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ORIGINAL ARTICLE

Risk of new-onset urinary incontinence 3 and 12 months after vaginal or cesarean delivery of twins: Part I

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Abstract

Introduction and hypothesis Our purpose was to compare the prevalence of urinary incontinence (UI) 3 and 12 months after vaginal vs cesarean delivery of twins after 34 weeks of gestation.

Methods This was a multicenter prospective cohort study conducted at 172 French maternity units and included 2812 primiparous women with twins with no prior history of UI. Participants were enrolled at the time of delivery and followed up to 12 months postpartum. The primary outcome was the prevalence of UI, both stress and urge, 3 months postpartum, based on the patient reporting any frequency of urine leakage to the first question of the International Consultation on Incontinence Questionnaire - Short Form (ICIQ-SF). The Pelvic Floor Distress Inventory - Short Form 20 (PFDI-20), Pelvic Floor Impact Questionnaire - Short Form 7 (PFIQ-7), Pelvic Organ Prolapse/Urinary Incontinence Sexual Questionnaire (PISQ-12), and Medical Outcome Study Short Form-12 (SF-12) were also used.

Results The ICIQ-SF was completed by 1155 (39.8%) and 800 (27.5%) women, respectively, at 3 and 12 months postpartum; 556 (48%) had delivered vaginally and 599 (52%) by cesarean section. The prevalence of UI at 3 months was 26% overall and was significantly higher in the vaginal delivery group at both 3 months (35% vs 17% in the cesarean group, $p < 0.0001$) and 12 months postpartum (38% vs 24%, $p < 0.0001$). UI was predominantly stress or mixed. The risk factors for UI at 3 months, determined by multivariate modeling, were vaginal delivery [odds ratio (OR) 3.073, 95% confidence interval (CI) 2.3–4.105, $p < 0.0001$) and body mass index >25 in early pregnancy (OR 1.620, 95% CI 1.188–2.209, $p = 0.0023$).

Conclusions Vaginal delivery is a risk factor for UI at 3 months after twin birth.

Keywords Urinary incontinence · Twin pregnancy · Postpartum · Risk factors · Vaginal delivery

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Introduction

Female urinary incontinence (UI) is a public health problem, affecting 10–15% (~1.5 million) of the population of women in France [1] and 25 to 45% of adult women [2] worldwide. UI can impair a woman's quality of life (QoL) and, for young women especially, [3], can be incompatible with a normal social, professional, and sex life. It therefore appears essential to identify the risk factors for UI and propose preventive strategies. Postpartum UI is a consequence of pregnancy and birth, resulting from neuromuscular injury and/or loss of urethral and bladder support. In a retrospective study from 2006, in a cohort of 3405 primiparas, UI was present in 29% at 3 months postpartum, and affected their hygiene, home life, work or social life, and sex life in 51, 47, and 17% of cases respectively [4].

Based on prior literature, the maternal factors significantly associated with postpartum UI are presence of UI before or

during pregnancy [5, 6], multiparity [7], maternal age > 25 years [4], being overweight or obese [body mass index (BMI) >25] [6], and smoking [6]. The obstetric factors significantly associated with postpartum UI are vaginal delivery [8], instrumental delivery [5, 9], and baby birth weight [4]. These data are derived from studies that excluded multiple pregnancies.

Due to increasing maternal age and the development of assisted reproductive technology [10], rates of multiple pregnancies have been increasing over the past 30 years. In France, twin births (12,437) accounted for 1.56% of all births in 2004 compared with 0.93% in 1975, i.e., a 68% increase [10]. The same trend has been seen in the United States, where the rate of twin pregnancies increased by a factor of 1.9 between 1971 and 2009 [11].

The most recent studies report UI rates of up to 40% for twin pregnancies 20 months postpartum, i.e., about twice as high as for singleton pregnancies [12]. Certain maternal factors appeared to be significantly associated with postpartum UI, including twin pregnancy, total fetal weight, maternal obesity, prenatal UI, duration of labor ≥8 h, and UI during the immediate postpartum period [12]. In a large Canadian study that included 2570 women in 25 countries, delivery route appeared to have a significant impact on UI rates both at 3 months after twin birth (15.3% after vaginal delivery vs 11.3% after cesarean section) [13], and 24 months (21.7 vs 16.2%) [14]. The percentage of patients who rated their UI as problematic was similar in both groups at 3 months (6.4% for vaginal vs 5.5% for cesarean delivery, $p = 0.31$), as were their Incontinence Impact Questionnaire Short Form (IIQ-7) scores (20.4 and 20.5 in vaginal and cesarean groups, respectively, $p = 0.99$). However, at 12 months, women in the planned cesarean group had lower problematic stress urinary incontinence (SUI) rates compared with women in the planned vaginal birth group (8.11 vs 12.15%, $p = 0{,}001$) [14].

The primary objective of our study was to compare the prevalence of UI 3 months postpartum in primiparous women after vaginal vs cesarean delivery of twins after 34 weeks of gestation. We also compared groups for the prevalence of UI 12 months postpartum, UI type and severity, urinary symptoms, and impact of these symptoms on QoL.

Methods

This study (JUMODA-CP) was a substudy of the French National *Jumeaux Mode d'accouchement* (JUMODA) study [15]. The primary objective of the JUMODA study was to evaluate in twin pregnancies the impact of the planned mode of delivery on perinatal morbidity of the second twin. All women who gave birth at or after 22 weeks of gestation to twins or triplets were eligible for inclusion, and data on several measures of mortality and severe morbidity were collected.

Study population

To calculate the number of participants required, it was hypothesized that 60% of twin pregnancies would be delivered by cesarean section [16], that the absolute difference to demonstrate the prevalence of UI at 3 months was 10%, and that the prevalence of UI at 3 months in the vaginal delivery group would be 50% [12]. To obtain a power of 90% with an alpha error of 5%, 1080 returned questionnaires would be required. Assuming that 50% of women would not respond or would be lost to follow-up, 2160 women needed to be recruited.

The JUMODA-CP study included all primiparous adult women from the JUMODA study who were pregnant with twins and gave birth to two live infants after 34 weeks of gestation, unless they chose to opt out. At the time of delivery, patients were given an information leaflet and an opt-out consent form. The leaflet explained the aims and procedures of the JUMODA and JUMODA-CP studies and informed the women that they would be sent questionnaires at 3 and 12 months postpartum. The attending obstetrician enrolled patients prospectively, immediately after delivery, using a web-based questionnaire. Groups were defined by the route of delivery. The vaginal delivery (exposed) group comprised women who gave birth vaginally to at least one twin, and the cesarean (nonexposed) group comprised women who had an elective cesarean or an emergency or nonemergency cesarean during labor, provided both twins were born by cesarean section.

Data collection methods

Demographic and medical data were entered into a web-based form. Each patient received five questionnaires at 3 and 12 months postpartum, corresponding to 69 questions per session and 207 questions per patient. The technician in charge of the clinical study contacted them by telephone, SMS, e-mail, or letter, inviting them to complete the questionnaires and reminding them of the importance of the study.

The questionnaires were:

ICIQ-SF (International Consultation on Incontinence Questionnaire–Short Form) [17] provides information about type and severity of urine leakage and the impact of symptoms on QoL. It is a short, straightforward questionnaire, making it a tool of choice for obtaining a brief but full overview of the level of impact and perceived causes of incontinence symptoms. It was used to evaluate the primary outcome of the study.

PFDI-20 (Pelvic Floor Distress Inventory–Short Form 20) and PFIQ-7 (Pelvic Floor Impact Questionnaire–Short Form 7) are self-administered questionnaires that evaluate all urinary, anorectal, and perineal/vaginal symptoms. They generate easily interpretable scores and

take into account the functional aspect of the various forms of pelvic floor disorders [18].

PISQ-12 (Pelvic Organ Prolapse/Urinary Incontinence Sexual Questionnaire) a self-administered questionnaire, evaluates the impact of pelvic floor disorders on sexual function, encompassing behavioral, emotive, physical, and partner-related aspects. Data from this questionnaire were analyzed 12 months postpartum only, since the responses pertained to the patient's sexuality during the previous 6 months [19].

SF-12 (Medical Outcome Study Short Form–12) [20], a shortened version of SF-36, for assessing mental, social and physical QoL.

All questionnaires were adapted for use by French speakers. Only results pertaining to UI are reported in this article.

Primary and secondary outcome measurements

The primary outcome of the study was presence or absence of UI 3 months after twin birth (after 34 weeks of gestation among primiparous women). The presence of UI of any type, regardless of severity and impact, was determined on the basis of the woman's answer to the first question of the ICIQ-SF, which asks how often she leaks urine. UI was present if the patient selected any response other than "never." If the answer was inconsistent with the second question of the ICIQ-SF, concerning the quantity of urine leakage, the patient was excluded from the analysis as missing data. For the 3-month postpartum outcomes, only answers provided between 2 and 4 months postpartum were analyzed (based on the reported questionnaire completion date). The patients' UI history, smoking status, BMI in early pregnancy, total weight gain during pregnancy, and presence or absence of gestational diabetes were also recorded. We chose, post hoc, to exclude all patients who had UI before or during pregnancy to focus on the effects of delivery on urinary disorders and eliminate as far as possible any incontinence provoked by the pregnancy itself.

For the 12-month postpartum outcomes, only answers provided between 6 and 24 months postpartum were analyzed (based on the reported questionnaire completion date). We also studied a number of secondary outcomes based on patients' answers to certain questions. The presence of UI 12 months postpartum was defined in the same way as at 3 months but using the second set of questionnaires. The type of UI was determined from the answer to the fourth question of the ICIQ-SF, which asks about the circumstances that lead to urine leakage. If the woman indicated it occurs when she coughs or sneezes and/or when physically active or exercising, her UI was categorized as SUI; if she indicated it occurs before she can get to the toilet, it was classified as urge UI (UUI); if both responses were selected, it was classified as mixed UI (MUI). Any other response selected in answer to this question was classified as "other type." UI severity was evaluated from the answer selected for the second question of the ICIQ-SF about quantity of leakage and from a score (on a scale of 0 to 21) based on the first three questions of the ICIQ-SF about frequency and quantity of urine leakage and how much it interferes with everyday life. The higher the score, the more severe the UI. Urinary symptoms were defined using the Urinary Distress Inventory-6 (UDI-6) subscale (maximum score 100) of the PFDI-20 (maximum score 300), with high scores indicating worse symptoms. The impact of urinary symptoms on QoL was determined using the Urinary Impact Questionnaire-7 (UIQ-7) subscale (maximum score 100) of the PFIQ-7 score (0–300), with higher scores indicating a greater impact on QoL. Questionnaires on symptoms and QoL were also used to determine the percentage of women whose scores were ≥0, indicating the absence or presence of symptoms or impact.

Statistical methods

Categorical variables are expressed as counts and percentages and continuous variables as means and standard deviations (SD) or medians and quartiles, depending on their distribution. Baseline comparisons between patients who had a vaginal delivery vs a cesarean section were analyzed using the chi-square test or Fisher's exact test for qualitative variables and Student's *t* test or the Wilcoxon-Mann-Whitney test for quantitative variables. Multivariate logistic regression was used to identify risk factors for postnatal UI. Risk factors entered into the multivariate model were selected at a threshold of 20% in univariate analysis. Confounding variables (those that differed across groups at baseline) were entered into the multivariate model when significant at a threshold of 5%. Backward stepwise selection was performed to select risk factors at a threshold of 5%. The impact of these factors is expressed by their odds ratio (OR) and 95% confidence interval (CI). Data analysis was performed using SAS version 9.4 (SAS Institute Inc., Cary, NC, USA), with an alpha level of 5% for all tests.

Quality and validity of the method

We chose to analyze only primiparous women because multiparity is a known risk factor for UI [7]. When forming the groups, we postulated that vaginal delivery of twins might increase the risk of UI. Women who delivered at least one of their twins vaginally were therefore considered to have been exposed to the postulated risk factor, even if the second twin was delivered by cesarean section. All questionnaires have been adapted for French-speaking patients, and their efficacy in the evaluation of the outcomes studied is internationally recognized, enabling high reproducibility. It should be noted, however, that ICIQ, PFDI-20, PFIQ-7, and PISQ-12 are usually used to evaluate women with pelvic floor disorders, but in the absence of an alternative validated method, we

extrapolated their application to a population who in principle do not have known pelvic floor disorders.

We chose to evaluate the primary outcome in the simplest manner possible. The first question of the ICIQ-SF is clear and straightforward, thus avoiding potential misunderstanding on the part of patients. We also felt that determining the presence or absence of UI of any type is most representative of the clinical reality of the impact of postpartum UI on women's lives. Only answers provided between 2 and 4 months after delivery were included in the analysis to focus solely on the early—and in particular, the immediate—postpartum period, as the presence of UI during this period increases the risk of long-term UI [12]. As the ICIQ-SF concerns symptoms experienced during the previous 4 weeks and the PFDI-20 and PFIQ-7 address symptoms experienced during the previous 3 months, the 2- to 4-month time window enabled the evaluate symptoms as close as possible to 3 months postpartum, limit interference from symptoms experienced during pregnancy, and evaluate symptoms before pelvic floor muscle training. A broader time window was accepted for the second set of questionnaires, and we analyzed those completed between 6 and 24 months postpartum. The upper limit of 24 months was set to minimize the number of patients who were pregnant again and to limit the data collection period.

Results

Flow chart and patient characteristics

Although 2904 patients were eligible for inclusion, 34 (1%) were not sent questionnaires because notification of their inclusion was not received; 58 were excluded post hoc (2 due to a history of UI before pregnancy, 13 to UI during pregnancy, and 43 to a lack of information concerning UI history). Of the 2846 patients eligible for analysis, 1734 (61%) returned at least one set of questionnaires at either 3 or 12 months and 34% returned both sets (Fig. 1).

Patients were recruited between 10 February 2014 and 01 March 2015 in 172 French maternity units with facilities for moderate- or high-risk pregnancies and performing >1500 deliveries per year. Table 1 shows the main characteristics of the 2846 patients included; 1297 (46%) gave birth vaginally and 1549 (54%) by cesarean section. The birthweight (total birthweight of both babies) was 4885 g ± 724 g; 27% of these patients (758) had a BMI >25 in early pregnancy.

Group comparability

After post hoc exclusion of 58 patients due to the presence of UI before delivery, 2846 patients were potentially analyzable. Of these, 1734 returned at least one set of questionnaires, 458 of whom returned only the 3-month questionnaire and 318 only the 12-month questionnaire. Table 2 shows the comparison of characteristics of respondents vs nonrespondents.

The primary outcome was analyzable from the responses of 1155 eligible patients and nonanalyzable for 1691. Analyzable patients were those who had answered the first question of ICIQ-SF, whose answer was consistent with their answer to the second question, and whose questionnaire was dated within the predefined time window. Table 3 shows the comparison of characteristics of analyzable patients delivered vaginally vs those who underwent cesarean section. As expected, a difference was found in the presentation of the first twin (97% cephalic in the vaginal delivery group vs 58% in the cesarean group), a difference directly related to the decision to perform cesarean section.

Among analyzable patients, 249 had an instrumental delivery for the first twin and 152 for the second. Two fetuses had shoulder dystocia, one of which was a first twin and the other a second. Bladder injury occurred in three patients during cesarean section.

Analysis of the primary outcome

The presence or absence of UI 3 months postpartum was analyzed for 1155 patients. Of these, 296 (26%) had UI between 60 and 124 days postpartum according to their answer to the first question of the ICIQ-SF. A significantly higher proportion of parturients who delivered vaginally had UI 3 months postpartum: 35.43% vs 17% in the cesarean group ($p < 0.0001$). Vaginal delivery therefore appears to be a risk factor for UI at 3 months postpartum, [OR 2.77, 95% CI 2.10–3.66 ($p < 0.0001$)]. The potential risk factors for UI 3 months postpartum in univariate analysis were vaginal delivery, high maternal age at delivery, obstetric maneuvers performed on the first twin, BMI >25 in early pregnancy, and smoking during pregnancy. Maternal age > 25 years and BMI >25 in early pregnancy were selected as confounding factors for multivariate analysis. The risk factors that emerged from multivariate modeling are shown in Table 4. Vaginal delivery was a risk factor for UI 3 months postpartum [OR 3.073, 95% CI 2.3–4.105, ($p < 0.0001$)]. There was no significant difference in the prevalence of UI between planned and emergency cesarean groups. The need for obstetric maneuvers and/or instrumental vaginal delivery had no significant impact on the prevalence of UI 3 months postpartum.

It should be noted that although more questionnaires were analyzed than required (1155 vs 1080), some rates were lower than expected, in particular, the rate of cesarean section (52% vs 60%) and the prevalence of UI among women who delivered vaginally (35% vs 50%). Nevertheless, the post hoc statistical power is 100%.

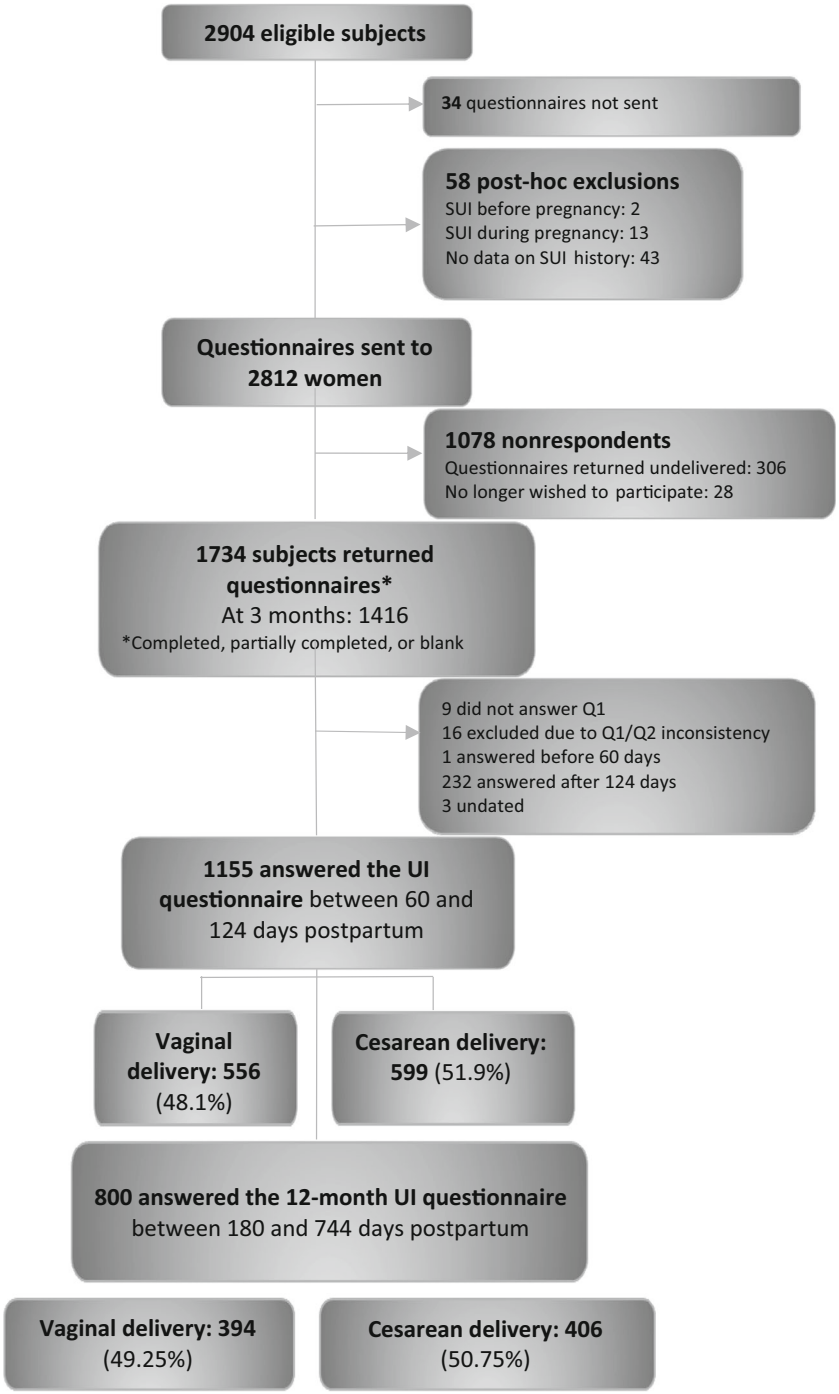

Fig. 1 Patient selection for primary outcome at 3 and 12 months

Secondary outcomes

Incontinence at 12 months

Of the 1155 analyzable patients, 800 reported whether they had UI at 12 months, completing the questionnaire a median of 365 days after delivery (between 180 and 744 days postpartum). Among these women, 247 (31%) reported having UI. Those who delivered vaginally were significantly more likely to have UI 12 months postpartum: 38%, vs 24%(unadjusted OR 1.87, CI 95% 1.38–2.53, $p < 0.0001$). The potential risk factors for UI 12 months postpartum were maternal age > 25 years, BMI >25 in early pregnancy, medical condition prior to pregnancy, maternal condition diagnosed during pregnancy, and route of delivery. The risk factors for UI at 12 months that emerged from multivariate analysis are shown in Table 5. It is noteworthy that more women with a high BMI reported having a medical condition prior to pregnancy ($p = 0.01$).

Table 1 Patient characteristics

Variables	No. patients (2846)
Maternal age (years ± SD)	32 ± 6
Maternal age > 25 years, *n* (%)	2488 (87)
Gestation, weeks ± SD	37 ± 1
Smoker, *n* (%)	356 (13)
Weight in early pregnancy (kg), (min–max)	62 (55–70)
BMI in early pregnancy (kg/m^2), (min–max)	22 (20–25)
Weight change during pregnancy (kg ± SD), (min–max)	15 (12; 20)
Gestational diabetes, *n* (%)	333 (12)
Endometriosis, *n* (%)	88 (3)
Antenatal pelvic floor muscle exercises, *n* (%)	6 (0.22)
Puerperal hematoma, *n* (%)	4 (0.14)

Qualitative variables are expressed as frequency (percentage)

BMI body mass index, *SD* standaard deviation

[a] Quantitative data: mean ± SD or median (25th; 75th) percentile according to the variable distribution

Table 2 Description and comparison of respondents and nonrespondents

Variables	Respondents at 3 and/or 12 months *n* = 1734	Nonrespondents[a] *n* = 1112	*P* value
All deliveries combined *n* = 2846[b]			
Maternal factors			
Age at delivery (years), mean ± SD	31.86 ± 5.27	31.00 ± 6.23	< 0.0001
Age > 25 years, *n* (%)	1581 (91.18)	907 (81.56)	< 0.0001
Weight in early pregnancy (kg), mean ± SD	64.3 ± 13.31	63.94 ± 13.18	0.6098
Weight gain during pregnancy (kg), mean ± SD	15.72 ± 6.17	15.89 ± 6.54	0.5277
BMI in early pregnancy	23.41 ± 4.63	23.43 ± 4.56	0.5146
BMI >25 in early pregnancy, *n* (%)	463 (27.48)	295 (27.39)	0.9602
Smoker, *n* (%)	203 (12.05)	153 (14.34)	0.0819
History of endometriosis, *n* (%)	62 (3.58)	26 (2.34)	0.0628
Medical condition diagnosed before pregnancy, *n* (%)	383 (22.09)	233 (20.95)	0.4734
Medical condition diagnosed during pregnancy, *n* (%)[c]	964 (55.59)	662 (59.53)	0.0383
Gestational diabetes, dietary management, *n* (%)	142 (14.75)	101 (15.26)	
Gestational diabetes, insulin therapy, *n* (%)	50 (5.19)	40 (6.04)	
Other, *n* (%)	771 (80.06)	521 (78.70)	
Antenatal pelvic floor muscle exercises, *n* (%)	2 (0.12)	4 (0.37)	0.2167
Puerperal hematoma treated by surgery or embolization, *n* (%)	3 (0.17)	1 (0.09)	1
Fetal factors			
Gestation (weeks), mean ± SD	36.58 ± 1.49	36.55 ± 1.48	0.64
Weight of twin 1 (g), mean ± SD	2480.74 ± 401.75	2479.90 ± 407	0.9571
Weight of twin 2 (g), mean ± SD	2400.89 ± 423.89	2410.35 ± 418.44	0.5595
Delivery type, *n* (%)			0.079
Cesarean	921 (53.11)	628 (56.47)	
Vaginal	813 (46.89)	484 (43.53)	
Maneuvers on twin 1 (regardless of route of delivery)	640 (37.08)	398 (35.95)	0.5436
Cesarean[d] *n* = 1037			
Timing of cesarean, *n* (%)			0.291
Before labor, before planned date	220 (35.31)	133 (32.6)	
Before labor, on planned date	305 (48.96)	196 (48.04)	
During labor	98 (15.73)	79 (19.36)	
Not reported	1	5	
Vaginal, *n* (%)[d], *n* = 1809	1110 (64.01)	699 (62.86)	
Episiotomy	339 (19.56)	199 (17.91)	0.2731
Perineal tear	358 (20.66)	209 (18.81)	0.2293
1st or 2nd degree	343 (96.08)	197 (95.17)	0.6382
3rd degree	11 (3.08)	9 (4.35)	
4th degree	3 (0.84)	1 (0.48)	
Not reported	1	2	
Cesarean for twin 2 after vaginal delivery of twin 1, *n* = 37	22 (2.71)	15 (3.10)	0.6808
Epidural anesthesia, *n* = 1986[e], *n* (%)	1082 (90.77)	674 (88.68)	0.1346

[a] 34 women were not sent questionnaires because notification of their inclusion was not received; 1078 women did not return any questionnaires

[b] 2904 eligible patients minus the 58 post hoc exclusions

[c] Details of conditions unavailable but included diabetes and hypertension

[d] In 176 cases, route of delivery not preplanned

[e] Vaginal or cesarean during labor

Table 3 Comparison of analyzable patients by route of delivery

Variables	Total population $n = 1155$	Cesarean $n = 599$	Vaginal $n = 556$	P value*
Maternal age (years)	32 ± 5	33 ± 5	31 ± 5	<0.001
Age > 25 years, *n* (%)	1060 (92)	563 (94)	497 (89)	0.0045
Gestation (weeks)	37 (35–38)	37 (35–38)	37 (36–38)	0.3693
Smoker, *n* (%)	145 (13)	78 (13)	67 (12)	0.6276
Weight in early pregnancy (kg)	62 (55–70)	62 (55–71)	62 (55–69)	0.5147
BMI in early pregnancy (kg/m^2)	22 (20–26)	22 (20–26)	22 (20–25)	0.0542
BMI >25 in early pregnancy	300 (27)	175 (30)	125 (23)	0.0115
Weight gain during pregnancy (kg)	16 ± 6	16 ± 6	16 ± 6	0.7338
Endometriosis, *n* (%)	42 (4)	28 (5)	14 (3)	0.0504
Antenatal pelvic floor exercises, *n* (%)	2 (0.2)	0 (0)	2 (0.4)	0.2358
Weight of largest baby (g)	2600 ± 385	2610 ± 384	2590 ± 389	0.4815
Total intrauterine weight (g)	4895 ± 727	4912 ± 792	4877 ± 651	0.4065

BMI body mass index, *SD* standard deviation

Qualitative variables expressed as frequency (%) using chi-square or Fisher's exact test; applies to comparison between vaginal delivery and cesarean section group

*Quantitative data are mean ± SD or median (25th; 75th percentile); Student's *t* test or Wilcoxon-Mann-Withney test was used according variable distribution

Type and severity of incontinence

A significant association was found between mode of delivery and the type of UI reported 3 months postpartum. Parturients who delivered vaginally more frequently appeared to have SUI or MUI ($p = 0.0005$), as shown in Table 6. This difference was also significant at 12 months ($p = 0.03$).

On analysis of responses to the questions: "Do you usually experience frequent urination?" or "Do you usually experience urine leakage associated with a feeling of urgency, that is, a strong sensation of needing to go to the bathroom?" (items 15 and 16 of the PFDI-20), the prevalence of UUI was significantly higher in the vaginal delivery group at 3 months: 245 (44%), vs 191 (32%) in the cesarean group ($p < 0.0001$). When the 296 women with UI between 60 and 124 days were asked about the quantity of urine leakage, 91% reported a small amount, 8% reported a moderate amount, and 1% reported a large amount. Of the 247 women analyzed at 12 months, 92% reported leaking a small amount, 7% a moderate amount, and 1% a large amount. UI severity did not, therefore, appear to change between 3 and 12 months ($p = 0.6713$ and $p = 0.3702$).

Symptoms and QoL questionnaires

Based on results from the PFDI-20, women who delivered vaginally had more symptoms or higher scores, with a median score of 25/300 (range 8–50), vs 17/300 (range 4–36) in the cesarean group ($p < 0.0001$). On subscale analysis, women who delivered vaginally had a significantly higher score on the UDI-6: 8/100 (0–21), vs 4/100 (0–13) in the cesarean group ($p < 0.0001$). At 12 months, the difference in PFDI-20 scores was no longer significant ($p = 0.6632$), but that in the UDI-6 scores persisted: median score of 8 (0–21) in the vaginal group vs 4 (0–17) in the cesarean group ($p = 0.0274$). The impact of these symptoms on QoL was evaluated using the PFIQ-7. The results of this self-administered questionnaire at 3 months revealed a higher proportion of scores >0 in the vaginal group (48%) than in the cesarean group (34%, $p < 0.0001$), indicating that tpelvic floor symptoms

Table 4 Multivariate analysis of primary outcome at 3 months

Variable, at 3 months	UI, $n = 296$; no UI, $n = 859$ *n* (%)		Multivariate analysis	
			OR[a] (95% CI)	P value
Vaginal delivery	197 (66.55)	359 (41.79)	3.073 (2.300–4.105)	<0.0001
BMI in early pregnancy > 25	93 (32.4)	207 (24.88)	1.620 (1.188–2.209)	0.0023

BMI body mass index, *UI* urinary incontinence, *OR* odds ratio, *CI* confidence interval

Data were missing on 51 participants in the group without and 15 in the group with UI

[a] Final multivariate modeling was performed with 1089/1151 patients, including 281 with UI at 3 months

Table 5 Multivariate analysis of primary outcome at 12 months

Variable, at 12 months	UI, $n = 247$; no UI, $n = 553$ n (%)		Multivariate analysis	
			OR[a] (95% CI)	P value
Vaginal delivery	148 (59.92)	246 (44.48)	2.076 (1.503–2.868)	<0.0001
BMI in early pregnancy > 25	94 (39.33)	114 (21.19)	2.671 (1.891–3.772)	<0.0001
Medical condition prior to pregnancy[b]	66 (26.72)	107 (19.35)	1.623 (1.117–2.358)	0.0111
No maternal condition diagnosed during pregnancy	125 (50.61)	245 (44.30)	1.456 (1.057–2.006)	0.0214

The data were missing for 15 subject in the group without UI and 8 in the group with UI

BMI body mass index, *UI* urinary incontinence, *OR* odds ratio, *CI* confidence interval

[a] Final multivariate modeling was performed with 777/800 participants, including 239 with UI at 12 months

[b] Including hypertension, diabetes, and other conditions on which no details were available

experienced after vaginal delivery had a greater impact on QoL, an effect that was more marked for the subscale UIQ-7: 29%, vs 13% ($p < 0.0001$). Nevertheless, median score for both groups was 0. At 12 months, differences remained significant, with 35% of women who delivered vaginally having a PFIQ-7 score >0 vs 27% in the cesarean group ($p = 0.0131$) and 23% having a UIQ-7 score >0, vs 16% ($p = 0.0156$). When analyzing symptom severity and QoL scores on PFDI-20 and PFIQ-7, including only women with postpartum UI, differences were no longer significantl based on mode of delivery both at 3 and 12 months postpartum.

There was no significant difference between groups in the prevalence of symptoms of voiding dysfunction at either 3 or 12 months ($p = 0.2699$ and $p = 0.4982$, respectively). No significant difference was found in the impact of UI on general QoL 3 months postpartum. At 12 months, the aggregated physical scores obtained with the SF-12 were significantly increased in the vaginal delivery (56; 53–59) vs the cesarean (55; 51–58) group ($p = 0.0104$), indicating a better general physical QoL.

When analyzing general QoL scores on SF-12 on women with postpartum UI alone at 12 months, there is a significant association between mode of delivery and score (56; 50–59) and therefore a better general QoL for physical appearance than those in the cesarean group (54; 47–57) ($p = 0.033$). There was no significant difference for the mental SF-12 scale, with median scores of 42 (34–50) after vaginal delivery vs 41 (34–51) after cesarean section ($p = 0.6963$).

Table 6 Type of urinary incontinence (UI) at 3 months, $n = 296$

Incontinence, n (%)	Vaginal, $n = 196$	Cesarean, $n = 97$	P value
Stress	93 (48)	37 (38)	0.0005
Overactive bladder	30 (15)	25 (26)	
Mixed	55 (28)	14 (14)	
Other type	18 (9)	21 (22)	

Discussion

Summary of main findings

UI was present in 26% of the study population, similar to results obtained by Glazener in 2006 [4] in a cohort of women with singleton births (29% had UI at 3 months). However, it was much higher than the prevalence of 13% at 3 months found by Hutton et al. in their study on maternal outcomes after twin delivery [13]. The marked difference between these two results could be due to three factors: First, in contrast to our study, all patients in Hutton's study were encouraged to undertake pelvic floor exercises during pregnancy. Second, their study included patients who gave birth before 34 weeks of gestation, which would reduce mean intrauterine weight; although total intrauterine weight did not emerge as a risk factor for UI in our study, others have shown that it is [4]. Finally, the definition of UI was not the same: patients in Hutton's study were only asked whether urine leaked when they sneezed, laughed, or coughed, resulting in the detection of SUI only.

Like Hutton et al., we found a significant difference between the prevalence of UI 3 months after vaginal delivery (35.43%) vs cesarean delivery (16.53%), although the difference in Hutton's study was less marked (15.3 vs 11.3%). Hutton's groups were defined by the intended mode of delivery, which might explain some loss of power after a change in mode of delivery due to local conditions. In addition, even the subgroups used to compare women according to actual mode of delivery were constructed differently from ours in that the vaginal group included women who delivered both twins vaginally and the cesarean group women who delivered at least one twin by this method, which would tend to underestimate the potential role of vaginal birth in the onset of postpartum UI. However, among women with a twin pregnancy and no prior history of SUI, a management strategy of planned cesarean compared with planned vaginal birth reduces the risk of problematic SUI 2 years postpartum in the rest of this study

[14]. Results of the two studies were comparable in the medium-term postpartum (1 year in our study and 2 years in the Hutton study).

The OR in our study for the excess risk associated with vaginal delivery of twins (~3) was, however, similar to that found in another study on singleton births (OR 2.8) [8] . At 12 months, the prevalence of UI (31%) was higher than at 3 months (26%), although it was lower than the rate of 40% at 20 months found in another study after twin birth [12], in which no difference was found between vaginal and cesarean delivery. The difference in the prevalence of UI between singleton and twin births was attributed to a difference in intrauterine weight, yet in our study, this factor had no impact. This raises the possibility of a persistent increase in UI rates over time after twin birth. In two studies conducted by the same author in the same cohort of patients from England, Scotland, and New Zealand [9, 21], a questionnaire was sent at 6 and 12 years postpartum to patients who reported having UI 3 months postpartum (irrespective of the mode of delivery). The prevalence of UI among respondents was 24% at 6 years and 37.9% at 12 years, with a lower prevalence of persistent UI among women delivered by cesarean section (OR 0.46 at 6 years and 0.42 at 12 years). Although these studies only included patients with UI at 3 months, re-emergence of symptoms was nevertheless observed over the long term. The other risk factors for UI found in these studies were older maternal age (at 6 years and 12 years) and obesity (at 12 years). However, it must be borne in mind that some of these women had other pregnancies in the intervening period and that multiparity is a known additional risk factor for UI [7].

In order to eliminate this bias, one study monitored women who had singleton births and remained primiparous 20 years later [22]: 1899/5118 (37%) had UI, and the rate of bothersome UI was 1.85-fold higher among women who gave birth vaginally than in the cesarean group (11.2% vs 6.3%). It therefore appears that the prevalence of UI continues to rise over time, especially in women who delivered vaginally.

The presence of a medical condition prior to pregnancy was a risk factor for UI at 12 months postpartum. The conditions were not always specified, but some of these women had insulin-dependent, non-insulin-dependent diabetes, or chronic hypertension. Diabetes is a known risk factor for SUI and overactive bladder (OAB) [23], although studies on this have tended to include older women. The association between the presence of a medical condition prior to pregnancy and BMI >25 in early pregnancy may explain this risk factor in part.

The apparent protective effect of diagnosing a condition during pregnancy was surprising. It is plausible that the discovery of gestational diabetes (2–6% of all pregnancies) [24] led to dietary measures that limited weight gain during pregnancy, which in turn reduced the risk of UI. We were unable to test this hypothesis, because no details were available on the conditions diagnosed.

We found a significant difference between vaginal and cesarean delivery in the PFDI-20 scores for anorectal, urinary, and perineal symptoms at 3 months postpartum. On analysis of the individual subscales, the difference was found to be due to urinary symptoms. This confirmed the results obtained for the primary outcome, even though these scores remained low: 8.3/100 (0–20.8) for vaginal births and 4.2/100 (0–12.5) for cesarean births. These low scores could be explained by the fact that UDI-6 does not cover UI-related symptoms only but all bladder and urinary symptoms, which in principle would be infrequent in this population of young women.

Based on data from the fourth question of the ICIQ-SF and items 15 and 16 of the PFDI-20, OAB appeared less common than SUI and MUI after vaginal delivery but significantly more common after vaginal than after cesarean delivery ($p < 0.0001$). This suggests that the difference in tUI prevalence applies to all types of UI.

Despite the results presented above, these disorders appeared to have little impact on the women's general QoL. Mode of delivery had no statistically significant effect on SF-12 score at 3 months, and at 12 months, scores for the vaginal group were actually higher (indicating a better QoL) than in the cesarean group (56 vs 55). Although a one-point difference is not clinically meaningful, other studies have confirmed this difference using a different questionnaire: one found that cesarean section was associated with more pain or discomfort and a worse general QoL than vaginal delivery at 12 months [EuroQoL-5D (EQ-5D)] [25], and another found a better score at 2 and 4 months after vaginal delivery than after cesarean section using the SF-36, which contains the SF-12 [26].

Although it is not surprising that vaginal delivery is a risk factor for UI, it was interesting to note that in a twin pregnancy, the additional factors of instrumented delivery or maneuvers at delivery were not risk factors. Possibly, this indicates that the pelvic floor damage from carrying a twin pregnancy is significant enough to negate the additional pelvic floor damage from the complicated delivery.

When these results are considered as a whole, the higher rate of UI after vaginal delivery is insufficient reason for delivering twins by cesarean section. More women who delivered vaginally had UI, but about two thirds of them were continent; 16% of patients delivered by cesarean section had UI. Cesarean section is not therefore a satisfactory solution for combating UI, hence the value of evaluating the efficacy of pelvic floor exercises in twin pregnancy. Furthermore, it must be borne in mind that cesarean section generates more morbidity and mortality than vaginal birth due, in particular, to complications related to anesthesia, infections, or thromboembolism [27].

The main strength of this study is its novelty, since no prospective studies focusing primarily on postnatal UI after twin births have been published. Our study also included a large number of women, more than the calculated number required, which resulted in comparable groups. Moreover,

the few differences found between groups (maternal age > 25 years and BMI >25 in early pregnancy) were dealt with by including them in the multivariate analysis as confounding factors. Its second strength is that it was a national multicenter study encompassing all regions of metropolitan France, maternity units providing various levels of care, and both public and private hospitals, which meant that the population was representative of the general population, thus reducing selection bias. The use of validated, standardized questionnaires made the study reproducible. Classification bias was limited by using a simple question, validated as a measure of UI, for the primary outcome. In addition, patients were unaware of the precise objective of the study. Finally, confounding bias was limited by performing multivariate analysis and adjusting for known confounding factors (smoking, total intrauterine weight, and instrumental delivery) and for the potential confounding factors identified in the study (maternal age > 25 years and BMI >25 in early pregnancy).

The weaknesses of the study were few, but an international study, although complicated to conduct, might have provided a fuller picture, since obstetric techniques—in particular, duration of the second stage of labor and indications for vaginal delivery—differ between countries and would influence the results. It might also be preferable to conduct a randomized study, although Hutton's study illustrates how randomization can generate selection bias and increase study duration considerably or reduce enrolment by increasing the number of women who refuse to participate. The stricter inclusion criteria of this study limited recruitment, and we therefore have no data on women who delivered before 34 weeks gestation or on triplet births. The inclusion of triplets may well have introduced in imbalance between groups, because they would have been delivered far more frequently by cesarean section. Similarly, we have no data on multiparous women. It would also have been interesting to have data on postpartum pelvic floor training, in particular between 3 and 12 months, to explore its efficacy and on the dynamic nature of UI with and without pelvic floor training. Finally, analysis of group comparability showed a significant difference between respondents and nonrespondents in terms of age at delivery (32 years vs 31 years), although this difference was not clinically significant and did not result in selection bias. Maternal age also differed between vaginal and cesarean groups (31 years vs 33 years, respectively). This difference was related to the decision to perform cesarean section and, given the link between age and UI, would have tended to underestimate the impact of vaginal delivery on UI due to the younger age of the women in this group.

Conclusion

The risk of UI (of any type or severity) for a primiparous woman giving birth to twins after 34 weeks of gestation is three times higher 3 months postpartum and twice as high 12 months postpartum if she delivers vaginally rather than by cesarean section. Nevertheless, the excess risk of UI alone does not warrant cesarean delivery for all such women due to the infrequency of severe forms and its moderate impact on QoL. It would, however, be interesting to evaluate the efficacy of pelvic floor exercises in the postpartum period after twin delivery, particularly after vaginal delivery, since UI at 3 months often persists at 12 months.

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Compliance with ethical standards

Conflicts of interest None.

Details of ethics approval The study was approved by the *Comité consultatif sur le traitement de l'information en matière de recherche dans le domaine de la santé* and by the *Commission Nationale de l'Informatique et des Libertés* (autorization no. 913,448).

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