Planned cesarean section vs planned vaginal delivery among women without formal medical indication for planned cesarean section: A retrospective cohort study of maternal short-term complications

Karin Dahlquist1,2 | Andrea Stuart1,2 | Karin Källén2

Abstract
Introduction: Rates of delivery by cesarean section have gradually risen in many parts of the world, and it is regarded as a safe surgical procedure with expanded indications. We assessed maternal complications within 6 weeks postpartum after planned cesarean section and after planned vaginal delivery among patients without medical indication for cesarean section.

Material and methods: This was a retrospective cohort study based on Swedish national registers and included 714,326 deliveries from 2008 to 2017. The study group consisted of cephalic, singleton, term pregnancies and excluded those with previous cesarean or pregnancy conditions that would qualify for cesarean section. We compared the risks of short-term complications between planned cesarean section and planned vaginal delivery. We obtained adjusted risk ratios (ARRs) using modified Poisson regression models adjusting for maternal age, parity, body mass index, smoking, country of birth, and county.

Results: The outcomes studied were infections and thromboembolism. In the planned cesarean section group (n = 22,855), 15% had a postpartum infection compared with 10% in the planned vaginal group (n = 691,471) (ARR 1.6; 95% confidence interval [CI] 1.5–1.6), and 0.08% vs 0.05% had a postpartum pulmonary embolism (ARR 1.7; 95% CI 1.0–2.6). The obtained risk estimates corresponded to “number needed to harm” estimates of 17 and 3448, respectively. When dividing the infections into subgroups, the risk of endometritis (ARR 1.2; 95% CI 1.1–1.3), wound infection (ARR 2.7; 95% CI 2.4–3.0), urinary tract infection (ARR 1.5; 95% CI 1.3–1.7), and mastitis (ARR 2.0; 1.9–2.2) was higher after planned cesarean section.

Conclusions: Among patients without medical indication for planned cesarean section, the risks of short-term maternal complications were higher with planned cesarean section than with planned vaginal delivery.

Abbreviations: ARR, adjusted risk ratios; BMI, body mass index; CS, cesarean section.
1 | INTRODUCTION

Rates of birth by cesarean section (CS) have gradually risen in many parts of the world. From 1990 to 2014, the global average CS rate increased three-fold from 6.7% to 19.1%, with an average rate increase of 4.4% per year. The CS rate varies considerably between different parts of the world and between counties, but the rise is a global phenomenon. In Sweden, the CS rate increased from 5% in 1973 to 18% in 2017. The overall rate of planned CS increased from 4% to 8% between 1991 and 2005, but no major increment was noted between 2005 and 2017. An estimated approximately 26% of the planned CS had no medical indication among primiparous patients. The corresponding percentage among multiparous patients was 33%.

Historically, CS was used only in life-threatening situations. With improved healthcare, CS is regarded as a safe surgical procedure, and the indications for CS have expanded. The potential advantages of CS include decreased risk of prolapse and stress incontinence, avoidance of labor pain, and convenience. However, most studies report increased risks of adverse outcomes associated with CS, such as postpartum infections and venous thromboembolism, which are major causes of maternal death. Long-term effects of CS, leading to a higher risk of complications in subsequent pregnancies, include uterine rupture and invasive placenta, with a risk for subsequent need for hysterectomy.

Despite an emerging body of literature reporting complications after CS, demand for planned CS without medical indication has increased and is termed “CS on maternal request”. A Cochrane report from 2012 described a lack of studies analyzing the risks and benefits of CS on maternal request. Complications after CS vs vaginal delivery are well described in the literature. However, to evaluate the risks and benefits of CS without medical indication, it is more appropriate to compare planned CS and planned vaginal delivery.

The aim of this study was to investigate the rates of short-term complications (infections and thromboembolism within 6 weeks postpartum) with planned CS compared with those with planned vaginal delivery in a group with no formal medical indication for planned CS.

2 | MATERIAL AND METHODS

2.1 | Statistical analyses

Data from three Swedish national registries (the medical birth register, the Swedish national patient register, and the Swedish prescribed drug registry, all held by the Swedish National Board of Health and Welfare) were merged using the national 12-digit maternal identification number and date of delivery.

Key message

The risk of infection and thrombosis is increased after planned cesarean compared with planned vaginal delivery among patients without medical indication for planned cesarean section.
We excluded patients with diagnoses/conditions (reported as ICD-10 codes) that implied a high risk for maternal/fetal morbidity: multiple gestation, none-cephalic presentation, preterm birth (gestational age <37 weeks), placenta accrete, placenta abruptio, placenta previa, diabetes mellitus, gestational diabetes mellitus, preeclampsia, HELLP syndrome (hemolysis, elevated liver enzymes, and low platelets), oligohydramnios, polyhydramnios, chorioamnionitis, small for gestational age (−2 birthweight standard deviation [SD] scores according to a Swedish ultrasound-based weight curve), large for gestational age (+2 birthweight SD scores according to a Swedish ultrasound-based fetal weight curve), macrosomia (>4500 g), and prolonged pregnancy (gestational age ≥42 weeks). To adjust to international clinical practice, we also excluded people with one previous CS, even though one previous CS is not regarded as a medical indication according to Swedish clinical practice.

We performed additional analyses to investigate whether any group, based on maternal characteristics such as age, parity, BMI etc., could benefit from planned CS or planned vaginal delivery. To achieve adequate power for those sensitivity analyses, we created a composite infection variable, including urinary tract infection, endometritis, mastitis, septicemia, wound infection, and need for prescription antibiotics.

We obtained adjusted risk ratios (ARRs) using modified Poisson regression models, adjusting for maternal age (years): <20, 20–34, 35–39, ≥40; parity: 1-para, 2-para, ≥3 para; BMI (kg/m²): >18.5, 18.5–24.9, 25–29.9, 30–34.9, ≥35; maternal height (cm): <155, 155–165, 165–174, ≥175; maternal country of birth (Nordic countries/non-Nordic countries); and healthcare region: Stockholm, Uppsala/Orebro, south-eastern region, southern region, western region, and northern region. Missing values (applies to smoking, BMI, and maternal height) were replaced by the overall mean. Findings with p-values below 0.05 were considered statistically significant. Possible confounders with p-value below 0.2 were included in the multivariable models.

2.2 | Ethical approval

Ethical approval was obtained on August 2, 2018, from the committee of ethics at Lund University (Dnr 2018/539).
We did not identify any group, based on maternal characteristics (such as age, height, BMI, smoking, and country of birth), that benefited from planned CS rather than planned vaginal delivery in terms of the risk of postpartum infections.

Several studies have compared maternal complications after CS and vaginal birth, although the complications after planned and emergency CS differ considerably. Other studies have analyzed emergency CS and planned CS separately but have used those with vaginal deliveries as the control group. Studies that compare complications only after planned CS and noninstrumental deliveries systematically underestimate the complications after vaginal birth since they do not consider complications in the planned vaginal group occurring after emergency CS, forceps, or vacuum extractions. To estimate the true impact of nonindicated planned CS on maternal morbidity, it is important to keep an intention-to-treat perspective, making the study of outcomes with planned CS and planned vaginal deliveries appropriate.

No randomized trials have compared maternal complications after planned CS and planned vaginal birth. In cohort studies,
We excluded those with breech deliveries, multiple births, diabetes, gestational diabetes, ablatio placentae, placenta accrete, and pre-eclampsia. The selection procedures differed between the quoted studies, but the intention was to include healthy patients with no known pregnancy complications. In the current study, we used strict selection criteria for both the planned CS and the planned vaginal delivery mode and risk of maternal complications. The power of the study by Larsson et al. (2011) was also low, but they detected a five-fold risk for wound infection after planned CS compared with after planned vaginal delivery. Our results confirm many of the associations reported by Liu et al. (2007). Dahlgren et al. (2009) and Larsson et al. (2011) included patients with planned CS indicated by term breech presentation as a surrogate for low-risk CS, and in the comparison group they selected a group who attempted a vaginal birth with fetuses in cephalic presentation. The selection procedures differed between the quoted studies, but the intention was to include healthy patients with no known pregnancy complications. In the current study, we used strict selection criteria for both the planned CS and the planned vaginal group to create two comparable low-risk groups. We excluded those with breech deliveries, multiple births, diabetes, gestational diabetes, ablatio placentae, placenta accrete, and pre-eclampsia.

Larsson et al. (2011) included only 541 people and did not have sufficient power to detect any association between planned delivery mode and risk of maternal complications. The power of the study by Dahlgren et al. (2009) was also low, but they detected a five-fold risk for wound infection after planned CS compared with after planned vaginal delivery. Our results confirm many of the associations reported by Liu et al. (2007), albeit often with lower point estimates of the relative risks. The present study showed an increased risk for mastitis after planned CS compared with after planned vaginal delivery (ARR 2.0), which to our knowledge has not been previously reported. The risk was surprisingly high given that, in Sweden, the newborn is encouraged to breastfeed while still in the operation theater. The higher prevalence of mastitis after planned CS compared with after planned vaginal birth could perhaps, at least partly, be explained by higher registration rates due to longer length of hospitalization in the former group. However, it is unlikely that hospitalization duration is a major source of bias since most cases of mastitis occur after at least 10 days post partum and very few hospital stays are longer than 4 days after planned CS. Another explanation for the increased risk for mastitis in the planned CS group could be the comparatively short time for the hormonal system to adjust for the postpartum period, which could lead to breast-feeding problems, which in turn could increase the risk for mastitis. A third explanation could be that those who request planned CS are less likely than others to initiate any breast feeding.

The current study used a large study population based on high-quality register data and with a clear intention-to-treat perspective. The group of nonindicated CS was created by excluding patients with diagnoses regarded as possible indications for CS. Even though our ambition was to include low-risk pregnancies only, we cannot exclude the possibility that those choosing planned CS had recorded pregnancy complications or other subtle conditions conferring smaller chances of vaginal delivery than in the planned vaginal group. Another topic for discussion is whether pregnancies with macrosomic fetuses should be included in the low-risk population. It could be argued that fetal size is not estimated before birth and that excluding those pregnancies would result in an advantage for the planned vaginal group. Including them would instead bias the results in the opposite direction. We excluded macromomous pregnancies as we believe that most obstetric units recognize the importance of identifying high-risk groups prior to delivery. The scope of the current study was limited to comparing the risk for short-term maternal complications by planned delivery mode. We did not evaluate complications that could only occur after vaginal delivery such as perineal lacerations and shoulder dystocia. Furthermore, we did not consider maternal long-term complications, perinatal outcomes such as complications due to fetal asphyxia, neonatal breathing

### Table 2: Risk of miscellaneous maternal postpartum complications among those without any formal medical indication for elective cesarean section: Planned cesarean section vs planned vaginal delivery

|                        | Elective CS N = 22855 | Vaginal trial of labor N = 691471 | Crude RR | ARR 95% CI | ARR 95% CI |
|------------------------|-----------------------|----------------------------------|----------|------------|------------|
| **Postpartum infections** |                       |                                  |          |            |            |
| Any<sup>a</sup>        | 3737                  | (163.5)                          | 70873    | (102.5)    | 1.6        | 1.5        | 1.6        |
| Endometritis           | 388                   | (17.0)                           | 9974     | (14.4)     | 1.2        | 1.1        | 1.3        |
| Wound infection        | 355                   | (15.5)                           | 3534     | (5.1)      | 3.0        | 2.7        | 3.4        |
| Urinary tract infection| 213                   | (9.3)                            | 4209     | (6.1)      | 1.5        | 1.3        | 1.8        |
| Mastitis               | 1052                  | (46.0)                           | 14853    | (21.5)     | 2.1        | 2.0        | 2.3        |
| Septicaemia            | 7                     | (0.3)                            | 149      | (0.2)      | 1.4        | 0.7        | 3.0        |
| Antibiotics 0–14 days  | 1758                  | (76.9)                           | 39680    | (57.4)     | 1.3        | 1.3        | 1.4        |
| Antibiotics 0–42 days  | 2937                  | (128.5)                          | 62631    | (90.6)     | 1.4        | 1.4        | 1.5        |
| **Other complications** |                       |                                  |          |            |            |
| Pulmonary embolism     | 19                    | (0.8)                            | 323      | (0.5)      | 1.8        | 1.1        | 2.8        |
| Venous thrombosis      | 6                     | (0.3)                            | 133      | (0.2)      | 1.4        | 0.6        | 3.1        |
| Cerebral venous thrombosis | 4               | (0.2)                           | 51       | (0.1)      | 2.4        | 0.9        | 6.6        |

Note: ARRs were computed adjusting for maternal age, parity, smoking, body mass index, country of birth, and county.

Abbreviations: ARR, adjusted RR; CI, confidence interval; CS, cesarean section; RR, risk ratio.

<sup>a</sup>Endometritis, wound infection, urinary tract infection, mastitis, septicaemia, prescribed and dispensed antibiotics within 6 weeks.
difficulties, or long-term consequences among children. Another important topic that was not addressed was possible psychological effects. Thus, the results from the current study only bring one piece of information to the complex topic of the advantages and disadvantages of planned CS.

5 | CONCLUSION

Patients who request CS without medical indication should be informed that planned CS confers an increased risk of maternal short-term complications compared with planned vaginal delivery, with
elevated risks for mastitis, endometritis, cystitis, and/or need of prescription antibiotics. Long-term complications, psychological effects, or complications occurring exclusively after vaginal birth (such as perineal ruptures) were not evaluated.

AUTHOR CONTRIBUTIONS
KD, AS, and KK designed and carried out the study and wrote the paper. KK performed the statistical analysis; all authors were present and analyzed the data. All authors approved the final version of the manuscript.

FUNDING INFORMATION
Gortfon Foundation.

ACKNOWLEDGMENT
Open access funding enabled and organized by ProjektDEAL.

CONFLICT OF INTEREST
None.

ORCID
Karin Dahlquist  https://orcid.org/0000-0001-9979-0564
Andrea Stuart  https://orcid.org/0000-0002-5131-6297
Karin Källén  https://orcid.org/0000-0001-5765-2630

REFERENCES
1. Betrán AP, Ye J, Moller AB, Zhang J, Gülmezoglu AM, Torloni MR. The increasing trend in caesarean section rates: global, regional and national estimates: 1990–2014. PLoS One. 2016;11:e0148343.
2. Källén K. Kejsarsnitt i Sverige 2008–2017. [Cesarean section in Sweden 2008–2017]. 2019. Available at kejsarsnitt i Sverige 2008–2017 (socialstyrelsen.se) or https://www.socialstyrelsen.se/globalassets/sharepoint-dokument/artikelkatalog/ovrigt/2019-12-6529.pdf
3. Leijonhufvud A, Lundholm C, Crattingius S, Granath F, Andolf E, Altman D. Risks of stress urinary incontinence and pelvic organ prolapse surgery in relation to mode of childbirth. Am J Obstet Gynecol. 2011;204(70):e1-e7.
4. Blondon M, Casini A, Hoppe KK, Boehlen F, Righini M, Smith NL. Risks of venous thromboembolism after cesarean sections: a meta-analysis. Chest. 2016;150:572-596.
5. Burrows LJ, Myen LA, Weber AM. Maternal morbidity associated with vaginal versus cesarean delivery. Obstet Gynecol. 2004;103:907-912.
6. Clark SL, Belfort MA, Dildy GA, Herbst MA, Meyers JA, Hankins GD. Maternal death in the 21st century: causes, prevention, and relationship to cesarean delivery. Am J Obstet Gynecol 2008;199:36.e1, 36.e5, discussion 91-2, e7-11.
7. Deneux-Tharaux C, Carmona E, Bouvier-Colle MH, Bréart G. Postpartum maternal mortality and cesarean delivery. Obstet Gynecol. 2006;108:541-548.
8. Hall MH, Bewley S. Maternal mortality and mode of delivery. Lancet. 1999;354:776.
9. Heit JA, Kobervig CE, James AH, Petterson TM, Bailey KR, Melton LJ III. Trends in the incidence of venous thromboembolism during pregnancy or postpartum: a 30-year population-based study. Ann Intern Med. 2005;143:697-706.
10. Holm C, Langhoff-Roos J, Petersen KB, Norgaard A, Diness BR. Severe postpartum haemorrhage and mode of delivery: a retrospective cohort study. BJOG. 2012;119:596-604.
11. Lindqvist P, Dahlbäck B, Maršíl K. Thrombotic risk during pregnancy: a population study. Obstet Gynecol. 1999;94:595-599.
12. Liu S, Liston RM, Joseph KS, Heaman M, Sauve R, Kramer MS. Maternal mortality and severe morbidity associated with low-risk planned cesarean delivery versus planned vaginal delivery at term. CMAJ. 2007;176:455-460.
13. Small FM, Gyte GM. Antibiotic prophylaxis versus no prophylaxis for preventing infection after cesarean section. Cochrane Database Syst Rev. 2014;2014(10):CD007482. doi: 10.1002/14651858.CD007482.pub3
14. Virkus RA, Løkkegaard E, Lidegaard Ø, et al. Risk factors for venous thromboembolism in 1.3 million pregnancies: a nationwide prospective cohort. PLoS One. 2014;9:e96495.
15. Say L, Chou D, Gemmill A, et al. Global causes of maternal death: a WHO systematic analysis. Lancet Glob Health. 2014;2:e323-e333.
16. Keag OE, Norman JE, Stock SJ. Long-term risks and benefits associated with cesarean delivery for mother, baby, and subsequent pregnancies: systematic review and meta-analysis. PLoS Med. 2018;15(1):e1002494.
17. Lavender T, Hofmeyr GJ, Neilson JP, Kingdon C, Gyte GM. Caesarean section for non-medical reasons at term. Cochrane Database Syst Rev. 2012;(3):CD0044660. doi: 10.1002/14651858.CD0044660.pub3
18. Karin Källén BK. The Swedish Medical Birth Register - a summary of content and quality. Socialstyrelsen. 2003. https://www.socialstyrelsen.se/globalassets/sharepoint-dokument/artikelkatalog/ovrigt/2003-112-3-20031123.pdf
19. 2011–11–22 Vr. Patient Registry. Swedish National Board of Health 2017.
20. Swedish registry of prescribed and dispensed drugs National Board of Health, Sweden; 2010. 2010.
21. Andolf I. Indikationer för kejsarsnitt på moderns önskan. [Indications for cesarean section at the mother’s request.] https://www.sfog.se/media/336234/nationella-indikationer-kejsarsnitt-moderns-onskan.pdf. 2011.
22. Marsål K, Persson PH, Larsen T, Lilja H, Selbing A, Sultan B. Intrauterine growth curves based on ultrasonically estimated foetal weights. Acta Paediatr. 1996;85:843-848.
23. Dahlgren LS, von Dadelszen P, Christilaw J, et al. Caesarean section on maternal request: risks and benefits in healthy nulliparous women and their infants. J Obstet Gynaecol Can. 2009;31:808-817.
24. Larsson C, Saltvedt S, Wiklund I, Andolf E. Planned vaginal delivery versus planned cesarean section: short-term medical outcome analyzed according to intended mode of delivery. J Obstet Gynaecol Can. 2011;33:796-802.
25. World Health O. Mastitis: causes and management. World Health Organization; 2000.
26. Prior E, Santhakumaran S, Gale C, Philipps LH, Modí N, Hyde MJ. Breastfeeding after cesarean delivery: a systematic review and meta-analysis of world literature. Am J Clin Nutr. 2012;95:1113-1135.

SUPPORTING INFORMATION
Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Dahlquist K, Stuart A, Källén K. Planned cesarean section vs planned vaginal delivery among women without formal medical indication for planned cesarean section: A retrospective cohort study of maternal short-term complications. Acta Obstet Gynecol Scand. 2022;101:1026-1032. doi:10.1111/aogs.14408