

The birth of a first child is a key life event marking a transformation in the roles and responsibilities of women, their partners and other family members. In high-income countries pregnancy and parturition are much safer for mothers and babies than in the past, or in contemporary low-income countries. Nevertheless quite high proportions of mothers, particularly first-time mothers, have adverse or unanticipated complications or interventions in pregnancy, delivery, or the postpartum period and/or have babies with health problems. Adverse birth experiences and neonatal health problems may influence bonding with the newborn, risks of post-natal depression, satisfaction with the parenthood role and partnership dynamics. These factors may also influence decisions about future fertility. In this study we use data for the whole Norwegian population to investigate how mode of delivery and health of the neonate are related to the probability of first-time mothers having a second birth during a follow-up period of up to ten years. We take account of prior maternal health and socio-demographic characteristics which may be related both to delivery and health of the neonate and to further fertility. We additionally consider postnatal depression and partnership breakdown as these may be related to birth experiences and neonatal health and to decisions about a second birth.

Data and Methods

The study population comprised all women in Norway who had a first singleton live birth in 2007-2017. The data extractions made for this analysis cover the period up to 1st January 2019. The key sources are the Norwegian Population Register, the Medical Birth Register and the Norwegian Control and Distribution of Health Reimbursement Database (KUHR). The Population Register includes information about country and year of birth, year of death (if any), annual information on whether the person lived in Norway on 1st January, and from 2005 information on marital and cohabitation status on 1st January of each year. The Medical Birth Register includes information about mode of deliveries and the health of the mother and child for all births in Norway from 1967. The KUHR register includes information about consultations with general practitioners (GPs) from 2006. Additionally, we included annual information from Statistics Norway on educational level and enrollment.

Measures

The main outcome measure was birth of a second child 2008-18. Secondary and intermediate outcomes considered include partnership breakdown and number of GP consultations for depression, other mental illness, and physical illness 0-2 and 12-15 months after the first birth. In the first part of the analysis, we also investigated factors associated with mode of delivery at first birth and health of the neonate. The main exposure variables were mode of delivery and neonatal health problems. We categorized mode of delivery into vaginal with no intervention (reference category); vaginal with episiotomy but no use of instruments; instrumental; elective caesarean section (CS) for breech or other non-cephalic presentation; elective CS for cephalic (normal) presentation, and emergency CS. Neonatal health problems were measured using a derived variable distinguishing babies who were full term and not low birthweight (reference); pre-term or low birthweight (<2500); or pre-term *and* low birthweight, and binary variables indicating whether the baby had an AGPAR score (an indicator of a newborn's physical condition scored 0-10) of below 9 (at any measurement point). We also included indicators of the infant's sex and whether they had any congenital abnormalities. Other co-variables included mothers' highest educational level; whether currently enrolled in education; partnership status (married, cohabiting or no co-resident partner) at time of the first birth, whether or not the mother had pregnancy related health problems, namely hypertension; (pre)-eclampsia; and diabetes (either pre-existing or gestational), and number of GP consultations 10-12 months before the first birth. All relevant models included year and duration since the first birth.

Methods

Maternal characteristics associated with mode of delivery and neonatal health problems

We used multinomial regression analysis to investigate associations between socio-demographic characteristics, pre-pregnancy medical consultations, and pregnancy related health conditions with type of delivery, distinguishing CS, instrumental, and non-instrumental vaginal deliveries. We used

ordinal logistic regression to investigate associations between the same maternal characteristics and maturity and birthweight of the newborn with the three outcome categories: full term and normal birthweight; either premature or low birth weight; both premature and low birthweight.

Consultations for depression 0-2 and 12-14 months after first birth

To investigate the association between birth experiences and subsequent depression, which may be a mediator of any association with second birth rates, we estimated linear models for post-natal depression (0-2 months postpartum) and for depression one year later (for women who had not had a second child by that time). The key exposure variables in these models were mode of delivery and neonatal health. We controlled for pre-pregnancy depression, other mental illness and physical illness (as indicated by medical consultations); pregnancy-related health conditions, and socio-demographic characteristics.

Discrete-time hazard models for second births and for partnership breakdown

We estimated discrete-time hazard models for a second birth 2008-2018 in the study population of women who had their first birth in Norway in 2007-2017. A series of 3-month observations was constructed for each woman, starting with 9-11 months after the first birth and ending with 117-119 months after the first birth or, if this occurred earlier, the 3-month period including the second birth, the last 3-month period before the end of the year when the mother turned 45 or 2018, or the last period before the end of the year before she died or emigrated. Each 3-month observation includes independent variables and the outcome variable, which is whether a second birth took place within the 3 months. The calendar year including the quarter is referred to as t below. Logistic models of the following form were estimated from all 3-month observations for all women:

$$\log(p_{iq}/(1-p_{iq})) = \beta_0 + \beta_1 \mathbf{X}_{iq}$$

where p_{iq} is the probability that woman i has a second birth within quarter q (within year t), β_0 is a constant term, $\mathbf{X}_{iq}$ is a vector of independent (categorical) variables, and β_1 is the corresponding vector of effect coefficients.

We also used hazard models to analyse risks of union dissolution. In this analysis, one-year observation periods were used because civil status was recorded at only one time point per annum. This analysis was restricted to mothers who lived with the father of the first child on 1st January after the birth.

Results

Vaginal births with no interventions accounted for half of the exposure time with the other main groupings being vaginal births involving an episiotomy; instrumental deliveries; and emergency CS deliveries. Elective CS deliveries were uncommon. Eighty-four percent of births observed were full-term and of normal birthweight.

Variables associated with mode of delivery and neonatal health at first birth

Results of the logistic regression modelling showed that, as might be expected, women who had pregnancy-related health problems had well over twice the odds of having a CS or having a baby with neonatal health problems compared to women without these conditions. We found an inverse association between educational level and both outcomes with the most highly educated women having the lowest risks. Women with lower levels of education and those with no co-resident partner had higher odds of having a baby with a neonatal health problem. This may reflect characteristics of these women, including a possible lack of social support, not accounted for in our analysis.

Associations between mode of delivery and neonatal health with consultations for depression 0-2 and 12-14 months after first birth and risks of partnership breakdown

Pregnancy related health problems, having had an elective CS for a normal presentation baby, an emergency CS, or an instrumental delivery were all positively associated with number of medical consultations for depression in the immediate postpartum period. We also found a positive -but weak- association between having a low birthweight, pre-term baby and consultations for depression 12-14

months after the birth. Risks of union dissolution were also higher for mothers who had had a CS for a normal presentation baby, those with a pre-term and/or low birth weight baby, and with pre-pregnancy and post-partum GP consultations.

Hazard models for second birth

Results from fully adjusted models of variation in having a second birth showed that the small group with an elective CS for a normal position baby had the lowest odds of progression to a second birth (Odds Ratio, 95% confidence interval, 0.71, 0.68-0.75). Odds of having a second birth were also lower for the larger groups of women who had had an emergency CS (0.82; 0.81-0.84) or a planned CS for a breech presentation baby (0.84; 0.80-0.88). Women whose first baby was pre-term and/or low birthweight were also less likely to have a second birth (OR, 95% CI for baby that was low birthweight and pre-term: 0.84; 0.81-0.87). Number of GP consultations, especially in the post-partum period, were associated with lower odds of having a second child and as would be expected, there was a large negative impact of partnership breakdown on progression to a second birth.

Discussion

We analysed data for the whole Norwegian population to investigate associations between mode of delivery and neonatal health of the first-born child and chance of progression to a second birth taking account of the mother's socio-demographic characteristics, health problems during pregnancy, pre- and post-pregnancy GP consultations, and partnership breakdown. Results showed that lower educational attainment, poorer pre-pregnancy health and pregnancy related health problems and were positively associated with CS delivery and with neonatal health problems. Our finding of an inverse association between educational level and CS is consistent with previous results for the Norwegian population which have reported higher rates of CS among the less well educated in analyses adjusted for age, but not other potential confounders. However, it is discordant with results from US studies which have reported possible 'overuse' of CS among low-risk highly educated mothers and 'underuse' among disadvantaged high-risk mothers, a finding which seems partly to reflect differences in access to funding for maternity care. This is not an issue in Norway where all health care for mothers and babies is provided free. Secondly, we analysed differentials in depression postpartum and one year later, and in union disruption, which might mediate associations between childbirth experiences and subsequent fertility. Having had an emergency CS was associated with an increased number of consultations for depressive conditions both in the immediate postpartum period and a year later. Mothers who had had an instrumental delivery, an elective CS for a normal presentation baby, or pregnancy complications also had slightly increased risks of consultations 0-2 months after the birth. Risks of union dissolution were higher for mothers who had had a CS for a normal presentation baby, those with a pre-term and/or low birth weight baby and with pre-pregnancy and postpartum GP consultations for depression (and to a lesser extent, other mental health conditions).

Results from analyses of variation in having a second birth, our main outcome of interest, showed that the small group with an elective CS for a normal position baby had the lowest chance of progression to a second birth. This may reflect characteristics of this group, such as extreme fear of childbirth, or serious maternal health problems not captured in our indicators based on pre-pregnancy health consultations and pregnancy related health conditions. There was also a substantial negative association between CS delivery for other reasons and chances of a second birth. We additionally found a negative effect of having had a preterm or low birthweight first baby on having a second birth.

Strengths of this analysis include use of a whole population sample with high quality data on circumstances of birth and control and investigation of effects of pre-birth health, as indicated by GP consultations. We included controls for educational attainment and partnership status, not considered in many previous studies. There are some limitations including lack of information on other possible mediators and confounders, such as health related behaviours and women's reports of their experience of childbirth. In common with other studies, we cannot conclude how much of the

negative association between having a first delivery by CS and having a second child is due to impairments of fecundity or due to choices influenced by first birth experience.

Despite these limitations, the study considerably strengthens the evidence base showing the importance of first-birth experiences for future outcomes, including progression to having a second child. Norway is a very safe country for mothers and infants with the lowest maternal mortality ratio in the world. Similarly to other Nordic countries, the proportion of caesarean deliveries has not increased to the same extent as in many high- and middle-income countries (WHO 2023). Implications of our results may be even more relevant in countries with less favourable conditions for pregnancy and childbirth and greater access to maternally requested CS, this merits further investigation.

Presence of a socio-economic gradient in use of CS in Norway, where health care costs are not relevant, suggests that one possible route for addressing increases in use of CS might be through addressing health inequalities in the population as a whole. Some factors associated with increased chance of CS such as obesity, for example, are socially patterned in Norway as in many other settings.

Our results also showed that women with lower levels of education and those with no co-resident partner had higher odds of having a baby with a neonatal health problem. This may reflect characteristics of these women, including a possible lack of social support, not accounted for in our analysis. This requires further investigation and consideration of policy responses to provide support for mothers with no co-resident partner and a baby with health problems.

In conclusion, first childbirth experiences, including mode of delivery and neonatal health, merit more attention in investigations of parity progression. This is especially important in the context of widespread postponement of fertility as older age at first birth increases the risk of complications in pregnancy and an operative or instrumental delivery.

Notes:

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