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The prevalence of urinary incontinence 20 years after child birth: a national cohort study in one-para women after vaginal or cesarean delivery

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Running title:

Urinary incontinence 20 years after child birth

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Abstract

Objective To investigate the prevalence and risk factors for urinary incontinence (UI) 20 years after one vaginal delivery (VD) or one cesarean section (CS).

Design Registry-based national cohort study.

Setting Women who returned postal questionnaires (response rate 65.2%) in 2008.

Population Primipara with one, single birth in 1985-1988 and no further births (n = 5 236).

Methods The SWEPOP (Swedish pregnancy, obesity and pelvic floor) study linked Medical Birth Register (MBR) data to a questionnaire about UI.

Main Outcome Measures Prevalence of UI and UI for more than 10 years (UI>10 years) were assessed 20 years after childbirth.

Results The prevalence of UI (40.3% vs. 28.8%, OR 1.67; 95% CI 1.45-1.92) and UI>10 years (10.1% vs. 3.9%, OR 2.75; 95% CI 2.02-3.75) was higher in women after VD than after CS. There was no difference in the prevalence of UI or UI>10 years after an acute CS or an elective CS. We found an 8% increased risk of UI per current BMI unit and age at delivery increased UI risk by 3% annually.

Conclusions Two decades after one birth, VD was associated with a 67% increased risk of UI and UI>10 years increased by 275% compared to CS. Our data indicated that it is necessary to perform 8-9 cesarean sections to avoid one case of UI. Weight control is an important prophylactic measure to reduce UI. Current BMI was the most important BMI-determinant for UI, which is important, as BMI is modifiable.

Keywords Urinary incontinence; vaginal delivery; cesarean section; body mass index; risk factor; epidemiology.

Introduction

In modern societies, women live the major part of their lives after giving birth to one or two children. Urinary incontinence (UI) is a common condition affecting adult women of all ages which may have a negative influence on quality of life.[1] Pregnancy and in particular vaginal delivery have been implicated in the etiology of UI.[1,2] An increasing number of women request cesarean section for non-medical indications and for some their demand appears to be motivated by a desire to prevent pelvic floor damage, including UI.

The etiology of UI is known to be multifactorial but obesity and ageing as well as obstetric trauma during childbirth are known to be three of the most important risk factors. [1,2] Although several studies have demonstrated an association between UI and vaginal delivery in the short- and medium long-term the long-term effects of childbirth on the risk of UI remain controversial.[3–6] The assessment of the influence of childbirth on urinary incontinence later in life has been hampered by the heterogeneity of study populations. Women of different ages and varying body weights have been included after a variable number of pregnancies often with different modes of delivery. The aim of this study was therefore to compare the prevalence of UI 20 years after delivery in a cohort of women who had given birth to only one child after vaginal delivery (VD) or cesarean section (CS).

Methods

A national survey of pelvic floor dysfunction, the SWEPOP (Swedish pregnancy, obesity and pelvic floor) study was conducted in 2008. The population studied and their obstetric data was obtained from the Swedish Medical Birth Register (MBR). The MBR, which was started in 1973, is a national register that includes more than 98% of all births in Sweden. Data from all antenatal clinics and all obstetric units are sent to the MBR at the National Board of Health and

Welfare. Obstetrical parameters from the delivery were obtained from the MBR. Cesarean done before the onset of labor was denoted as an elective cesarean section (ECS) and cesarean done during labor was denoted as an acute cesarean section (ACS). The weight and height of pregnant women had been measured by a midwife at the antenatal clinic, usually at 8-10 weeks of gestation and was also obtained from the MBR. Maternal weight at delivery and the weight gain during pregnancy were recorded at the delivery unit and were also obtained from the MBR. When individual data was initially examined it was noted that the maximum-recorded body weight from the MBR was 99 kg. Due to lack of data storage capacity in the 1980s the MBR had decided to restrict registration of "heavy women" by recording up to two digits only. We therefore reviewed the patient records of the 300 women recorded as having a body weight of 99 kg to obtain the correct weights of these women.

The quality of this national database has been shown to be good and suitable for population studies of this type. A description of the MBR in english can be found at *(http://www.socialstyrelsen.se/register/halsodataregister/medicinskafodelseregistret/inenglish)* and an evaluation of the MBR has been performed by Cnattingius et al.[7] as well as by the National Board of Health and Welfare and is available at http://www.socialstyrelsen.se/publikationer2002/2002-112-4. Inclusion criteria for participation in this study were *primiparae* with *one*, *single birth* 1985-1988 and *no further births*. Multifetal pregnancies were excluded. Ethical approval was obtained from the Regional and the National Ethic Review Boards (the Ethics Committee at Sahlgrenska Academy, Gothenburg University, and the National Board of Health and Welfare).

The results of this study have been reported according to the STROBE statement.

The questionnaire was sent to 9 423 women (Fig. 1) who were asked to provide written, informed consent to participate and to complete a questionnaire. Subjects were excluded from the study, based on the answers in the questionnaire, if they affirmed multiparity (misdiagnosis of 'parity' is predominantly related to immigration, the first birth in Sweden is sometimes misdiagnosed as the first ever), multifetal or ongoing pregnancy (Fig. 1). The results regarding anal incontinence and genital prolapse will be reported separately.

The 31-item questionnaire included questions about current height and weight, urinary or anal incontinence and genital prolapse, menstrual status, hysterectomy, the menopause, hormone treatment etc. Urinary incontinence (UI) was defined according to the International Continence Society and by the question "Do you have involuntary loss of urine?". [8] Participants reporting UI were grouped according to the duration of UI (UI< 5 years, 5–10 years, or >10 years). The severity of UI (frequency, leakage amount) was assessed using the Sandvik score.[9] After three mailing cycles during a four month period the questionnaire was returned by 6148 women (65.2 %).

Maternal BMI was categorized as normal (<25), overweight (≥25-29.9) and obese (≥30) according to the WHO classification[10] and was calculated for each woman according to weight and height measurements in early pregnancy at week 8-10, (BMI-Early Pregnancy), at delivery (BMI-Delivery) and 20 years after delivery (Current BMI).

Characteristics of the sample population and the non-responders

The proportion of missing data varied between 0% (age) and 15.9% for hysterectomy in the population cohort. There was little difference difference in the proportions of missing data between groups, eg. the proportion of missing data for hysterectomy which had the greatest proportion of missing data was 15.5% (620/3995) in the VD-group and 17% (205/1204) in the CS-group. The non-responders were 1.6 years younger (49.6 yrs ± 5.9 vs. 51.2 yrs ± 5.9;

p<0.001), and they were more often overweight or obese (37% vs. 27%; p<0.001 and had an infant birth weight <4000 g (43% vs. 48%; p<0.003) compared to responders.

Statistical analysis

Statistical analysis was performed with SAS 9.1 (SAS Institute Inc, Cary, NC, USA). For cohort characteristics χ^2 test was used to compare categorical variables and the Students t-test for continuous variables. A *p*-value less than 0.05 was considered statistically significant. Adjusted frequencies and odds ratios for UI were calculated using a covariance analysis model to obtain effect measures. A logistic regression model was used to assess risk factors for UI while controlling for potential confounders. Potential risk factors used in the analysis were mode of delivery, maternal age at delivery, maternal BMI (at delivery, and current), hysterectomy, hormone replacement therapy, gestational age, infant birth weight and head circumference. Odds ratio (OR) and their 95% confidence intervals (CI) were calculated from the model. Prevalence figures permitted the calculation of the number of cesarean sections needed to avoid one case of UI using the number needed to treat principle (NNT). The NNT was calculated as the inverse of the absolute risk reduction, where risk reduction was the difference of adjusted UI prevalence between VD and CS.

Results

Basic characteristics of the women grouped according to mode of delivery are shown in Tables 1 and 2. The mean follow-up time after delivery was 21.5 yrs. (SD 1.5) in VD group and 21.8 yrs (SD 1.1) in the CS group. Women delivered by CS were older (current age 53.7 yrs. (SD 6.3) compared to 50.4 yrs. (SD 5.6) in the VD group p<0.001) and gave birth to an infant with a lower birth weight (p<0.001) at a lower gestational week (p<0.001) compared to women who were delivered vaginally (Table 1). The proportion of women aged ≥35 years at delivery was higher ($p<0.001$) in the CS group whereas the proportion of infants with a birth weight ≥ 3500 g was lower ($p<0.001$) in the CS group compared to the VD group.

The prevalence of UI (Table 3) was 67% higher (OR 1.67 CI; 1.45-1.92) after a vaginal delivery (40.3%) compared to women who had been delivered by cesarean section (28.8%). From the prevalence data available on UI it was possible to calculate using the NNT principle that it is necessary to perform 8-9 cesarean sections to avoid one case of UI. Furthermore, the prevalence and risk increase of UI for more than 10 years almost tripled after VD compared to after CS. Prevalence of UI for >10 years after VD was 10.1% compared to 3.9% after CS (OR 2.75 CI: 2.02-3.75). There was however no significant differences in the prevalence of UI (27.1% vs. 24.4%, OR 1.15 CI: 0.88-1.51) or UI for more than 10 years (6.5% vs. 5.1%, OR 1.30 CI: 0.79-2.14) between women delivered by acute cesarean section (ACS) or elective cesarean section (ECS) respectively.

The prevalence of urinary incontinence was higher after VD compared to CS for each current BMI class (BMI<25, BMI≥25-29.9, and BMI≥30) with differences ranging from 11 to 14% (Table 4). Again using the NNT principle ,we calculated the number of cesarean section that would need to be performed to prevent one case of UI for the different BMI groups (9 for BMI <25; 7 for BMI 25-29.9 and 8 for BMI ≥ 30.). The combined effect of BMI and mode of delivery was substantial, for example the adjusted frequency of UI after CS with a current BMI<25 was 24.7% whereas the frequency more than doubled to 54.8% after VD with a current BMI≥30 (Table 4). When using “normal BMI” as reference the risk of UI increased significantly for both overweight and obese women after both modes of delivery. The risk increase of UI in obese women more than doubled in comparison to women with a normal BMI after VD and more than tripled after CS (Table 5). In the logistic regression analyses we found an 8% (range 6-10%) increased risk of UI per BMI unit increase and the increased rate of UI was apparent for both modes of delivery (Table 6).

Due to a interaction term between IBW and mode of delivery ($p<0.01$) we made separate analyses of IBW for the CS group and VD group. The prevalence of UI following VD was higher than after CS in all infant birth weight groups except for weights <3000 g. For women who delivered vaginally rates of incontinence increased with increasing infant birth weight but this was not observed after CS (Table 4). Logistic regression analysis in the total cohort failed to demonstrate a significant increase of UI risk for infant birth weights ≥4500 g (Table 5).

The multivariable analysis (Table 6) did not demonstrate any significant increased risk of UI associated with infant head circumference. However, there was an increased risk of UI after VD compared to CS regardless of fetal head circumference. The risk increase associated with VD in comparison to CS was stronger for fetal head circumference ≥ 36 cm than for head circumference less than 36 cm, OR 2.46 (1.66–3.63) vs. 1.64 (1.40–1.91) (Table 4). Nor were there any differences in UI prevalence in the women grouped according to fetal head circumference (Table 5) after both modes of delivery.

The prevalence of UI was 10% higher in women ≥35 years at delivery compared to women <23 years who had undergone CS and 7% higher in women of the same ages who had a VD (Table 4). In the logistic regression analysis a higher maternal age was associated with an increased risk of UI (OR 1.03, 1.02–1.04), which corresponds to an annual risk increase of 3% per year.

Discussion

The risk of developing UI was found to be 67-71% higher after VD than after CS and the prevalence of UI for more than 10 years almost tripled after VD compared to CS. We found no difference in the prevalence of UI or UI for more than 10 years between women delivered by ACS or ECS, indicating that it is during the later stages of delivery, when the fetus passes through the pelvic floor, that leads to the increased risk of UI. Maternal weight was also an important risk factor and in the logistic regression analyses we found an 8% increased risk of UI per BMI unit increase and the rate of UI was apparent for both modes of delivery. Current BMI was the most important BMI-determinant for UI and this finding is important, as BMI is modifiable. For women who delivered vaginally rates of incontinence increased with increasing infant birth weight but this was not observed after CS. The prevalence of UI increased with maternal age and there was an annual increase in UI prevalence of 3% per year.

The main strengths of this study are the use of a large national, population-based cohort of I-para women and the high response rate. There are advantages of studying I-para women as the first delivery is considered to exert the greatest risk increase for UI even if subsequent deliveries contribute to a further increase in the risk of UI.[1,11] Including multiparous women would disrupt obstetric homogeneity and since most risk factors also covariate with time/age also this would confound effect measures of the analysis. The inclusion of I-para women regardless of maternal health status, maternal and fetal complications is considered a strength as it allows for a greater generalisation of results and therefore a better basis for consultation about elective cesarean section on request. The weight and height data during pregnancy were objectively measured at the antenatal clinics and a validated questionnaire was used.[9,12]

Some limitations of the present investigation must also be considered. First, women with incontinence may be more predisposed to participate in studies and therefore UI might be over-estimated. Secondly, the symptoms of UI were self-reported. However, several studies have shown that self-reported symptoms are consistent and valid when assessing current UI and changes in incontinence severity over time which applies to our study.[11,13] This study also lacks information on whether UI was present or not before or/and during pregnancy or started after delivery. However there is little evidence to suggest any difference in UI prevalence before the first pregnancy or during pregnancy in women grouped according to mode of delivery. It was not possible to assess the importance of the length of the second stage of delivery, as this is unfortunately not documented in the MBR. Obstetric techniques and parameters have varied over time (fewer episiotomies, increasing number of vacuum extractions and severe lacerations, older mothers, higher BMI and heavier children) which may also influence the clinical interpretation of our results. It may also in some respects seem unrepresentative to study the consequences of giving birth to only one child. However, United Nations data show that total fertility rates (TFR) study[14] are rapidly declining globally and the predicted TFR in the middle of this century is predicted to be less than 2.0 children/woman and in many developed countries the TFRs is already between 1.0 and 1.5. Analyses of the non-responder group suggest a small selection bias on our results acting in both directions (younger women and smaller children leading to overestimation of results; overweight/obesity to the opposite).

In this study, CS was often used as reference for comparison with VD to quantify the effect of vaginal birth on UI. The baseline outcome after CS can then be interpreted as representing the risk of pregnancy *per se* and the risk of VD represented the risk of pregnancy plus VD and hence the difference between VD and CS is therefore a measure (in terms of UI prevalence and risk) of vaginal birth trauma. Even if the nulliparous pelvis represents the best available clinical model of normal function, the prevalence of UI in nulliparous women of childbearing age has been reported to be 10-15% study.[2,15] Urinary leakage preceding pregnancy in nulliparous women has been shown to be a strong precursor for increased prevalence of UI 4-12 years post partum.[1,15] Pregnancy *per se*, independent of labour and delivery practice, has been reported to be a risk factor for postpartum UI [4,16] especially if the incontinence started during the first trimester.[17] Several studies have demonstrated that postpartum UI is a risk factor for UI after varying terms of follow-up.[3-5]

There is still no general agreement whether or not the long-term maternal effects of the two delivery modes differ with regard to prevalence of UI. The prospective multicenter study of McKinnie et al.[18] did not show a significant difference of risk for bothersome UI between women delivered by one or more VD compared to one or more CS. Also The Omnibus Survey of MacLennan et al.[19] could not demonstrate an increased risk for any type of UI after VD when compared to CS. In these studies however the CS groups were relatively small and heterogeneous with respect to parity. On the other hand the EPINCONT study demonstrated a 1.7-fold increased age-adjusted risk of UI after one or more VD compared with one or more CS. The age-standardized prevalence rate of UI was 15.9% for the CS group and 21.0% for the VD group.[2] The study population was younger and the follow-up time shorter in the EPINCONT-study compared to the cohorts and the follow up time of our study. Other later studies have also indicated an increased risk of UI following VD compared to CS.[20-22]

Several studies have reported that a higher BMI is a risk factor for UI[1] and cross-sectional studies have confirmed this association in middle-aged women.[23,24] We found an increased risk of UI of ≈ 8 % per unit BMI. Our findings correspond with those of others who showed a risk increase varying between 2-10% per unit increase of BMI.[25,26] The overall assessment of the relation between BMI and prevalence of UI in this study indicated that there was a dose-response relationship between BMI and UI whereas the effect of mode of delivery (i.e. VD or CS) appeared to be constant regardless of maternal BMI status.

The results of this study indicated that current BMI was the most important determinant for UI and this finding is important, as BMI is modifiable. Resolution of UI has been demonstrated after weight loss.[27] Intervention by non-surgical means or laparoscopic gastric bypass surgery indicate that there is a dose-response association between prevalence of UI and the magnitude of weight reduction.[28] The strong association between the prevalence of UI and current BMI is encouraging as it means that it is never too late to achieve improvement of UI through weight reduction and weight control.

The negative effect of VD on urinary continence is consistent with results of several clinical studies that have demonstrated poor urethral support and increased urethral mobility after VD, leading to UI.[29,30] Impaired urethral function could also be shown after VD[29] but this was not observed after CS.[31]

In conclusion, the risk of developing UI and UI for more than 10 years was higher 20 years after a VD compared to a CS. Prevalence did not differ between women delivered by ACS or ECS, indicating the importance of the later stages of delivery during the passage of the fetus through the pelvic floor for the occurrence of UI in later life. Weight control was also shown to be an important preventive measure to reduce UI. Our data also provide a quantification of the importance of mode of delivery and body weight for the risk of future UI. The results of this study indicate that one has to perform 8-9 cesarean sections to avoid one case of UI.

However there may be other advantages regarding the possible protective effective of CS on future pelvic floor function, such as a reduced prevalence of vaginal prolapse which could be included in the decision of whether or not CS is advantageous. Vaginal delivery and BMI have been shown to be important risk factors for UI but operative delivery by CS also involves a degree of risk for morbidity and mortality over and above that of VD.[32]

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Disclosure of interests

We declare that we have no conflict of interests.

Contribution to Authorship

All authors were involved in the conception and design of the study, acquisition of data and interpretation of the results as well as the writing of the manuscript. All authors approved the final version of the submitted manuscript. MG and IM take full responsibility for the integrity of the data and the accuracy of the data analysis.

Details of ethics approval

Ethical approval for the SWEPOP-study was obtained from the Regional and the National Ethic Review Boards (the Ethics Committee at Sahlgrenska Academy, Gothenburg University, Ref No 381-07, August 13th 2007 and the National Board of Health and Welfare, Ref No 34-9148/2007, October 26th 2007).

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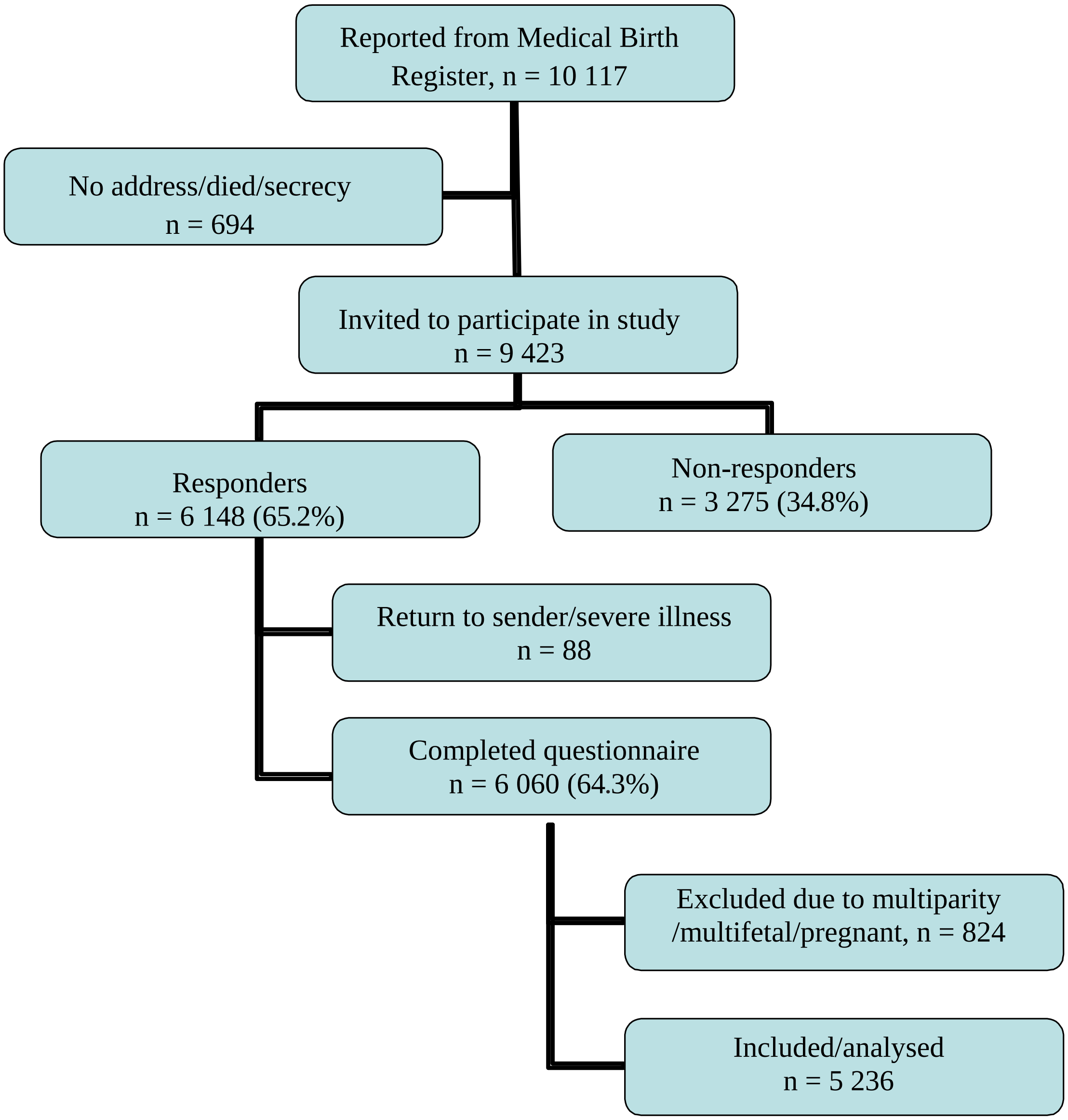
Legend to Figure

Figure 1. Flowchart of the women who gave birth to one child 1985–1988 identified from the Swedish Medical Birth Register (MBR).

Fig. 1



The current addresses of 9423 of these women could be traced in the Swedish population address register and these women were invited to participate in the study. The difference, 694 women, was due to newly deceased women or women with unknown address or hidden personal identity. Of the 6 148 who returned questionnaires 6060 women were able to participate or gave their informed consent for participation in the study. At this stage however a further 824 women were excluded from the study population due to the fact that they had given birth abroad unknown to the MBR, were currently pregnant or had been wrongly categorized as having had only one child in the MBR. Excluded due to multiparity (n = 716); multifetal (n = 43); ongoing pregnancy (n = 6) and 59 missing data about parity in the questionnaire.

Table 1. The basic characteristics of the women grouped according to mode of delivery.

	VD **mean (range)/%**	**CS** **(ECS and ACS)** **mean (range)/%**	**Difference** **CI (95%)**	***p*-value**
	n = 3 995	n = 1 204		
Age at delivery	29.0 (15–46)	31.9 (15–45)	2.9 (2.6–3.3)	<0.001
Age ≥35 years	17.4%	35.6%	18.2 (15.3–21.2)	<0.001
BMI early pregnancy	23.0 (15.0–45.6)	23.0 (15.2–41.7)	0.0 (-0.3–0.3)	=0.94
BMI at delivery	28.3 (17.2–50.3)	28.3 (18.3–47.2)	0.0 (-0.3–0.3)	=0.95
BMI at delivery ≥25	79.0%	78.1%	0.9 (-4–2)	=0.56
BMI current	26.1 (14.5–63.0)	26.3 (16.1–53.8)	0.2 (-0.1–0.5)	=0.16
BMI current ≥25	51.3%	51.2%	0.1 (-3–3)	=0.98
Infant birth weight (g)	3585 (850–5680)	3294 (820–5615)	291 (245–336)	<0.001
Infant birth weight ≥3500 g	55.8%	38.2%	17.6 (14.4–20.7) .	<0.001
Gestational age (weeks)	39.7 (24–45)	38.5 (27–43)	1.2 (1.1–1.4)	<0.001
Hysterectomy	7.9%	9.9%	2.0 (0.00–0.04)	=0.06
Estrogen therapy	7.1%	10.0%	2.9 (0.8–4.9)	<0.01

VD = vaginal delivery; CS = cesarean section; ECS = Elective cesarean section; ACS = Acute cesarean section; BMI = body mass index. Student's t-test was used for statistical comparison between groups.

Table 2. Cohort characteristics for the women who underwent elective or acute cesarean section.

	ECS mean (range)/%	**ACS mean (range)/%**	**Difference CI (95%)**	***p*-value**
	n = 766	n = 438		
Age at delivery	32.5 (15–45)	30.9 (18–45)	-1.64(-2.32 – - 0.95)	<0.001
Age ≥ 35 years	40.7%	26.7%	-14.0 (-19.4 – -8.6)	<0.001
BMI early pregnancy	22.4 (15.2–41.7)	23.9 (15.4–41.7)	1.52 (1.00–2.04)	<0.001
BMI at delivery	27.6 (18.3–47.2)	29.3 (18.9–46.5)	1.75 (1.20–2.30)	<0.001
BMI at delivery ≥ 25	74.7%	83.6%	8.9 (3.8–14.0)	<0.001
BMI current	25.8 (18.9–50.8)	27.0 (18.1–53.8)	1.16 (0.55–1.77)	<0.001
BMI current ≥ 25	47.1%	58.2%	11.1 (5.2–17.0)	<0.001
Infant birth weight (g)	3157(820–5615)	3534 (950–5310)	377 (286–468)	<0.001
Infant birth weight ≥ 3500 g	27.2%	57.5%	30.3 (24.7–36.0)	<0.001
Gestational age (weeks)	38.0 (27–43)	39.4 (27–43)	1.44 (1.15–1.73)	<0.001
Hysterectomy	10.1%	9.5%	-0.01 (-0.04–0.03)	=0.75
Estrogen therapy	11.5%	7.4%	-0.04(-0.08– 0.00)	<0.05

ECS = Elective cesarean section; ACS = Acute cesarean section; BMI = body mass index.
Student's t-test was used for statistical comparison between groups.

Table 3. Crude and adjusted* prevalence and odds ratio of urinary incontinence and urinary incontinence for more than 10 years in relation to mode of delivery.

	CS %	**VD %**	**Crude OR (95% CI)**	**CS %**	**VD %**	**Adjusted* OR (95% CI)**
Urinary incontinence	30.0	40.2	1.56 (1.36-1.80)	28.8	40.3	1.67 (1.45–1.92)
Urinary incontinence for >10 years	4.6	10.0	2.30 (1.73-3.08)	3.9	10.1	2.75 (2.02-3.75)

VD = vaginal delivery; CS = cesarean section; BMI = body mass index.

*Adjusted for BMI-current, BMI at delivery, maternal age, gestational weeks, infant birth weight and head circumference.

Table 4. The results* of logistic regression analysis of possible risk factors for urinary incontinence (odds ratio 95% CI).

Risk factors/confounders	OR (95% CI)
Vaginal delivery	1.71 (1.41–2.08)
BMI-current	1.08 (1.06–1.10)
BMI-at delivery	0.98 (0.96–1.00)
Maternal age at delivery	1.03 (1.02–1.04)
Gestational weeks	1.01 (0.96–1.06)
Infant birth weight (hg)	1.00 (0.98–1.02)
Infant head circumference ≥ 36 cm	1.06 (0.84–1.34)
Hysterectomy	1.21 (0.90–1.63)
Hormone replacement therapy yes vs. no	1.34 (0.98–1.82)

BMI = body mass index. * 3488 women contributed to the model.

Table 5. Crude and adjusted* prevalence and odds ratio of urinary incontinence in relation to mode of delivery stratified for each risk factor

Prevalence of urinary incontinence						
	CS %	**VD %**	**Crude OR (95% CI)**	**CS %**	**VD %**	**Adjusted* OR (95% CI)**
Infant birth weight (g)						
< 3000	33.0	37.6	1.23 (0.91–1.64)	35.5	37.4	1.08 (0.81–1.49)
3000–3499	28.6	38.6	1.57 (1.22–2.00)	27.3	39.1	1.71 (1.33–2.19)
3500–3999	30.9	40.5	1.53 (1.14–2.05)	27.6	41.3	1.85 (1.36–2.50)
4000–4499	27.8	41.5	1.85 (1.28–2.67)	25.3	41.3	2.08 (1.42–3.03)
≥ 4500	23.1	50.4	3.39 (1.63–7.04)	21.2	48.8	3.56 (1.68–7.53)
Infant head circumference (cm)						
< 36	29.8	39.9	1.56 (1.34–1.82)	29.0	40.1	1.64 (1.40–1.91)
≥ 36	26.9	43.1	2.06 (1.41–3.01)	24.0	48.8	2.46 (1.66–3.63)
BMI early pregnancy						
< 25	30.9	37.5	1.34 (1.12–1.61)	29.7	37.8	1.44 (1.20–1.74)
25–29.9	29.2	44.5	1.94 (1.37–2.76)	27.6	44.9	2.14 (1.50–3.05)
≥ 30	45.5	51.9	1.29 (0.67–2.50)	47.7	51.9	1.18 (0.61–2.28)
BMI at delivery						
< 25	29.4	32.7	1.17 (0.84–1.63)	28.9	32.9	1.20 (0.86–1.68)
25–29.9	30.8	39.3	1.45 (1.17–1.80)	30.2	39.5	1.51 (1.21–1.87)
≥ 30	30.5	46.3	1.96 (1.49–2.59)	28.4	46.9	2.93 (1.68–2.95)
Current BMI						
< 25	24.5	34.1	1.59 (1.29–1.97)	24.7	35.6	1.68 (1.36-2.08)
25–29.9	29.3	41.7	1.73 (1.34–2.23)	28.1	42.4	1.88 (1.46-2.43)
≥ 30	45.3	52.8	1.35 (1.01–1.81)	41.6	54.8	1.71 (1.27-2.29)
Maternal age at delivery (years)						
<23	22.8	35.6	1.87 (1.18–2.96)	22.8	36.0	1.90 (1.20–3.02)
23–29	27.9	39.0	1.65 (1.26–2.17)	26.0	38.3	1.77 (1.34–2.33)
30–34	33.8	42.9	1.47 (1.14–1.89)	33.2	43.2	1.53 (1.19–1.97)
≥35	30.4	43.0	1.72 (1.33–2.23)	32.3	42.7	1.56 (1.21–2.01)

VD = vaginal delivery; CS = cesarean section; BMI = body mass index.

*Adjusted for BMI-current, BMI at delivery, maternal age, gestational weeks, infant weight and head circumference.

Table 6. Adjusted* additional risks of UI in relation to stratified risk factors grouped according to mode of delivery.

	CS (95% CI)	**VD (95% CI)**
BMI-current		
<25	ref	ref
25–29.9	1.50 (1.11–2.03)	1.32 (1.14–1.53)
≥30	3.27 (2.34–4.59)	2.50 (2.10–2.98)
Age at term		
<23	ref	ref
23–29	1.29 (0.73–2.26)	1.22 (1.02–1.46)
30–34	1.84 (1.06–3.18)	1.49 (1.23–1.80)
≥35	1.66 (1.00–2.74)	1.49 (1.21–1.84)
Infant birth weight		
< 4500	ref	ref
≥ 4500	0.66 (0.33–1.29)	1.23 (0.87–1.76)
Infant head circumference		
< 36	ref	ref
≥ 36	0.86 (0.59–1.25)	1.07 (0.88–1.29)

VD = vaginal delivery; CS = cesarean section; BMI = body mass index.

*Adjusted for maternal age, gestational length, BMI at term, current BMI, infant birth weight and infant head circumference.A