GYNECOLOGY

Pelvic floor symptoms from first pregnancy up to 8 years after the first delivery: a longitudinal study

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BACKGROUND: Despite the strong association between vaginal childbirth and pelvic floor dysfunction, genetic factors, pregnancy, advancing age, and lifestyle also play a role. The pelvic floor undergoes substantial changes during pregnancy, which may contribute to pelvic floor dysfunction. Conversely, these changes may be favorable for vaginal delivery. However, there is a lack of studies assessing pelvic floor symptoms over time according to delivery mode and including predelivery assessment.

OBJECTIVE: This study aimed to describe urinary incontinence, vaginal symptoms, and bowel control symptoms from 21 weeks of gestation in the first pregnancy up to 8 years after the first delivery, stratified by delivery mode.

STUDY DESIGN: This was a longitudinal observational cohort study. A total of 300 nulliparous women were recruited during their first pregnancy. Pelvic floor symptoms were assessed at 21 and 37 weeks of gestation, and at 6 weeks, 6 months, 12 months, and 8 years after first delivery using the International Consultation on Incontinence Questionnaire modules: the urinary incontinence sum score, the weighted vaginal symptom sum score, the vaginal-associated quality of life score, the bowel control sum score, and the bowel-associated quality of life sum score. Delivery mode at first delivery defined delivery groups as: normal vaginal, operative vaginal, and cesarean delivery. A linear mixed-model analysis was used to assess symptom scores over time and differences in symptom scores between the delivery groups.

RESULTS: Of the 300 women included in the study, 193 attended the 8-year follow-up. Pelvic floor symptoms differed between women who had vaginal delivery and those who had cesarean delivery. The symptom scores showed a nonlinear statistically significant trend. In women who delivered vaginally, there was an increase of urinary incontinence and vaginal symptom scores already during pregnancy. In women who later delivered by cesarean, there was a decrease of symptom scores during pregnancy, and overall lower symptom scores relative to women who had vaginal delivery at 12 months after the first delivery. Pelvic floor symptom scores increased from 12 months to 8 years after the first delivery and exceeded pregnancy levels in all delivery groups; however, overall symptom scores were low. Differences between delivery groups were not statistically significant.

CONCLUSION: Pelvic floor symptoms differed between women who had vaginal delivery and those who had cesarean delivery from the first pregnancy up to 8 years after the first delivery. These differences were already recognizable before the first delivery.

Key words: anal incontinence, cesarean section, pelvic floor dysfunction, urinary incontinence, vaginal delivery, vaginal symptoms

Introduction

Pelvic floor dysfunction in women comprises a multifaceted group of conditions.[1] The term includes, but is not limited to, urinary incontinence, anal incontinence, and pelvic organ prolapse.[1,2] Pelvic floor dysfunction may cause physical and psychological morbidity and diminish women's quality of life, and its etiology is multifactorial.[1–4] Despite the strong association with vaginal childbirth, especially operative vaginal delivery,[5–11] genetic factors, pregnancy, advancing age, and lifestyle also play a role in its development.[2,12–14] This complex and diverse network of risk factors is challenging to unravel because the risk factors often overlap and interact with each other.[1,2] The pelvic floor undergoes substantial changes during pregnancy,[15,16] which may contribute to pelvic floor dysfunction. Conversely, these changes may be favorable for vaginal delivery. In fact, vaginal delivery has been associated with a larger, more distensible levator hiatus and a greater degree of bladder neck mobility during pregnancy. These pelvic floor characteristics are also associated with an increased risk of urinary incontinence and pelvic organ prolapse.[17–19] Several observational and 2 large prospective longitudinal studies showed a strong association between vaginal delivery and pelvic floor dysfunction development. However, antenatal data on pelvic floor symptoms were not considered.[5–11,20] The present study provides longitudinal data on pelvic floor symptoms obtained at 2 time points during the first pregnancy and 4 time points in the 8 years following the first delivery, in women recruited from an unselected childbearing population. The aim of this study was to describe urinary incontinence, vaginal symptoms, and bowel control symptoms from 21 weeks of gestation in the first pregnancy and up to 8 years after the first delivery, stratified by delivery mode.

Materials and Methods

This was a single-center longitudinal observational cohort study. Nulliparous women were recruited at gestational weeks 17 to 19 of their first pregnancy. This cohort study explored anatomic and functional pelvic floor changes in women from the first pregnancy, throughout the

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AJOG at a Glance

Why was this study conducted?

This study aimed to describe urinary incontinence, vaginal symptoms, and bowel control symptoms from 21 weeks of gestation in the first pregnancy up to 8 years after the first delivery, stratified by delivery mode.

Key findings

Already during pregnancy, women who later delivered vaginally had more and increasing pelvic floor symptoms relative to women who later delivered by cesarean delivery. After delivery, women who had cesarean delivery had lower symptom scores than women who had vaginal delivery; however, symptom scores increased at 8-year follow-up in all delivery groups. Symptom scores were generally low in the entire population.

What does this add to what is known?

The differences in pelvic floor symptoms before delivery highlight the need of considering antenatal data when assessing pelvic floor symptoms according to delivery mode.

first postpartum year, and finally at an 8-year follow-up.[16,21–23] Inclusion criteria at baseline were singleton pregnancy and the ability to speak a Scandinavian language. Exclusion criteria at baseline were previous pregnancy of >16 weeks of gestation and serious maternal or fetal pathology. Ongoing exclusion criteria were premature delivery before 32 weeks of gestation (at first delivery) and stillbirth (at first delivery).[16,21–23] A concurrent randomized controlled trial (RCT) included 139 women from 6 weeks to 6 months after their first delivery, aiming to explore the effect of pelvic floor muscle training on pelvic floor anatomy and function.[24] All assessments were conducted at Akershus University Hospital, Norway, from 2010 to 2012 (follow-up during pregnancy and up to 12 months after first delivery) and 2017 to 2020 (8-year follow-up). We omitted women from analysis at specific time points if they had an ongoing pregnancy of >6 weeks of gestation. The 8-year follow-up was scheduled at least 6 months after the last delivery, and at this follow-up we also omitted women from analysis if they had undergone pelvic floor surgery. All participants provided informed consent. Ethical approval was obtained from the regional ethics committee (REK South-East 2009/170 and 2017/89) and the hospital's data protection officer (17-055 and 17-086).

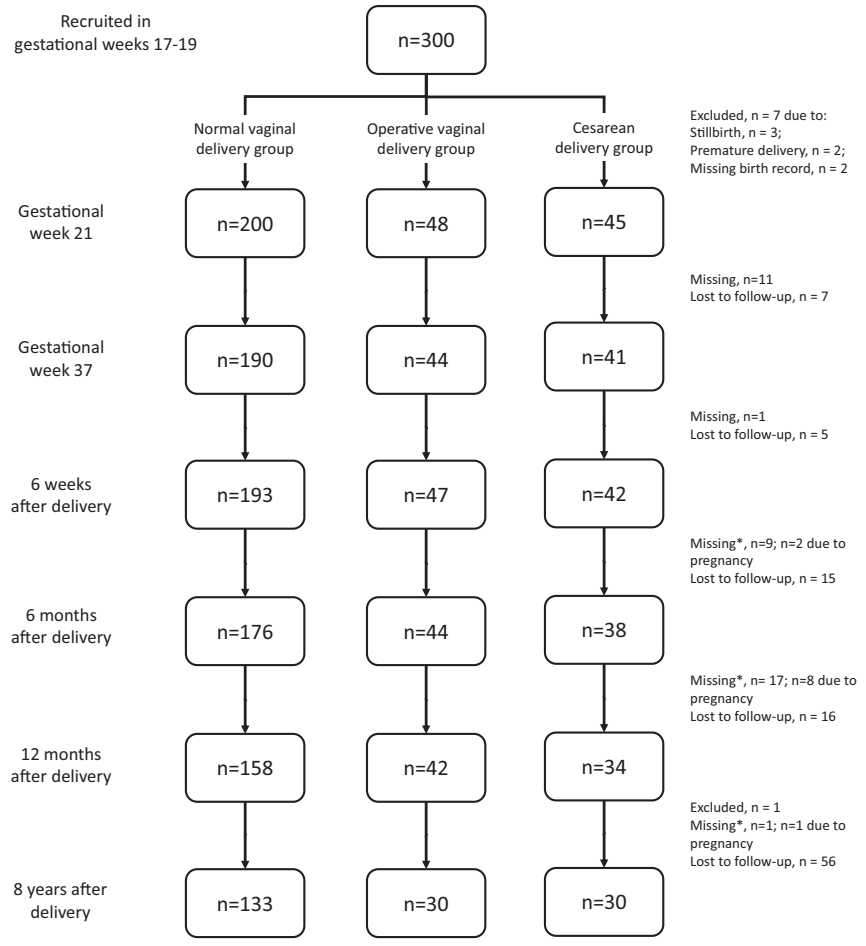
An electronic questionnaire was sent to the participants at 6 time points: at 21 and 37 weeks of gestation; and at 6 weeks, 6 months, 12 months, and 8 years after the first delivery. To assess urinary incontinence, vaginal symptoms, and bowel control symptoms, the following International Consultation on Incontinence Questionnaire (ICIQ) modules were used: the "urinary incontinence short form," the "vaginal symptoms module," and the "anal incontinence and quality of life module."[25–27] We calculated the urinary incontinence sum score, the weighted vaginal symptom sum score, the vaginal-associated quality of life score, the bowel control sum score, and the bowel-associated quality of life sum score. The urinary incontinence short form includes a question on how symptoms interfered with everyday life on a linear scale from 0 to 10. The Supplemental Figure shows how question items in each module are organized, ultimately providing a sum score. Low scores indicate little or no symptoms or interference with everyday life, whereas high scores indicate considerable symptoms or interference with everyday life. The modules do not provide validated thresholds that define clinically significant pelvic floor dysfunction. Demographics and delivery data (at first delivery) were obtained from the women's electronic medical records (PARTUS) and questionnaire items exploring additional background data. Delivery mode at first delivery defined the delivery groups: (1) normal vaginal, (2) operative vaginal (including vacuum and forceps), and (3) cesarean delivery. In the questionnaire at 8-year follow-up, we obtained information on subsequent delivery modes, but this did not allocate study participants to a different delivery group at the 8-year follow-up.

A linear mixed model with random intercepts for women was estimated to assess the differences between delivery groups over time. Random slopes did not improve the model fit and were therefore not included. The model included fixed effects for the nonlinear time component (in weeks), dummy for the delivery group, and the interaction between these. The Bayesian information criterion was applied in building the model. Standard residual diagnostics were performed. A post hoc analysis was performed to estimate mean sum scores within each group at all time points and compare these scores between the groups. Results were illustrated graphically. At the 8-year follow-up, we additionally included the observed mean sum scores with standard deviations (SDs) for 2 subgroups in the cesarean group: women who had exclusively cesarean delivery and women who had subsequent vaginal delivery after cesarean delivery. At 6 weeks and 6 months after delivery, we adjusted for participation in the RCT training group. At the 8-year follow-up, we adjusted for parity. No previous power calculation was performed. Results with $P<.05$ were considered statistically significant. The analyses were performed in IBM SPSS Statistics, version 27 (IBM, Armonk, NY) and Stata, version 16 (StataCorp, College Station, TX).

Results

Of the 300 women included in the study, 193 attended the 8-year follow-up (Figure 1). One woman with a normal vaginal delivery at first delivery had undergone pelvic floor surgery and was therefore omitted from the 8-year analysis. Mean follow-up time points were at 20.9 (SD, 0.1) and 37.0 (SD, 0.7) weeks of gestation, and at 6.2 weeks (SD, 1.1),

FIGURE 1
Flowchart of study participants



* Missing study participants may provide data in later follow-ups.

A total of 300 women were recruited at the routine ultrasound scan at gestational weeks 17 to 19. Study groups were defined according to delivery mode at first delivery: normal vaginal delivery, operative vaginal delivery, and cesarean delivery. Follow-up rates in each delivery group were 66.5% (133/200) in normal delivery group, 62.5% (30/48) in operative vaginal delivery group and 66.7% (30/45) in cesarean delivery group.

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6.1 months (SD, 0.6), 11.9 months (SD, 0.8), and 8.1 years (SD, 0.8) after first delivery. There was no difference in follow-up time between delivery groups. At least 1 subsequent delivery occurred in 84.2% (112/133) of women who had normal vaginal delivery, 93.3% (28/30) of women who had operative vaginal delivery, and 76.7% (23/30) of women who had cesarean delivery at first delivery ($P<.05$).

The Table shows the demographics and delivery data of the study population.

Figure 2 illustrates mean sum scores at each time point as estimated by the linear mixed model. There was a significant nonlinear trend in symptom scores in the delivery-stratified analysis (Supplemental Tables 1 and 2). Adjustment for participation in the RCT training group and parity at 8-year follow-up did not change results.

The estimated urinary incontinence mean sum scores varied between 0.9 and 3.7 (maximum sum score, 21) in this study population. In women who delivered vaginally at first delivery, there was an increase in sum scores throughout the entire study period. In women who delivered by cesarean, the estimated sum scores decreased during the first pregnancy and up to 12 months after first delivery. For all delivery groups, sum scores increased from 12-month to 8-year follow-up. At 12-month follow-up, women who had operative vaginal delivery had significantly higher sum scores than women who had cesarean delivery ($P=.039$). Otherwise, differences in sum scores between delivery groups were not statistically significant.

The estimated vaginal symptom sum scores varied between 3.5 and 5.7 (maximum score, 53). In women who had vaginal delivery, vaginal sum scores increased during pregnancy and up to 6 months after delivery and decreased at 12-month follow-up. In women who had cesarean delivery, estimated sum scores decreased during pregnancy and up to 12 months after first delivery. In all delivery groups, sum scores increased from 12-month to 8-year follow-up. At 6 weeks after delivery, women who had operative vaginal delivery had statistically significantly higher vaginal sum scores than women who had cesarean delivery ($P=.041$). At 6-month follow-up, women who had normal and operative vaginal delivery had higher sum scores than women who had cesarean delivery ($P=.002$ and $P=.004$, respectively). No other differences were statistically significant.

The vaginal-associated quality of life score varied between 0.8 and 1.8 (maximum score, 10). At 6 months after first delivery, vaginal-associated quality of life scores were statistically significantly higher in women who had operative vaginal delivery than in women who had cesarean delivery ($P=.047$) or women who had normal vaginal delivery ($P=.042$). At 8 years after first delivery, vaginal-associated quality of life score decreased in all delivery mode groups.

The estimated bowel control mean sum scores varied between 0.8 and 2.6 (maximum score, 28). Bowel control sum scores increased in women who had operative vaginal delivery throughout the entire study period but remained unchanged in women who had normal vaginal and cesarean delivery. Women

TABLE
Demographic and delivery data of the study population

Demographic and delivery data	NVD	OVD	CD
Demographic, baseline[a]			
Maternal age at first delivery (y)	29.2 (SD, 4.3)[b]	29.6 (SD, 3.8)	30.9 (SD, 4.8)[b]
Prepregnancy BMI (kg/m2)	23.9 (SD, 4.0)	23.7 (SD, 3.7)	24.0 (SD, 3.5)
Training group in RCT (yes)	54 (27.0%)	17 (35.4%)	0
Mean follow-up time:			
First visit (gestational wk)	21.0 (SD, 1.4)	21.0 (SD, 1.3)	20.5 (SD, 1.4)
Second visit (gestational wk)	37.0 (SD, 0.7)	36.9 (SD, 0.6)	37.1 (SD, 0.7)
Third visit (wk after delivery)	6.2 (SD, 1.1)	6.1 (SD, 0.8)	6.3 (SD, 0.9)
Fourth visit (mo after delivery)	6.1 (SD, 0.6)	6.2 (SD, 0.5)	6.0 (SD, 0.4)
Fifth visit (mo after delivery)	11.9 (SD, 0.7)	11.9 (SD, 0.7)	11.8 (SD, 1.2)
Sixth visit (y after delivery)	8.1 (SD, 0.8)	8.0 (SD, 0.9)	8.2 (SD, 0.7)
First delivery data			
Length of second stage (min)[c]	61.6 (SD, 42.7)[b]	97.4 (SD, 60.3)[b]	—
Neonatal birthweight (g)	3451.6 (SD, 454.1)[b]	3671.0 (SD, 517.2)[b]	3515.6 (SD 693.1)
Total gestational length (d)	280.6 (SD, 10.4)	283.5 (SD, 9.3)	278.7 (SD 13.8)
Episiotomy (yes)	49 (24.5%)[b]	26 (54.2%)[b]	1 (2.2%)
Grade 3 or 4 perineal tear (yes)	5 (2.5%)[b]	5 (10.4%)[b]	
Operative delivery mode:			
Vacuum		44 (91.7%)	
Forceps		4 (8.3%)	
CD, prelabor (<3 cm)			21 (46.7%)
CD, active labor (>3 cm)			24 (53.3%)
Indication for CD:			
Failure to progress			12 (26.7%)
Fetal distress			12 (26.7%)
Maternal request			9 (20.0%)
Breech presentation not qualified for vaginal delivery			7 (15.6%)
Other indications			5 (11.1%)
Demographics, 8-year follow-up[d]			
Maternal age at follow-up (y)	37.5 (SD, 4.3)	37.6 (SD, 3.5)	38.1 (SD, 4.6)
Time interval between last delivery and follow up (y)	4.9 (SD, 2.2)	4.6 (SD, 1.9)	5.6 (SD, 2.2)
Number of women without subsequent delivery	21/133 (15.8%)	2/30 (6.7%)	7/30 (23.3%)
Number of women with 1 subsequent delivery	90/133 (67.7%)	24/30 (80.0%)	20/30 (66.7%)
Delivery mode of subsequent delivery			
NVD	86	21	10
OVD	1	2	1
CD	3	1	9

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TABLE
Demographic and delivery data of the study population *(continued)*

Demographic and delivery data	NVD	OVD	CD
Number of women with 2 subsequent deliveries	22/133 (16.5%)	4/30 (13.3%)	3/30 (10.0%)
Delivery mode of subsequent deliveries			
Vaginal deliveries	19	4	1
CD + NVD		3	
Only CD			2

Study groups are defined according to delivery mode at first delivery: NVD, OVD (vacuum and forceps), and CD. Means with SDs and frequencies in numbers and percentages.

BMI, body mass index; *CD*, cesarean delivery; *CI*, confidence interval; *NVD*, normal vaginal delivery; *OVD*, operative vaginal delivery; *RCT*, randomized controlled trial; *SD*, standard deviation.

[a] Number of women at baseline: n=200 for NVD, n=48 for OVD, and n=45 for CD; [b] Statistically significant differences between the delivery groups: maternal age (NVD vs CS; mean difference, 1.7 [95% CI, 0.2−1.7]), length of second stage (OVD vs NVD; mean difference, 35.8 [95% CI, 17.1−54.4]), fetal birthweight (OVD vs NVD; mean difference, 219.4 [95% CI, 71.6−367.2]), episiotomy rate (OVD vs NVD; $P<.05$), and anal sphincter tear rate (OVD vs NVD; $P<.05$); [c] Defined as time from full dilatation of the cervix until the birth of the fetus; [d] Number of women attending the 8-year follow-up: n=133 for NVD; n=30 for OVD; and n=30 for CD.

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who had operative vaginal delivery had statistically significantly higher sum scores at 6 weeks ($P=.014$), 6 months ($P=.002$), and 12 months ($P=.002$) after first delivery than women who had cesarean delivery. Furthermore, they had statistically significantly higher sum scores than women who had normal vaginal delivery at 6-month ($P=.016$), 12-month ($P=.004$), and 8-year ($P<.001$) follow-up.

The estimated bowel control–associated quality of life scores varied between 1 and 2.6 (maximum score, 26). They followed the same pattern in all delivery groups, with a decrease from 21 weeks of gestation to 12 months after first delivery and an increase at 8-year follow-up. There was no statistically significant difference between the delivery groups.

The observed mean sum scores at 8-year follow-up were similar for women who had exclusively cesarean delivery and women who had subsequent vaginal delivery after cesarean delivery, except for vaginal symptom scores. The observed mean vaginal symptom sum score was 2.7 (SD, 4.3) for women who had exclusively cesarean delivery and 8.3 (SD, 6.4) for women who had subsequent vaginal delivery after cesarean delivery.

Comment

Principal findings

In our study, pelvic floor symptoms differed between women who had vaginal delivery and those who had cesarean delivery. These differences were already recognizable before delivery. Pelvic floor symptoms increased at 8-year follow-up and exceeded pregnancy levels in all delivery groups. Women who had cesarean delivery had lower symptom scores than women who had vaginal delivery within the first year postpartum. However, the differences between delivery groups were only statistically significant at some time points. Overall, symptom scores were low for all delivery groups.

Results in context

During pregnancy, the pelvic floor undergoes considerable hormone-mediated changes, presumably in preparation for vaginal delivery, hence facilitating the passage of the fetus.[15] Conversely, these changes may increase the risk of pelvic floor dysfunction. The increase of urinary and vaginal symptoms during pregnancy in women who later delivered vaginally could be interpreted as supportive of this hypothesis. Therefore, in some degree vaginal delivery may be an expression of pelvic floor characteristics associated with pelvic floor dysfunction rather than the cause of it.

It is assumed that urinary incontinence is a dynamic process that may occur and disappear at different time points throughout a woman`s life.[28–30] Nevertheless, for most women, urinary incontinence persists over time, and the risk of both persisting and de novo urinary incontinence has been found to be higher in women who had vaginal delivery than in women who had cesarean delivery.[5,30] Our data concur with those findings. Similar to our results, operative vaginal delivery, in particular vacuum delivery, did not increase the risk of urinary incontinence relative to normal vaginal delivery in other studies.[5,30–32]

In our study, the vaginal symptom scores were in line with DeLancey's lifespan model in women who had vaginal delivery.[1] The increase of vaginal symptom scores up to 6 months after delivery may reflect the impact of the inciting factor: delivery. The decrease in symptom score from 6 months to 12 months after delivery could be interpreted as recovery. At the 8-year follow-up, there was a slight increase in vaginal symptoms in all delivery groups, presumably due to deterioration with advancing age and subsequent deliveries. Our operative vaginal delivery group comprised mainly women who had vacuum assistance. In accordance with data from a large Swedish cohort study assessing the long-term effect of vacuum delivery,[31] we found similar vaginal symptom scores in women who had vaginal delivery, with and without operative assistance. As described by others, women who had cesarean delivery had fewer vaginal

FIGURE 2
Pelvic floor symptoms from pregnancy to 8 years after first delivery

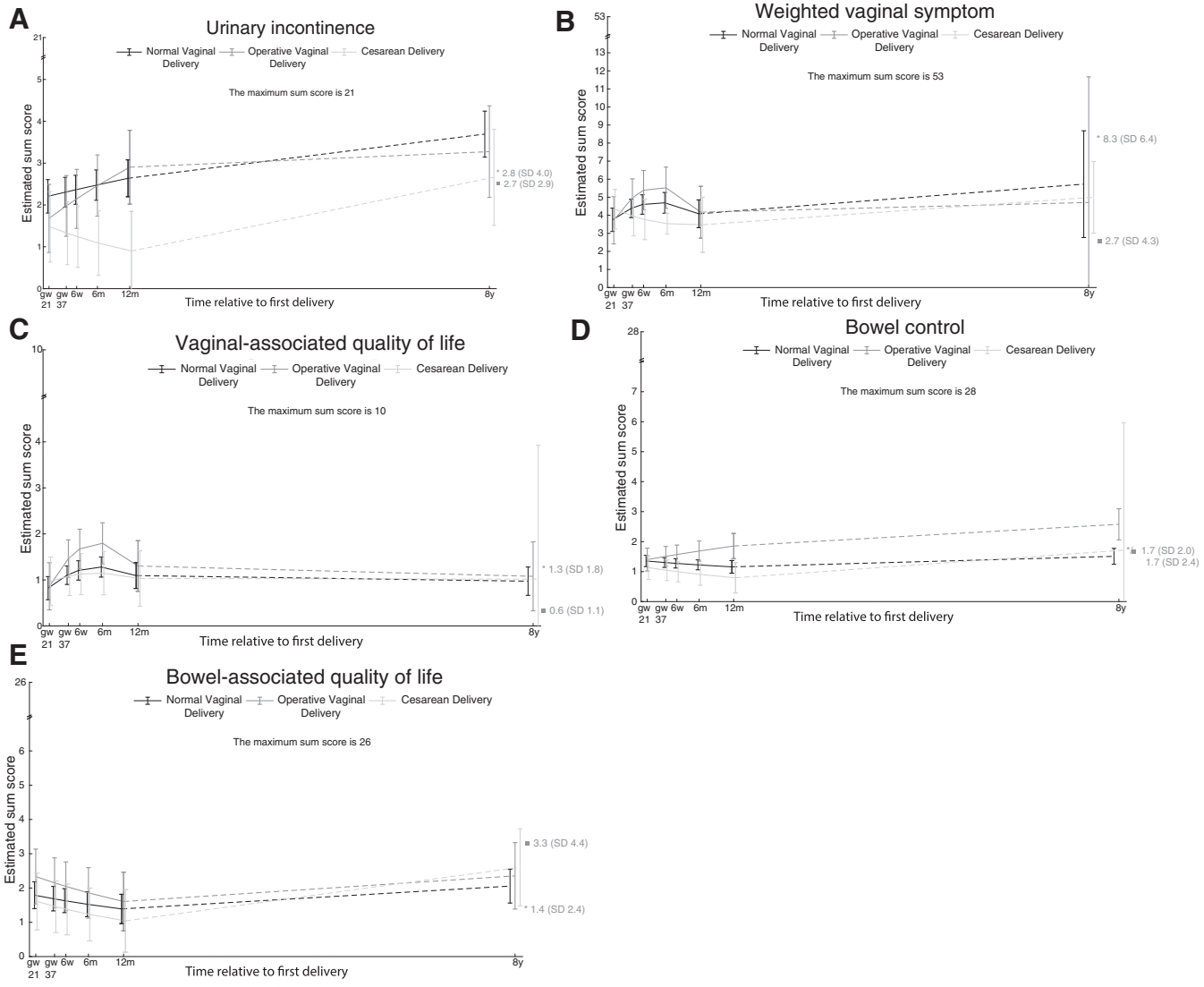

Illustration of the estimated mean sum scores with 95% confidence intervals for (**A**) urinary incontinence; (**B**) weighted vaginal symptoms; (**C**) vaginal-associated quality of life; (**D**) bowel control; and (**E**) bowel-associated quality of life at gestational weeks 21 and 37, and at 6 weeks, 6 months, 12 months, and 8 years after first delivery. Study groups were defined according to delivery mode at first delivery: normal vaginal delivery, operative vaginal delivery (vacuum and/or forceps), and cesarean delivery. At 8 years after delivery, estimates are slightly shifted from each other to better visualize point estimates and confidence intervals.

The *asterisk* represents observed mean sum score with standard deviation at 8 years after delivery for the cesarean delivery subgroup: vaginal delivery after cesarean delivery.

The *diamond* denotes observed mean sum score with standard deviation at 8 years after delivery for the cesarean delivery subgroup: exclusively cesarean delivery.

gw, gestational week; *m*, months; *w*, week; *y*, years.

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symptoms than women who had vaginal delivery.[7,33] In our study, the reported vaginal-associated quality of life scores followed the vaginal symptom scores up to 12 months after first delivery. Interestingly, vaginal-associated quality of life score decreased at 8-year follow-up in all delivery groups. This indicated little symptomatic disease in our population, independent of delivery mode. However, 1 woman who had vaginal delivery had undergone prolapse surgery before the 8-year follow-up.

Bowel control symptoms changed only slightly during the study period in

all delivery groups. Nevertheless, the most pronounced change was observed in women who had operative vaginal delivery, with an increase in symptom scores throughout the entire study period. Anal sphincter injuries are associated with anal incontinence,[34,35] and in our study women who had operative vaginal delivery had higher prevalence of anal sphincter injuries. However, Johannessen et al found an increased risk of anal incontinence in women who had vaginal deliveries complicated by anal sphincter injury and women who had operative vaginal delivery without the diagnosis of anal sphincter injury.[11] Similar to other studies, there were only slight differences in bowel control symptoms between women who had normal vaginal delivery and those who had cesarean delivery.[5,9] In our study, the bowel-associated quality of life sum scores were low in all delivery groups.

Clinical implications

The results from this study give insight into the changes of pelvic floor symptoms in an unselected childbearing population within the first decade after first delivery. The ICIQ modules do not provide a validated threshold for defining when women meet criteria for disorder or dysfunction, or cutoff values for minimal clinically important difference in an unselected population. Therefore, the interpretation of the clinical importance of changes in sum score over time and the differences between delivery groups remains speculative. However, in our study, symptom scores and the symptom-associated quality of life scores were low in all delivery mode groups.

Research implications

Pelvic floor characteristics before delivery are likely to play a role in the development of pelvic floor dysfunction. Better understanding of changes in pelvic floor characteristics during pregnancy and their impact on pelvic floor dysfunction development should be the aim of further research.

Strengths of the study

This study provided prospective collected data on pelvic floor symptoms at 2 time points during pregnancy and several times up to 8 years after first delivery. Participants were recruited from an unselected childbearing population. The study population was comparable to the background population (n=2547) of pregnant nulliparous women scheduled for delivery at Akershus University Hospital during the inclusion period with regard to age, body mass index, and delivery mode.[22,36] However, higher educational levels and the selection of White women speaking a Scandinavian language may represent a bias, and findings may be limited to this ethnic group. There was little variation in the time points fixed for symptom evaluation. A linear mixed-model analysis was used. This is a more suitable statistical approach than repeated cross-sectional analysis because it properly accounts for the intrasubject correlation of response measurements and for missing data, which is a known challenge in longitudinal studies.[37] The use of fully validated questionnaires and the assessment of quality of life add further strength. Sum scores, rather than prevalence of symptoms, were used to describe symptom development in a comprehensive manner.

Limitations of the study

The small sample size is a limitation of this study and may have resulted in insufficient power to show statistically significant differences between delivery groups. Indication of cesarean delivery is not accounted for in our analysis, and it is likely that in some cases delivery mode was not associated with pelvic floor characteristics during pregnancy at all. However, the delivery process is highly complex, and interactions of all factors influencing the course of labor are difficult to assess. Furthermore, cesarean delivery rates depend on obstetrical practice, which may differ between hospitals and countries. This introduces bias and should be taken into account when interpreting our data. The difference in parity and the variety of subsequent delivery modes represent further limitations. The impact of subsequent deliveries on pelvic floor dysfunction is controversial.[3,10,14,38–40] Most women in our population were multiparous, and controlling for parity at 8-year follow-up did not change the results. Of the 30 women who initially had a cesarean delivery, 12 had $\geq$1 subsequent vaginal deliveries. Because of the small sample size, it was not possible to perform subgroup analysis to assess statistical differences.Therefore, the observed mean sum scores in the subgroups, vaginal delivery after previous cesarean delivery, and exclusively cesarean delivery were estimated at 8-year follow-up. A further limitation was the lack of first-trimester or prepregnancy data. This would have given a baseline to describe all changes in pelvic floor symptoms due to pregnancy. Some of the women included in the study participated in a RCT with pelvic floor muscle training as the intervention between 6 weeks and 6 months after first delivery.[24,41,42] No statistically significant differences were found between the control and intervention group regarding urinary incontinence prevalence, vaginal symptoms, and pelvic organ support measured with the pelvic organ quantification system.[24,41,42] Controlling for participation in the RCT training group did not alter the results in our analysis.

Conclusion

The increase of pelvic floor symptom scores already during pregnancy in women who later delivered vaginally highlights the need of including antenatal data when assessing pelvic floor dysfunction according to delivery mode. Women who had cesarean delivery had lower symptom scores than women who had vaginal delivery, both before and after first delivery. However, symptom scores increased at 8-year follow-up in all delivery groups. Overall, symptom scores were low in the entire population. ■

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SUPPLEMENTAL FIGURE

Overview of question items in each score module from ICIQ

ICIQ-Urinary Incontinence Short Form (ICIQ-UI SF)	ICIQ-Vaginal Symptoms (ICIQ-VS)	ICIQ Anal Incontinence and Quality of life (ICIQ-B)
Urinary incontinence sum score (3 items, score 0–21)	Weighted vaginal symptom sum score (8 items, score 0–53)*	Bowel control sum score (7 items, score 0–28)
Frequency of urinary incontinence	Dragging pain in lower abdomen	Underwear staining (soiling)/use of pads
Amount of leakage	Soreness in vagina	Control of watery/loose stools
Everyday life affected (quality of life)	Reduced sensation in vagina	Control of formed/solid stools
	Loose vagina	Control of wind (flatus)
	Lump felt inside	Control of mucus (discharge)
	Lump seen outside	Accidents
	Dry vagina	Leakage predictability
	Fecal evacuation	
	*Some question items in the vaginal symptoms module are weighted when summarized.	
	Vaginal-associated quality of life score (1 item, score 0–10)	Bowel-associated quality of life sum score (5 items, score 0–26)
	Everyday life affected (quality of life)	Bowels causing embarrassment
		Awareness of toilet location
		Make plans according to bowels
		Stay at home more often
		Everyday life affected (quality of life)

ICIQ, International Consultation on Incontinence Questionnaire.

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SUPPLEMENTAL TABLE 1

Results from the linear mixed-model analysis for urinary incontinence sum score, weighted vaginal symptom sum score, vaginal quality of life score, bowel control sum score, and bowel-associated quality of life sum score

Results from the linear mixed model analysis for urinary incontinence

	Total		Stratified by delivery mode	
Urinary incontinence sum score	RC (SE)	*P*value	RC (SE)	*P*value
Intercept	5.06 (0.17)	<.001	5.08 (0.19)	<.001
Time	0.02 (0.005)	<.001	0.02 (0.006)	<.001
Time^2	−0.00005 (0.00001)	.001	−0.00005 (0.00002)	.003
Group				
NVD — ref.			0	
OVD			−0.12 (0.46)	.788
CD			0.02 (0.55)	.973
Time × OVD			0.02 (0.01)	.263
CS			−0.03 (0.02)	.048
Time^2 × OVD			−0.00005 (0.00004)	.210
CD			0.00008 (0.00004)	.068

Results from the linear mixed model analysis for vaginal symptoms

	Total		Stratified by delivery mode	
Weighted vaginal symptom sum score	RC (SE)	*P*value	RC (SE)	*P*value
Intercept	4.49 (0.22)	<.001	4.47 (0.26)	<.001
Time	0.02 (0.008)	.004	0.03 (0.01)	.007
Time^2	−0.0007 (0.0002)	.001	−0.0007 (0.0003)	.007
Time^3	$1.8x10^{-6}$ ($5.7x10^{-7}$)	.001	$1.9x10^{-6}$ ($6.9x10^{-7}$)	.007
Group				
NVD — ref.			0	
OVD			0.67 (0.60)	.262
CD			−0.59 (0.62)	.338
Time × OVD			0.02 (0.02)	.265
CD			−0.05 (0.02)	.040
Time^2 × OVD			−0.0008 (0.0006)	.200
CD			0.001 (0.0006)	.115
Time^32 × OVD			$2.0x10^{-6}$ ($1.5x10^{-6}$)	.210
CD			$-2.4x10^{-6}$ ($1.6x10^{-6}$)	.133

Results from the linear mixed model analysis for vaginal quality of life

	Total		Stratified by delivery mode	
Vaginal-associated quality of life score	RC (SE)	*P*value	RC (SE)	*P*value
Intercept	1.20 (0.09)	<.001	1.14 (0.10)	<.001
Time	0.01 (0.003)	<.001	0.01 (0.004)	.001
Time^2	−0.0003 (0.00009)	<.001	−0.0003 (0.0001)	.006
Time^3	$8.0x10^{-7}$ ($2.2x10^{-7}$)	<.001	$7.1x10^{-7}$ ($2.7x10^{-7}$)	.009

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SUPPLEMENTAL TABLE 1

Results from the linear mixed-model analysis for urinary incontinence sum score, weighted vaginal symptom sum score, vaginal quality of life score, bowel control sum score, and bowel-associated quality of life sum score *(continued)*

Results from the linear mixed model analysis for vaginal quality of life

	Total		Stratified by delivery mode	
Vaginal-associated quality of life score	RC (SE)	*P*value	RC (SE)	*P*value
Group				
NVD — ref.			0	
OVD			0.40 (0.24)	.087
CD			−0.04 (0.24)	.872
Time × OVD			0.01 (0.008)	.122
CD			−0.007 (0.009)	.399
Time^2 × OVD			−0.0004 (0.0002)	.119
CD			0.0002 (0.0003)	.541
Time^32 × OVD			$9.2x10^{-7}$ ($6.0x10^{-7}$)	.127
CD			$-3.6x10^{-7}$ ($6.4x10^{-7}$)	.567

Results from the linear mixed model analysis for bowel control symptoms

	Total		Stratified by delivery mode	
Bowel control sum score	RC (SE)	*P*value	RC (SE)	*P*value
Intercept	1.29 (0.07)	<.001	1.29 (0.08)	<.001
Time	−0.002 (0.002)	.288	−0.003 (0.002)	.109
Time^2	$7.9x10^{-6}$ ($4.5x10^{-6}$)	.075	0.00001 (0.000005)	.056
Group				
NVD — ref.			0	
OVD			0.23 (0.18)	.205
CD			−0.27 (0.19)	.159
Time × OVD			0.01 (0.004)	.022
CD			−0.002 (0.005)	.612
Time^2 × OVD			−0.00002 (0.00001)	.076
CD			0.00001 (0.00001)	.423

Results from the linear mixed model analysis for bowel-associated quality of life

	Total		Stratified by delivery mode	
Bowel-associated quality of life sum score	RC (SE)	*P*value	RC (SE)	*P*value
Intercept	1.71 (0.15)	<.001	1.67 (0.18)	<.001
Time	−0.008 (0.003)	.006	−0.006 (0.003)	.058
Time^2	0.00002 (0.00001)	.001	0.00002 (0.00001)	.025
Group				
NVD — ref.			0	
OVD			0.45 (0.41)	.277
CD			−0.24 (0.42)	.570

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SUPPLEMENTAL TABLE 1

Results from the linear mixed-model analysis for urinary incontinence sum score, weighted vaginal symptom sum score, vaginal quality of life score, bowel control sum score, and bowel-associated quality of life sum score *(continued)*

Results from the linear mixed model analysis for bowel-associated quality of life

	Total		Stratified by delivery mode	
Bowel-associated quality of life sum score	RC (SE)	*P* value	RC (SE)	*P* value
Time × OVD			−0.005 (0.008)	.496
CD			−0.003 (0.008)	.728
Time^2 × OVD			0.00001 (0.00002)	.529
CD			0.00001 (0.00002)	.534

CD, cesarean delivery at first pregnancy; *NVD*, normal vaginal delivery at first pregnancy; *OVD*, operative vaginal delivery at first pregnancy; *RC*, regression coefficient; *SE*, standard error.

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SUPPLEMENTAL TABLE 2

Observed mean scores with standard deviations for urinary incontinence and vaginal and bowel control symptoms according to delivery mode at first delivery

ICIQ-module		Gestational week 22, n=293	Gestational week 37, n=275	6 wk after delivery, n=282	6 mo after delivery, n=258	12 mo after delivery, n=234	8 y after delivery, n=193
Urinary incontinence	Delivery mode (first delivery)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Urinary incontinence sum score (0–21)	Normal vaginal delivery	1.7 (2.7)	2.9 (3.2)	2.5 (3.4)	2.3 (3.5)	2.5 (3.7)	3.7 (4.1)
	Operative vaginal delivery	1.2 (1.9)	2.2 (3.1)	3.3 (3.7)	1.8 (2.6)	2.9 (4.2)	2.9 (3.3)
	Cesarean delivery	1.4 (2.6)	2.5 (4.2)	0.4 (1.4)	0.5 (1.4)	1.4 (2.4)	2.7 (3.3)
	Exclusively cesarean delivery						n=18 2.7 (2.9)
	Vaginal delivery after cesarean delivery						n=12 2.8 (4.0)
Vaginal symptoms							
Weighted vaginal symptom sum score (0–53)	Normal vaginal delivery	3.7 (4.0)	4.4 (4.3)	4.7 (5.2)	4.6 (4.8)	4.2 (4.3)	5.9 (5.8)
	Operative vaginal	3.8 (5.2)	4.6 (4.8)	5.4 (6.9)	5.5 (6.1)	4.2 (5.3)	4.8 (4.4)
	Cesarean delivery	3.9 (4.3)	5.4 (3.7)	2.4 (2.6)	3.3 (3.6)	3.2 (4.2)	5.0 (5.9)
	Exclusively cesarean delivery						2.7 (4.3)
	Vaginal delivery after cesarean delivery						8.3 (6.4)
Vaginal-associated quality of life score (0–10)	Normal vaginal delivery	0.9 (1.6)	1.0 (1.5)	1.3 (2.1)	1.3 (2.0)	1.1 (1.9)	1.0 (1.7)
	Operative vaginal	0.9 (1.8)	1.3 (1.9)	1.6 (2.4)	1.8 (2.5)	1.3 (2.1)	1.0 (1.9)
	Cesarean	1.0 (1.8)	1.2 (1.7)	0.8 (1.7)	1.3 (2.3)	0.8 (1.5)	0.9 (1.4)
	Exclusively cesarean delivery						0.6 (1.1)
	Vaginal delivery after cesarean delivery						1.3 (1.8)
Bowel control symptoms							
Bowel control domain sum score (0–28)	Normal vaginal	1.3 (1.3)	1.4 (1.6)	1.4 (1.5)	1.1 (1.2)	1.2 (1.6)	1.5 (1.6)
	Operative vaginal	1.3 (1.9)	1.1 (1.1)	2.1 (2.0)	1.5 (1.8)	1.7 (2.3)	2.5 (2.6)
	Cesarean delivery	1.1 (1.7)	1.2 (1.4)	0.9 (1.2)	0.8 (1.3)	0.7 (1.0)	1.7 (2.2)
	Exclusively cesarean delivery						1.7 (2.4)
	Vaginal delivery after cesarean delivery						1.7 (2.0)
Bowel-associated quality of life sum score (0–26)	Normal vaginal delivery	1.8 (2.9)	1.7 (2.7)	1.8 (3.1)	1.6 (3.3)	1.5 (3.4)	2.1 (3.8)
	Operative vaginal	2.0 (3.1)	1.8 (3.5)	2.8 (3.9)	1.7 (2.8)	1.4 (2.6)	2.0 (3.5)
	Cesarean delivery	1.7 (3.2)	1.1 (2.8)	1.1 (2.3)	1.3 (3.0)	0.6 (1.9)	2.5 (3.8)

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SUPPLEMENTAL TABLE 2

Observed mean scores with standard deviations for urinary incontinence and vaginal and bowel control symptoms according to delivery mode at first delivery *(continued)*

ICIQ-module		Gestational week 22, n=293	Gestational week 37, n=275	6 wk after delivery, n=282	6 mo after delivery, n=258	12 mo after delivery, n=234	8 y after delivery, n=193
Urinary incontinence	Delivery mode (first delivery)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
	Exclusively cesarean delivery						n=18 3.3 (4.4)
	Vaginal delivery after cesarean delivery						n=12 1.4 (2.4)

Scores calculated from the corresponding International Consultation on Incontinence Questionnaire (ICIQ) score modules. Study groups were defined according to delivery mode at first delivery: normal vaginal delivery, operative vaginal delivery, and cesarean delivery. The observed mean sum scores for 2 subgroups in the cesarean delivery group: women with exclusively cesarean delivery and women with subsequent vaginal delivery after cesarean delivery at the 8-year follow-up.

ICIQ, International Consultation on Incontinence Questionnaire; *SD*, standard deviation.

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