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1 Specific obstetrical risk factors for urinary versus anal incontinence four years after first
2 delivery.

3 **Abstract**

4 Aim: delivery can be complicated by urinary or anal incontinence (UI or AI). We
5 hypothesized that the mechanisms of injury may differ for UI and AI. Hence, obstetrical risk
6 factors may be specific for different types of incontinence.

7 Design: Data on maternal characteristics were collected at first delivery. Data on incontinence
8 were obtained by a questionnaire completed by 627 women four years after first delivery. UI
9 was defined by “Do you have involuntary loss of urine” and AI by “Do you have involuntary
10 loss of flatus or stool”. A multinomial logistic regression analysis was conducted to assess
11 risk factors for UI only, AI only, and UI + AI.

12 Results: 22% of women reported UI only, 6.5% AI only, and 6.5% both. Risk factors
13 associated with UI only were age (at 1st delivery) ≥ 30 (OR 2.27 [95% CI 1.47-3.49]), pre-
14 existing UI (6.44 [2.19-19.0]) and pregnancy UI (3.64 [2.25-5.91]). Risk factors associated
15 with AI only were length of the second active stage > 20 minutes (2.86 [1.15-7.13]) and third
16 degree perineal tear (20.9 [1.73-252]). Significant predictors of UI+AI were age ≥ 30 (2.65
17 [1.29-5.46]), no epidural (4.29 [1.65-11.1]), third degree perineal tear (20.0 [1.28-314]), and
18 UI before pregnancy (32.9 [9.00-120]). Cesarean delivery was not significantly associated
19 with UI, AI, or UI+AI, although for all three outcomes, the adjusted odds ratios were
20 substantially less than one.

21 Conclusion: We found specific associations between obstetrical risk factors and urinary
22 versus anal incontinence four years after first delivery. Our results are consistent with the
23 hypothesis that the underlying mechanisms of injury differ for UI and AI.

24

25 **Key-words:** urinary incontinence; anal incontinence; delivery

26 **Word count:** abstract 261; text 1996.

27

28 Facteurs de risque obstétricaux spécifiques de l'incontinence urinaire ou de l'incontinence
29 anale quatre ans après le premier accouchement.

30 **Résumé**

31 Objectif : L'accouchement peut se compliquer par une incontinence urinaire ou anale (IU ou
32 IA). Notre hypothèse est que si les mécanismes lésionnels sont différents pour chaque
33 incontinence, les facteurs de risque obstétricaux devraient être spécifiques à chaque type
34 d'incontinence.

35 Méthodes : Les données sur la mère ont été recueillies à la première naissance. Les données
36 sur l'incontinence ont été obtenues par un questionnaire rempli par 627 femmes, quatre ans
37 après le premier accouchement. L'IU était définie par « Avez-vous des fuites involontaires
38 d'urine » et l'IA par « Avez-vous des pertes involontaires de gaz ou de selles ». Une régression
39 logistique multinomiale a été conduite afin d'estimer les facteurs de risque pour l'IU isolée,
40 l'IA isolée, et IU+IA.

41 Résultats : 22% des femmes avaient une IU isolée, 6,5% une IA isolée, et 6,5% les deux à la
42 fois. Les facteurs de risque associés à l'IU isolée étaient un âge (au 1er accouchement) \geq 30
43 ans (OR 2,27 [IC 95% 1,47-3,49]), une IU préexistante (6,44 [2,19-19,0]), et une IU de la
44 grossesse (3,64 [2,25-5,91]). Les facteurs de risque associés à l'IA isolée étaient une durée des
45 efforts expulsifs $>$ 20 minutes (2,86 [1,15-7,13]) et un périnée complet (20,0 [1,28-314]). Les
46 facteurs de risques pour IU+IA étaient un âge \geq 30 ans (2,65 [1,29-5,46]), l'absence de
47 péridurale (4,29 [1,65-11,1]), un périnée complet (20,0 [1,28-314]), et une IU préexistante à la
48 grossesse (32,9 [9,00-120]). L'accouchement par césarienne n'était pas significativement
49 associée à l'IU isolée, à IA isolée, ou IU+IA, bien que pour les trois, les OR ajustés étaient
50 sensiblement inférieur à un.

51 Conclusion : Nous avons trouvé des associations spécifiques entre des facteurs obstétricaux et
52 l'incontinence urinaire ou anale quatre ans après le premier accouchement. Nos résultats sont
53 compatibles avec l'hypothèse que les mécanismes lésionnels diffèrent pour l'IU et l'IA.

54

55 Mots-clés: incontinence urinaire ; incontinence anale ; accouchement

56

57 **Introduction**

58 First childbirth may become complicated by urinary or anal incontinence (UI or AI). The
59 exact pathophysiology of postnatal incontinence is not well understood. Observable lesions
60 such as third degree perineal tears can explain anal incontinence but this occurs in only a
61 minority of deliveries. Other occult injury to the pelvic floor, e.g., pudendal neuropathy or
62 levator ani muscle avulsion could affect urinary or anal continence.¹ The pudendal nerve
63 innervates striated muscles of the pelvic floor, including levator ani, urethral sphincter and
64 anal sphincter. Risk factors for pudendal nerve damage during childbirth are birth weight > 4
65 kg and a second active stage longer than 30 minutes.² The levator ani muscle which is
66 involved in the maintenance of the urinary and anal continence can also be injured at the time
67 of childbirth. Using MRI findings, DeLancey reported injuries of the levator ani in 20% of
68 primiparous women and Dietz found lesions in 36% of women using sonography.^{3,4} Risk
69 factors for the lesions of the levator ani during childbirth are advanced maternal age, forceps
70 delivery and the duration of the second stage.⁵ The two sphincteric (urinary and anal)
71 complexes are also bound by crossed reflex like the vesico-anal reflex.⁶

72 Previous literature has not elucidated to what extent postnatal urinary incontinence and
73 postnatal anal incontinence result from the same underlying mechanisms of injury. The
74 analysis of risk factors associated with postnatal incontinence suggests that certain risk factors
75 such as advanced maternal age and parity may be common to both UI and AI.^{7,8} Other risk
76 factors may be more specifically associated with one type of incontinence. For example, UI
77 during pregnancy has been found to be a specific risk factor for postnatal UI and instrumental
78 vaginal childbirth for postnatal AI.^{9,10}

79 We hypothesized that pregnancy and delivery-associated traumatic mechanisms at the origin
80 of postnatal incontinence differ at least to some extent for UI and AI. Therefore, specific
81 obstetrical risk factors are likely to be associated with different types of incontinence. The
82 analysis of risk factors related to stress UI was published previously for a portion of the
83 population.¹¹ To complete this objective we performed a secondary analysis in the whole
84 sample of primiparous to identify both risk factors that may be common to UI and AI, and
85 those that may be specifically associated with different types of postnatal incontinence, four
86 years after a 1st delivery.

87

88 **Materials and Methods**

89 Our data were initially collected for a study aimed at comparing the risk of incontinence for
90 women delivering in two maternity units.¹² One maternity had a policy of systematic
91 episiotomy and the other a restrictive policy for episiotomy. The study population includes
92 nulliparous women who delivered a live-born singleton at 37-41 weeks in cephalic
93 presentation in 1996. Mothers whose current mailing address was not known (and those
94 deceased) were excluded. Data on maternal characteristics (age, height, weight), pregnancy
95 (gestational age, epidural, second active stage duration, delivery mode, newborns'
96 birthweight) were collected at the time of childbirth. Women were asked to provide
97 information about pelvic floor disorders using a postal questionnaire, which was sent four
98 years after childbirth. In the absence of response to the first mail, a second and if necessary a
99 third mail was sent. The questionnaire collected data about profession and education level of
100 the mother, interventions on the pelvic floor since childbirth, new pregnancies and pelvic
101 floor symptoms. Urinary incontinence was defined by a positive response (Yes) to the
102 question "Do you have involuntary loss of urine?" and anal incontinence was defined by the
103 answer "Yes" to "Do you have involuntary loss of flatus or stool?" The type of UI was
104 defined using a validated questionnaire (Bristol Female Lower Urinary Tract Symptoms
105 questionnaire),¹³ severity of UI was measured with Sandvik's score,¹⁴ and AI was assessed
106 using Pescatori's score,¹⁵ as detailed in a previous publication.¹² The complete questionnaire
107 used for the study is available online. The choice of cut-off values for continuous variables
108 (maternal age < 30, BMI < 25 kg/m², gestational age < 40 weeks, active second stage length >
109 20 minutes, newborn weight < 4000g) was done a priori. We found no evidence of a
110 difference in the risk of urinary incontinence four years after 1st childbirth for women
111 delivering in the two maternity units. However, the risk of anal incontinence was slightly
112 higher for women who delivered in the maternity with a policy of systematic episiotomy.¹²
113 Using data from this enquiry, we first examined risk factors associated with each type of
114 incontinence (UI or AI) using two separate logistic regression models adjusted on maternity.
115 All significant risk factors for UI or AI were then included in a multinomial logit analysis to
116 assess specific risk factors for the following outcomes: UI only, AI only, and UI + AI.
117 Variables for mode of delivery, third degree perineal tear and maternity unit were forced in
118 the model irrespective of their statistical significance in the logistic models. We used
119 estimates of the odds ratios in the multinomial model for each risk factor and outcome in

120 order to examine the extent to which specific risk factors may be associated with different
121 types of incontinence.

122 We complied with French laws on data confidentiality, and restrictions on type of data
123 collected (e.g. no religious or racial data). Informed consent was obtained from all study
124 participants.

125

126 **Results**

127 Among the 1323 primiparous women who met inclusion criteria, postal address was no longer
128 valid for 548 (41%) and one had died, 774 (59%) women received the postal questionnaire
129 and 627 (81 %) completed it. The first delivery was spontaneous vaginal in 368 cases,
130 instrumental in 209 cases (95 by vacuum) and by cesarean section for 50 women. Continence
131 disorders four years after 1st childbirth of the 627 women who responded are summarized in
132 Table 1. The prevalence of UI was 29% (N=181) and that of AI 13% (82), 22% of women
133 (140) reported UI only, 6.5% (41) AI only, and 6.5% (41) both UI and AI.

134 Risk factors for UI (with or without AI) were maternal age ≥ 30 at 1st delivery (adjusted OR,
135 2.3 [95% CI 1.5-3.4]), UI before 1st pregnancy (10.2 [3.7-28.1]), and UI during 1st pregnancy
136 (3.3 [2.1-5.1]). Risk factors for AI (with or without UI) were UI before 1st pregnancy
137 (adjusted OR 5.2 [95% CI 2.3-11.8]), no epidural (versus yes) during 1st delivery (2.4 [1.2-
138 4.8]), second active stage > 20 min (2.5 [1.2-5.1]), and occurrence of 3rd degree perineal tear
139 during 1st delivery (13.3 [2.1-83.0]). Other factors tested and non-significant were: education
140 level, a BMI greater than 25 kg/m², gestational age at first delivery, a first newborn over
141 4000g, pelvic floor exercises after first delivery, episiotomy at first delivery, a second
142 delivery (this concerns 381 women), and an ongoing pregnancy (see online additional tables
143 S1 and S2).

144 Table 2 presents the results of the multinomial logistic regression analysis to assess specific
145 risk factors associated with UI only, AI only, and UI+AI. Estimates suggested that different
146 risk factors were associated with the three outcomes. Risk factors associated with UI only
147 were maternal age at delivery ≥ 30 (adjusted OR 2.3 [95% CI 1.5-3.5]), pre-existing UI (6.4
148 [2.2-19.0]) and UI during pregnancy (3.6 [2.2-5.9]), whereas risk factors for AI only were
149 duration of the second active stage > 20 min (2.9 [1.1-7.1]), and 3rd degree perineal tear (20.9
150 [1.7-252]). Risk factors significantly associated with UI + AI were maternal age > 30 years
151 (2.6 [1.3-5.5]), UI before pregnancy (32.9 [9.0-120]), no epidural (4.3 [1.6-11.1]) and 3rd
152 degree perineal tear (20.0 [1.3-314]).

153

154 **Discussion**

155 To our knowledge, this is one of the few studies that evaluated specific risk factors associated
156 with UI and AI four years after 1st delivery. One previous study, which looked at specific risk
157 factors for UI and AI, was based on data collected six months after first childbirth.¹⁶ This
158 study found that risk factors were different for postnatal UI (shoulder dystocia and vaginal
159 delivery) vs. postnatal AI (age over 35 years, smoking, duration of the second stage of labor
160 more than an hour and third degree perineal tear).

161 We found that different risk factors were associated with UI only (i.e., without AI), AI only,
162 and UI + AI four years after 1st delivery. Risk factors for UI only were maternal age at 1st
163 delivery ≥ 30 , pre-existing UI and pregnancy UI. Risk factors associated with AI only were
164 length of the second active stage > 20 min and 3rd degree perineal tear. Risk factors associated
165 with UI + AI were age ≥ 30 , no epidural, 3rd degree perineal tear, and UI before pregnancy.

166 The relatively long period of follow-up in our study (four years after 1st delivery) is an
167 important advantage as the prevalence of postpartum UI tends to decrease spontaneously in
168 the 1st postpartum year.¹⁷ Nevertheless, our study has certain limitations. The sample size of
169 the study was based on the number of subjects needed to have sufficient power for showing a
170 difference in the outcomes between the two maternities that had different policies for
171 episiotomy in our initial study.¹² The study was not specifically designed to have sufficient
172 power to explore the specific effects associated with different risk factors. Indeed, the
173 confidence intervals for the estimates of the effects for several risk factors were wide and lack
174 of sufficient power may explain the absence of statistically significant results for some of the
175 risk factors in the present study. In particular, the lack of statistical significance for the
176 associations between mode of delivery and outcomes (different types of incontinence) is
177 likely to be due to insufficient power. It is worth noting that the point estimates (odds ratios)
178 suggested a lower, albeit not statistically significant, risk for all three outcomes (UI only, AI
179 only and UI+AI) for women who delivered following a cesarean section. For reasons of
180 statistical power we also renounced conduct an analysis based on the type of instrument used
181 for delivery (forceps or vacuum).

182 Our findings of specific associations between obstetric risk factors and prevalence of UI only,
183 AI only and UI+AI may be due to differences in the underlying mechanisms of injury for
184 different types of incontinence. The two main mechanisms proposed to explain postnatal AI
185 are sphincter injury and pudendal neuropathy. In our study, the specific risk factors for AI

186 (third degree perineal tear and prolonged second active stage) are compatible with these
187 mechanisms. Prolonged active second stage is associated with pudendal nerve damage.² Even
188 following repair, 3rd degree perineal tear is associated with anal incontinence years after
189 delivery.¹⁸

190 Concerning postnatal stress urinary incontinence, the mechanisms of injury are still largely
191 unknown.¹⁷ Vaginal birth is likely to increase the mobility of the urethra or to be accompanied
192 by lesions of the levator ani.^{3,4} However, urethra mobility returns to prenatal values a few
193 months after delivery.¹⁹ Wijma *et al.* found no relation between urethra mobility and postnatal
194 UI.²⁰ Dietz and Lanzarone found no link between levator ani avulsion and postnatal stress
195 UI.⁴ DeLancey *et al.* reported that only 16% of postnatal stress UI could be explained by
196 urethra mobility, whereas urethra closing pressure could account for 25% of postnatal de novo
197 stress UI.²¹ The relation between urethra closure pressure and pregnancy remains unclear.
198 Iosif *et al.* found closure pressure to increase during pregnancy and to decrease after delivery,
199 while Le Coutour *et al.* reported opposite findings.^{22,23} In our study, the finding of an
200 association between maternal age and UI could be explained by a lower urethra closure
201 pressure as the latter is known to decrease with increasing maternal age.²⁴ We are not aware
202 of any studies that have examined the link between pregnancy UI and urethra closure pressure
203 or urethral mobility.¹⁷

204 In conclusion, our results suggest that urinary incontinence and anal incontinence four years
205 after 1st delivery do not share the same set of risk factors. These results are consistent with the
206 hypothesis that the underlying mechanisms of postnatal incontinence differ for urinary versus
207 anal incontinence. This implies in turn that different strategies may be needed for prevention
208 of urinary and anal incontinence.

209

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Table 1

Continence complaints 4 years after 1st childbirth. Where percentages do not add to 100%, there were some missing data (from 0 to 3.3%).

Troubles de la continence 4 ans après le premier accouchement. Quand la somme des pourcentages est inférieure à 100% c'est le signe de quelques données manquantes (de 0 à 3,3%).

Continence troubles 4 years after 1 st childbirth		
	N = 627	n (%)
Urinary Incontinence (UI)	no	438 (71)
	yes	181 (29)
Severity of UI (Sandvik score)	no UI	438 (71)
	slight	110 (18)
	Moderate	42 (7)
	Severe	16 (3)
Type of UI (% among women with UI)	stress	55 (30)
	urgency	12 (7)
	mixed	109 (60)
UI bothersome (% among women with UI)	<i>Not a problem</i>	24 (13)
	<i>A bit of a problem</i>	107 (59)
	<i>Quite a problem</i>	27 (15)
	<i>A serious problem</i>	17 (9)
Anal Incontinence (AI)	no	525 (84)
	yes	82 (13)
Type of AI (% among women with AI)	Flatus only	64 (78)
	Stool	18 (22)
AI bothersome (% among women with AI)	<i>Not a problem</i>	1 (1)
	<i>A bit of a problem</i>	36 (44)
	<i>Quite a problem</i>	13 (16)
	<i>A serious problem</i>	30 (37)

Table 2

Risk factors for urinary incontinence (UI) only, anal incontinence (AI) only, and UI+AI. Multinomial logistic regression adjusted on maternity. Other factors tested and non-significant were: education level, a BMI greater than 25 kg/m², gestational age at first delivery, a first newborn over 4000g, pelvic floor exercises after first delivery, episiotomy at first delivery, a second delivery, and an ongoing pregnancy. Case numbers may not add up because of some missing data for given risk factors (from 0 to 4.6%).

Facteurs de risque d'incontinence urinaire (IU) isolée, d'incontinence anale (IA) isolée, et d'IU+IA. Régression logistique multinomiale ajusté sur la maternité. Les autres facteurs testés et non-significatifs sont les suivants : le niveau scolaire, un BMI supérieur à 25 kg/m², l'âge gestationnel au premier accouchement, un premier enfant de plus de 4000g, une rééducation périnéale après le premier accouchement, un nouvel accouchement, et une grossesse en cours. Le nombre de sujet peut être inférieur à ce qui est attendu en raison de données manquantes pour certains facteurs de risque (de 0 à 4,6%).

Variable		UI only adjusted OR (N) (CI 95%)	AI only adjusted OR (CI 95%)	IU+IA adjusted OR (CI 95%)
Age at 1 st childbirth	< 30 years	(415) 1	1	1
	≥ 30 years	(212) 2.27 (1.47-3.49)	1.34 (0.65-2.73)	2.65 (1.29-5.46)
UI before pregnancy	no	(565) 1	1	1
	yes	(33) 6.44 (2.19-19.0)	2.02 (0.21-18.9)	32.9 (9.00-120)
UI during pregnancy	no	(468) 1	1	1
	yes	(133) 3.64 (2.25-5.91)	1.57 (0.64-3.90)	1.87 (0.77-4.55)
Epidural	no	(101) 0.96 (0.51-1.78)	1.52 (0.59-3.92)	4.29 (1.65-11.1)
	yes	(526) 1	1	1
Second active stage	≤ 20 minutes	(561) 1	1	1
	> 20 minutes	(59) 1.26 (0.62-2.57)	2.86 (1.15-7.13)	2.29 (0.73-7.15)
Mode of delivery	spontaneous	(368) 1	1	1
	instrumental	(209) 1.16 (0.74-1.81)	1.11 (0.54-2.31)	0.96 (0.43-2.11)
	cesarean	(50) 0.54 (0.22-1.31)	0.61 (0.14-2.79)	0.28 (0.05-1.70)
Third degree perineal tear	no	(621) 1	1	1
	yes	(6) 3.67 (0.22-61.3)	20.9 (1.73-252)	20.0 (1.28-314)