidemiology of Incontinence in the County of Nord-Trøndelag (EPINCONT) study, a large community-based study, to evaluate the risks of incontinence associated with cesarean section and vaginal delivery.

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## METHODS

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### STUDY PARTICIPANTS

The EPINCONT study, which is described in detail elsewhere,<sup>11</sup> is part of the Nord-Trøndelag Health Study 2 (HUNT 2), which was conducted in a county of Norway between 1995 and 1997. All women older than 20 years of age (a total of 47,313 women) received a mailed invitation to visit a screening station. The source population for the EPINCONT study consisted of the 34,755 community-dwelling women who attended the screening. Women were asked to complete a questionnaire at home, and 27,936 women (80 percent) answered questions related to incontinence.

The data were linked to the Medical Birth Registry of Norway, in which the registration of all births in Norway has been compulsory since 1967. A total of 10,509 women who had given birth one or more times before 1967 and 332 women who had had multifetal gestations were excluded, as were 896 women who had delivered both vaginally and by cesarean section. In addition, we excluded 761 women who were 65 years of age or older, since few women in this age group had had all their deliveries recorded in the birth registry, and childbearing is not a significant risk factor in this age group.<sup>1</sup> Since no woman in the cesarean group had delivered more than four children, we excluded 131 women with more than four children from the vaginal-delivery group. The study group then comprised 15,307

women who were younger than 65 years of age and who either were nulliparous or had had only cesarean deliveries or only vaginal deliveries.

### QUESTIONS ABOUT INCONTINENCE

If a woman answered yes to an entry question about any involuntary loss of urine, she was asked about the frequency of leakage (less than once a month, once or more per month, once or more per week, or every day, every night, or both), the amount of leakage each time (drops, small amounts, or large amounts), the circumstance of leakage (which could include coughing, sneezing, laughing, and lifting heavy items), whether leakage was accompanied by a sudden and strong urge to urinate, and to what extent she considered leakage a problem (no problem, a small nuisance, some bother, much bother, or a major problem).

### VARIABLES AND CATEGORIZATION

Women who answered yes to the entry question (3068 women) or who gave answers regarding the frequency, volume, and type of leakage that confirmed the presence of incontinence (an additional 108 women) were considered to have incontinence. A severity index developed by Sandvik et al. was used to characterize the degree of incontinence.<sup>12</sup> The index value (ranging from 1 through 8) is calculated by multiplying the frequency (four levels) with the amount of leakage each time (reduced to two levels: drops, or small or large amounts), and incontinence was further categorized as slight (an index of 1 to 2), moderate (3 to 4), or severe (6 to 8). The severity index has been validated against a 48-hour pad-weighing test.<sup>13</sup> According to this test, slight, moderate, and severe incontinence represent a mean leakage of 6 g per 24 hours (95 percent confidence interval, 2 to 9), 17 g per 24 hours (95 percent confidence interval, 13 to 22), and 56 g per 24 hours (95 percent confidence interval, 44 to 67), respectively. Women who reported having some bother, much bother, or major problems with their leakage were classified as having bothersome incontinence.

On the basis of answers about the urge to urinate and the circumstances of leakage, the incontinence was classified as stress incontinence (if leakage was associated with coughing, sneezing, laughing, or lifting heavy items), urge incontinence (if leakage was associated with a sudden and strong urge to urinate), or mixed-type incontinence (if both stress and urge symptoms were present).<sup>11</sup> A total of 128 women with other types of incontinence or unclas-

sifiable incontinence were not included in analyses of type.

Age was categorized in 5-year or 10-year groups. Body-mass index (the weight in kilograms divided by the square of the height in meters) was calculated on the basis of measurements obtained at the screening visit, and three categories were used: less than 25.0, 25.0 to 29.9, and 30.0 or higher.

For parous women, the number of deliveries was obtained from the birth registry. The nulliparous women were identified by their absence from the birth registry; their nulliparous status was confirmed by answers about parity in the HUNT 2 study in 99.5 percent of the cases. The mode of delivery (cesarean section or vaginal delivery) was indicated in the birth registry. Since 1987, cesarean sections have been further classified in the registry as elective or nonelective. Other variables used from the birth registry were years since last delivery (in five-year increments), birth weight (0 to 2499 g, 2500 to 3999 g, or 4000 g or more), and gestational age (<28 weeks, 28 to 36 weeks, or 37, 38, 39, 40, 41, or 42 weeks — in some analyses, dichotomized into <37 weeks and  $\geq$ 37 weeks). In some analyses of birth weight and gestational age, women with two or more deliveries were included only if all deliveries were in the same category.

#### EFFECT MODIFICATION, CONFOUNDING, AND STANDARDIZATION

Age and body-mass index (in analyses in which both nulliparous and parous women were included), as well as parity, years since last delivery, birth weight, and gestational age (in analyses in which only parous women were included), were considered as potential confounders and effect modifiers. Age-standardized prevalences for 10-year categories were calculated, with nulliparous women serving as the reference population.

#### ETHICS APPROVAL

Ethics approval was obtained from both the regional and the national ethics review boards. All subjects gave explicit written informed consent to the use of the data. Approval was obtained from the Norwegian Data Inspectorate.

#### STATISTICAL ANALYSIS

Chi-square tests were performed to test differences between proportions. Effect modification was tested by the Breslow–Day test for homogeneity between odds ratios after stratified analyses.<sup>14</sup> Confounding

was evaluated by Mantel–Haenszel common odds ratios and logistic-regression analyses. Multiple logistic-regression analyses were performed to adjust for the confounders. Continence was the alternative outcome for all other outcomes (any incontinence, moderate or severe incontinence, bothersome incontinence, and all types of incontinence) in the logistic-regression analyses. We modeled age as a linear term with the use of one-year increments. Other independent variables were treated as categorical.

The proportion of incontinence among parous women that can be attributed to vaginal delivery was calculated. The attributable risk among women who had had vaginal deliveries was estimated as a percentage with the formula  $([P_e - P_o] \div P_e) \times 100$ , where  $P_e$  and  $P_o$  are prevalences in the “exposed” (vaginal-delivery) and the “unexposed” (cesarean-section) groups, respectively. The population attributable risk was estimated as a percentage with the formula  $([P_e - P_o] \times Pr_e \times 100) \div P_t$ , where  $Pr_e$  is the proportion of exposed parous women and  $P_t$  is the prevalence in the total population of parous women. Odds ratios are reported with 95 percent confidence intervals. Two-sided P values of less than 0.05 were considered to indicate statistical significance. SPSS software (version 11.0, SPSS) was used for statistical analyses.

## RESULTS

#### PREVALENCE

The prevalence of any incontinence was 20.7 percent, and the prevalence of moderate or severe incontinence was 8.7 percent. The prevalence of stress incontinence was 12.2 percent, the prevalence of urge incontinence was 1.8 percent, and the prevalence of incontinence of mixed type was 5.9 percent. The mean age was lowest in the nulliparous group and highest in the vaginal-delivery group (Table 1). The mean body-mass index was highest in the cesarean-section group, whereas values for parity, years since last delivery, mean birth weight, and gestational age were higher in the vaginal-delivery group than in the cesarean-section group. The prevalence of any incontinence increased with increasing age, body-mass index, years since last delivery, and in the vaginal-delivery group, with parity (Table 2).

#### DIFFERENCES AMONG GROUPS

Any incontinence was more frequent in the cesarean-section group and the vaginal-delivery group

than in the nulliparous group (Table 3). The difference between the two groups of parous women was attenuated by age standardization. Among the 239 primiparous women in the cesarean-section group who delivered in 1987 or later, prevalences did not differ significantly according to whether the cesarean section was elective or nonelective (15.4 percent vs. 12.1 percent,  $P=0.50$ ). When the women were stratified according to age, the same pattern found among women of all ages could be seen in the youngest age group (20 to 39 years), whereas in the oldest age group (50 to 64 years), the prevalence of incontinence was similar among women who had had vaginal deliveries and those who had had cesarean sections (Table 3).

A total of 1335 women (8.7 percent) reported incontinence that was moderate or severe. The prevalence of this end point was also higher among women who had had cesarean sections than among nulliparous women, and it was even higher among those who had had vaginal deliveries (Table 3).

The association between stress incontinence and mode of delivery was similar to that between any incontinence and mode of delivery (Table 3). Urge incontinence was not associated with mode of delivery. Mixed-type incontinence was associated with mode of delivery in the same manner as any incontinence.

**ODDS RATIOS FOR INCONTINENCE**

Table 4 shows odds ratios for incontinence associated with mode of delivery. As compared with nulliparous women, women who underwent cesarean sections had an age-adjusted odds ratio for incontinence of 1.5 (95 percent confidence interval, 1.2 to 1.9), and those who had vaginal deliveries had an age-adjusted odds ratio of 2.3 (95 percent confidence interval, 2.0 to 2.6). The odds ratios for moderate or severe incontinence were similar. Body-mass index did not confound these results, and we therefore did not adjust for it. We found no significant association between urge incontinence and any mode of delivery.

Table 4 also shows the odds ratios for incontinence associated with vaginal delivery as compared with cesarean section, with adjustment for age, parity, years since last delivery, and body-mass index. Adjustment for birth weight and gestational age did not materially affect these results (data not shown). The association between mode of delivery and moderate or severe incontinence was stronger than the association between mode of delivery and any in-

**Table 1. Characteristics of the Women in Each Study Group.\***

Characteristic	No Deliveries (N=3339)	Cesarean Sections (N=669)	Vaginal Deliveries (N=11,299)
Age (yr)	31.0±12.0	36.0±8.3	39.8±8.4
Body-mass index	25.0±4.6	26.2±4.8	25.4±4.2
No. of deliveries	—	1.7±0.8	2.2±0.8
Yr since last delivery	—	7.7±6.4	12.1±8.0
Birth weight (g)†	—	3396±743	3542±570
Gestational age (wk)†	—	39.1±2.5	40.0±2.4

\* Plus-minus values are means ±SD.

† Data are for all births in each group.

continence, in both univariable and multivariable analyses. The association between mode of delivery and bothersome incontinence was similar to the association with moderate or severe incontinence (data not shown). Stress incontinence was the only type of incontinence that was significantly associated with the mode of delivery. Effect modification by age, time since last delivery, parity, body-mass index, birth weight, or gestational age was evaluated. No effect modification of clinical interest was found.

**ATTRIBUTABLE RISK**

The attributable risk — that is, the proportion of any incontinence among women who delivered vaginally that would be preventable by cesarean sections — was 35 percent. The population attributable risk — that is, the proportion of incontinence in the population that is attributable to vaginal delivery — was 33 percent in this cohort, since 94.4 percent of the parous women had had vaginal deliveries. Corresponding figures for moderate or severe incontinence were 47 percent and 46 percent, respectively.

**DISCUSSION**

In this study, women who had delivered by cesarean section were at higher risk for any incontinence than were nulliparous women. Vaginal delivery was associated with a greater increase in risk. The risk of moderate or severe incontinence was also higher in the vaginal-delivery group than in the cesarean-section group. As compared with nulliparous status, cesarean section was associated with stress incontinence and mixed-type incontinence, whereas vaginal delivery further increased the risk of stress incontinence only.

**Table 2.** Prevalence of Incontinence and Cesarean Sections, According to Other Characteristics of the Study Participants.\*

Variable	No. (%) of Women	Percent with Any Incontinence	P Value	Percentage with Cesarean Section
<b>Age</b>				
			<0.01	
20–24 yr	1850 (12.1)	10.2		9.4
25–29 yr	1987 (13.0)	14.3		9.0
30–34 yr	2147 (14.0)	18.0		9.1
35–39 yr	2351 (15.4)	20.7		6.3
40–44 yr	2587 (16.9)	23.8		3.8
45–49 yr	2525 (16.5)	28.4		2.8
50–54 yr	1337 (8.7)	29.3		2.8
55–59 yr	343 (2.2)	22.7		4.7
60–64 yr	180 (1.2)	16.1		8.8
<b>Body-mass index</b>				
			<0.01	
<25.0	8261 (54.2)	17.1		4.8
25.0–29.9	5007 (32.9)	22.8		5.7
≥30.0	1968 (12.9)	30.5		8.1
<b>Mode of delivery</b>				
No deliveries	3339 (100.0)	10.1		—
<b>Vaginal deliveries</b>				
			<0.01	
1	2020 (17.9)	20.6		—
2	5372 (47.5)	23.8		—
3	3199 (28.3)	26.4		—
4	708 (6.3)	27.7		—
<b>Cesarean sections</b>				
			0.12	
1	330 (49.3)	17.0		—
2	231 (34.5)	17.3		—
3	98 (14.6)	9.2		—
4	10 (1.5)	10.0		—
<b>Yr since last delivery</b>				
			<0.01	
0–4	3056 (25.5)	20.3		8.9
5–9	2318 (19.4)	22.1		8.1
10–14	1871 (15.6)	24.1		5.5
15–19	2110 (17.6)	26.2		3.2
20–24	1837 (15.3)	27.6		1.3
≥25	776 (6.5)	25.4		2.1
<b>Birth weight</b>				
			0.59	
<2500 g	172 (2.0)	22.1		34.3
2500–3999 g	7654 (87.4)	22.7		5.1
≥4000 g	932 (10.6)	23.4		9.2
<b>Gestational age</b>				
			0.03	
<37 wk	202 (2.0)	17.3		19.3
≥37 wk	9666 (98.0)	23.9		5.0

\* A total of 15,307 women were included in the analysis of age, 15,236 women in the analysis of body-mass index, 15,307 women in the analysis of mode of delivery, 11,968 women in the analysis of years since last delivery, 8758 women in the analysis of birth weight, and 9868 women in the analysis of gestational age. The analyses of birth weight and gestational age included only women all of whose children were in the same category. P values were calculated by the chi-square test for trend for any incontinence in each category. Percentages for cesarean section are the proportions among parous women.

**Table 3. Observed Prevalence and Age-Standardized Prevalence of Urinary Incontinence, According to Mode of Delivery.\***

Variable	All Women	Any Incontinence	Moderate or			Mixed-Type Incontinence
			Severe Incontinence	Stress Incontinence	Urge Incontinence	
<i>number of women (percent)</i>						
<b>Any age</b>						
No deliveries	3,339 (21.8)	338 (10.1)	125 (3.7)	158 (4.7)	52 (1.6)	104 (3.1)
Cesarean sections	669 (4.4)	106 (15.8)	37 (5.5)	47 (7.0)	15 (2.2)	37 (5.5)
Age-standardized		(15.9)	(6.2)	(6.9)	(2.2)	(5.3)
Vaginal deliveries	11,299 (73.8)	2732 (24.2)	1173 (10.4)	1664 (14.7)	203 (1.8)	768 (6.8)
Age-standardized		(21.0)	(8.7)	(12.2)	(1.8)	(6.1)
<b>20–29 Yr</b>						
No deliveries	2,134 (55.6)	168 (7.9)	59 (2.8)	67 (3.1)	32 (1.5)	53 (2.5)
Cesarean sections	155 (4.0)	21 (13.5)	8 (5.2)	9 (5.8)	2 (1.3)	7 (4.5)
Vaginal deliveries	1,548 (40.3)	283 (18.3)	111 (7.2)	163 (10.5)	27 (1.7)	82 (5.3)
<b>30–39 Yr</b>						
No deliveries	448 (10.0)	38 (8.5)	11 (2.5)	19 (4.2)	2 (0.4)	15 (3.3)
Cesarean sections	309 (6.9)	40 (12.9)	12 (3.9)	18 (5.8)	7 (2.3)	12 (3.9)
Vaginal deliveries	3,741 (83.2)	794 (21.2)	316 (8.4)	476 (12.7)	60 (1.6)	220 (5.9)
<b>40–49 Yr</b>						
No deliveries	363 (7.1)	72 (19.8)	34 (9.4)	34 (9.4)	10 (2.8)	24 (6.6)
Cesarean sections	156 (3.1)	31 (19.9)	10 (6.4)	14 (9.0)	2 (1.3)	14 (9.0)
Vaginal deliveries	4,593 (89.8)	1230 (26.8)	545 (11.9)	790 (17.2)	82 (1.8)	322 (7.0)
<b>50–64 Yr</b>						
No deliveries	394 (21.2)	60 (15.2)	21 (5.3)	38 (9.6)	8 (2.0)	12 (3.0)
Cesarean sections	49 (2.6)	14 (28.6)	7 (14.3)	6 (12.2)	4 (8.2)	4 (8.2)
Vaginal deliveries	1,417 (76.2)	425 (30.0)	201 (14.2)	235 (16.6)	34 (2.4)	144 (10.2)

\* For age standardization, 10-year categories of age were used, and nulliparous women served as the reference category. The sum of women with the various types of incontinence does not equal the total with any incontinence, because the category "other types" is not shown.

Three groups of women were selected for this substudy: those who had had no deliveries, those who had had cesarean sections only, and those who had had vaginal deliveries only. This selection reduced the number of women available for analyses but made the results clearer, without loss of power to demonstrate important differences between the groups.

The detailed data on incontinence and the large number of participants permitted analyses of subgroups defined according to age, type of incontinence, and severity of incontinence. The part of the questionnaire addressing incontinence has been used in previous studies,<sup>15</sup> and the classification of types of incontinence<sup>16</sup> and the severity index have

been validated.<sup>12,13,17</sup> The EPINCONT study was community-based, and the overall response rate was very satisfactory.<sup>11</sup> Since younger women were less likely than middle-aged women to participate in this study and since healthy nulliparous women may be overrepresented in the group that chose not to participate, our results may underestimate the association between childbearing and incontinence. However, a study of nonparticipants in the Nord-Trøndelag Health Study 1 (HUNT 1) showed that the youngest nonparticipants did not have lower general morbidity than participants.<sup>18</sup> Incontinent women may have been more likely to complete the questionnaire regarding incontinence. If so, our results might slightly overestimate the prev-

**Table 4. Odds Ratios for Incontinence According to Mode of Delivery.**

Comparison	Any Incontinence	Moderate or Severe Incontinence	Stress Incontinence	Urge Incontinence	Mixed-Type Incontinence
<i>odds ratio (95 percent confidence interval)</i>					
<b>Cesarean sections as compared with no deliveries</b>					
Univariable analysis	1.7 (1.3–2.1)	1.6 (1.1–2.3)	1.6 (1.1–2.2)	1.5 (0.9–2.8)	1.9 (1.3–2.8)
Age-adjusted analysis	1.5 (1.2–1.9)	1.4 (1.0–2.1)	1.4 (1.0–2.0)	1.4 (0.8–2.6)	1.7 (1.2–2.5)
<b>Vaginal deliveries as compared with no deliveries</b>					
Univariable analysis	2.8 (2.5–3.2)	3.3 (2.7–4.0)	3.7 (3.1–4.4)	1.4 (1.0–1.9)	2.6 (2.1–3.2)
Age-adjusted analysis	2.3 (2.0–2.6)	2.6 (2.1–3.1)	3.0 (2.5–3.5)	1.2 (0.9–1.6)	2.1 (1.7–2.6)
<b>Vaginal deliveries as compared with cesarean sections</b>					
Univariable analysis	1.7 (1.4–2.1)	2.1 (1.5–2.9)	2.3 (1.7–3.1)	0.9 (0.5–1.5)	1.4 (1.0–1.9)
Multivariable analysis*	1.7 (1.3–2.1)	2.2 (1.5–3.1)	2.4 (1.7–3.2)	0.9 (0.5–1.6)	1.3 (0.9–1.9)

\* Analysis was adjusted for age, parity, years since last delivery, and body-mass index.

alence of incontinence; however, this would not influence associations between mode of delivery and the risk of incontinence.

A few studies have investigated whether cesarean section is an independent risk factor for incontinence.<sup>5,6,19</sup> Among 1333 women 48 years of age, symptoms of stress incontinence were reported by 36.7 percent of nulliparous women and by 44.4 percent in the cesarean-section group — a nonsignificant difference.<sup>6</sup> In the present study, the absolute difference of 5.7 percent in the prevalence of any incontinence between nulliparous women and women who had had cesarean sections was significant.

It is uncertain whether observed associations between a history of cesarean section and incontinence really represent an effect of pregnancy itself. Labor is common before a cesarean section, and the surgery itself might carry a risk of incontinence. However, there was no significant difference in the rate of incontinence between women who underwent elective cesarean sections and those who underwent nonelective cesarean sections. Another study of 484 primiparous women found a nonsignificant absolute difference of 7 percent between the elective group and the nonelective group, but that study had a follow-up period of only six months.<sup>7</sup>

The association between the mode of delivery and incontinence has been investigated in greater detail. A few studies have shown a greater risk after

vaginal delivery than after cesarean section. Two of these studies were conducted during the postpartum period, with short follow-up,<sup>7,20</sup> and the use of a selected population in a third study (women who had had surgery for incontinence) makes it difficult to generalize its results.<sup>8</sup> Other studies have not demonstrated significant associations, but some of them had limited statistical power.<sup>5,6</sup> Our study group was large, was selected from the general population, had a wide age distribution, and was not studied only during the postpartum period. Thus, the 8.4 percent higher prevalence of incontinence we observed among women who had had vaginal deliveries than among those who had had cesarean deliveries may be a valid estimate for the population as a whole. We did not investigate the effect of instrument-assisted deliveries, but the role of such factors is questionable,<sup>4</sup> especially in large community-based samples.

The possible effect of our findings on policy regarding indications for cesarean section requires cautious discussion. The population attributable risk associated with vaginal delivery among parous women was 33 percent for any incontinence and 46 percent for moderate or severe incontinence. A low proportion of the parous women (5.6 percent) had had all their deliveries by cesarean section. Even if this proportion were increased to 15 percent, the population attributable risk would be 30 percent

for any incontinence and 41 percent for moderate or severe incontinence. These figures imply that attempts to prevent both any incontinence and moderate or severe incontinence in the population by encouraging the use of cesarean section would have limited effect, unless a very large proportion of women were to give birth by cesarean section only. The individual woman's risk of moderate or severe incontinence would be decreased from about 10 percent to about 5 percent if she delivered all of her children by cesarean section, and this decrease would apply only until 50 years of age, since there was no association of incontinence with mode of delivery in older age groups. In addition, a previous substudy of EPINCONT did not show an association between parity and incontinence after 65 years of age.<sup>1</sup> Together, these studies imply that the mode of delivery is of minimal importance in elderly women, who have the highest prevalence of both any incontinence and moderate or severe incontinence.<sup>11</sup> Furthermore, we did not evaluate the risk of other conditions, the risk of death, or economic costs associated with the mode of delivery, and such factors would also need to be considered in any policy decisions.

We found that childbearing is associated with

an increased risk of both stress incontinence and mixed-type incontinence, whereas only the risk of stress incontinence is associated with the mode of delivery. Most studies have investigated the effect of the mode of delivery on any incontinence or stress incontinence only.<sup>7,8,21</sup> Kuh et al. reported no effect of the mode of delivery on symptoms of urge incontinence but noted an increased prevalence of symptoms of stress incontinence after vaginal delivery that was similar in magnitude to the increase in prevalence of any incontinence that we observed.<sup>6</sup>

Our study demonstrates an increased risk of urinary incontinence among women who have delivered by cesarean section as compared with nulliparous women and a further increase among women who have had vaginal deliveries. These results suggest that the mechanical strain during labor may add to the risk associated with pregnancy itself. Although these results have relevance for policy regarding indications for cesarean sections, they should not be used as an argument for the increased use of cesarean delivery.

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