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## 1 Title

2 Mode of delivery and fecal incontinence at midlife. A study of 2640 women in the GAZEL cohort.

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## 27 Short title

28 Mode of delivery and fecal incontinence

1 Précis

2 In our population of women in their 50s, fecal incontinence was not associated with either parity or mode of

3 delivery.

1           **Abstract**

2    Objective: To estimate obstetrical risk factors of fecal incontinence among middle-aged women.

3    Methods: We conducted a mail survey of the GAZEL cohort of volunteers for epidemiological research. A  
4    questionnaire on anal incontinence was mailed to 3114 women aged 50-61 years; 2640 (85%) returned it. Fecal  
5    incontinence was defined by involuntary loss of stool. Logistic regression was used to estimate the impact of  
6    obstetrical and general risk factors.

7    Results: Prevalence of fecal incontinence in the past 12 months was 9.5% (250). Significant risk factors for fecal  
8    incontinence were completion of high school (adjusted odd ratio [OR] 1.5; 95% confidence interval 1.1-2.0),  
9    self-reported depression (OR 2.1; 1.6-2.7), overweight or obesity measured by body mass index (OR 1.5 for  
10   BMI of 25-30; 1.1-2.0, OR 1.6 for BMI > 30; 1.1-2.5), surgery for urinary incontinence (OR 3.5; 2.0-6.1), and  
11   anal surgery (OR 1.7; 1.1-2.9). No obstetrical variable (parity, mode of delivery, birth weight, episiotomy, or  
12   third-degree perineal tear) was significant. Prevalence of fecal incontinence was similar for nulliparous,  
13   primiparous, secundiparous, and multiparous women (11.3, 9.0, 9.0, and 10.4% respectively), and among parous  
14   women, it was similar for women with spontaneous vaginal, instrumental (at least one), or only cesarean  
15   deliveries (9.3, 10.0, and 6.6% respectively).

16   Conclusion: In our population of women in their 50s, fecal incontinence was not associated with either parity or  
17   mode of delivery.

1           **Introduction**

2           Fecal incontinence is a serious handicap and its prevalence increases with age.<sup>1-3</sup> Because injury to the  
3           anal sphincter may occur during vaginal delivery, childbirth is thought to be a predisposing event that may lead  
4           to fecal incontinence.<sup>4, 5</sup> Several months after delivery, fecal incontinence is more frequent in women with  
5           instrumental deliveries and less frequent in those with cesarean deliveries than among women with vaginal  
6           deliveries.<sup>6</sup> It is unclear, however, if cesarean delivery still exerts a protective effect later in life.<sup>7, 8</sup>

7           Our main purpose was to estimate the prevalence of fecal incontinence among middle-aged women  
8           enrolled in a cohort study and to assess its obstetrical risk factors, while taking other characteristics into account.

9           Our secondary purpose was to analyze the association between fecal incontinence and other pelvic floor  
10          disorders.

## 1 **Methods**

2 Our population belongs to the French GAZEL cohort ([www.gazel.inserm.fr](http://www.gazel.inserm.fr)), which began in 1989 with  
3 more than 20 000 men and women employed by the French national power company (EDF-GDF) who  
4 volunteered to participate in an epidemiological research coordinated by INSERM (Institut National de la Santé  
5 et de la Recherche Médicale, that is the French National Institute for Health and Medical Research).<sup>9</sup> Women of  
6 the GAZEL cohort aged 45-50 years between 1990 and 1996 (n = 3 114) were included in a separate prospective  
7 survey, the “Women and their Health” project. Its principal objective is to study women's health as they reach  
8 menopause and afterwards.<sup>10</sup> They receive a general health questionnaire each year as part of the overall GAZEL  
9 survey and a specific questionnaire about women’s health issues every three years. In 2000 an additional  
10 questionnaire about incontinence and obstetrical history was mailed to all the women in this survey. All our data  
11 come from the mail questionnaires, primarily the questionnaire focusing on incontinence and obstetrical history.  
12 Two previous reports about urinary incontinence based on the same questionnaire and database have previously  
13 been published.<sup>11-12</sup>

14 The prevalence of anal incontinence over the previous year was estimated from responses to the question:  
15 *In the past 12 months, have you experienced involuntary loss of gas or stool? Yes or No.* Fecal incontinence was  
16 defined by involuntary loss of liquid or solid stool. Severity of anal incontinence was estimated according to  
17 Pescatori’s scoring system,<sup>13</sup> which takes into account degree (flatus, liquid stool, solid stool) and frequency  
18 (less than once a week, at least once a week, every day) of anal incontinence. Pescatori scores range from 2 (loss  
19 of flatus less than once a week) to 6 (loss of solid stool every day). Severe anal incontinence was defined by a  
20 score of 4 or higher. Stress urinary incontinence was assessed by responses to the question: *Does urine leak*  
21 *when you are physically active, cough or sneeze? Never, Rarely, Sometimes, Often, or All the time.*<sup>14</sup> Women  
22 who answered *Sometimes, Often* or *All the time* were considered to have stress urinary incontinence. Other pelvic  
23 floor symptoms (urinary urge incontinence, voiding difficulties, constipation, defecation difficulties, lower  
24 abdominal pain, pain at intercourse, vaginal bulge) were assessed by the same method.

25 We tested a wide assortment of potential risk factors for fecal incontinence: general characteristics (age at  
26 questionnaire, educational level, body mass index (BMI), and menopausal status), medical history (diabetes  
27 mellitus, hysterectomy, surgery for urinary incontinence or pelvic organ prolapse, anal surgery, and depression),  
28 life-style (household income, marital status, smoking habits, and regular physical exercise), and obstetrical  
29 history (parity, episiotomy, third-degree perineal tear, birth weight, and mode of delivery). Depression was

1 defined by self-reported depression, depressed mood, anxiety or stress during the previous 12 months.  
2 Continuous variables were transformed into categories of three classes. Standard cutoff points were used when  
3 they existed (BMI and birth weight); otherwise, classes were separated at the 25<sup>th</sup> and 75<sup>th</sup> percentiles (age and  
4 income). We compared women with fecal incontinence to all others and conducted a multivariable analysis with  
5 backward stepwise logistic regression (Table 4). Candidate variables for the multivariable model were those with  
6 a p value less than 0.10 on univariable analysis. Variables remained in the final multivariable model only if the  
7 OR was significant after backward elimination; otherwise they were excluded. Our population's size and  
8 characteristics enabled us to show a significant 6% difference in the prevalence of fecal incontinence among the  
9 parous women compared with the nulliparous (17 versus 11%) and a difference of 7% among those with  
10 spontaneous vaginal delivery compared with cesarean delivery (13 versus 6%) with a power of 80% ( $\alpha = 0.05$ ,  
11  $\beta = 0.20$ , bilateral test). We examined the association between anal incontinence according to the Pescatori score  
12 and both parity and mode of delivery (Table 5).

13 To achieve our secondary objective, we studied the association between fecal incontinence and other  
14 pelvic floor disorders, as defined above (Table 3). The univariable and multivariable analyses used logistic  
15 regression, as described above.

16 The odds ratio and its 95% confidence interval is reported for all. All analyses were performed with  
17 Statview SAS Institute Inc., Cary, NC, USA.

18 The GAZEL cohort scientific committee and the CNIL (Commission Nationale de l'Informatique et des  
19 Libertés, that is the French Data Protection Authority) approved this study, which received no external funding.

## 1        **Results**

2            Questionnaires were sent to 3 114 women, and 2640 (85%) completed and returned them. Details of the  
3 population's characteristics and obstetrical history have been already published.<sup>11</sup> Briefly, median age was 54  
4 (range 50-61) and median parity 2 (0-6); 79% were postmenopausal (Table 1). Comparisons between  
5 respondents and non-respondents showed no significant differences for age, BMI, parity, marital status or  
6 smoking. Respondents had a higher educational level than non-respondents. Data about anal continence were  
7 missing for 136 women and data concerning its severity for 11. Prevalence of anal incontinence in the past 12  
8 months was 38.5% (1016), with 28.6% (755) experiencing flatus incontinence only and 9.5% (250) fecal  
9 incontinence. The degree and frequency of anal incontinence symptoms are reported in Table 2, and the  
10 association of fecal incontinence with other anorectal, pelvic or urinary symptoms in Table 3.

11            Characteristics associated with fecal incontinence were high BMI (overweight and obesity), anal surgery,  
12 urinary incontinence surgery, completion of high school, and self-reported depression or stress (Table 4). No  
13 obstetrical variable (parity, mode of delivery, birth weight, episiotomy, or third degree perineal tear) was  
14 significant. Prevalence of fecal incontinence was similar for nulliparous, primiparous, secundiparous, and  
15 multiparous women (11.3, 9.0, 9.0, and 10.4% respectively). Among parous women, the prevalence of fecal  
16 incontinence was similar for women with spontaneous vaginal, instrumental (at least one) or only cesarean  
17 deliveries (9.3, 10.0, and 6.6% respectively). We found no association between severity of anal incontinence and  
18 parity or mode of delivery (Table 5).

## 1 **Discussion**

2 In our population of women in their 50s, the prevalence of fecal incontinence was 9.5%. Risk factors for  
3 fecal incontinence were overweight and obesity, anal surgery, urinary incontinence surgery, completion of high  
4 school, and lower household incomes. Its prevalence was similar among nulliparous and parous women and  
5 among women with spontaneous, instrumental or cesarean deliveries.

6 Our population sample is not exactly representative of middle-aged French women, because women  
7 enrolled in the GAZEL cohort were recruited from a work setting and volunteered to participate in medical  
8 research. We know, for example, that the women who agreed to participate in GAZEL had a higher education  
9 level and were in better health than nonparticipating employees.<sup>9-11</sup> The prevalence of fecal incontinence found  
10 in our study is consistent with results from other studies of women in their 50s (Table 6).<sup>1-3,15</sup>

11 The prevalence of fecal incontinence increases with age.<sup>1-3</sup> Even in asymptomatic women, manometry  
12 shows that age alters the mechanisms of anal continence.<sup>16</sup> We did not find any association with age, but the  
13 narrow range of the age distribution in our study sample (50-61 years) may explain this result.

14 The effect of pregnancy itself on anal continence has not been clearly demonstrated. Several cross-  
15 sectional studies report a higher prevalence of anal and fecal incontinence among women with children, but this  
16 association disappears after adjustment for other risk factors.<sup>17-19</sup> The large survey (10 116 men and women) by  
17 Perry et al found no difference between men and women aged 40 years or more in the prevalence of fecal  
18 incontinence (6.2 versus 5.7 respectively).<sup>2</sup> Van Brummen et al report a similar prevalence of flatus or fecal  
19 incontinence at the beginning of a first pregnancy, at the end of the pregnancy and at 3 and 12 months  
20 postpartum.<sup>20</sup> In their study, the only factors associated with flatus incontinence 12 months after first delivery  
21 were BMI and presence of the symptom at 12 weeks of gestation. It is not surprising that the relation between  
22 parity and fecal incontinence is so weak when we consider that the median age of onset of fecal incontinence is  
23 55 years.<sup>1</sup>

24 The effect of mode of delivery on anal continence is still debated. Vaginal delivery is known to expose  
25 the anal sphincter to laceration, especially during first or instrumental deliveries or when birth weight is high.<sup>21,22</sup>  
26 Even without clinical tears, vaginal delivery may lead to occult injury of the anal sphincter, visible on  
27 endosonography.<sup>5</sup> The clinical significance of these occult defects is unclear. Chaliha et al reported similar  
28 prevalence rates for fecal incontinence before and after first delivery and found no association between anal

1 symptoms and anal sphincter defects.<sup>23</sup> In cohort studies, the differences between women with vaginal and  
2 cesarean deliveries appear to weaken with time since delivery (Table 7). MacArthur et al showed that three  
3 months after a first delivery, fecal incontinence is more frequent after spontaneous or forceps delivery than after  
4 cesareans (8.8, 13.9 and 5.0% respectively).<sup>6</sup> In the same population six years later, however, no difference was  
5 observed between women with spontaneous vaginal and cesarean deliveries.<sup>25</sup> The only randomized trial  
6 evaluating vaginal delivery versus planned cesarean for breech presentation found no significant difference  
7 concerning fecal incontinence.<sup>26, 27</sup> Similarly, cross-sectional studies (of somewhat older women, on average)  
8 found no differences for women with cesarean and vaginal deliveries, especially when other risk factors were  
9 taken into account.<sup>1, 3, 18, 28, 29</sup> In our study, fecal incontinence was slightly less frequent and anal incontinence  
10 less serious after only cesarean deliveries and slightly more frequent and more serious after at least one forceps  
11 delivery (Tables 4 & 5), but this difference is not significant. This may be due to a lack of power, but it also  
12 means that the effects of mode of delivery, if they exist, are minor.

13 Third- and fourth-degree anal sphincter tears are associated with fecal incontinence one year after  
14 childbirth,<sup>20</sup> but the association is not found 6 years after delivery.<sup>25</sup> In our work, fecal incontinence was slightly  
15 more frequent among women reporting anal tears during delivery, but the difference is not significant.  
16 We found an association between history of anal surgery and fecal incontinence. Our study did not collect details  
17 of the surgery, but we can reasonably suppose that it most often involved minor procedures (for hemorrhoids,  
18 fissures, or fistula), which involve a risk of fecal incontinence when the internal sphincter is cut or damaged.<sup>30-31</sup>  
19 Barucha et al thus found an increased risk of fecal incontinence among patients with a history of anorectal  
20 surgery (univariable OR=2.3; 95%CI: 1.6-3.3), anal fissure (OR=1.6; 95%CI: 1.2-2.2) or anal fistula (OR=2.9;  
21 95%CI: 1.7-5.0).<sup>1</sup> There is no known effect of urologic surgery that explains the association we found with fecal  
22 incontinence. Nonetheless, we know that anal and fecal incontinence are often associated.<sup>3, 15, 18, 28</sup> This  
23 association may be explained by tissue characteristics that predispose women to pelvic floor disorders.

24 We observed that women with a higher educational level were more likely to report fecal incontinence.  
25 Overall, respondents in the Gazel cohort have a higher educational level than nonrespondents.<sup>9, 11</sup> We also note  
26 that only 19% of our sample had completed high school (including passing the baccalaureate examination). It  
27 may be that the better educated women find it easier to admit this type of symptom, which may be perceived as  
28 stigmatizing, humiliating, or taboo. This association was not reported in two other studies that considered  
29 educational level, but this result may be explained in part by the type of the population studied or by adjustments

1 for other characteristics, such as race or comorbidities.<sup>3,19</sup> The association between obesity and anal incontinence  
2 has previously been reported.<sup>17,18,32</sup> The mechanism of this association remains unknown.

3 Melville et al also reported an association between depression — major depression in their study — and  
4 fecal incontinence.<sup>3</sup> We did not measure depression with a specific validated scale, but simply asked women to  
5 report a history of depression, depressed mood or stress. The cross-sectional nature of our study sheds no light  
6 on the question of whether incontinence causes depression in women, or whether depression itself causes  
7 incontinence. It is possible that both depression and incontinence share a common pathway. On the other hand,  
8 depressed subjects may be more sensitive to symptoms or more likely to report symptoms than nondepressed  
9 subjects.

10 The principal limitation of this study was that fecal incontinence was not clinically confirmed. In  
11 addition, we were unable to distinguish planned and cesarean section during labor. We note however that the  
12 women questioned had given birth for the first time 30 years earlier on average (1970), at a time when elective  
13 caesareans were still rare. Despite these limitations, our study is the largest epidemiological survey about anal  
14 incontinence among middle-aged women that includes a detailed questionnaire about their delivery. In our  
15 population of women in their 50s, fecal incontinence was not associated with either parity or mode of delivery.

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Table 1

Characteristics of population (% for nominal variables and mean  $\pm$  standard deviation for continuous variables).

| Characteristics                            | Fecal incontinence |                |
|--|--------------------|----------------|
|  | No                 | Yes            |
| N  | 2243               | 250            |
| Age, years                                 | 54.9 $\pm$ 3.4     | 54.9 $\pm$ 3.4 |
| High school diploma: Yes                   | 19.0 %             | 24.4%          |
| Occupation:                                |                    |                |
| Blue collar, clerical staff                | 25.5%              | 28.9%          |
| Supervisors, sales representatives         | 65.9%              | 63.2%          |
| Management or training                     | 8.5%               | 7.9%           |
| House monthly income:                      |                    |                |
| < 1600 €                                   | 20.4%              | 19.6%          |
| 1600-2592 €                                | 43.4%              | 42.0%          |
| > 2592                                     | 18.8%              | 18.4%          |
| Marital status: Couple                     | 67.1%              | 62.8%          |
| Smoking: Yes                               | 11.3%              | 14.8%          |
| Regular physical exercise: Yes             | 52.6%              | 45.6%          |
| Depression or stress: Yes                  | 25.4%              | 41.6%          |
| Body mass index, kg/m <sup>2</sup>         | 24.3 $\pm$ 4.0     | 25.2 $\pm$ 4.3 |
| Premenopausal                              | 20.2%              | 17.6%          |
| Diabetes: Yes                              | 2.5%               | 4.4%           |
| Hysterectomy: Yes                          | 17.5%              | 19.2%          |
| Urinary incontinence surgery: Yes          | 2.1%               | 7.6%           |
| Pelvic organ prolapse surgery: Yes         | 2.5%               | 4.4%           |
| Anal surgery: Yes                          | 4.7%               | 8.4%           |
| Parity                                     | 1.6 $\pm$ 0.9      | 1.6 $\pm$ 1.0  |
| Heaviest birth weight:*                    |                    |                |
| < 3.0                                      | 16.2%              | 16.7%          |
| 3.0–3.9                                    | 72.0%              | 72.6%          |
| $\geq$ 4.0                                 | 10.4%              | 9.3%           |
| Mode of deliveries:*                       |                    |                |
| Spontaneous                                | 76.0%              | 76.3%          |
| Forceps, at least 1                        | 17.8%              | 19.5%          |
| Cesarean only                              | 6.1%               | 4.2%           |
| Episiotomy: Yes*                           | 56.7%              | 62.3%          |
| 3 <sup>rd</sup> degree perineal tear: Yes* | 7.8%               | 9.8%           |

\* For obstetrical variables percentages are among parous women only.

Table 2

Degree and frequency of anal incontinence symptoms in the past 12 months.

| Anal Incontinence             | < once a week<br>% (n) | At least once a<br>week % (n) | Every day<br>% (n) | All<br>% (n) |
|-------------------------------|------------------------|-------------------------------|--------------------|--------------|
| Flatus incontinence only      | 13.3 (352)             | 10.8 (286)                    | 4.4 (117)          | 28.6 (755)   |
| Liquid stool incontinence     | 7.2 (191)              | 0.4 (10)                      | 0.1 (3)            | 7.7 (204)    |
| Solid stool incontinence      | 1.5 (40)               | 0.2 (6)                       | 0.0 (0)            | 1.7 (46)     |
| Degree / frequency not stated | -                      | -                             | -                  | 0.4 (11)     |
| Missing data                  | -                      | -                             | -                  | 5.2 (136)    |

Table 3

Association between pelvic floor disorders and fecal incontinence. Univariable and multivariable analysis using logistic regression.

| Women's pelvic floor symptoms               |     | n    | Fecal incontinence<br>% | Univariable analysis<br>crude OR (95%CI) | Multivariable analysis<br>adjusted OR (95%CI) |
|---|-----|------|-------------------------|--|---|
| Difficult defecation                        | No  | 1735 | 8.8                     | 1  | <i>not significant</i>                        |
|   | Yes | 730  | 12.6                    | 1.5 (1.1-2.0)                            |   |
| Bowel movement < 3/week                     | No  | 1998 | 9.6                     | 1  | <i>not introduced</i>                         |
|   | Yes | 454  | 11.7                    | 1.3 (0.9-1.7)                            |   |
| Pain in lower abdomen                       | No  | 1960 | 8.5                     | 1  | <i>not significant</i>                        |
|   | Yes | 494  | 15.4                    | 2.0 (1.5-2.6)                            |   |
| Vaginal bulge                               | No  | 2351 | 9.4                     | 1  | <i>not significant</i>                        |
|   | Yes | 96   | 20.8                    | 2.5 (1.5-4.3)                            |   |
| Painful intercourse                         | No  | 1566 | 8.2                     | 1  | <i>not significant</i>                        |
|   | Yes | 350  | 14.9                    | 2.0 (1.4-2.8)                            |   |
| Stress urinary incontinence                 | No  | 1557 | 7.4                     | 1  | <i>not significant</i>                        |
|   | Yes | 1072 | 12.5                    | 1.8 (1.3-2.3)                            |   |
| Urge urinary incontinence                   | No  | 2186 | 7.5                     | 1  | 1   |
|   | Yes | 445  | 19.1                    | 2.8 (2.1-3.8)                            | 2.1 (1.6-2.9)                                 |
| Urinary infection during the past 12 months | No  | 2265 | 9.3                     | 1  | <i>not introduced</i>                         |
|   | Yes | 329  | 11.9                    | 1.3 (0.9-1.9)                            |   |
| Difficult voiding                           | No  | 2106 | 7.4                     | 1  | 1   |
|   | Yes | 433  | 20.6                    | 3.2 (2.4-4.3)                            | 2.5 (1.9-3.4)                                 |

The candidate variables introduced in the multivariable model were those with a p value < 0.10 on univariable analysis. Variables remained in the final multivariable model only if the OR was significant (p value < 0.05) after backward elimination.

Table 4

Association between women's characteristics and fecal incontinence. Bivariable analysis and logistic regression.

| Women's characteristics                 |                                    | n    | Fecal incontinence<br>% | Univariable analysis<br>crude OR (95%CI) | Multivariable<br>analysis<br>adjusted OR (95%CI) |
|---|------------------------------------|------|-------------------------|--|--|
| Age at<br>questionnaire                 | < 52                               | 643  | 9.8                     | 1  | <i>not introduced</i>                            |
|   | 52–57                              | 1396 | 9.0                     | 0.9 (0.7-1.3)                            |  |
|   | ≥ 58                               | 601  | 10.1                    | 1.1 (0.7-1.5)                            |  |
| High school<br>diploma                  | No                                 | 2069 | 8.8                     | 1  | 1  |
|   | Yes                                | 509  | 12.0                    | 1.4 (1.02-1.9)                           | 1.5 (1.1-2.0)                                    |
| Occupation                              | Blue-collar, clerical staff        | 667  | 10.5                    | 1  | <i>not introduced</i>                            |
|   | Supervisors, sales representatives | 1679 | 9.1                     | 0.8 (0.6-1.1)                            |  |
|   | Management or training             | 213  | 8.9                     | 0.8 (0.5-1.4)                            |  |
| Household<br>monthly income             | < 1600 €                           | 534  | 9.2                     | 1  | <i>not introduced</i>                            |
|   | 1600-2592 €                        | 1133 | 9.3                     | 1.0 (0.7-1.4)                            |  |
|   | > 2592 €                           | 489  | 9.4                     | 1.0 (0.7-1.6)                            |  |
| Marital status                          | Couple                             | 1759 | 8.9                     | 1  | <i>not introduced</i>                            |
|   | Alone                              | 600  | 10.7                    | 1.2 (0.9-1.7)                            |  |
| Smoking                                 | No                                 | 2297 | 9.1                     | 1  | <i>not introduced</i>                            |
|   | Yes                                | 307  | 12.1                    | 1.4 (0.9-2.0)                            |  |
| Regular physical<br>exercise            | No                                 | 1214 | 11.0                    | 1  | <i>not significant</i>                           |
|   | Yes                                | 1368 | 8.3                     | 0.7 (0.6-0.96)                           |  |
| Depression or<br>stress                 | No                                 | 1934 | 7.5                     | 1  | 1  |
|   | Yes                                | 706  | 14.7                    | 2.1 (1.6-2.7)                            | 2.1 (1.6-2.7)                                    |
| Body mass index<br>(kg/m <sup>2</sup> ) | < 25                               | 1672 | 8.1                     | 1  | 1  |
|   | 25–30                              | 660  | 11.2                    | 1.4 (1.1-1.9)                            | 1.5 (1.1-2.0)                                    |
|   | > 30                               | 249  | 13.3                    | 1.7 (1.1-2.6)                            | 1.6 (1.1-2.5)                                    |
| Menopausal<br>status                    | Pre                                | 529  | 8.3                     | 1  | <i>not introduced</i>                            |
|   | Post with HRT                      | 1306 | 9.6                     | 1.2 (0.8-1.7)                            |  |
|   | Post without HRT                   | 791  | 10.0                    | 1.2 (0.8-1.8)                            |  |
| Diabetes                                | No                                 | 2499 | 9.4                     | 1  | <i>not significant</i>                           |
|   | Yes                                | 71   | 15.5                    | 1.7 (0.9-3.4)                            |  |
| Hysterectomy                            | No                                 | 2120 | 9.4                     | 1  | <i>not introduced</i>                            |
|   | Yes                                | 463  | 10.4                    | 1.1 (0.8-1.5)                            |  |
| Urinary<br>incontinence<br>surgery      | No                                 | 2563 | 9.0                     | 1  | 1  |
|   | Yes                                | 71   | 26.8                    | 3.8 (2.2-6.5)                            | 3.5 (2.0-6.1)                                    |
| Pelvic organ<br>prolapse surgery        | No                                 | 2506 | 9.4                     | 1  | <i>not significant</i>                           |
|   | Yes                                | 70   | 15.7                    | 1.8 (0.9-3.5)                            |  |
| Anal surgery                            | No                                 | 2445 | 9.2                     | 1  | 1  |
|   | Yes                                | 134  | 15.7                    | 1.8 (1.1-3.0)                            | 1.7 (1.1-2.9)                                    |
| Parity                                  | 0                                  | 310  | 11.3                    | 1  | <i>not introduced</i>                            |
|   | 1+                                 | 2330 | 9.2                     | 0.8 (0.6-1.2)                            |  |
| Heaviest birth<br>weight<br>(kg)        | < 3.0                              | 378  | 9.5                     | 1  | <i>not introduced</i>                            |
|   | 3.0–3.9                            | 1675 | 9.3                     | 1.0 (0.7-1.4)                            |  |
|   | ≥ 4.0                              | 244  | 8.2                     | 0.9 (0.5-1.5)                            |  |
| Mode of<br>deliveries                   | Spontaneous                        | 1772 | 9.3                     | 1  | <i>not introduced</i>                            |
|   | Forceps, at least 1                | 421  | 10.0                    | 1.1 (0.8-1.6)                            |  |
|   | Cesarean only                      | 137  | 6.6                     | 0.7 (0.3-1.4)                            |  |
| Episiotomy                              | No                                 | 903  | 8.2                     | 1  | <i>not introduced</i>                            |
|   | Yes, at least 1                    | 1342 | 10.0                    | 1.3 (0.9-1.7)                            |  |
| 3 <sup>rd</sup> degree<br>perineal tear | No                                 | 2039 | 9.2                     | 1  | <i>not introduced</i>                            |
|   | Yes, at least 1                    | 184  | 11.4                    | 1.3 (0.8-2.0)                            |  |

The candidate variables introduced in the multivariable model were those with a p value < 0.10 on univariable analysis. Variables remained in the final multivariable model only if the OR was significant (p value < 0.05) after backward elimination.

Table 5

Anal incontinence severity assessed with the Pescatori score (2-3: mild, 4-6: severe), parity and mode of delivery.

|                         | Anal incontinence severity |               |              |               |
|-------------------------|----------------------------|---------------|--------------|---------------|
|                         | Mild % (n)                 | OR (CI 95%)   | Severe % (n) | OR (CI 95%)   |
| <b>Parity</b>           |                            |               |              |               |
| 0                       | 31.2 (93)                  | 1             | 7.7 (23)     | 1             |
| 1                       | 32.1 (233)                 | 1.0 (0.8-1.4) | 6.1 (44)     | 0.8 (0.5-1.3) |
| 2                       | 32.5 (373)                 | 1.1 (0.8-1.5) | 9.6 (110)    | 1.3 (0.8-2.1) |
| 3 +                     | 30.5 (99)                  | 1.0 (0.7-1.4) | 9.2 (30)     | 1.2 (0.7-2.2) |
| <b>Mode of delivery</b> |                            |               |              |               |
| Vaginal                 | 31.1 (520)                 | 1             | 8.3 (138)    | 1             |
| Instrumental            | 34.1 (135)                 | 1.2 (0.9-1.5) | 10.1 (40)    | 1.3 (0.9-1.9) |
| Cesarean only           | 38.2 (50)                  | 1.3 (0.9-1.9) | 4.6 (6)      | 0.6 (0.3-1.4) |

Table 6

Cross-sectional studies estimating the frequency of fecal incontinence among middle aged women.

| Cross-sectional study            | Population |                                      |       | Fecal Incontinence                                |      |
|----------------------------------|------------|--------------------------------------|-------|---|------|
|                                  | n          | type                                 | age   | definition  | %    |
| Roberts et al 1999 <sup>15</sup> | 228        | random sample from a health register | 50-59 | leakage of stool in the previous year             | 13.1 |
| Perry et al 2002 <sup>2</sup>    | ns         | random sample from a health register | 50-59 | leakage from bowels at least several times a year | 4.3  |
| Melville et al 2005 <sup>3</sup> | ns         | random sample from a health register | 50-59 | loss of stool occurring at least monthly.         | 7.5  |
| Bharucha et al 2006 <sup>1</sup> | 493        | random sample from a health register | 50-59 | leakage of stool in the previous year             | 21.7 |
| Varma 2006 <sup>18</sup>         | 796        | random sample from a health register | 50-59 | leakage of stool in the previous year             | 24.2 |
| Our work 2007                    | 2640       | volunteer workers                    | 50-61 | leakage of stool in the previous year             | 9.5  |

ns: not stated

Table 7

Cohort studies estimating the frequency of fecal incontinence (FI) after delivery.

| Cohort study                 | Population      | Time postpartum | Cesarean<br>% FI | Vaginal         |                     |
|------------------------------|-----------------|-----------------|------------------|-----------------|---------------------|
|                              |                 |                 |                  | Forceps<br>% FI | Spontaneous<br>% FI |
| MacArthur 2001 <sup>6</sup>  | 3261 primiparas | 3 months        | 5.0*             | 13.9*           | 8.8                 |
|                              | 3893 multiparas |                 | 9.7              | 12.2            | 10.0                |
| Eason 2002 <sup>24</sup>     | 897             | 3 months        | 1,8              | 4.1             | 3.2                 |
| Hannah 2002 <sup>26,26</sup> | 1596 †          | 3 months        | 0,8              |                 | 1,5                 |
| Hannah 2004 <sup>27</sup>    | 917 †           | 2 years         | 2,4              |                 | 2,2                 |
| MacArthur 2005 <sup>25</sup> | 1793 primiparas | 6 years         | 2.1              | 6.8*            | 2.8                 |

\* significant difference compared with spontaneous vaginal delivery.

† breech presentation, randomized trial, intention-to-treat analysis.