

**Urinary incontinence 4 and 12 years after first delivery:
Risk factors associated with prevalence, incidence,
remission, and persistence in a cohort of 236 women.**
Anne-Cécile Pizzoferrato, Arnaud Fauconnier, Emeline Quiboef, Karine
Morel, Jean-Patrick Schaal, Xavier Fritel

► **To cite this version:**

Anne-Cécile Pizzoferrato, Arnaud Fauconnier, Emeline Quiboef, Karine Morel, Jean-Patrick Schaal, et al.. Urinary incontinence 4 and 12 years after first delivery: Risk factors associated with prevalence, incidence, remission, and persistence in a cohort of 236 women.: Urinary incontinence 4 and 12 years after first delivery. Neurourology and Urodynamics, Wiley, 2014, 181, pp.259-66. <10.1002/nau.22498>. <inserm-00908244>

HAL Id: inserm-00908244

<http://www.hal.inserm.fr/inserm-00908244>

Submitted on 22 Nov 2013

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1 Title

2 **Urinary incontinence 4 and 12 years after first delivery: risk factors associated with**
3 **prevalence, incidence, remission and persistence in a cohort of 236 women**

4 Authors

5 Anne-Cécile Pizzoferrato (a,b), Arnaud Fauconnier (b,c), Emeline Quiboef (a,d), Karine
6 Morel (d), Jean-Patrick Schaal (e), Xavier Fritel (f,g)

7 Institutions

8 a) INSERM, UMR S953, Epidemiological research unit on perinatal health and
9 women's' and children's health, UPMC Univ Paris 6, Paris, France.

10 b) Department of Gynaecology and Obstetrics, Intercommunal Hospital Center of Poissy-
11 Saint-Germain-en-Laye, Poissy, France

12 c) Research unit EA7285, Risk and safety in clinical medicine for women and perinatal
13 health, Université Versailles St-Quentin, Montigny-le-Bretonneux, France.

14 d) University Hospital of La Réunion, Saint-Denis, France

15 e) University Hospital Saint-Jacques, Franche-Comté University, Besançon,
16 France

17 f) Poitiers University, INSERM CIC802, University Hospital of Poitiers, Poitiers,
18 France

19 g) INSERM, CESP Centre for Research in Epidemiology and Population Health,
20 U1018, Gender, Sexual and Reproductive Health Team, Univ Paris-Sud, UMRS
21 1018, Kremlin-Bicêtre, France; Institut National des Etudes Démographiques,
22 Paris, France

23 Correspondence

24 Prof. Xavier Fritel. Service de Gynécologie-Obstétrique et Médecine de la
25 Reproduction, CHU de Poitiers, 2 rue de la Milétrie, F-86000 Poitiers, France.
26 xavier.fritel@univ-poitiers.fr

27 Shortened running title: Urinary incontinence 4 and 12 years after first delivery

28 Word count: 2543

29 Urinary incontinence 4 and 12 years after first delivery: risk factors associated with
30 prevalence, incidence, remission and persistence in a cohort of 236 women

31 Abstract:

32 Aims: Our aim was to study risk factors associated with prevalence, incidence and remission
33 of UI 4 and 12 years after first delivery

34 Methods: 774 nulliparous women who gave birth in 1996 in two French maternity units at
35 term received a questionnaire about their urinary symptoms in 2000 and again in 2008. 236
36 women returned a questionnaire about UI 4 and 12 years after first delivery. Four groups of
37 women were built: A) women continent 4 and 12 years after first delivery; B) women
38 continent at 4 and incontinent at 12 years; C) women incontinent at 4 and continent at 12
39 years; and D) women incontinent at 4 and 12 years. Multivariate logistic regressions were
40 used to determine risk factors of UI prevalence (groups B+D vs. A+C), incidence (B vs. A),
41 remission (C vs. D) and onset of UI (D vs. B).

42 Results: Factors associated with UI 12 years after first pregnancy were: BMI (OR = 1.17
43 [95%CI: 1.04-1.32], by 1 kg/m²) and increasing BMI (1.43 [1.19-1.73]), first child's weight
44 (1.08 [1.001-1.16], by 100 g) and UI during first pregnancy (3.77 [1.83-7.76]). Factors
45 associated with UI incidence were age at first delivery (0.86 [0.75-0.98]) and high BMI (1.24
46 [1.05-1.45]). Increasing BMI, UI during first pregnancy, and heavy first child reduce the
47 likelihood of UI remission (0.37 [0.20-0.68], 0.11 [0.02-0.63], and 0.73[0.59-0.91]
48 respectively).

49 Conclusions: UI during first pregnancy could be indicative of individual susceptibility to UI.
50 Obesity appears to be a modifiable factor for remission of UI in women.

51

52 Keywords: Urinary incontinence, mode of delivery, parity, body mass index, age

53 Introduction

54 Various risk factors such as age, obesity, pregnancy and mode of delivery have been
55 associated with an increased risk of urinary incontinence (UI) in women. Numerous
56 epidemiological studies are in favour of a causal link between vaginal delivery and UI.¹⁻⁵
57 These observations are supported by studies showing that vaginal delivery can cause injuries
58 to the levator ani or the pudendal nerves.^{6,7} For DeLancey, deterioration of the continence
59 mechanisms depends on ageing and the severity of obstetric events, particularly the first
60 delivery that may lead to various types of irreversible damage.⁸ The role of menopause and
61 hormone replacement therapy (HRT) in tissue ageing are currently controversial.⁹ Concerning
62 pregnancy-related incontinence, how and when obstetric and metabolic risk factors may
63 promote UI is not clearly established.¹⁰ Viktrup et al., who reported prevalence of UI during
64 pregnancy and after first delivery,¹¹ found a maximal prevalence just before delivery with a
65 sudden drop and progressive remission twelve months after first delivery.² This may suggest
66 that we have to consider UI as a dynamic process which may sometimes begin before first
67 delivery and disappear during the year following delivery. Later, UI may reoccur in some
68 women with ageing or weight gain. Our group suggests that the trauma effect of first delivery
69 may progressively disappear with ageing while other factors possibly linked with pregnancy
70 such as weight gain could explain the link between pregnancy and late onset UI.¹⁰
71 Our objective was to analyse prevalence, incidence, remission of UI, and late or early UI
72 onset between 4 and 12 years after the first delivery in a cohort of 236 women.

73

74 Methods

75 We conducted a follow-up of women included in a previous comparative study, the main
76 objective of which was to compare pelvic floor disorders 4 years after first delivery in two
77 hospitals with different policies for episiotomy.^{3,12} This study included nulliparous women
78 who gave birth in 1996 at a term of 37–41 weeks to a live-born singleton with a cephalic
79 presentation. The cohort was based on extraction from the obstetrics database of the two
80 hospitals. The patients received a postal questionnaire in 2000, 4 years after first delivery
81 (baseline). If no response was received, a second and then a third letter were sent. They were
82 asked in this questionnaire if they agreed to participate in a new enquiry. If the response was
83 “Yes”, they received a second questionnaire in 2008, 12 years after first delivery (follow-up)
84 (Figure 1).

85 Data about the mothers (age at first delivery, height and weight), pregnancy and delivery
86 (epidural, mode of delivery, duration of the active-pushing second stage of labour, child’s
87 weight) were collected at delivery. Information about pelvic floor disorders, weight, new
88 pregnancies and deliveries were obtained from the mailed questionnaires. A question about
89 urinary incontinence during the first pregnancy was included in the 4-year questionnaire.
90 Height and weight were obtained to determine body mass index (BMI) in 2000 and 2008 for
91 each patient. The BMI-variation variable allowed us to study the variations of patients’ BMI
92 during follow-up. In 2008, questions were asked about parity twelve years after first delivery
93 and the mode of delivery. The “additional parity” variable during follow-up was defined as
94 the number of subsequent pregnancies between 2000 and 2008 to study more specifically the
95 influence of pregnancy on later UI. We also selected the “first child’s weight” variable which
96 can be linked with the trauma theory. The responses to the “mode of delivery” question could
97 be ‘vaginally every time’ or ‘always by caesarean section’ or ‘at least once vaginally and at
98 least once by caesarean section’.

99 The question of interest 4 and 12 years after first delivery was ‘Do you have involuntary loss
100 of urine?’. If the women answered ‘yes’ to this question, they were considered to have urinary
101 incontinence. The Sandvik score was used to estimate UI severity. This score combines
102 frequency and amount of leakage and it showed good correlation with pad-weighing tests.¹³

103 For the analysis we distinguished four groups of women based on UI at base-line (4 years
104 after first delivery) and UI at follow-up (12 years after first delivery): i) women continent at
105 base line and follow-up (n=125, group A, *Stay continent*); ii) women continent at baseline and
106 incontinent at follow-up (n=32, group B, *Become incontinent*); iii) women incontinent at
107 baseline and continent at follow-up (n=30, group C, *Become continent*); and iv) women
108 incontinent at baseline and follow-up (n=49, group D: *Stay incontinent*) (Figure 2). In the
109 bivariate analysis, we examined the differences between variables in the four groups of
110 women. The Chi-square test for heterogeneity was used for categorical variables and the
111 ANOVA test for quantitative variables. In order to check that the four groups built
112 corresponded to described events, we built the “deltaSandvik” variable, subtracting the
113 Sandvik score in 2008 from the Sandvik score in 2000.

114 Four final explanatory models were built using multiple logistic regression, and these models
115 numbered from 1 to 4 were used for the following comparisons: 1) *Prevalence UI model*
116 comparing incontinent women (groups B +D) with continent women (groups A+C) at follow-
117 up; to study factors associated with UI prevalence 12 years after first delivery. 2) *Incidence*
118 *UI model* comparing group B (become incontinent) with group A (stay continent). This model
119 analyses risk factors associated with UI arising at some time after the first pregnancy. They
120 can be associated with new pregnancies or other events such as weight gain. 3) *Remission UI*
121 *model* comparing group C (become continent) with group D (stay incontinent), to pinpoint
122 factors associated with remission of UI some time after the first pregnancy; 4) *Onset UI*
123 *model* comparing group B (become incontinent) with group D (stay incontinent). This

124 comparison concerns the beginning of UI: women in group D were incontinent less than 4
125 years after first delivery while in group B UI first occurred at a later date. It investigates more
126 specifically the supposed factors associated with the traumatic aspect of UI.

127 Variables were not divided into classes in order to avoid loss of power due to categorization
128 of the variables. The linearity of our variables was verified by using likelihood ratios. The
129 parameter values for each of the final models were estimated by the maximum likelihood
130 method.

131 The factors retained for the multivariable analysis were those associated with a level of
132 significance $p < 0.20$ during bivariate analysis and those that were clinically relevant to our
133 hypothesis (for example mode of delivery, parity). We also included in our models the
134 patients' age and the centre, considered as confusion factors. We planned to build each
135 multivariate model with the same variables.

136 All analyses were performed with Stata 9.0 (Stata Corp., College Station, Texas).

137

138 Results

139 The questionnaire was mailed, 12 years after first delivery, to the 572 women who had
140 accepted to participate in the survey. However 254 (44.4%) had moved, and didn't receive it.
141 Of the 318 women who received the questionnaire, 236 sent their responses (74.2%) (Figure
142 1).

143 The mean age of the responders was 41.3 years (± 4.5), mean parity was 2.1 (± 0.5) and mean
144 BMI was 22.7 kg/m² (± 3.7). The mean age was not significantly different between women
145 who stayed I-para and women who had 1 or more supplementary pregnancies. Responders
146 were significantly older at first delivery (29.3 versus 27.8 years, $p=0.03$) and had a higher
147 educational level (72.7 versus 64.4% had high school diploma, $p=0.001$) than the non-
148 responders (defined as all women who didn't answer). Differences between responders and
149 non-responders for obstetrical variables, centre, or body mass index (BMI) were not
150 significant (data not shown). The prevalence of UI was similar at baseline and follow-up (4
151 and 12 years after first delivery), respectively 33.5 and 34.3% ($p=0.23$, Figure 2). The mean
152 Sandvik score was also similar at baseline and follow-up (0.8 ± 1.4 versus 0.9 ± 1.8 , $p=0.23$).
153 The *de novo* UI rate was 20.4% during follow-up and the UI remission rate was 38.0%
154 (Figure 2). Between baseline and follow-up the continence status had changed for 62 women
155 (26%). No women reported UI surgery during the interval.

156 The mean difference in UI severity score (deltaSandvik) was zero in group A (stay continent
157 during the period), was greater than 1 in group B (become incontinent) and negative in group
158 C (become continent) with a significant difference between the four groups (Table I).

159 The women's characteristics according to continence status at baseline and follow-up are
160 presented in Table II. The prevalence of UI at follow-up increased with a higher weight for
161 the first child, a higher BMI at baseline, and increased BMI at follow-up (Model 1, Table III).
162 Incident UI during follow-up was associated with a younger age and a higher BMI at baseline

163 (Model 2, Table III). A BMI increase, UI during first pregnancy, and a heavy first child
164 reduce the likelihood of UI remission (0.37 [0.20-0.68], 0.11 [0.02-0.63], and 0.73 [0.59-0.91]
165 respectively) (Model 3, Table III). An early UI onset (vs. later) was associated with UI during
166 the first pregnancy, and increased BMI at follow-up (Model 4, Table III). No association was
167 found between additional parity and UI in any model.

168

169 Discussion:

170 Our study showed that despite similar prevalence rates 4 and 12 years after first delivery, UI
171 is a dynamic condition with various situations and different risk factors: an older age was
172 associated with a higher risk of developing UI 12 years after first delivery in women continent
173 at 4 years; UI during the first pregnancy increased the long-term risk of UI and decreased the
174 chance of remission between 4 and 12 years; a higher weight of the child was associated with
175 a higher risk of UI 12 years after first delivery and decreased the chance of remission; a high
176 BMI at baseline was associated with a higher risk of developing UI 12 years after first
177 delivery, while loss of weight increased the chance of remission.

178 The strength of this study resides in its longitudinal design and the long follow-up period.
179 Most epidemiological studies analysing UI are cross-sectional.^{1,14-16,19,20} They consist in
180 interviewing women of different ages at the same point in time. This element is of major
181 importance in the examination of obstetric risk factors because obstetrical practices have
182 considerably changed over the last 30 years. Specifically, women are not equally exposed to
183 caesarean section now as compared to 30 years ago. In France, the c-section rate rose from
184 11% in 1981 to 16% in 1995, and 21% in 2010.^{15,16} Cross-sectional studies compare women
185 exposed to different prevalences for c-section, which may explain why, in the EPINCONT
186 study, women delivered by c-section were younger than women delivered vaginally.¹⁴

187 Four studies^{2,4,17,18} have reported on UI more than 10 years after the first delivery. Unlike in
188 our study, their analysis addressed UI prevalence: this type of analysis does not allow factors
189 which may modulate the risk of UI after delivery to be taken into account, in particular
190 modifiable factors or factors posterior to delivery.

191 However, the small size of our sample limits the power of the study and the number of
192 variables which could be used in multivariate analyses. The lack of association between mode
193 of delivery and incontinence could be explained by our small sample size. In addition the fact

194 that UI during the first pregnancy was assessed 4 years after delivery rather than during or
195 immediately after delivery is also a limitation of our study. We had a high rate of non-
196 response twelve years after the first delivery, mostly because the women had moved. We
197 assume that that moving was not associated with UI. Older women and women with a higher
198 educational level had higher response rates at baseline and follow-up. These differences might
199 affect symptom prevalence, but not changes (incidence or remission) between baseline and
200 follow-up. Using self-administered questionnaires introduces an element of subjectivity. This
201 element of subjectivity is admitted by the ICS definition of UI “complaint of involuntary
202 loss”¹⁹ and the use of a validated questionnaire and the Sandvik score allowed us to test the
203 reality of our question of interest.

204 Obesity and overweight are risk factors for an increased risk of UI found in numerous cross-
205 sectional epidemiological studies.²⁰⁻²² We found that higher BMI 4 years after first delivery
206 and an increase of the BMI between 4 and 12 years were associated with a significant increase
207 of the risk of long-term UI. The incidence of *de novo* UI was associated with a higher BMI
208 while remission of UI was associated with a decrease in BMI. This last result is in agreement
209 with the recent randomised trial by Subak et al. on 338 overweight and obese incontinent
210 women. They showed that a programme of moderate weight loss allowed the frequency of the
211 episodes of incontinence to be reduced by about 50 %.²³

212 Despite the fact that the mode of delivery in our study was not associated with incidence or
213 remission of IU, it is interesting to note that other obstetric variables (first child’s weight, UI
214 during first pregnancy) do seem to be associated with UI remission. Negative outcomes
215 related to obstetrical factors are always difficult to interpret and events occurring during a
216 subsequent pregnancy and delivery may influence later continence status.

217 Pregnancy could reveal an individual susceptibility for later UI through cervico-urethral
218 mobility. We know that there is a link between prenatal urethral mobility and postnatal SUI²⁴

219 but there is still no data in the literature about the link between cervico-urethral mobility and
220 UI during first pregnancy.

221 The first child's weight was already known to be a risk factor for UI after the first
222 delivery.^{17,18} In our study, an increase of 100 g in the first child's weight increased the risk of
223 long-term incontinence by 8.0 %, independently of the mother's BMI and mode of delivery,
224 and decreased the chances of remission. This factor was possibly associated with the mode of
225 delivery and the consequences in terms of trauma. But the association between the first
226 child's weight and risk of UI can also be explained by metabolic causes, e.g. gestational
227 diabetes mellitus (GDM). We know that GDM favours foetal macrosomia and is a risk factor
228 for later type 2 diabetes and SUI.^{25,26}

229 Another point to discuss is the inverse relation between *de novo* UI and age at first delivery:
230 the older the women were at the time of their first delivery, the lower the risk of developing
231 *de novo* UI. Our hypothesis is that older continent primiparous women are a selected healthy
232 population: if they are still continent despite ageing and a first delivery, they are protected
233 against *de novo* UI later.

234 As we specified above, the "onset of UI" model, which compares early versus later UI,
235 investigates more specifically the supposed risk factors associated with the first delivery. The
236 risk of early UI is considerably increased in women whose UI started before the first delivery
237 compared with the women whose UI began later; this suggests the importance of
238 constitutional factors in UI. BMI was also associated with an earlier onset of UI but we were
239 not able to explain our results.

240

241

242 Conclusion

243 The presence of UI during first pregnancy could be indicative of an individual susceptibility
244 to UI. Obesity appears to be a modifiable factor for remission of UI in women. It seems
245 essential to consider these constitutional factors (UI during the first pregnancy) and weight
246 gain as being just as important as the mode of delivery when studying female UI.

247

248 Tables and figures

249 Table I : Mean deltaSandvik according to the four groups of patients.

250 Table II : Distribution of risk factors according to continence status 4-12 years after first
251 delivery.

252 Table III : Risk factors for UI prevalence 12 years after first delivery, incidence, remission
253 and persistence of UI between 4 and 12 years after first delivery.

254 Figure 1 : Flowchart.

255 Figure 2 : Continence status 4-12 years after first delivery.

256

257 Contribution to authorship

258 ACP contributed to analysis and interpretation of data and article writing. XF contributed to
259 the conception of the study, the design and the interpretation of data and article writing. KM
260 contributed to data management, AF contributed to analysis and interpretation of data and
261 revision of the article and EQ to data interpretation and revision of the manuscript. JPS
262 contributed to conception of the initial study.

263

264 Disclosure of interests

265 We have no direct or indirect commercial financial incentive associated with publication of
266 the article.

267

268 Ethical approval

269 Our work complies with French statutes and regulations, which authorize epidemiological
270 surveys without advance approval of an ethics committee. Our survey involved no
271 intervention and is thus excluded from the French statute on biomedical research (LoiHuriet-
272 Serusclat, dated 20 December 1998). We complied with all French statutes concerning data

273 about the subjects, confidentiality, and restrictions (e.g. no religious or racial data). Informed
274 consent was obtained from each responding woman. The Ethical Review Committee «
275 Comité d'éthique de la recherche en obstétrique et gynécologie » of the French college of
276 Gynaecologists and Obstetricians has examined the research and found it to comply with
277 generally accepted scientific principles and medical research ethical standards (CEROG-
278 2009-022).

279

280 Funding

281 We had no exterior funding for this work.

282

- 1 Rortveit G, Daltveit AK, Hannestad YS, Hunskaar S. Urinary incontinence after vaginal delivery or cesarean section. *N Engl J Med* 2003;348:900-7.
- 2 Viktrup L, Rortveit G, Lose G. Risk of stress urinary incontinence twelve years after the first pregnancy and delivery. *ObstetGynecol* 2006;108:248-54.
- 3 Fritel X, Fauconnier A, Levet C, Bénifla JL. Stress urinary incontinence 4 years after the first delivery: a retrospective cohort survey. *ActaObstetGynecol Scand* 2004;83:941-5.
- 4 MacArthur C, Glazener CM, Wilson PD, Lancashire RJ, Herbison GP, Grant AM. Persistent urinary incontinence and delivery mode history: a six-year longitudinal study. *BJOG* 2006;113:218-24.
- 5 MacArthur C, Glazener C, Lancashire R, Herbison P, Wilson D; on behalf of the ProLong study group. Exclusive caesarean section delivery and subsequent urinary and faecal incontinence: a 12-year longitudinal study. *BJOG* 2011;118:1001-7.
- 6 Dietz HP, Lanzarone V. Levator trauma after vaginal delivery. *ObstetGynecol* 2005;106:707-12.
- 7 Kearney R, Miller JM, Ashton-Miller JA, DeLancey JO. Obstetric factors associated with levator ani muscle injury after vaginal birth. *Obstet Gynecol* 2006;107:144-9.
- 8 DeLancey JOL, Kane Low L, Miller JM, et al. Graphic integration of causal factors of pelvic floor disorders: an integrated life span model. *Am J Obstet Gynecol* 2008;199:610.e1-5.
- 9 Legendre G, Fritel X, Ringa V, Lesavre M, Fernandez H. Urinary incontinence and menopause. *Prog Urol* 2012;22:615-21.
- 10 Fritel X, Ringa V, Quiboeuf E, Fauconnier A. Female urinary incontinence, from pregnancy to menopause: a review of epidemiological and pathophysiological findings. *Acta Obstet Gynecol Scand*. 2012 Aug;91:901-10.
- 11 Viktrup L, Lose G, Rolff M, Boarfoed K. The symptom of stress incontinence caused by pregnancy or delivery in primiparas. *Obstet Gynecol* 1992;79:945-9.
- 12 Fritel X, Schaal JP, Fauconnier A, Bertrand V, Levet C, Pigné A. Pelvic floor disorders 4 years after first delivery, a comparative study of restrictive versus systematic episiotomy. *BJOG* 2008;115:247-52.

-
- 13 Sandvik H, Seim A, Vanvik A, Hunskaar S, Sandvik A. Severity index for epidemiological surveys of female urinary incontinence: comparison with 48-hour pad-weighing tests. *Neurourol Urodyn* 2000;19:137-45.
- 14 Rortveit G, Hannestad YS, Daltveit AK, Hunskaar S. Age- and type-dependent effects of parity on urinary incontinence : The Norwegian EPINCONT Study. *Obstet Gynecol* 2001;98:1004-10
- 15 Blondel B, Bréart G, du Mazaubrun C, Badeyan G, Wcislo M, Lordier A, Matet N. La situation périnatale en France, évolution entre 1981 et 1995 [The perinatal situation in France. Trends between 1981 and 1995]. *J Gynecol Obstet Biol Reprod* 1997;26:770-80.
- 16 DREES, Ministère des affaires sociales, du travail et de la solidarité. La situation périnatale en France en 2010, premiers résultats de l'enquête nationale périnatale [Perinatal situation in France in 2010, first results of the national perinatal survey]. *Etudes et résultats* 2011;775. <http://www.drees.sante.gouv.fr/IMG/pdf/er775-2.pdf>, last accessed August 2012.
- 17 Dolan LM, Hosker GL, Mallett VT, Allen RE, Smith AR. Stress incontinence and pelvic floor neurophysiology 15 years after the first delivery. *BJOG* 2003;110:1107-14.
- 18 Gyhagen M, Bullarbo M, Nielsen T, Milsom I. The prevalence of urinary incontinence 20 years after childbirth: a national cohort study in singleton primiparae after vaginal or caesarean delivery. *BJOG* 2013;120:144-51.
- 19 Haylen BT, de Ridder D, Freeman RM, Swift SE, Berghmans B, Lee J, Monga A et al. An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for female pelvic floor dysfunction. *Neurourol Urodyn* 2010;29:4-20.
- 20 MacLennan A, Taylor AW, Wilson DH, Wilson D. The prevalence of pelvic floor disorders and their relationship to gender, age, parity and mode of delivery. *BJOG* 2000;107:1460-70.
- 21 Hannestad YS, Rortveit G, Sandvik H, Hunskaar S. A community-based epidemiological survey of female urinary incontinence; The Norwegian EPINCONT Study. *J Clin Epidemiol* 2000;53:1150-7.
- 22 Minassian VA, Stewart WF, Wood GC. Urinary incontinence in women: variation in prevalence estimates and risk factors. *Obstet Gynecol* 2008;111:324-31.

-
- 23 Subak LL, Wing R, West DS, Franklin F, Vittinghoff E, Creasman JM, Richter HE, Myers D, Burgio KL, Gorin AA, Macer J, Kusek JW, Grady D; PRIDE Investigators. Weight loss to treat urinary incontinence in overweight and obese women. *N Engl J Med* 2009;360:481-90.
- 24 King JK, Freeman RM. Is antenatal bladder neck mobility a risk factor for postpartum stress incontinence? *BJOG* 1998;105:1300-7.
- 25 McDonald SD, Yusuf S, Sheridan P, Anand SS, Gerstein HC; Diabetes Reduction Assessment with Ramipril and Rosiglitazone Medication Trial Investigators. Dysglycemia and a history of reproductive risk factors. *Diabetes Care* 2008;31:1635-8.
- 26 Brown JS, Vittinghoff E, Lin F, Nyberg LM, Kusek JW, Kanaya AM. Prevalence and risk factors for urinary incontinence in women with type 2 diabetes and impaired fasting glucose: findings from the National Health and Nutrition Examination Survey (NHANES) 2001-2002. *Diabetes Care* 2006;29:1307-12.

284 Table I.

285

286 Evolution of the urinary incontinence severity score (deltaSandvik) between baseline and follow-up according to
287 the four groups of women.

288

289 Group A) women who were continent at baseline and follow-up; B) women continent at baseline who became
290 incontinent at follow-up; C) women incontinent at baseline who became continent at follow-up; and D) women
291 incontinent at baseline and follow-up.

292

293

Evolution of the UI severity score

Groups	Stay continent	Become incontinent	Become continent	Stay incontinent	
	Group A	Group B	Group C	Group D	
	(n=125)	(n=32)	(n=30)	(n=49)	
	mean (\pm SD)	mean (\pm SD)	mean (\pm SD)	mean (\pm SD)	p
deltaSandvik*	0 (\pm 0.0)	+2.0 (\pm 1.6)	-2.1 (\pm 1.4)	+0.6 (\pm 2.0)	<10 ⁻⁴

294 *deltaSandvik = variable subtracting the Sandvik score in 2008 by the Sandvik score in 2000.

295

296

297 Table II.

298 Distribution of risk factors according to continence status 4-12 years after 1st delivery. Group A) women who
 299 were continent 4-12 years after 1st delivery; B) women who were continent 4 years after 1st delivery and 12
 300 years after; C) women who were incontinent 4 years after 1st delivery and became continent 12 years after, and
 301 D) women incontinent 4-12 years after 1st delivery.

302 Three bivariate logistic regressions were performed between groups A versus B, C vs. D, and B vs. D.
 303 Significant results ($p < 0.20$) are indicated by the index letter of the group concerned by the comparison.

Risk Factors	n (%) or mean (\pm SD)	Continence status 4 and 12 years after first delivery			
		Stay continent Group A (N=125)	Become incontinent Group B (N=32)	Become continent Group C (N=30)	Stay incontinent Group D (N=49)
Menopausal	No	118 (94.4)	31 (96.9)	29 (96.7)	46 (93.9)
	Yes	7 (5.6)	1 (3.1)	1 (3.3)	3 (6.1)
High school diploma	No	34 (27.4)	7 (21.9)	10 (34.5)	13 (26.5)
	Yes	90 (72.6)	25 (78.1)	19 (65.5)	36 (73.5)
Regular physical activity	<1/week	70 (56.0)	21 (65.6)	18 (60.0)	32 (65.3)
	\geq 1/week	55 (44.0)	11 (34.4)	12 (40.0)	17 (34.7)
Age at 1st delivery	(years)	29.0 (\pm 4.4)	28.3 (\pm 3.7)	30.3 (\pm 4.7)	30.1 (\pm 4.8)
UI* during 1 st pregnancy	No	106 (86.9)	25 (80.7)	20 (69.0)	21 (43.7)
	Yes	16 (13.1) ^D	6 (19.3)	9 (31.0)	27 (56.3) ^A
Gestational age at 1st delivery	< 40 weeks	61 (48.8)	16 (50.0)	14 (46.7)	19 (38.8)
	\geq 40 weeks	64 (51.2)	16 (50.0)	16 (53.3)	30 (61.2)
Mode of 1 st delivery	vaginal	115 (92.0)	29 (90.7)	29 (96.7)	45 (91.8)
	cesarean	10 (8.0)	3 (9.4)	1 (3.3)	4 (8.2)
First child's weight	(/100g)	32.4 (\pm 4.4) ^D	32.9 (\pm 4.4)	31.7 (\pm 3.4) ^D	33.9 (\pm 4.0) ^{A,C}
BMI at baseline [‡]	(kg/m ²)	21.3 (\pm 2.7) ^{B,D}	22.8 (\pm 4.1) ^A	22.5 (\pm 3.7)	23.0 (\pm 3.9) ^A
Delta BMI during follow-up ^{‡‡}	(kg/m ²)	0.7 (\pm 1.6) ^D	1.1 (\pm 2.1)	-0.2 (\pm 2.4) ^D	1.7 (\pm 2.0) ^{A,C}
Parity at baseline [†]	1	53 (42.4)	11 (34.4)	13 (43.3)	22 (44.9)
	2+	72 (57.6)	21 (65.6)	17 (56.7)	27 (55.1)
Additional parity during follow-up ^{††}	0	28 (22.4)	5 (15.6)	8 (26.7)	14 (28.6)
	1	60 (48.0)	16 (50.0)	16 (53.3)	24 (49.0)
	2+	37 (29.6)	11 (34.4)	6 (20.0)	11 (22.4)
Mode of all deliveries	Only vaginal	107 (85.6)	29 (90.6)	28 (93.3)	45 (91.8)
	Only cesarean	9 (7.2)	0	0	3 (6.1)
	Mixed	9 (7.2)	3 (9.4)	2 (6.7)	1 (2.1)

304 *UI: Urinary incontinence.

305 ‡BMI at baseline: Body Mass Index in 2000 (four years after first delivery). ‡‡Delta BMI during follow-up:
 306 variation of Body Mass Index between 2000 and 2008 (between four and twelve years after first delivery).

307 †Parity at baseline: parity four years after first delivery. ††Additional parity during follow-up: number of
 308 subsequent pregnancies between 2000 and 2008 (between four and twelve years after first delivery).

309

310 Table III.

311 Risk factors for UI prevalence 12 years after first delivery, incidence, remission, and persistence of UI between 4
 312 and 12 years after first delivery. Variables included in each multivariate model were those associated with p
 313 <0.20 during bivariate analysis (BMI at baseline, delta BMI during follow-up, UI during first pregnancy, first
 314 child's weight) and those originally planned (maternity, age, mode of delivery). Non significant variables
 315 (p>0.20) during bivariate analysis (menopausal status, high school diploma, regular physical exercise, smoking)
 316 were not included.

317 Group A) women who were continent at baseline and follow-up; B) women continent at baseline who became
 318 incontinent at follow-up; C) women incontinent at baseline who became continent at follow-up; and D) women
 319 incontinent at baseline and follow-up.

320

Risk factors for UI prevalence 12 years after 1 st delivery, incidence, remission, and persistence of UI between 4 and 12 years after 1 st delivery					
		Model 1: UI prevalence at follow-up	Model 2: Incidence of UI at follow-up in women continent at baseline	Model 3: UI remission at follow-up in women incontinent at baseline	Model 4: Onset of UI in women incontinent at follow-up
		UI vs. no UI (B+D vs. A+C)	(B vs. A)	(C vs. D)	early vs. later (D vs. B)
Risk factors		adjusted OR [95% CI]			
Age at 1st delivery (years)		0.97 [0.89-1.05]	0.86 [0.75-0.98]	0.96 [0.82-1.13]	1.26 [1.05-1.50]
UI* during 1st pregnancy	No	1	1	1	1
	Yes	3.77 [1.83-7.76]	1.72 [0.54-4.49]	0.11 [0.02-0.63]	7.33 [2.06-26.04]
BMI at baseline (kg/m2) [‡]		1.17 [1.04-1.32]	1.24 [1.05-1.45]	0.97 [0.76-1.25]	0.88 [0.74-1.06]
Delta BMI during follow up ^{‡‡}		1.43 [1.19-1.73]	1.17 [0.93-1.47]	0.37 [0.20-0.68]	1.46 [1.03-2.08]
First child's weight (/100g)		1.08 [1.001-1.16]	0.99 [0.89-1.10]	0.73 [0.59-0.91]	1.24 [1.03-1.48]
Parity at baseline [†]	1	1	1	1	1
	2+	1.03 [0.54-1.98]	1.63 [0.62-4.25]	0.95 [0.25-3.55]	0.75 [0.21-2.65]
Additional parity during follow up ^{††}	No	1	1	1	1
	Yes	1.03 [0.51-2.07]	1.01 [0.40-2.52]	0.33 [0.07-1.51]	1.10 [0.31-3.93]
Mode of 1 st delivery	Vaginal	1	1	1	1
	Caesarean	0.51 [0.14-1.90]	0.78 [0.15-4.19]	0.34 [0.01-11.69]	0.15 [0.02-1.45]

321 *UI: Urinary incontinence.

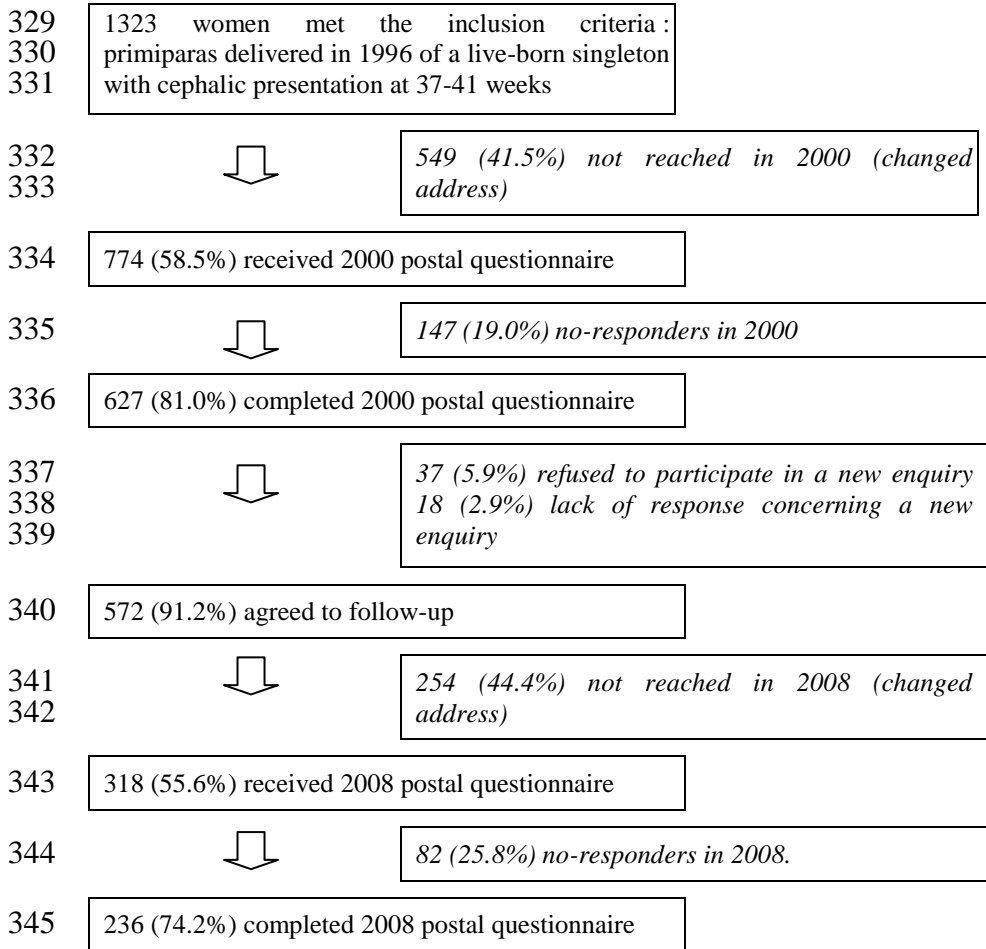
322 ‡BMI at baseline: Body Mass Index in 2000 (four years after first delivery). ‡‡Delta BMI during follow-up:
 323 variation of Body Mass Index between 2000 and 2008 (between four and twelve years after first delivery).

324 †Parity at baseline: parity four years after first delivery . ††Additional parity during follow-up: number of
 325 subsequent pregnancies between 2000 and 2008 (between four and twelve years after first delivery).

326

327

328 Figure 1: flowchart

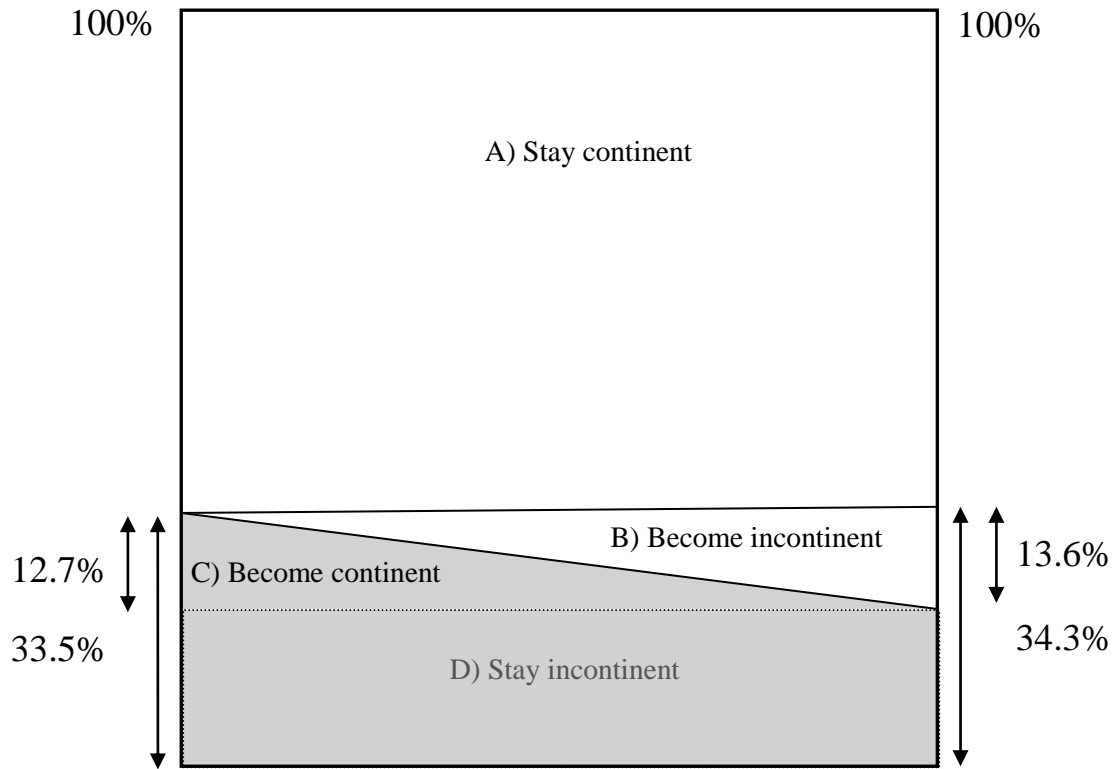


346

347

348 Figure 2.

349 Continenence status 4-12 years after 1st delivery: Group A) women who were continent at baseline (in 2000) and
350 follow-up (in 2008); B) women continent at baseline who became incontinent at follow-up; C) women
351 incontinent at baseline who became continent at follow-up; and D) women incontinent at baseline and follow-up.



373 4 years after 1st delivery

12 years after 1st delivery

374