



Centralizing Swedish maternal and labor care: Consequences for women's health

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Abstract:

This thesis examines the consequences of the centralization of Swedish maternity care for women's health. During the study period (1993-2024), the number of maternity wards decreased by almost one-third, despite continuous population growth. The effects of centralization on health outcomes are *a priori* ambiguous. On one hand, larger hospitals may be more cost-efficient and provide higher-quality care than smaller units. On the other hand, centralization increases travel time and is likely to increase crowding and workload for maternity ward staff. This has raised concerns regarding trade-offs between cost-effectiveness and maternal health outcomes.

This thesis relies on three sources of data: regional-level data from the Medical Birth Registry, hospital-level data constructed from yearly Birth Reports, and data from a survey I designed and conducted. The analysis uses an event-study difference-in-difference design to determine the effects of maternity ward closures on maternal health outcomes and finds an increase in C-sections and severe vaginal tears. Associations between maternal health outcomes and travel time, as well as hospital size, were also examined. I find that increased travel time is associated with negative psychological outcomes, and that hospital size is correlated with indicators of quality and some adverse health outcomes.

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LIST OF ABBREVIATIONS

OASIS – Obstetrical Anal Sphincter Injuries

EDA – Epidural anesthesia

ATT – Average Treatment effect on Treated

MBR – Medical Birth Registry

SGA – Small for Gestational Age

LGA – Large for Gestational Age

GP – General Practitioner

PPH – Postpartum Hemorrhage

NICU – Neonatal Intensive Care Unit

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1 Introduction

Centralization and consolidation of Swedish maternity and neonatal health care have been a recurring subject of debate for decades. The number of maternity wards and birthing clinics has been reduced from 95 in 1973 to 45 in 2025 (Chamy, 2021; Socialstyrelsen, 2022). Due to population growth, this means that the number of maternity wards per 100,000 women (aged 15-49 years) has decreased from 5.18 to 1.99¹ (Socialstyrelsen, 2022; Statistiska Centralbyrån, 2025a).

These closures have substantially increased travel time and distance to the nearest maternity ward, particularly for mothers in northern and central Sweden, potentially affecting timely access to care during labor and delivery (Socialstyrelsen, 2025a, p. 32). During the temporary closures of Lycksele maternity ward in Region Västerbotten, some mothers living in the mountain areas reportedly faced distances exceeding 400 km to the nearest maternity ward (Everljung, 2023; Lindgren, 2021). At the same time, receiving maternity wards have experienced increases in patient volumes, contributing to crowding (Avdic et al., 2024; Lindqvist Ståhle et al., 2023; SvD, 2016).

Centralization and consolidation of health care are not unique to Sweden but reflect broader international trends observed in both publicly financed and mixed-funded health care systems, including France, Norway, Italy, Finland, and the United States (Battaglia, 2025; Cantarutti et al., 2025; Engjom et al., 2017; Huotari et al., 2020; Minion et al., 2022; Pilkington et al., 2014). Sweden is geographically large and has low population density², posing challenges for the provision of health care services. These challenges intensify trade-offs between equitable access, quality of care, and economic efficiency. These challenges become particularly notable in a predominantly tax-financed health-care system such as Sweden's, as policymakers aim to maximize public utility from the limited public resources (Avdic et al., 2024; *Hälso- Och Sjukvårdslag (2017:30)*, 2017; A. Örtqvist & Stephansson, 2021; Regeringskansliet, 2019).

From an economic perspective, centralization and consolidation are often justified by potential cost savings and efficiency gains. In obstetric care, where surgical capacity and advanced

¹ Women (age 15-49) in 1973: 1,834,860 and in 2024: 2,263,231 (Statistiska Centralbyrån, 2025a)

² Population density per square km 1991: 21.0, 2024: 25.8 (Statistiska Centralbyrån, 2025b)

medical technology can be necessary, larger hospitals may be better able to provide the highly expensive medical equipment needed to deliver high-quality care. In addition, quality of care may be better in larger hospitals as staff attend more deliveries and therefore have more experience dealing with rare complications (Avdic et al., 2024; Cantarutti et al., 2025). Maternity wards located in rural areas may also face additional challenges concerning recruiting (Lindqvist Ståhle et al., 2023). From the supply side, centralization and consolidation may therefore be viewed as cost-effective, as they allow resources to be concentrated in fewer, better-equipped units capable of delivering higher-quality care. On the other hand, maternity ward closures may also negatively affect patient outcomes. As timely access can be crucial during labor and delivery, reduced access to care and increased travel time could pose increased health risks for patients associated with arriving too late when complications arise, or delivering outside the hospital (Engjom et al., 2017; Minion et al., 2022; A. K. Örtqvist et al., 2021). Another concern is that remaining hospitals may face increased patient flows, which, if not adequately addressed, could lead to longer waiting times for patients, increased workload, and less time for staff competence development (Avdic et al., 2024; Lindqvist Ståhle et al., 2023; SvD, 2016).

These developments and trade-offs raise important questions about the costs of maternity ward centralization and consolidation.

1.1 Research questions

This thesis aims to examine if the centralization and consolidation of Swedish labor and delivery care are associated with increased risk of adverse maternal health outcomes³.

Specifically, this thesis seeks to address the following research questions:

- i. Is increased travel time to the nearest maternity ward associated with adverse maternal health outcomes?
- ii. Do maternity ward closures lead to adverse maternal health outcomes?
- iii. Is hospital size, measured in number of deliveries per year, associated with maternal health outcomes?

³ The main maternal health outcomes examined in this thesis are: OASIS (severe vaginal tears (grade III-IV)), C-section rates, rates of induced labor and rates of instrumental help during vaginal birth. Using survey data this thesis will also examine other outcomes such as psychological health and maternal experience (self-reported).

To answer questions i), I will rely on data from a survey I designed and administered to women who gave birth between 2010 and 2025, examining results using OLS regression. To answer question ii), I use hospital- and regional-level registry data, the analysis relies on two event studies using difference-in-difference design. For question iii), the hospital-level registry data are used to examine correlations by OLS regression.

2 Background

Between 1993 and 2024, 93,000 to 120,000 children were born yearly in Sweden, with a peak occurring in 2016. According to the National Board of Health and Welfare [Socialstyrelsen], birth rates go up and down with peaks occurring every 10 to 15 years (Socialstyrelsen, 2025m). Most births are concentrated in Region Stockholm, Region Västra Götaland, and Region Skåne, while Region Gotland has had the lowest birth rate. Figure 1 illustrates a map with the number of births per region in 2016.

Between 1993 and 2024, 24 maternity wards were permanently closed, and one additional ward was temporarily closed for a long period. In 1993, Sweden had 63 maternity wards; in 2025, that number is 45, meaning almost a third of all maternity wards had been closed during that time. Most of these closures took place between 1993 and 2009, when 20 maternity wards were closed.⁴

Between 2015 and 2024, 4 maternity wards were closed permanently, while 1 was closed temporarily for a year and several shorter periods⁵. Figure 2 illustrates a map of all maternity wards that have been open at any time between 1993 and 2025.

Several reasons were cited for recent maternity ward closures, including budget cuts, recruitment difficulties, and patient safety concerns. When Sollefteå maternity ward closed, budget cuts and challenges with recruiting doctors were given as the main reasons (Weilenmann, 2016). Challenges regarding sufficient staffing and patient safety are reasons mentioned in the latest closures in Karlskoga, Mölndal, and the temporary closures of Lycksele.

⁴ In addition, 3 hospitals have been opened during the research period, Sunderbyn maternity ward was opened in 2000 replacing Luleå and Bodens maternity wards, BB Sophia maternity ward which would close in 2016 and Capio St Görans maternity ward which opened in 2023.

⁵ BB Sophia maternity wards, Sollefteå maternity ward, Sahlgrenska Mölndal maternity ward and Karlskoga maternity wards were closed permanently. Lycksele maternity ward was closed during all of 2023, while being reopened since 2024, the maternity ward has been closed during shorter periods.

The closures of Karlskoga maternity ward and Mölndal maternity ward have mainly mentioned challenges regarding the safety of neonatal health, which has also raised questions regarding women's health (SVT Nyheter, 2019; Region Örebro Län, 2023; Everljung, 2023; SVT Nyheter, 2025; Olsson, 2016).

While larger hospitals should *a priori* be able to deliver higher quality care (Avdic et al., 2024; Cantarutti et al., 2025), a report published by the Swedish Agency for Health and Care Service Analysis [Myndigheten för vård- och omsorgsanalys] stated that the smaller maternity wards in Sweden, while faced with staffing challenges, often had more staffing hours per delivery (Lindqvist Ståhle et al., 2023), likely allowing them to deliver better quality care.

In addition, several of the closures between 1993 and 2025 have raised concerns over travel distance, as shown in Figure 2. Regions in the central west and central north parts of Sweden have long distances to the nearest maternity ward. While most of these areas have low populations, questions arise concerning associations between travel distance and maternal health.

Table 1. Examples of increased travel distance and time

Closure	Municipality	Travel time to the nearest maternity ward before closure	Travel time to the nearest maternity ward after closure
Mora maternity ward (2009)	Malung	73 km, 1h	146 km, 2 h
Sollefteå maternity ward (2017)	Sollefteå	11 km, <20 min	100-120 km, 1,5-2 h
Karlskoga maternity ward (2019)	Karlskoga	10 km <20 min	50 km, 1 h

Travel distances and times were estimated using Google Maps (*Google Maps, n.d.*)

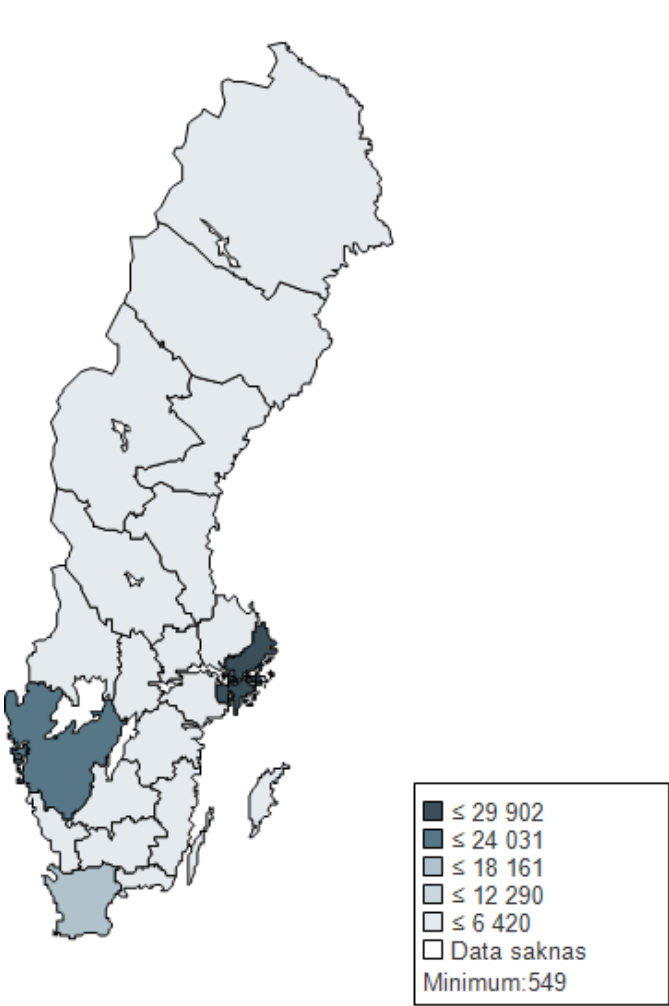


Figure 1

Statistics on deliveries, showing the total number of deliveries observed in each region for 2016.

SOURCE: Generated using Socialstyrelsen, statistical database, 2025. https://sdb.socialstyrelsen.se/if_mfr_004/val.aspx

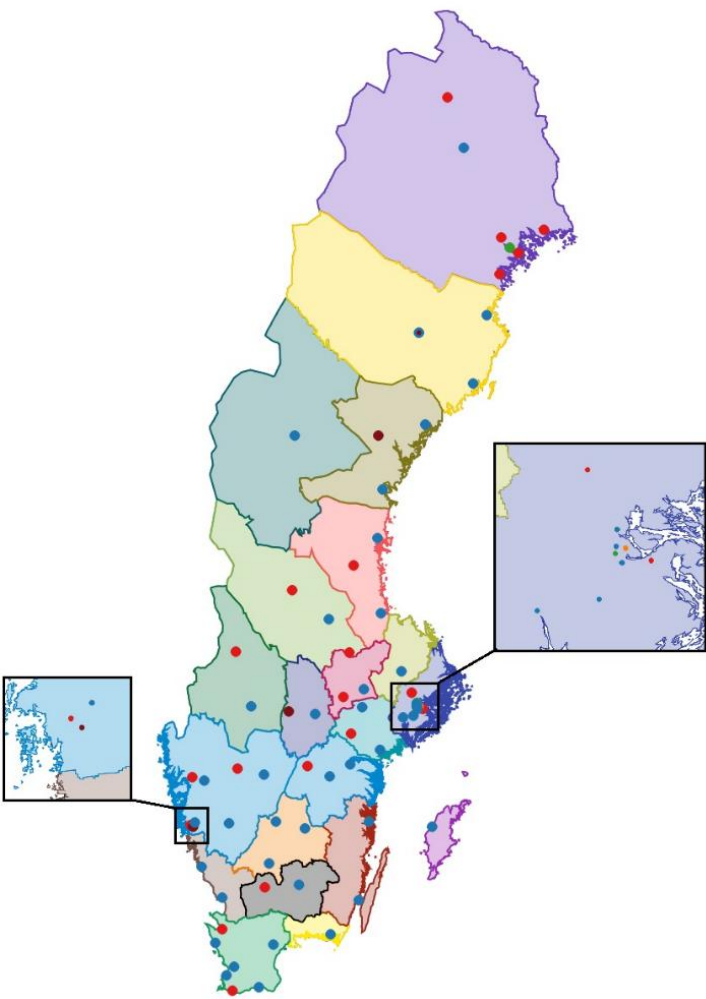


Figure 2

Maternity wards open in 2025 seen in blue
 Maternity wards closed between 1993 and 2014 seen in bright red
 Maternity wards closed between 2015 and 2025 seen in dark red
 BB Sopiha maternity ward, which was opened in 2014 and closed in 2016 seen in orange
 Lycksele maternity ward which was temporarily closed during all of 2023, and periodically closed durin 2024 and 2025. Seen with blue contour and red filling.

SOURCE: Own illustration created in QGIS, using data from Socialstyrelsen, regions, and relevant news articles.

3 Literature review

Three bodies of literature are of primary relevance to this thesis; the first body of work examines the effects of distance to the nearest maternity ward and health outcomes. The second body of literature examines the effects of maternity ward centralization and consolidation. The third body of literature examines associations between hospital size and health outcomes. Each body of literature is presented in a separate subsection.

3.1 Distance and travel time

The first body of literature looks at the association between increased distance and health outcomes. Most studies have examined perinatal and neonatal health outcomes such as neonatal mortality and morbidity, with little evidence on maternal health outcomes. Due to the limited literature on maternal health outcomes, studies examining perinatal and neonatal health have been included. An important limitation of existing work is that studies are correlational; hence, they cannot fully disentangle the effect of travel time from other patient characteristics.

A Canadian study examined associations between differences in access to maternity care services and levels of stress and anxiety. The study included a total of 187 women, of whom 40 lived in communities with no local access to maternity services. Lack of local service was defined as having no maternity service within one hour of residency. The study used two control groups, one group with access to maternity services provided by a physician or GP surgeon, and a second group with local access provided by at least one specialist. Kornelsen et al. (2011) found that lack of local access to maternity care services was strongly associated with increased levels of stress and anxiety.

Örtqvist et al. (2021) investigated the associations between travel time to the delivery unit and unplanned out-of-hospital birth, infant morbidity, and mortality in Sweden. Results suggested that increased travel time to a delivery unit was associated with out-of-hospital birth. Travel times of ≤ 30 minutes were used as the baseline; while this travel distance had the most observations of out-of-hospital deliveries in absolute numbers, this travel time was associated with the lowest risk. Travel times between 31 and 60 minutes were associated with a doubled risk of unplanned out-of-hospital. Travel times above 1 hour were associated with three times the risk of unplanned out-of-hospital birth. As for the risk of morbidity, no associations were

found. Significant associations were found between stillbirth, perinatal, and neonatal mortality. However, when an adjusted analysis was performed, the results lost statistical significance (A. K. Örtqvist et al., 2021).

Studies from neighboring countries, Norway and Finland, also found evidence suggesting that longer distances to birth institutions⁶ were correlated with increased risk of out-of-hospital births. These studies, in addition, found evidence that out-of-hospital births were associated with increased rates of neonatal mortality and morbidity (Engjom et al., 2017; Ovaskainen et al., 2015). Similar associations have also been found by studies conducted in France and the United States (Blondel et al., 2011; Combier et al., 2013; Kozhimannil et al., 2018). While these studies only examine perinatal and neonatal outcomes, out-of-hospital birth could potentially be an important aspect for maternal health, as unplanned out-of-hospital birth may deprive or delay access to trained health care professionals. Attendance of skilled health care professionals such as midwives is highly important in preventing maternal birth trauma (Abu Shqara et al., 2025; Edqvist et al., 2022; Edqvist & Rubertsson, 2025; Engjom et al., 2017). This evidence suggests that travel distance constitutes an important risk factor which should be considered when evaluating future centralization of maternity wards. Combier et al. (2013) also discovered significant associations between increased travel time and increased probability of the mother being hospitalized 24 hours or more before delivery. Admitting mothers before labor onset may be a strategy used by providers to minimize risks associated with travel time and the randomness of labor onset.

Beyond travel time, Engjom et al. (2017) compared neonatal outcomes between basic obstetric care institutions, led by midwives, and emergency obstetric and newborn care institutions, with specialists. They found comparable results on neonatal mortality rates, indicating well-functioning routines for identification and referral of high-risk pregnancies, in Norway. While this thesis does not examine neonatal outcomes, this evidence could be an indication that well-functioning routines may be a possibility for maternal health as well.

Minion et al. (2022) researched associations between increased travel time and maternal health outcomes, while also studying NICU admissions. The authors found that increased driving distance was associated with a higher risk of adverse maternal health outcomes⁷. While the

⁶ Such as maternity wards and midwife led birthing clinics.

⁷ Defined by a composite variable including maternal blood transfusion, unplanned operation, ruptured uterus, unplanned hysterectomy or maternal admission to the intensive care unit.

results held for robustness tests, concerns were raised as the shortest distances to the delivery hospital did not guarantee the lowest risk, suggesting that there may be other causes.

An important limitation of previous work is the minimal research on the correlation between travel time and psychological health outcomes, such as anxiety, stress, and depression, during and after pregnancy.

3.2 Centralization, consolidation, and closures

A small body of work discusses the effects of maternity care centralization and closures on birth trauma. A highly relevant study for this thesis is Avdic et al. (2024), who examined how patients, both infants and mothers, were affected by maternity ward consolidation in Sweden between 1990 and 2004. The study used individual-level data. One advantage of individual-level data was that they were able to confirm travel distances, which mothers were referred to a new hospital, and which mothers would belong to the referral hospital regardless of consolidation. While the authors found evidence of improvements in health outcomes for infants, they also found increased rates of maternal trauma (including uterine ruptures and cervical lacerations) and the likelihood of prolonged labor. It should be noted that no substantial changes in OASIS were observed. The adverse health outcomes were concentrated among women living close to the referral hospital, suggesting that travel distance was not the main driver, but rather crowding. Avdic et al. (2024) examined the effects of overcrowding relating to midwives' workloads. They found that births per midwife increased by 13 percent following closures, giving further evidence supporting crowding as the main driver for adverse maternal health outcomes. While Avdic et al. (2024) found adverse health outcomes, their findings also showed evidence that larger maternity wards with >2000 births per year displayed less risk of maternal trauma⁸ and infant trauma⁹ during labor and delivery. The findings suggest that maternity ward consolidation can have positive

⁸ Maternal health was measured by prevalence of trauma, including perineal lacerations (tears) grade III-IV, uterine rupture, cervical lacerations, while also studying the likelihood of prolonged labor, and hemorrhage (large bleeding), use of C-sections, instrumental assistance by forceps or vacuum. (Avdic et al., 2024, pp. 169–179)

⁹ Infant health was measured by Apgar scores, infant mortality, fetal stress (which includes complications caused by lack of oxygen) and infant birth trauma (which includes several different injuries sustained during labor. (Avdic et al., 2024, pp. 169–170)

effects on maternal health for women who are referred to a larger hospital. (Avdic et al., 2024)

In another relevant study, Edqvist et al. (2022) researched having a second midwife assist during the final stages of labor as a preventative method to reduce instances of severe perineal tearing (OASIS). The study was a randomized controlled trial, conducted at five obstetric units in Sweden. The results showed that women who were assisted by two midwives during the active second stage of labor had lower risks of severe perineal trauma (SPT). A more recent study examined how midwives' experience level and the time of delivery affect the risk of OASIS. Abu Shaqara et al. (2025) found that mothers who were delivered by a more experienced midwife experienced lower rates of OASIS. They also observed a positive correlation between OASIS and longer second-stage labor, evening shifts, and deliveries occurring in the last 2 h of a midwife's shift. The two studies highlight the importance of attendance by highly trained health care professionals on maternal health.

3.3 Hospital size

A small body of research examines the correlation between hospital size and health outcomes. Lindqvist Ståhle et al. (2023) found that smaller maternity wards in Sweden had more staffing hours per delivery. Although higher levels of staffing hours per delivery resulted in higher costs, the authors note that the work environment seemed more sustainable. While it was reported that smaller hospitals seem to have more sustainable work environments, previous research provides ambiguous results regarding how hospital size may impact health outcomes.

A recent Swedish study examined relationships between obstetric volume and adverse maternal health outcomes, including onset of labor, postpartum hemorrhage (PPH), and OASIS. Using Swedish registry data from 1992 until 2019, three size categories were examined; low: 0-1999, medium: 2000-3999, and high: ≥ 4000 births per year. Holowko et al. (2025) found a lower probability of PPH. Regarding labor onset and OASIS, no significant associations were found.

In a similar study, Snowden et al. (2015) examined associations between obstetric volume and maternal outcomes using vital statistics and patient discharge data across 267 hospitals in California between 2007-2008. Hospitals were categorized by volume and rural versus non-rural. The study focused on several health outcomes, including various infections, PPH, and

OASIS. For most maternal outcomes, the results showed minimal differences. However, in contrast to the findings of Holowko et al., being delivered in a low-volume (rural) hospital was associated with increased odds of PPH. Another relevant finding was that mothers experiencing complications were observed to stay longer in the lowest-volume hospitals compared to the highest-volume hospitals.

Although neonatal outcomes are not the focus of this thesis, a study by Cantarutti et al. (2025) adds relevant knowledge. The authors examined neonatal health outcomes in relation to hospital size and travel distance in Italy. The main results regarding hospital size suggested that a minimum of 1000 births per year could be sufficient to ensure quality care during and after delivery, as this reduced the risk of the infant needing to be transferred to a larger hospital for care. One perspective that is brought up in their discussion is that maternal-newborn separation could be caused by neonatal transfer, which in turn can negatively affect bonding between mother and child, and may therefore also affect maternal health. While Cantarutti et al. (2025) also studied the effects of travel distance, they found no adverse associations between distance and neonatal health outcomes. The authors noted limitations in the data regarding actual travel distance. Furthermore, the maximum distance traveled category was ≥ 21 km, which remains relatively short compared to travel distances faced in many Swedish regions¹⁰ (Everljung, 2023; Måwe, 2017; A. K. Örtqvist et al., 2021).

3.4 Gaps in literature

Despite a growing body of literature studying the effects of the centralization and consolidation of labor care, three key gaps remain. First, a large portion of the literature is focused on mortality, perinatal, and neonatal outcomes, with limited attention to maternal health, particularly psychological health outcomes. Second, while some studies have examined associations between hospital closures and maternal health outcomes, there is little evidence on causal effects. Although recent work by Avdic et al. (2024) has addressed causality, more evidence is needed. Third, literature provides limited insight into whether, and through which mechanisms, the maternity wards impact maternal health outcomes.

¹⁰ Based on my own analysis using Google Earth to estimate travel time to the nearest maternity ward and relevant news articles.

4 Theoretical framework

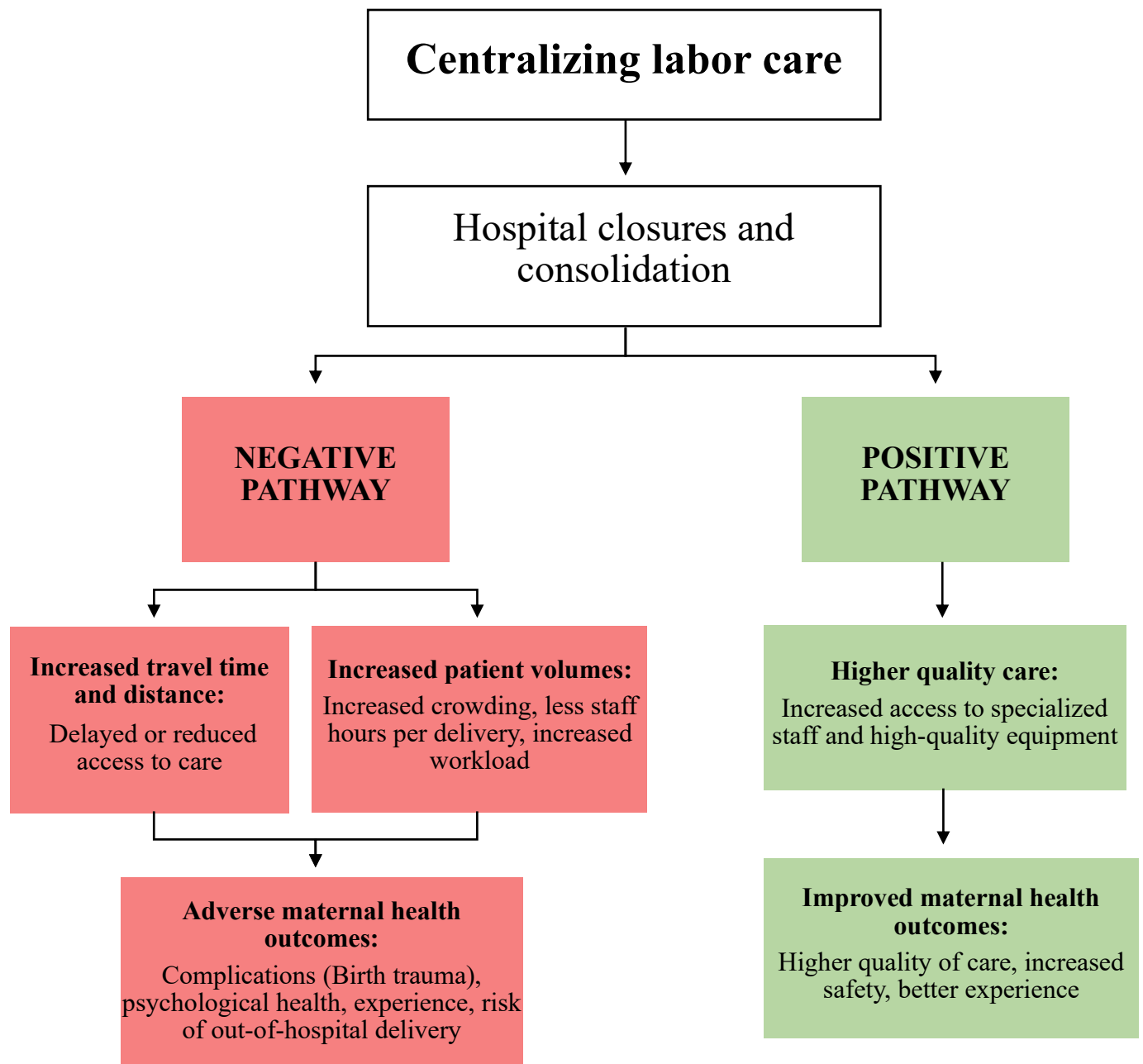
This section provides a simple conceptual framework for the research, in particular for the second research question, which examines the effect of the centralization of maternity care on maternal health outcomes.

The key outcome focus is maternal health, which is highly important from an economic perspective. The Grossman model conceptualizes health as a form of human capital that produces healthy time (Grossman, 1972). In this framework, health is both a consumption good and an investment good, as better health increases well-being and enables individuals to engage in productive activities. Adverse health outcomes can, in contrast, be interpreted as reductions in healthy time, with implications for individual welfare. From this perspective, maternal health during pregnancy and labor is particularly important, as complications or trauma may reduce physical and psychological well-being in the short and medium term. While investments in health can increase the stock of health capital, negative health shocks may reduce it, highlighting the importance of understanding how health care providers, such as maternity wards, affect maternal health outcomes. Several studies have suggested the importance of early life development on child outcomes. Some studies have also found links between maternal health and child development, suggesting that maternal health may also be highly important for future generations' health (Almond et al., 2018; Berger & Spiess, 2011; Johnson & Schoeni, 2011).

This study focuses on the effects of centralization on patient outcomes, which is *a priori* ambiguous. First, centralization may increase the quality of care, give access to more advanced medical technology, and provide access to specialized staff. As larger hospitals are more likely to have these, and as we expect these factors to have a positive effect on patients' health, there might be positive effects of centralization on patient outcomes. On the other hand, centralization may increase travel time, which can delay access to care and may also reduce access to care. Delayed access or absence of care could, in turn, cause adverse health outcomes. In addition, hospital closures may also increase the catchment areas of remaining hospitals, which could lead to higher patient volumes, increased workload, longer waiting times, and fewer staff hours per delivery (Avdic et al., 2019, 2024; Battaglia, 2025; Cantarutti et al., 2025)

Figure 3 illustrates the conceptual framework guiding this thesis and summarizes ways in which centralization of labor and delivery care may affect maternal health outcomes.

Figure 3 Conceptual framework figure



5 Data

The analysis relies on three sources of data:

1. Survey data, which includes information on travel time, self-reported labor and delivery experiences, and maternal health outcomes. The survey was administered to 116 mothers who gave birth in Sweden between 2010 and 2025, using Google Forms.
2. Regional-level data with yearly observations on the number of deliveries, delivery methods and outcomes, maternal age, maternal BMI and parity, pregnancy length and number of fetuses (singleton, multiple), infant birth weight and number of hospital closures.
3. Hospital-level data with yearly observations on the number of deliveries, the number of fetuses (singleton, multiple), use of epidural, perineotomy, OASIS, and average hospital stays for vaginal and C-section delivery.

5.1 Survey data

To provide information on key outcomes not captured by the registry data, I implemented an anonymized digital survey. The data set consists of 125 observations of deliveries from 116 mothers who gave birth in Sweden between 2010 and 2025. The survey was published and shared via social media pages for women (Instagram and Facebook). Respondents come from 15 of the 21 Swedish regions.

The data set focuses on six main health outcomes: (1) anxiety, stress, and worry about not arriving on time for delivery; (2) likelihood of being admitted before labor onset; (3) satisfaction with labor and delivery experience; (4) feeling safe during labor and delivery; (5) anxiety and postpartum depression without clinical diagnosis; (6) clinically diagnosed postpartum depression. As these outcomes may be related to other factors, several control variables are included, such as maternal characteristics, having a midwife present during labor and delivery, and several labor and delivery complications that may affect psychological health outcomes postpartum. These descriptive statistics are shown in Table 2.

The survey consisted of 23 questions, including the month and year of delivery and the place of birth, as well as 21 multiple-choice questions about delivery and birth. The survey design is shown in the Appendix.

To be able to use the survey data as intended, preparations had to be made. All yes-or-no questions were turned into binary variables, taking on the value 1 if “yes” and the value 0 if “no”. In addition, the multiple-choice questions regarding complications had to be separated so each complication had its own variable. To be able to control for several of the complications an ‘all-complications variable’ was created including all mothers who suffered OASIS, postpartum depression, anxiety and depression which had not been clinically diagnosed, bleeding resulting in blood transfusion.

Some limitations and concerns of this data set should be noted. First, the sample size is small, with only 125 observations. Although the sample contains observations from 15 of the 21 Swedish regions, there are high concentrations of observations from Region Halland, Region Stockholm, and Region Västra Götaland, which may cause bias. Second, the variables and estimates are self-reported, and for some respondents, the delivery occurred up to 15 years before answering the survey. This could affect the accuracy of recalled experiences and reporting.

Table 2. Descriptive statistics survey data

Variable	N	Obs	Ratio	Mean	Std. dev.	Min	Max
Distance:							
Travel time	125			0.768	0.9599731	0	3
Category 0 (<31 min)		40	0.32				
Category 1 (31-60 min)		63	0.504				
Category 2 (1-2 hours)		10	0.08				
Category 3 (2-3 hours)		12	0.096				
Arrived at the hospital before birth	125	120	0.96	0.96	0.1967478	0	1
Maternal Characteristics:							
First time mother	125	60	0.48	0.48	0.5016103	0	1
Previous vaginal birth	125	56	0.448	0.448	0.4992898	0	1
Previous C-section	125	9	0.072	0.072	0.2595281	0	1
Education level	125			2.76	0.4472136	1	3
9 years compulsory school		1	0.008				
High school		28	0.224				
University 2-3 years		40	0.32				
University ≥4 years		56	0.448				
Age category	125			2.712	0.9053248	1	4
≤24 years		10	0.08				
25-29 years		44	0.352				
30-34 years		43	0.344				
35-39 years		24	0.192				
≥40 years		4	0.032				
Labor and delivery:							
Vaginal birth	125			0.76	0.4288018	0	1
Induced labor start	125			0.112	0.3166355	0	1
Induced start, ending with instrumental assistance	125			0.08	0.2723849	0	1
C-section emergency	125			0.2	0.4016097	0	1
C-section planned	125			0.04	0.1967478	0	1
C-section all	125			0.24	0.4288018	0	1
Midwife present during full labor	125	101	0.808	0.808	0.3954581	0	1
Admitted before labor start	125			0.12	0.3934955	0	1
≤3 days	9		0.072				
>3 days	3		0.024				
Maternal health outcomes:							
All complications ¹¹	125			0.656	0.4769527	0	1
Vaginal tear grade I-II	125	53	0.242	0.32	0.4683533	0	1
Vaginal tear III-IV	125	7	0.056	0.04	0.1967478	0	1
Bleeding (needing blood transfusion)	125	7	0.056	0.056	0.230847	0	1
Mental health:							
Worry and anxiety about not making it scale 1-10	125			3.992	3.135376	1	10
Anxiety and/or depression after birth without diagnosis	125	25	0.2	0.2	0.4016097	0	1
Postpartum depression (diagnosed)	125	8	0.064	0.072	0.2595281	0	1
Satisfaction:							
Feeling safe during labor scale 1-10	125			7.608	2.442553	1	10
How satisfied the mother is with labor experience scale 1-10	125			7.216	2.441523	1	10

¹¹ All complications variable includes OASIS, clinically diagnosed postpartum depression, anxiety, and depression without a clinical diagnosis, bleeding resulting in blood transfusion.

5.2 Maternity ward closures

I created a data set on all maternity ward closures between 1973 and 2024 in Sweden. This information was based on data from the Medical Birth Registry (Socialstyrelsen, 2022), a list of hospital IDs (Socialstyrelsen, 2025k), the 1177 “Find a Clinic” service (1177, 2025) and relevant news articles (Chamy, 2021; Eriksson, 2020; Everljung, 2023; Lagerqvist, 2016; Nilsson, 2003; Sveriges Radio, 2003; Sydöstran, 2003). The data and information on closures were also used to assess which maternity wards women facing closures were referred to.

This data set was merged with the registry data at both the regional- and hospital-level, creating the two main data sets used to examine the consequences of maternity ward closures. In the following sections, I will present both the regional- and hospital-level data sets which were used for the final analysis.

5.3 Regional-level data set

The original regional data set consists of yearly observations from all 21 Swedish regions, as well as a national-level observation for each year from 1973 to 2023. A total of 3,212,441 deliveries were observed, resulting in 3,259,737 births. Approximately 16 percent ended in C-sections, while vaginal deliveries accounted for around 84 percent. Severe vaginal tears were observed in approximately 2.37 percent of vaginal births. During the research period, 24 hospitals were permanently closed, while 2 new ones opened.

The data includes the number of births, number of children born and number of hospital closures within the region. The data set also includes the main outcome variables: induced labor onset, C-section rates, rates of instrumental assistance and rates of vaginal tears grade III-IV (OASIS). As these outcomes can be affected by other factors, the data also includes control variables on maternal characteristics and pregnancy: Maternal Body Mass Index (BMI), Parity (first-time mother or previous birth), Gestation (pregnancy length), the birth weight, SGA (Small for Gestational Age) and LGA (Large for Gestational Age). These descriptive statistics are shown in Table 3.

To be able to use the data set as desired, some preparations were made, as not all regions had observations of severe vaginal tears (OASIS) or induced labor previous to 1993; these years were deleted. In the beginning, the panel was formatted by YEAR*REGION*PARITY*AGE, to be able to examine regional change, variables for parity and maternal age were created, and the full panels were aggregated, structured by YEAR*REGION. The final data set consists of 651 panels. As there was no data on emergency C-sections, an estimate was calculated by summarizing all spontaneous started labor, all induced labor, and all C-sections, then subtracting the total amount of deliveries. It should be noted that this estimate of emergency C-section rate is subject to uncertainty, especially as some observations are negative, which should not be possible.

Two main limitations need to be considered regarding the regional data set. First, due to the sensitive nature of health care data, all published data is aggregated at the regional level, and observations below a certain threshold have been assigned missing values. Second, some observations are missing in 2021. Region Skåne (Region ID 28) had approximately 690 unreported births; in 2022, around 500 births are missing, approximately 400 births are missing from Region Gävleborg (Region ID 61), and 100 from Region Skåne (Region ID 28)

Table 3. Descriptive statistics, Region-level data

Variable	N	Sum	% of all	Mean	SD	Min	Max
Regional:							
Number of closures in year	651	24		.0337942	.2328966	-1	3
Deliveries	651	3212441		4934.625	6037.797	367	28835
Children born	651	3259737		5007.276	6130.019	364	29299
Maternal Characteristics:							
Maternal age <24 years	651	461644	0.1437	709.1306	723.921	0	4482
Maternal age 25-29 years	651	1018364	0.3170	1564.307	1697.919	115	8669
Maternal age 30-34 years	651	1096456	0.3413	1684.264	2263.002	138	12100
Maternal age 35-39 years	651	522537	0.1626	802.6682	1242.428	0	6880
Maternal age 40+ years	651	113440	0.0353	174.255	294.5078	0	1790
BMI <18.5	651	53806	0.0167	82.65131	147.8135	0	847
BMI 18.5-24.9	651	1721449	0.5358	2644.315	3496.397	0	18404
BMI 25-29.9	651	705070	0.2194	1083.057	1304.151	0	7000
BMI ≥30	651	332221	0.1034	510.3241	628.3856	0	3511
Primiparous	651	1391336	0.4331	2137.229	2748.47	133	13360
Multiparous	651	1821105	0.5668	2797.396	3296.481	200	15703
Labor and delivery:							
Spontaneous start	651	2434720	0.7579	3739.969	4522.065	167	21152
Induced start	651	450223	0.14014	691.5868	1050.012	0	7431
C-sections (all)	651	512918	0.1596	787.8925	1129.272	44	6237
Estimate Emergency C -section	651	327498	0.1019	503.0691	630.8742	-74	3715
Instrumental assistance	651	181957	0.0566	279.5038	435.8596	0	2474
EDA	651	830309	0.2584	1275.436	1901.497	0	12205
OASIS	651	63999	0.0237 ¹²	98.30876	183.3787	0	1112
Pregnancy:							
Multiple fetuses	651	32594	0.0101	50.06759	93.18396	0	461
Born <31 weeks	651	20071	0.0061	30.83103	60.75689	0	319
Born 32to36 weeks	651	143908	0.0441	221.0568	303.1984	0	1417
Born 37to41 weeks	651	2852023	0.8749	4380.988	5388.946	329	26204
Born >42 weeks	651	184002	0.0564	282.6452	422.7866	0	2128
Infant:							
Birth weight <2500g	651	124799	0.0382	191.7035	279.4612	0	1330
Birth weight 2500-3499g	651	1373067	0.4212	2109.166	2700.386	69	13210
Birth weight 3500-4499g	651	1581767	0.4852	2429.75	2987.949	180	14231
Birth weight ≥4500	651	86628	0.0265	133.0691	189.1346	0	899
SGA	651	59506		91.40707	154.4343	0	746
LGA	651	82870		127.2965	184.9902	0	926

¹² Of vaginal deliveries

5.4 Hospital-level data set

The hospital-level data set consists of aggregate hospital-level data from the Swedish Medical Birth Registry. The data was acquired via the data files from the yearly statistical Birth reports published by The National Board of Social Affairs and Health [Socialstyrelsen, (2025b, 2025c, 2025d, 2025e, 2025f, 2025g, 2025h, 2025i, 2025j, 2025l)]. Yearly observations for each hospital were merged into a master file. The final data set covers yearly observations following 49 individual hospitals between 2015 and 2024, resulting in a total of 490 panels. As some hospitals were not open throughout the full research period, some of the panels only show missing values.

During the full research period, 1,101,644 deliveries were observed, resulting in the births of 1,116,645 children. Approximately 81.5 percent of infants were delivered vaginally, while 18.1 percent were delivered by C-section. In total, approximately 2.7 percent of vaginal deliveries resulted in severe vaginal tears (OASIS), the minimum observed was 0%, while the maximum observed was 5.04 percent.

To capture epidural anesthesia (EDA) use, I constructed a variable using the number of deliveries multiplied by the percentage of EDA use for each hospital and year. All variables containing the number of observations between primiparous and multiparous (e.g., difference in hospital stay) were also dropped as there were no observations of the total number of primiparous and multiparous, resulting in them not being usable.

The final data set includes the number of maternity ward closures, the number of deliveries and the number of children born. The data set also includes main outcome variables: C-section rates, rates of instrumental assistance, labor onset (spontaneous or induced), OASIS rates and average hospital stay. In addition, the data set includes data on delivery method, parity, number of fetuses (singleton vs multiple), perineotomy (perineal cut to prevent severe tearing), and use of EDA, which are used as control variables as they may affect the main outcomes.

Two main limitations of the hospital-level data should be noted. As with the regional-level data, the hospital-level data reports missing values when the number of observations is too low. Second, the data set contains missing or unreported birth observations for certain hospitals and years.

Table 4. Descriptive statistics hospital-level data

Variable	N	Sum	%	Mean	SD	Min	Max
Hospital:							
Closed hospitals	490	5		.0101626	.1003983	0	1
Deliveries	459	1101644		2400.096	1824.8	39	10320
Children born	459	1116645		2432.778	1853.632	39	10463
Pregnancy:							
Singletons	459	1086797	0.9732	2367.749	1796.314	39	10177
Multiple fetuses	457	29852	0.0267	65.32166	60.35356	0	333
Labor and delivery:							
Vaginal delivery	458	897197	0.8144	1958.945	1458.392	28	8393
All C-sections	458	199697	0.1812	436.0197	378.7901	11	2122
Emergency C-section	458	101641		221.9236	191.5208	4	1395
Planned C-section	458	94015		205.2729	195.1926	5	1100
C-section, unknown	458	4041		8.823144	16.87907	0	138
EDA (N)	458	563253.8		1229.812	1065.772	16.731	5918.608
EDA (%)	458			49.0291	11.5642	17.4	75.38961
Instrumental assistance	458	59167		129.1856	95.52045	1	516
Perineotomy	458	49250		107.5328	120.4792	0	811
OASIS (N)	464	24267		52.29957	43.11533	0	275
OASIS (%)	464			2.590348	.8443484	0	5.048335
Average hospital stay, vaginal birth (days)	458			1.685332	.2483181	1.039422	2.409756
Average hospital stay, c-sections (days)	458			2.780374	.3664271	1.80303	4.419192

To examine hospitals by size, I created a variable which categorizes each hospital by size, creating 5 size categories, as shown in Table 5. Approximately 49 percent of hospitals changed sizes at least once during the research period.

Table 5. Descriptive statistics; hospital size

Hospital size	Freq.	Percent	Cum.
0 (1-500 deliveries)	23	5.12	5.12
1 (501-1000)	66	14.70	19.82
2 (1001-1500)	55	12.25	32.07
3 (1501-2000)	72	16.04	48.11
4 (2001<)	233	51.89	100.00
Total	449	100.00	

6 Ethics

The regional and hospital-level data used in this study are publicly available and hold no ethical concerns.

Given that the survey included questions related to childbirth experiences and health, particular care was taken to phrase questions in a non-invasive manner. Participation did not require respondents to disclose any sensitive medical details beyond self-reported experiences, and no follow-up contact was possible, further ensuring anonymity. Survey data were stored securely and accessed only by the author for the purpose of this thesis.

7 Methods

In this section, I will present the methods used to examine each research question. The section will be divided into three sections, one for each research question.

7.1 Survey data

The survey data were used to examine the first research question i.) Is increased travel time to the nearest maternity ward associated with adverse maternal health outcomes?

The primary health outcomes focus on maternal mental health during pregnancy, which were examined using self-reported measures of anxiety, stress, and worry about not arriving at the hospital on time (1-10 scale). In addition, the likelihood of being admitted to the hospital or a patient hotel before labor onset due to travel-related concerns was examined. Maternal mental health during labor, delivery, and in the postpartum period was examined using perceived safety during labor and delivery measured on a 1-10 scale, satisfaction with labor and delivery experience (1-10 scale), anxiety and depression without clinical diagnosis, and clinically diagnosed postpartum depression.

The main coefficient of interest is the travel time. This is measured by mothers' self-reported estimates of the actual time it took to reach the maternity ward on the day of delivery (<31 min, 31-60 min, 1-2 hours, or 2-3 hours), allowing us to examine correlations between travel time and the primary outcomes.

As this analysis is studying simple correlations between an outcome variable (maternal health outcomes) Y and an independent variable X_i , Ordinary Least Squares (OLS) regression was used. I estimated the following model:

$$Y = \beta_0 + \beta_1 t + \beta_i X_i + U$$

where Y is the outcome of interest, β_0 is the constant, X_i is a vector of control variables. β_1 is the coefficient of interest: travel distance (measured in time). To account for heteroscedasticity, robust standard errors were used in all regressions.

In all regressions, the shortest travel time (<31min) was used as the comparison group. In addition, particular regressions use a binary variable, such as “admitted before labor onset” as the outcome, where the results should be interpreted as the likelihood of the outcome occurring, with a minimum value of 0 and a maximum value of 1.

7.2 Event study

To answer research question ii), which examines whether maternity ward closures lead to adverse maternal health outcomes, I use two event studies. One uses regional-level data, and the second uses hospital-level data described above.

I focus on the effect of hospital closures on maternal health outcomes. Specifically, I capture the following outcomes per 1000 births: (1) C-sections, which include all observations of C-section (surgical delivery), regardless of whether it was planned or an emergency response; (2) emergency C-sections, which are defined as unplanned C-sections used to urgently deliver the baby due to health concerns for the mother or baby (In the regional-level analysis, emergency C-sections were estimated¹³, while in the hospital-level data, emergency C-sections were reported); (3) induced labor, defined as labor that was medically induced before the spontaneous start; (4) instrumental assistance, defined as deliveries in which forceps or vacuum were used to assist the birthing mother during the pushing phase; and (5) OASIS, defined as severe vaginal tears (grade III-IV), which need medical attention and in some cases surgery.

¹³ Estimation: emergency C-section= ((all spontaneous starts + all induced starts + all C-sections)-all deliveries) as spontaneous starts, induced starts and all C-sections amounted for more deliveries than total observations.

For interpretability, all outcome variables were log-transformed, meaning that all results should be interpreted as approximate percentage changes.

I examine the effect of maternity ward closures on maternal health outcomes using a difference-in-differences design with staggered treatment effects. I use hospital closures as the treatment to examine the effect of centralization of maternity care in the regional as well as hospital-level.

At the regional level, treated regions are defined as regions that experience at least one maternity ward closure during the research period, while never-treated regions serve as the control group. The regional-level analysis examines closures from 1993 to 2023. During this period, there were 24 maternity ward closures¹⁴. All 21 regions are included in the analysis; 14 regions were treated¹⁵ and the remaining 7 serve as the control group.

At the hospital level, treated hospitals are defined as hospitals that receive patient flows from the hospitals where the maternity ward was closed, while control hospitals are those hospitals that were not affected by any closure during the study period. The hospital-level analysis examines maternity ward closures from 2015 to 2024. During this time, there were five closures¹⁶. The seven hospitals¹⁷ which received patients following these closures constitute the treatment group, while the hospitals that did not receive new patients nor experience closure serve as the control group.

¹⁴ A list of all hospital closures can be found in Appendix 12.2

¹⁵ Treated regions include: Region Dalarna, Region Västmanland, Region Skåne, Region Västra Götaland, Region Stockholm, Region Gävle, Region Sörmland, Region Norrbotten, Region Värmland, Region Östergötland, Region Kronoberg, Region Västernorrland and Örebro Län.

¹⁶ Sollefteå in January of 2017, BB Sophia in May of 2017, Sahlgrenska Mölndal in April of 2017, Karlskoga in June of 2019. While Lycksele maternity ward has not closed permanently, the maternity ward was closed during all of 2023, and partly during 2024.

¹⁷ Treated hospitals included: Södersjukhuset (responding to the closure of BB Sophia), Sahlgrenska Östra (responding to the closure of Sahlgrenska Mölndal), Örebro maternity ward (responding to the closure of Karlskoga maternity ward), Sundsvall Hospital, and Örnsköldsviks Hospital (responding to the closure of Sollefteå maternity ward). Additionally, Norrlands University Hospital and Skellefteå Hospital responded to the temporary closure of Lycksele maternity ward.

Table 6. Closures during the research period

Year	Number of closures
1993	1
1994	1
1996	3
1997	1
1998	1
1999	4
2000	1
2001	3
2003	2
2007	1
2009	1
2016	1
2017	2
2019	1
2023	1 (temporary)

The identification of the treatment effect relies on the assumption that, in the absence of maternity ward closure, treated regions or hospitals would have followed the same trend in maternal health outcomes as the control groups. While the parallel trends assumption cannot be ultimately tested, using pre-treatment trends can give an indication of whether they hold. In this thesis, the pre-trends were defined by the four years prior to treatment, year 0 is the treatment year and the post-trends are defined by the four years post-treatment. To assess the evidence of parallel trends, a graphical analysis was conducted. All graphs are presented in the results section.

The Average Treatment effect on Treated (ATT) was estimated using the Callaway and Sant'Anna difference-in-differences method, as the method allows the possibility of staggered treatment effects over multiple time periods (Callaway et al., 2021). Model equation:

$$ATT(g, t) = \mathbb{E}[Y_t(g) - Y_t(0) | G_g = 1], \text{ for } t \geq g$$

Here, ATT represents the Average Treatment effect on the Treated regions or hospitals: Y_t denotes the maternal health outcomes for year t, g indicates the period in which a region or hospital first experienced a maternity ward closure, and $Y_t(0)$ represents the counterfactual outcome in the absence of treatment for year t.

This analysis uses a doubly robust inverse probability weighting estimator, which combines outcome regression and reweighting to account for observable differences between treated and control regions or hospitals.

7.3 Hospital size

To examine associations between hospital size¹⁸ and maternal health outcomes (research question iii), OLS regression was used.

Primary outcomes are maternal health outcomes, specifically: (1) OASIS per 1000 births, defined as severe vaginal tears (grade III-IV) needing medical attention and, in some cases, surgery; (2) C-sections, which include all observations of C-section (surgical delivery), regardless of whether it was planned or an emergency response; (3) emergency C-sections per 1000 births, which were defined by the C-sections being unplanned and used to urgently deliver the baby due to health concerns for the mother or baby; (4) instrumental assistance per 1000 births, deliveries in which forceps or vacuum were used to assist the birthing mother during the pushing phase; (5) average hospital stay after vaginal birth (measured in days); and (6) average hospital stay after C-section (in days).

The key variable of interest is hospital size, measured in the number of deliveries per year. This variable allows us to examine differences in maternal health outcomes across hospital sizes.

Two main models were implemented. Model 1 examines correlations between hospital size and the primary outcomes. To account for variations over the years, year-fixed effects were used. The second model uses year- and hospital-fixed effects, also accounting for hospital-specific differences. The second model, as it only accounts for variations within the specific hospital, looks at differences as hospitals changed in size. Approximately 49 percent of hospitals changed between hospital size categories over the research period. Model specifications:

$$\text{Model 1: } Y_{it} = \beta_0 + \beta_s \text{HospitalSize}_{it} + \beta' X_{ti} + \gamma_t + \varepsilon_{it}$$

$$\text{Model 2: } Y_{it} = \beta_s \text{HospitalSize}_{it} + \beta' X_{ti} + \gamma_t + \alpha_i + \varepsilon_{it}$$

Where Y_{it} represents the outcome variable being examined, β_0 is the constant which also represents our baseline hospital size 0, β_s represents the coefficient for hospital size while X_{it} represents the hospital size category at year t, β' represents covariates which are controlled for,

¹⁸ Hospital sizes were defined in categories: Hospital size 0 was defined by having 1-500 deliveries per year, Hospital size 1 was defined by having 501-1000 deliveries per year, Hospital size 2 was defined by having 1001-1500 deliveries per year, Hospital size 3 was defined by having 1501-2000 deliveries per year and Hospital size 4 was defined by having 2001≤ deliveries per year.

γ_t represents our year-fixed effects, α_i is added in the second model, representing the hospital-fixed effects and ε_{it} represents the error term.

8 Results

This section presents the results of my analysis, aiming to answer my three research questions. The section has been divided into three subsections, each presenting results for one of the research questions.

8.1 Travel-time to nearest maternity ward

This section presents results examining correlations between travel time to the maternity ward and several maternal health outcomes. Columns 1-2 of Table 7 show the regression results for maternal health outcomes during pregnancy. Columns 3-6 of Table 7 show results for maternal health outcomes during labor, delivery and the postpartum period. The shortest travel time (<31 min) is used as the comparison group in all regressions.

In the survey, women were asked to self-report how much anxiety, stress, and worry they had experienced around not making it to the hospital in time for the delivery, on a scale of 1-10. The results show that increased travel time is correlated with higher levels of self-reported anxiety, stress and worry about not arriving at the hospital in time. The time was measured in travel-time categories¹⁹, where the OLS regression shows a statistically significant positive correlation between travel time, previous vaginal delivery and anxiety, stress and worry about not making it in time. For previous C-section, the correlation is negative, also statistically significant. All results can be seen in Table 7, Column (1).

Column (2) of Table 7 presents regression results, using the likelihood of being admitted before labor onset as the outcome variable. In the sample women who had 2-3 h travel time were approximately 72 percent more likely to be admitted before labor started, compared to the comparison group. The results also indicate that in the sample, women with higher levels of anxiety, stress, and worry of not making it in time were more likely to be admitted before labor onset.

¹⁹ Measured in categories: <31min, 31-60min, 1-2 hours, 2-3 hours

Column (3) of Table 7 presents regression results, using self-reported satisfaction with the labor and delivery experience as the outcome variable. Significant results show that travel times of 31-60 minutes had a negative correlation with satisfaction, while all increases in travel time had negative coefficients; the others were not significant. The results also suggest that women who had C-sections or any complications²⁰ report significantly lower satisfaction with their labor experience.

Column (4) of Table 7 presents regression results, using self-reported levels of feeling safe during labor and delivery experience as the outcome variable. While none of the travel time coefficients are significant, significant results show a negative association for women who had C-sections and women who experienced complications²⁰.

Regression results examining correlations between psychological maternal health outcomes, column 5 shows regression results where anxiety and depression without a clinical diagnosis was used as the outcome variable. While none of the travel time categories show no significant results, all show positive coefficients. When examining clinically diagnosed postpartum depression as the outcome variable, all travel time coefficients become significant. Regression results are shown in column 6 of Table 7. Estimated coefficients for travel time longer than 1 h also change from positive to negative, suggesting that there is a negative correlation with diagnosed postpartum depression. Other significant results suggest that being admitted before going into labor is positively correlated with being diagnosed, while having had a previous C-section was negatively correlated.

²⁰ Complications variable includes OASIS, Postpartum depression, Postpartum psychosis, Anxiety and depression which had not been clinically diagnosed, Bleeding resulting in blood transfusion.

Table 7. OLS Regression Results: Survey data

Variable	(1) Anxiety, stress and worry about not arriving (scale 1-10)	(2) Admitted before labor start	(3) Satisfaction with labor and delivery experience (scale 1-10)	(4) Feeling safe during labor and delivery (scale 1-10)	(5) Anxiety postpartum, without clinical diagnosis	(6) Postpartum depression, clinically diagnosed
Travel t 31-60m	1.742*** (3.00)	0.0240 (0.44)	-1.028** (-2.24)	-0.581 (-1.27)	0.0646 (0.81)	0.100* (1.66)
Travel t 1-2h	3.594*** (4.87)	0.0108 (0.10)	-0.909 (-1.22)	0.231 (0.32)	0.196 (1.06)	-0.0858* (-1.97)
Travel t 2-3h	5.062*** (7.73)	0.721*** (3.45)	-0.894 (-0.98)	-0.606 (-0.65)	0.0756 (0.64)	-0.205** (-2.22)
Previous Vaginal del.	0.946* (1.83)		-0.208 (-0.50)	-0.197 (-0.45)	-0.128 (-1.60)	-0.0657 (-1.32)
Previous C- section	-1.255*** (-2.92)		0.411 (0.66)	0.0288 (0.05)	-0.177 (-1.46)	-0.122** (-2.42)
Anxiety not Arrived in time		0.0203** (2.19)				
C-section all			-1.854*** (-3.25)	-1.525*** (-2.83)	0.185 (1.52)	0.0623 (0.78)
Admitted before labor start			0.163 (0.22)	0.405 (0.47)	-0.0791 (-0.70)	0.196* (1.95)
All complication			-1.655*** (-3.53)	-2.118*** (-4.36)		
Midwife present			-0.0174 (-0.03)	0.809 (1.53)	-0.0228 (-0.24)	0.0714 (1.23)
Education level					-0.000356 (-0.00)	0.0575 (1.15)
OASIS					-0.209** (-2.50)	-0.0251 (-0.63)
N	125	125	125	125	125	125
t statistics in parentheses * p<0.10, ** p<0.05, *** p<0.01						

Results show a positive association between increased travel time and increased anxiety, stress, and worry regarding not being able to arrive at the hospital in time. Suggesting that increased travel time to the nearest maternity ward may increase anxiety and stress during pregnancy.

8.2 Hospital closures and maternal health outcomes

This section will examine the association between hospital closures and maternal health outcomes. The section will be split into two subsections, presenting evidence from two event studies, one using regional-level data and one using hospital-level data.

8.2.1 Event study, regional-level

A total of 3,212,441 deliveries were reported between 1993 and 2023. About 76 percent of the observed deliveries started spontaneously, and 14 percent were induced. 16 percent of deliveries were registered ending in C-section, where calculations estimate that planned C-sections accounted for 64 percent of all C-sections, and 36 percent were estimated as emergency C-sections²¹. Approximately 5.6 percent of deliveries ended with instrumental assistance, and approximately 2.37 percent of women who delivered vaginally acquired OASIS.

During this period, 24 maternity wards were closed permanently, which represents 34.4 percent of the maternity wards that were open at the beginning of 1993. Another maternity ward, Lycksele maternity ward, was closed during all of 2023, but was later reopened. A total of 14 regions were treated during the research period. The remaining 7, which were never treated during the research period, were used as the control group. All regression results can be found in Table 8, while event study figures are found in Figure

The main results show statistically significant positive associations between the closure of a maternity ward and observations of C-section and OASIS. The estimated ATT for C-sections was approximately +55 percent (see column (5) of Table 8), and for OASIS was approximately 105 percent (see column (1) of Table 8). The event study figures, shown in Figure 4, give an indication of parallel trends. While insignificant the estimate for emergency C-sections (column (2), Table 8) and the use of instrumental assistance (column (4) of Table 8), have negative coefficients. Induced labor, while also insignificant, shows a positive coefficient, shown in column (3) of Table 8.

²¹ Estimation: emergency C-section= ((all spontaneous starts + all induced starts + all C-sections)-all deliveries) as spontaneous starts, induced starts and all C-sections amounted for more deliveries than total observations.

When using not-yet-treated as the control group, no statistically significant results are observed. While all coefficients change, all except induced labor remain positive or negative. Results for not-yet-treated are shown in Appendix 11.4.1, Table 12 and Figure 6.

Table 8. ATT regional-level data

	(1) All C-section	(2) Emergency C- section (estimated)	(3) Induced labor	(4) Instrumental assistance	(5) OASIS (Vaginal tears grade III-IV)
ATT	0.546*** (4.24)	-0.230 (-0.69)	0.305 (0.54)	-0.0817 (-0.36)	1.046* (2.17)

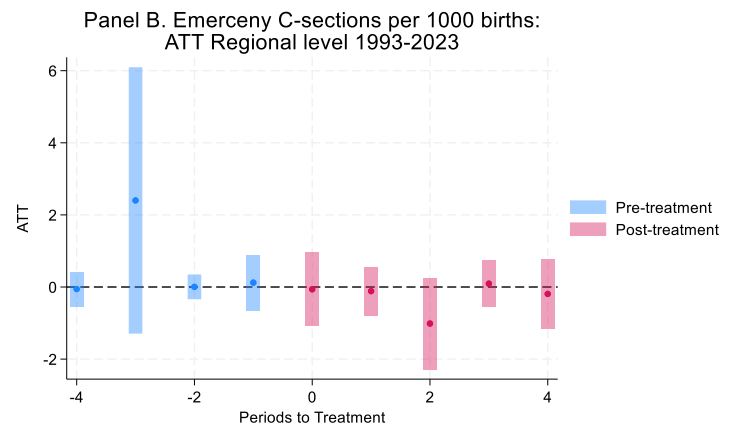
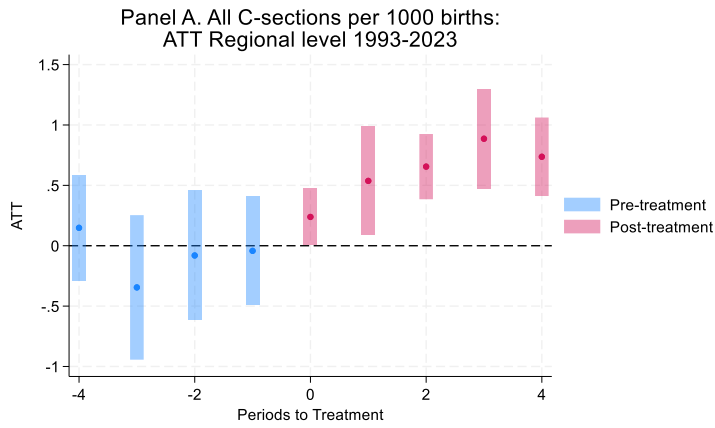
t statistics in parentheses

* p<0.05, ** p<0.01, *** p<0.001

All outcome variables were log-transformed and should be interpreted as approximate percentage changes.

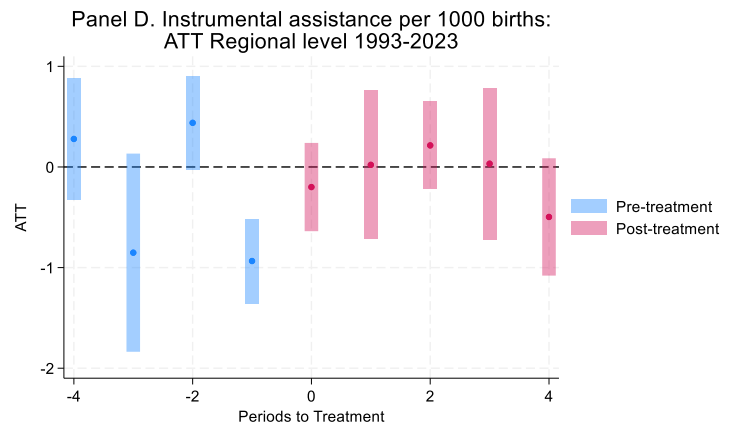
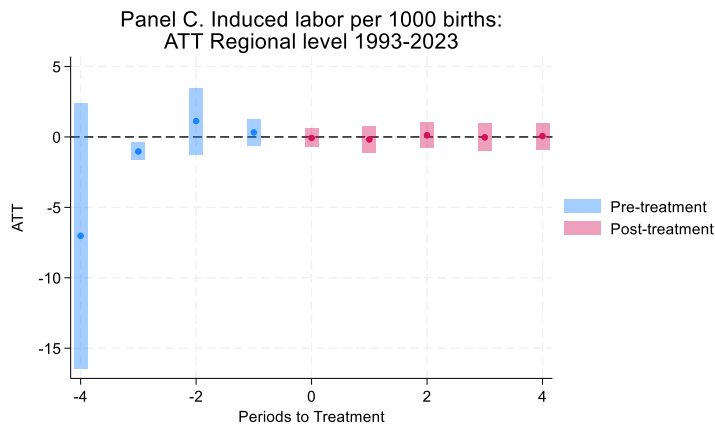
- (1) Control variables: Birth weight, multiple fetuses, maternal age, parity and BMI ≥ 30
- (2) Control variables: Birth weight, multiple fetuses, maternal age, parity and BMI ≥ 30
- (3) Control variables: Maternal age, parity, LGA and Gestational age ≥ 42 weeks
- (4) Control variables: Birth weight ≥ 4500 g, LGA, maternal age, induced onset and parity
- (5) Control variables: Instrumental assistance, Birth weight ≥ 4500 g and parity, BMI

Figure 4. Event study figures: Region-level



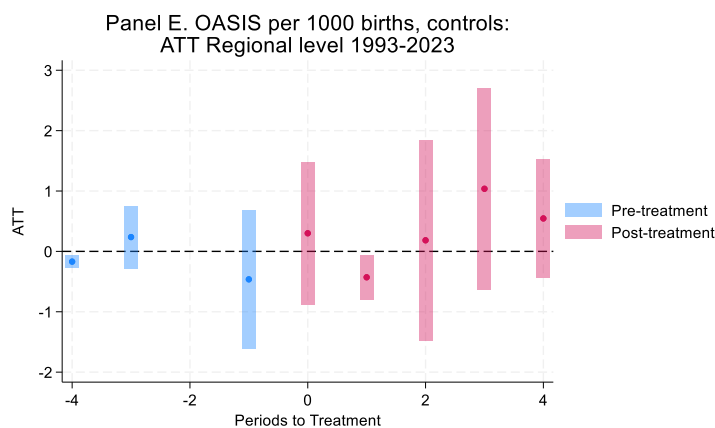
Panel A. The pre-trends give an indication of parallel trends. The post-trends show an increase in C-section rates. It seems like rates increase in the first years post-treatment, peaking at year 3 post, before decreasing a bit in year 4 post-treatment.

Panel B. The pre-trends show evidence of parallel trends. However, there is no indication of a treatment effect.



Panel C. While there is evidence suggesting parallel trends, no treatment effect can be seen.

Panel D. Pre-trends suggest that the parallel-trends assumption is violated. Hence, we cannot draw any conclusions regarding treatment effect.



Panel E. While not the strongest, there is evidence in support of parallel trends. The treatment effect post-treatment is varying in the first years, peaking in year 3, then decreasing in year 4 post-treatment.

The results provide statistically significant evidence of an association between hospital closures and adverse maternal health outcomes, in the form of increased use of C-sections and OASIS, while the graphical analysis for OASIS seems to suggest weak evidence, as the post-trends cannot be definitely differentiated from zero.

8.2.2 Event study, hospital-level

1,101,644 deliveries were observed between 2015 and 2024. Approximately 82 percent were vaginal deliveries, 18 percent were C-sections, around 51 percent were emergency, and 47 percent were planned, while 2 percent were unknown.

The results provide statistically significant evidence that hospital closures increase use of C-sections and observations of OASIS. The average treatment effect suggests that the use of C-sections increased by approximately 6.7 percent, see column (1) of Table 9. The number of women who obtained OASIS increased by approximately 14.5 percent, see column (5) of Table 9. When examining the event study figures, a graphical analysis suggests that C-sections slowly increase every year. While the pre-trends are not perfectly aligned, they give an indication supporting the assumption of parallel trends. As for OASIS, the graphical analysis suggests that the largest increases happen during years 1 and 2 post-treatment. While the pre-trends are again not perfectly aligned, they give an indication in support of parallel trends. No other significant evidence was found.

To assess if receiving hospitals, the treatment group, saw an increase in the number of deliveries, the number of deliveries was also examined. The ATT suggests an increase of 150 deliveries per 1000 births, approximately increasing deliveries by 1,5 percent. Results are shown in column (6) of Table 9. The correlations and statistical significance persist when using not-yet-treated as a control. The results using not-yet-treated as the control group can be found in Appendix 11.4.2, Table 13 and Figure 7.

Table 9. ATT hospital-level data

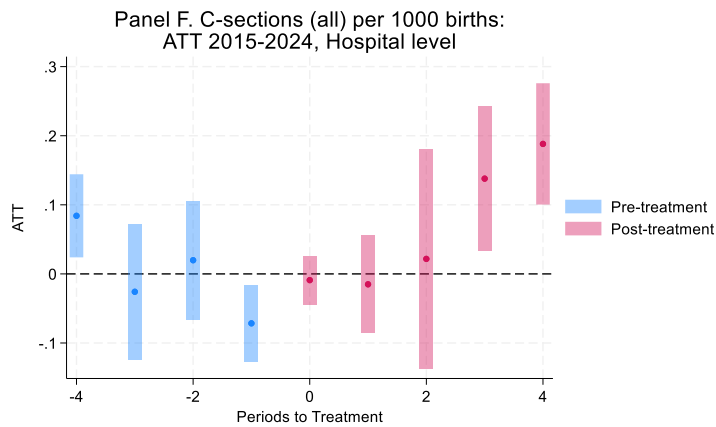
	(1) All C-section	(2) Emergency C-section	(3) Planned C- section	(4) Instrumental assistance	(5) OASIS (Vaginal tear grade III-IV)	(6) Number of births
ATT	0.0673* (2.39)	0.0694 (1.47)	0.0220 (0.45)	-0.0453 (-0.34)	0.145* (2.48)	149.7* (2.08)

t statistics in parentheses

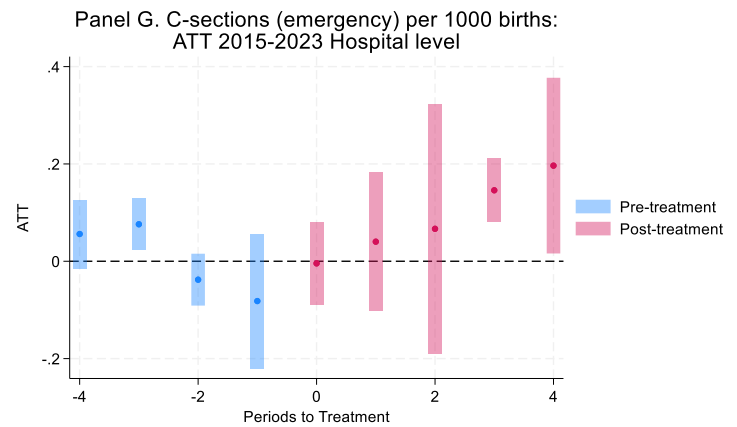
* p<0.05, ** p<0.01, *** p<0.001

- (1) Outcome variable: Log-transformed
Control variables: Instrumental assistance, Multiple features, EDA
- (2) Outcome variable: Log-transformed
Control variables: Instrumental assistance, Multiple features, EDA
- (3) Outcome variable: Log-transformed
Control variables: Instrumental assistance, Multiple features, EDA
- (4) Outcome variable: Log-transformed
Control variables: Perineotomy, Vaginal delivery
- (5) Outcome variable: Log-transformed
Control variables: Instrumental assistance, EDA
- (6) Outcome variable: In absolute numbers
No control variables

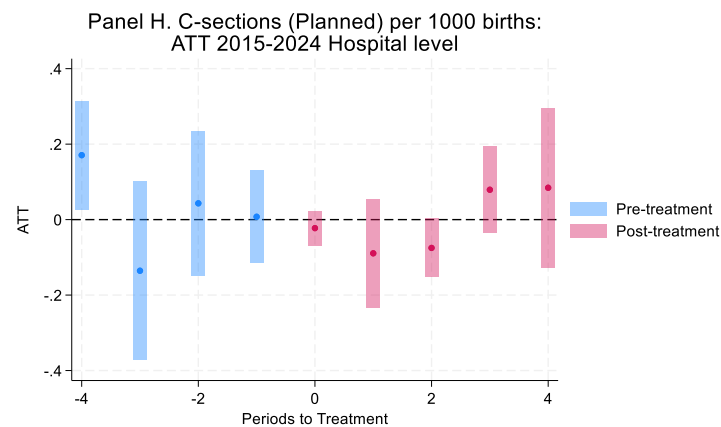
Figure 5. Event study figures: Hospital-level



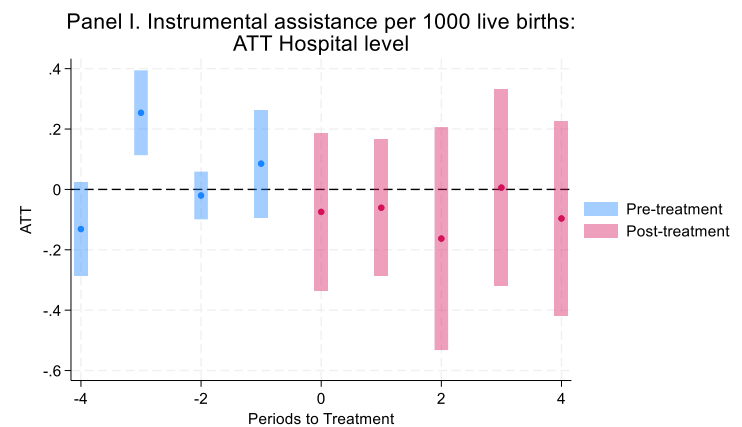
Panel F. The pre-treatment trends are fairly similar; however, they are not the strongest when examining years 4 and 1 pre-treatment. Examining the treatment effect, C-section rates are clearly rising, especially in years 3 and 4 post-treatment, with no clear peak.



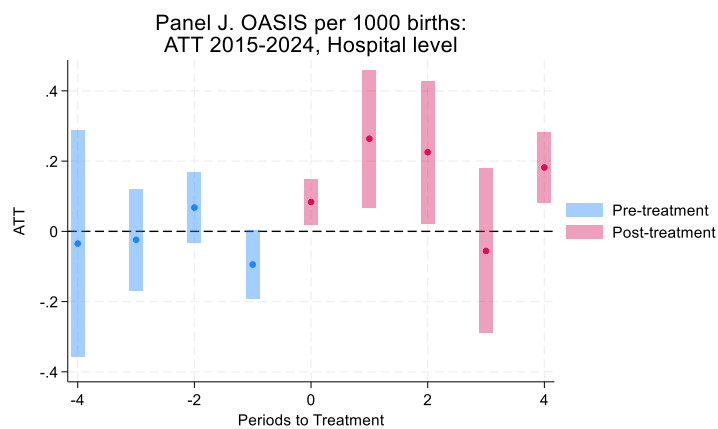
Panel G. The pre-treatment years show a similar trend, in support of parallel trends. In the years post-treatment, the Emergency C-section rate rises, similarly to those shown in Panel F, which examines C-section rates for all C-sections.



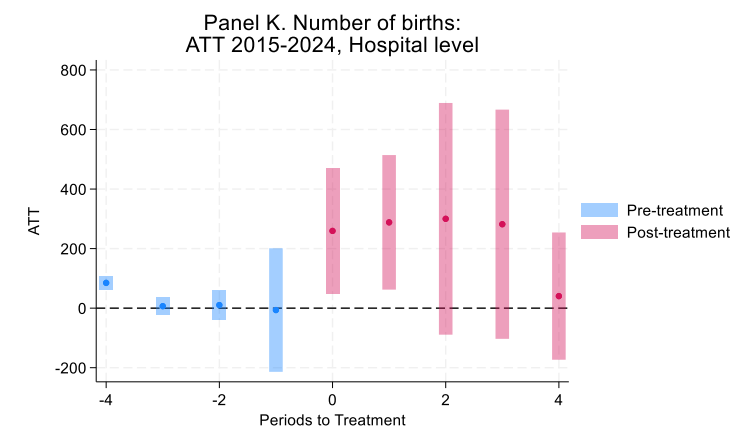
Panel H. While there is evidence of parallel trends, there is no clear treatment effect.



Panel I. The evidence of parallel is not fully satisfied as shown in the graph. It is also clear that there is no clear treatment effect in the years post-treatment.



Panel J. The pre-treatment trend look similar, giving an indication of parallel trends. Post-treatment OASIS rates rise, especially in years 1-2 post-treatment, decreasing in year 3, then increasing again in year 4 post-treatment.



Panel K. The pre-trends show evidence of parallel trends, and the post-trends show a clear treatment effect. Suggesting that

8.3 Hospital size and maternal health outcomes

This section examines if hospital size, in terms of the number of deliveries, is associated with maternal health outcomes, such as severe vaginal tears, C-sections, instrumental assistance in vaginal delivery, and average hospital stay after delivery.

The results for model 1, which uses year-fixed effects, indicate a statistically significant association between hospital size and OASIS per 1000 births, suggesting that larger hospitals have a higher OASIS rate compared to small hospitals that perform 1-500 deliveries per year. While only the coefficient for hospital size 4 is significant, results indicate that larger hospitals show lower rates of C-sections, both for all C-sections and for emergency C-sections. Regarding instrumental assistance, Model 1 finds a negative correlation, where hospital sizes 2, 3, and 4 show statistically significant results. Another interesting finding is a negative association between average hospital stay after vaginal birth and hospital size, which is statistically significant for all hospital sizes. Suggesting that, on average, women who give birth in the smallest maternity wards stay longer. Results regarding hospital stay after C-sections, while none are statistically significant, the coefficients are negative for hospital size 1-3, while size 4 has a positive coefficient.

The results from model 2, while no coefficients are statistically significant, suggest a positive correlation between cases of OASIS per 1000 births and hospital size for hospital sizes 1-3, and a negative association for hospital size 4.

For all C-sections per 1000 births, all coefficients are positive, while only the coefficients for hospital size 1 and 2 show statistical significance. For Emergency C-sections, hospital sizes 1-3 stay positive, but only hospital size 1 is statistically significant. Hospital size 4, however, becomes negative, while not statistically significant.

Regarding the use of instrumental assistance per 1000 births, no statistically significant results are seen (column (4) model 2, Table 10). As for the average hospital stay after vaginal birth, all coefficients are negative and statistically significant, suggesting that when hospitals observe an increase in the number of deliveries, mothers, on average, stay in the hospital for shorter periods. The Average hospital stay after C-section, coefficients for hospital size 3 and 4 are negative and show statistical significance. As for hospital size 2, the coefficient is also negative, however, not statistically significant. Hospital size 1 differs from the rest, having a positive coefficient; however, like hospital size 2 the results are not statistically significant.

Table 10. Regression results: Hospital size.

	(1) OASIS per 1000 births		(2) All C-sections per 1000 births		(3) Emergency C- sections per 1000 births		(4) Instrumental assistance per 1000 births		(5) Average hospital stay after vaginal birth, in days		(6) Average hospital stay after C-section, in days	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Hospital size 1 (1-500)	0.263* (2.39)	0.207 (1.53)	-0.0747 (-1.45)	0.0880* (2.54)	-0.0429 (-0.81)	0.115* (2.43)	-0.109 (-1.59)	0.157 (1.55)	-0.263*** (-4.49)	-0.103* (-2.09)	-0.137 (-1.55)	0.0293 (0.46)
Hospital size 2 (501-1000)	0.442*** (4.05)	0.178 (0.99)	-0.103 (-1.96)	0.108* (2.09)	-0.0328 (-0.60)	0.119 (1.48)	-0.157* (-2.23)	0.143 (1.17)	-0.301*** (-5.29)	-0.168** (-2.73)	-0.0694 (-0.76)	-0.0591 (-0.65)
Hospital size 3 (1001-1500)	0.382*** (3.77)	0.0189 (0.10)	-0.0502 (-0.97)	0.0474 (0.81)	-0.0338 (-0.66)	0.0132 (0.15)	-0.171* (-2.52)	0.184 (1.38)	-0.385*** (-6.82)	-0.229** (-3.17)	-0.0935 (-1.08)	-0.245* (-2.28)
Hospital size 4 (1501-2000)	0.274** (2.76)	-0.0684 (-0.36)	-0.117* (-2.16)	0.0401 (0.61)	-0.101* (-1.98)	-0.0112 (- 0.12)	-0.138* (-2.06)	0.190 (1.38)	-0.331*** (-5.66)	-0.219** (-2.80)	0.121 (1.44)	-0.268* (-2.36)
Instrument	0.00202*** (7.00)	0.00170*** (4.04)	-0.000242 (-1.01)	-0.000260 (-1.31)	-0.000106 (-0.48)	0.0000808 (0.33)			-0.000375 (-1.32)	-0.000289 (-0.91)		
Perineotomy	-0.00132*** (-11.58)	-0.000861** (-2.60)					-0.000356** (-3.25)	0.000845*** (3.39)	0.0000183 (0.12)	0.0000856 (0.36)		
EDA	0.000000991 (0.04)	-0.0000388 (-0.73)	0.0000321 (1.38)	0.0000426 (1.78)	-0.00000740 (-0.38)	0.0000243 (0.76)	0.0000135 (0.86)	-0.00000607 (-0.16)	-0.0000573* (-2.07)	0.0000680* (2.29)	-0.000121*** (-3.42)	0.0000732 (1.87)
Multiple fetuses			0.00119** (2.97)	0.000459 (1.49)	0.00125*** (4.08)	-0.0000726 (-0.17)			0.000814 (1.77)	-0.0000437 (-0.08)	0.00303*** (5.38)	0.00165* (2.36)
All C-sections					0.0768*** (12.53)	0.103*** (10.14)						
OASIS									0.00220*** (3.37)	0.00152*** (3.01)		
Emergency C- section											-0.000191 (-0.97)	-0.000304 (-1.72)
N	447	447	446	446	446	446	448	448	445	445	446	446
t statistics in parentheses												
* p<0.05, ** p<0.01, *** p<0.001												
Model 1 uses year-fixed effects												
Model 2 uses hospital- and year-fixed effects												

9 Discussion

This thesis examined the centralization of Swedish maternity care. The research questions focus on increased travel time, maternity ward closures and hospital size.

As a whole, the findings indicate several ways in which centralization may affect maternal health. Longer travel times were associated with higher levels of anxiety, stress, and worry about reaching the hospital in time for delivery. Admission before labor onset appears to be a strategy used by health care providers for mothers facing the longest travel times (2-3 hours). C-section and OASIS rates were higher in the years following maternity ward closures. While the regional- and hospital-level data show differences in the estimated levels of increase, both consistently demonstrate increased C-section and OASIS rates. Beyond access, centralization may also affect maternal health through increased hospital size. Larger hospitals were associated with increased OASIS rates. In addition, larger hospitals were also associated with shorter hospital stays, especially after vaginal birth, which may reduce opportunities for professional support when settling into motherhood. While the associations were not statistically significant across all hospital sizes, larger hospitals were associated with lower rates of emergency C-sections and instrumental assistance. This finding suggests that larger hospitals may also be associated with some improvements for maternal health. However, when adding hospital-fixed effects, the improvements are no longer observed.

These findings can be situated within a broader body of literature studying the relationship between health outcomes and travel time, centralization of maternity wards, and hospital size. Kornelsen et al. (2011) found that Canadian women who lacked access to local maternity care were more likely to experience anxiety and stress during pregnancy. Using Swedish survey data, this thesis finds similar associations, suggesting that women who live farther than 1 hour from the nearest maternity ward report significantly higher stress levels during pregnancy. Several previous studies have provided evidence that increased travel time is associated with significantly increased risk of unplanned out-of-hospital deliveries, which may be one of the risks causing anxiety and stress for women residing more than 1 hour from a maternity ward (Blondel et al., 2011; Combier et al., 2013; Engjom et al., 2017; Kozhimannil et al., 2018; A. K. Örtqvist et al., 2021; Ovaskainen et al., 2015). Combier et al. also noted that mothers with long travel times were more likely to be admitted before labor onset, similar to the evidence provided in this study. Avdic et al. (2024) found that C-sections increased following maternity ward closures, which is consistent with the findings in this thesis. In contrast, while Avdic et

al. found increased rates of uterine ruptures and cervical lacerations, they did not find increased OASIS, which this thesis found. While this study on its own cannot conclusively establish increased crowding as the main cause of adverse maternal health outcomes, the evidence suggests that patient flows do increase, in line with findings by Avdic et al. One potential risk with increased crowding is fewer staffing hours per delivery, which several studies have shown also increases risk for OASIS. Previous studies examining associations between hospital size and maternal outcomes, such as Holowko et al. (2025) and Snowden et al. (2015) found no noticeable associations between hospital size and OASIS. In contrast to these findings, this thesis found that larger hospitals were associated with increased rates of OASIS. Examining associations with average hospital stays, Snowden et al. found that the smallest hospitals were associated with longer stays, however, it should be noted that their findings were specifically connected to mothers who had experienced complications. In line with the results found in this study, women delivered in the smallest maternity wards had the longest average hospital stays.

9.1 Strengths and limitations

This thesis has three primary strengths. The first strength is the variety of data, including registry data covering all births in Sweden at the regional level between 1993 and 2023, and at the hospital level from 2015 to 2024. In addition, I designed and administered an anonymous digital survey to supplement the registry data by capturing additional outcomes and variables. The second strength is the use of multiple methods, including OLS regression and event studies using a difference-in-difference design. This allows for a more thorough analysis and strengthens the robustness of the analysis. The third strength lies in the depth of the background and contextual analysis, in which several potential mechanisms were evaluated. In addition, all hospital closures were systematically confirmed by multiple sources.

However, this thesis is not without limitations. First, despite using multiple data sets, several limitations in these data sets remain. The regional- and hospital-level data are aggregated, which limits possibilities to examine and adjust for individual-level characteristics. In addition, the data sets also have some missing and unreported observations, which could affect results. Another concern is that the data only includes yearly observations. This may introduce measurement errors, as several hospitals were closed during the year, rather than at the beginning or end of the year. Furthermore, a limitation of the survey data is the small sample

size, while some statistically significant results are found, the findings may not persist in a larger sample and should therefore be interpreted with caution. Second, the empirical models are simplified, mainly due to the data limitations, and therefore, introducing potential omitted variable bias. Thirdly, this thesis exclusively focuses on maternal health outcomes, excluding other factors such as neonatal outcomes and costs.

9.2 Policy implications and further research

This thesis provides further insight into adverse maternal health outcomes associated with the centralization of maternal care. At the same time, previous literature has also found positive effects, especially for neonatal health outcomes. These conflicting findings imply the importance of weighing several trade-offs to maximize welfare. While this thesis cannot provide definitive answers, the findings can help policymakers assess the risks and trade-offs. There may also be ways in which these risks can be addressed; one example could be implementing a protocol on who and when an expectant mother is admitted to the maternity ward. Another may be giving midwives working in prenatal care further training focused on psychological health, to be able to help expectant mothers with increased anxiety, worry and stress. In addition, decentralizing, by opening small midwife-led birthing clinics, may be a cost-effective way of increasing access for expectant mothers with low-risk pregnancies, while lowering crowding in larger hospitals for expectant mothers with high-risk pregnancies. While this demands assessments to identify high-risk pregnancies, Engjom et al. (2017) found evidence indicating well-functioning routines in Norway, which may also be able transferable to Sweden.

This thesis identified several adverse maternal health outcomes associated with the centralization of maternal care, adding to the growing body of literature. There are still three areas where further research is needed, beyond the scope of this thesis. First, there is still limited evidence on psychological health outcomes. Additionally, to examine whether the previous findings can be generalized, research needs to focus on additional geographic areas. Second, more evidence is necessary on causal effects and identifying underlying mechanisms. Third, future research needs to focus on the costs, adding another important dimension.

9.3 Conclusion

This thesis examined the consequences of the centralization of Swedish maternity care for women's health. The analysis found increased rates of C-sections and severe vaginal tears in the years following a maternity ward closure. Associations between maternal health outcomes and travel time, as well as hospital size, were also examined. Findings show that increased travel time is associated with negative psychological outcomes and that hospital size is correlated with differences in quality of care and some adverse health outcomes.

10 References

1177. (2024a, February 1). *Bristningar vid förlossning—1177*. <https://www.1177.se/Halland/barn--gravid/forlossning/efter-forlossningen/bristningar-under-forlossning/> [Accessed: 2025-12-06]
1177. (2024b, October 25). *Kejsarsnitt. 1177*. <https://www.1177.se/barn--gravid/forlossning/olika-satt-att-foda-barn/kejsarsnitt/> [Accessed: 2025-12-06]
1177. (2025). *Hitta vård. 1177*. <https://www.1177.se/hitta-varld/> [Accessed: 2025-10-12]
- Abu Shqara, R., Mustafa Mikhail, S., Nahir Biderman, S., Ganem, N., Lowenstein, L., & Frank Wolf, M. (2025). The Impact of Midwife Experience and Time of Birth on the Risk of Obstetric Anal Sphincter Injuries (OASIS). *Birth, n/a(n/a)*. <https://doi.org/10.1111/birt.70018>
- Almond, D., Currie, J., & Duque, V. (2018). Childhood Circumstances and Adult Outcomes: Act II. *Journal of Economic Literature*, 56(4), 1360–1446. <https://doi.org/10.1257/jel.20171164>
- American College of Obstetricians & Gynecologists. (2022). *Cesarean Birth*. <https://www.acog.org/womens-health/faqs/cesarean-birth> [Accessed: 2025-12-07]
- Avdic, D., Lundborg, P., & Vikström, J. (2019). Estimating returns to hospital volume: Evidence from advanced cancer surgery. *Journal of Health Economics*, 63, 81–99. <https://doi.org/10.1016/j.jhealeco.2018.10.005>
- Avdic, D., Lundborg, P., & Vikström, J. (2024). Does Health Care Consolidation Harm Patients? Evidence from Maternity Ward Closures. *American Economic Journal: Economic Policy*, 16(1), 160–189. <https://doi.org/10.1257/pol.20200734>
- Bäckenbotten-utbildning. (n.d.). *Tång*. Retrieved December 17, 2025, from <https://backenbottenutbildning.se/index.php/utbmateriel/prevention/instrumentell-forlossning/tang> [Accessed: 2025-12-17]
- Battaglia, E. (2025). The Effect of Hospital Maternity Ward Closures on Maternal and Infant Health. *American Journal of Health Economics*, 11(2), 201–246. <https://doi.org/10.1086/727738>

- Berger, E. M., & Spiess, C. K. (2011). Maternal Life Satisfaction and Child Outcomes: Are They Related? *Journal of Economic Psychology*, 32(1), 142–158.
<https://doi.org/10.1016/j.joep.2010.10.001>
- Blondel, B., Drewniak, N., Pilkington, H., & Zeitlin, J. (2011). Out-of-hospital births and the supply of maternity units in France. *Health & Place*, 17(5), 1170–1173.
<https://doi.org/10.1016/j.healthplace.2011.06.002>
- Boijesen Linde, J. (2025, June 18). *Igångsättning av förlossning (induktion)*.
<https://www.karolinska.se/varld/tema/tema-kvinnohalsa-och-halsoprofessioner/graviditetochforlossning/bb-karolinska-solna/induktion/>
[Accessed: 2025-12-16]
- Callaway, B., Sant’Anna, P. H. C., & Rios-Avila, F. (2021). *csdid: Difference-in-Differences with Multiple Time Periods in Stata*. chrome-extension://efaidnbmnnnibpcajpglclefindmkaj/https://www.stata.com/meeting/us21/slides/US21_SantAnna.pdf
- Cantarutti, A., Boracchini, R., Bellù, R., Ronco, R., Rea, F., Locatelli, A., Zanini, R., & Corrao, G. (2025). Assessing the Impact of Distance Traveled and Birth Volumes of Hospital Maternity Units on Newborn Outcomes: Population-Based Cohort Study. *JMIR Public Health and Surveillance*, 11, e58944–e58944. <https://doi.org/10.2196/58944>
- Chamy, T. A. G. och C. (2021, November 28). *Varannan förlossningsenhet har lagts ner sedan 70-talet*. DN.se. <https://www.dn.se/sverige/varannan-forlossningsenhet-har-lagts-ner-sedan-70-talet/> [Accessed: 2025-12-06]
- Cleveland Clinic. (2022a). *Episiotomy: Procedure, Advantages, Complications & Healing*. Cleveland Clinic. <https://my.clevelandclinic.org/health/treatments/22904-episiotomy>
[Accessed: 2025-12-17]

Cleveland Clinic. (2022b). *Forceps Delivery: What to Expect, Risks & Recovery*. Cleveland Clinic.

<https://my.clevelandclinic.org/health/treatments/23260-forceps-delivery>

[Accessed: 2025-12-17]

Cleveland Clinic. (2022c). *Types Of Delivery: Childbirth Options, Differences & Benefits*. Cleveland

Clinic. <https://my.clevelandclinic.org/health/articles/9675-pregnancy-types-of-delivery>

[Accessed: 2025-12-17]

Cleveland Clinic. (2023, July 24). *Vaginal Tearing During Childbirth*. Cleveland Clinic.

<https://my.clevelandclinic.org/health/diseases/21212-vaginal-tears-during-childbirth>

[Accessed: 2025-12-06]

Cleveland Clinic. (2024). *Fetal Position & Why It Matters*. Cleveland Clinic.

<https://my.clevelandclinic.org/health/articles/9677-fetal-positions-for-birth>

[Accessed: 2025-12-17]

Combier, E., Charreire, H., Le Vaillant, M., Michaut, F., Ferdynus, C., Amat-Roze, J.-M., Gouyon, J.-B.,

Quantin, C., & Zeitlin, J. (2013). Perinatal health inequalities and accessibility of maternity

services in a rural French region: Closing maternity units in Burgundy. *Health & Place*, 24,

225–233. <https://doi.org/10.1016/j.healthplace.2013.09.006>

Edqvist, M., Dahlen, H. G., Häggsgård, C., Tern, H., Ängeby, K., Teleman, P., Ajne, G., & Rubertsson, C.

(2022). The effect of two midwives during the second stage of labour to reduce severe

perineal trauma (Oneplus): A multicentre, randomised controlled trial in Sweden. *The*

Lancet, 399(10331), 1242–1253. [https://doi.org/10.1016/S0140-6736\(22\)00188-X](https://doi.org/10.1016/S0140-6736(22)00188-X)

Edqvist, M., & Rubertsson, C. (2025, December 5). *Reduction in severe perineal tearing when two*

midwives are present during childbirth | Lund University.

<https://www.lunduniversity.lu.se/article/reduction-severe-perineal-tearing-when-two->

[midwives-are-present-during-childbirth](https://www.lunduniversity.lu.se/article/reduction-severe-perineal-tearing-when-two-midwives-are-present-during-childbirth) [Accessed: 2025-12-06]

- Engjom, H. M., Morken, N.-H., Høydahl, E., Norheim, O. F., & Klungsøyr, K. (2017). Increased risk of peripartum perinatal mortality in unplanned births outside an institution: A retrospective population-based study. *American Journal of Obstetrics & Gynecology*, 217(2), 210.e1-210.e12. <https://doi.org/10.1016/j.ajog.2017.03.033>
- Eriksson, J.-P. (2020, September 30). *Snart 20 år sedan BB i Bollnäs stängdes*. SVT Nyheter. <https://www.svt.se/nyheter/lokalt/gavleborg/snart-20-ar-sedan-bb-i-bollnas-stangdes>
[Accessed: 2025-12-05]
- Everljung, J. (2023, January 21). *Gravida i Västerbotten har längst avstånd i landet när Lycksele BB är stängt*. SVT Nyheter. <https://www.svt.se/nyheter/lokalt/vasterbotten/gravida-i-vasterbottensfjallen-far-langst-avstand-i-landet-till-bb-om-lycksele-laggs-ned>
[Accessed: 2025-12-05]
- Fogelström, F. M. (2025, December 9). *Sugklocka*. <https://www.karolinska.se/vard/tema/tema-kvinnohalsa-och-halsoprofessioner/graviditet-och-forlossning/dags-att-foda/sugklocka/>
[Accessed: 2025-12-09]
- Google Maps. (n.d.). Retrieved January 19, 2026, from <https://www.google.com/maps/>
[Accessed: 2026-01-19]
- Grossman, M. (1972). On the Concept of Health Capital and the Demand for Health. *Journal of Political Economy*, 80(2), 223–255. <https://www.jstor.org/stable/1830580>
- Hälso- och sjukvårdslag (2017:30). (2017, February 9). https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/halso-och-sjukvardslag-201730_sfs-2017-30/
[Accessed: 2025-12-17]
- Holowko, N., Ladfors, L. V., Örtqvist, A. K., Ahlberg, M., & Stephansson, O. (2025). Hospital obstetric volume and maternal outcomes: Does hospital size matter? *Acta Obstetrica et Gynecologica Scandinavica*, 104(1), 55–67. <https://doi.org/10.1111/aogs.14980>

- Huotari, T., Rusanen, J., Keistinen, T., Lähderanta, T., Ruha, L., Sillanpää, M. J., & Antikainen, H. (2020). Effect of centralization on geographic accessibility of maternity hospitals in Finland. *BMC Health Services Research*, 20, 337. <https://doi.org/10.1186/s12913-020-05222-5>
- Johnson, R. C., & Schoeni, R. F. (2011). The Influence of Early-Life Events on Human Capital, Health Status, and Labor Market Outcomes Over the Life Course. *The B.E. Journal of Economic Analysis & Policy*, 11(3). <https://doi.org/10.2202/1935-1682.2521>
- Kornelsen, J., Stoll, K., & Grzybowski, S. (2011). Stress and anxiety associated with lack of access to maternity services for rural parturient women. *Australian Journal of Rural Health*, 19(1), 9–14. <https://doi.org/10.1111/j.1440-1584.2010.01170.x>
- Kozhimannil, K. B., Hung, P., Henning-Smith, C., Casey, M. M., & Prasad, S. (2018). Association Between Loss of Hospital-Based Obstetric Services and Birth Outcomes in Rural Counties in the United States. *JAMA*, 319(12), 1239–1247. <https://doi.org/10.1001/jama.2018.1830>
- Lagerqvist, S. (2016, March 1). *Förlossningar från två BB till Södertälje*. LT. <https://www.lt.se/2016-03-01/forlossningar-fran-tva-bb-till-sodertalje/> [Accessed: 2025-12-08]
- Lilliecreutz, C., & Friedmann, I. (2023). *Förlossning med sugklocka*. 1177. <https://www.1177.se/barn-gravid/forlossning/olika-satt-att-foda-barn/forlossning-med-sugklocka/> [Accessed: 2025-12-17]
- Lindgren, M. (2021, November 21). *Resan till BB kan ta fem timmar – men barnmorskorna ser ljusning*. DN.se. <https://www.dn.se/sverige/resan-till-bb-kan-ta-fem-timmar-men-barnmorskorna-ser-ljusning/> [Accessed: 2025-12-05]
- Lindqvist Ståhle, S., Strömblad, J., Olgart Höglund, C., & Eklundh Ahlgren, C. (2023). *I tid och otid En fördjupningsstudie av beamnningen inom förlossningsvården* (Agency report No. 2023:5; p. 89). The Swedish Agency of Health and Care Services Analysis. <https://www.vardanalys.se/digital-publikation/i-tid-och-otid/> [Accessed: 2025-12-05]

March of Dimes. (2024, November). *Having a c-section* [Health Topic].

<https://www.marchofdimes.org/find-support/topics/birth/having-c-section>

[Accessed: 2025-12-07]

Måwe, I. (2017, June 12). BB-avstånden ökar: Så långt är det i din kommun. *Ottar*.

<https://www.ottar.se/bb-avst-nden-kar-s-l-ngt-r-det-i-din-kommun/> [Accessed: 2025-12-28]

Minion, S. C., Krans, E. E., Brooks, M. M., Mendez, D. D., & Haggerty, C. L. (2022). Association of Driving Distance to Maternity Hospitals and Maternal and Perinatal Outcomes. *Obstetrics & Gynecology*, 140(5), 812–819. <https://doi.org/10.1097/AOG.0000000000004960>

Moldenhauer, J. S. (2024, January). *Fetal Presentation, Position, and Lie (Including Breech Presentation)*—*Women's Health Issues*. MSD Manual Consumer Version.

<https://www.msdmanuals.com/home/women-s-health-issues/complications-of-labor-and-delivery/fetal-presentation-position-and-lie-including-breech-presentation>

[Accessed: 2025-12-17]

Nilsson, S. (2003, July 12). *I morgon stänger BB- lätt i Karlshamn Personalen kritisk inför*

nedläggningen. Blekinge Läns Tidning. <https://www.blt.se/nyheter/i-morgon-stanger-bb-latt-i-karlshamn-personalen-kritisk-infor-nedlaggningen/> [Accessed: 2025-12-05]

Olsson, A. (2016, June 16). *Förlossningen i Mölndal får skarp kritik efter att barn dog*. Vårdfokus.

<https://www.vardfokus.se/yrkesroller/barnmorska/forlossningen-i-molndal-far-skarp-kritik-efter-att-barn-dog/> [Accessed: 2025-12-27]

Örtqvist, A. K., Haas, J., Ahlberg, M., Norman, M., & Stephansson, O. (2021). Association between travel time to delivery unit and unplanned out-of-hospital birth, infant morbidity and mortality: A population-based cohort study. *Acta Obstetricia Et Gynecologica Scandinavica*, 100(8), 1478–1489. <https://doi.org/10.1111/aogs.14156>

- Örtqvist, A., & Stephansson, O. (2021, June 24). Ökad restid till förlossningen ökade risken att föda utanför sjukhus. *Läkartidningen*. <https://lakartidningen.se/vetenskap/okad-restid-till-forlossningen-okade-risken-att-foda-utanfor-sjukhus/> [Accessed: 2025-12-28]
- Ovaskainen, K., Ojala, R., Gissler, M., Luukkaala, T., & Tammela, O. (2015). Out-of-hospital deliveries have risen involving greater neonatal morbidity: Risk factors in out-of-hospital deliveries in one University Hospital region in Finland. *Acta Paediatrica, International Journal of Paediatrics*, 104(12), 1248–1252. <https://doi.org/10.1111/apa.13117>
- Pilkington, H., Blondel, B., Drewniak, N., & Zeitlin, J. (2014). Where does distance matter? Distance to the closest maternity unit and risk of foetal and neonatal mortality in France. *The European Journal of Public Health*, 24(6), 905–910. <https://doi.org/10.1093/eurpub/ckt207>
- Regeringskansliet, R. och. (2019, April 10). *Statens budget i siffror* [Text]. Regeringskansliet; Regeringen och Regeringskansliet. <https://www.regeringen.se/sveriges-regering/finansdepartementet/statens-budget/statens-budget-i-siffror/> [Accessed: 2025-12-09]
- Region Örebro Län. (2023, August 4). *Förlossningen Karlskoga lasarett—Bakgrund • regionorebrolan.se*. <https://www.regionorebrolan.se/de/vard-och-halsa/sa-fungerar-varden-i-regionen/utvecklings--och-forbattringsarbete/forlossningen-karlskoga-lasarett-bakgrunden/> [Accessed: 2025-11-24]
- Snowden, J. M., Cheng, Y. W., Emeis, C. L., & Caughey, A. B. (2015). The impact of hospital obstetric volume on maternal outcomes in term, non–low-birthweight pregnancies. *American Journal of Obstetrics and Gynecology*, 212(3), 380.e1–380.e9. <https://doi.org/10.1016/j.ajog.2014.09.026>
- Socialstyrelsen. (2022, May 30). *Medicinska födelseregistret variabelförteckning*. Socialstyrelsen. <https://www.socialstyrelsen.se/globalassets/sharepoint-dokument/dokument-webb/statistik/register-medicinska-fodelseregistret-variabelforteckning.xls> [Accessed: 2025-10-28]

Socialstyrelsen. (2025a). *Graviditet, förlossning och tiden efter – Förslag till nationell plan 2026–2035*

(Nos. 2025-9–9715). chrome-

extension://efaidnbmninnbpcajpcglclefindmkaj/https://www.socialstyrelsen.se/contentasse

ts/e63524bf5ce448308bfa56274f514fe5/2025-9-9715.pdf [Accessed: 2025-10-28]

Socialstyrelsen. (2025b, June 17). *Statistik om graviditeter, förlossningar och nyfödda barn 2015.*

Socialstyrelsen. [https://www.socialstyrelsen.se/publikationer/statistik-om-graviditeter-](https://www.socialstyrelsen.se/publikationer/statistik-om-graviditeter-forlossningar-och-nyfodda-barn-2015-2017-3-3/)

[forlossningar-och-nyfodda-barn-2015-2017-3-3/](https://www.socialstyrelsen.se/publikationer/statistik-om-graviditeter-forlossningar-och-nyfodda-barn-2015-2017-3-3/) [Accessed: 2025-10-28]

Socialstyrelsen. (2025c, June 17). *Statistik om graviditeter, förlossningar och nyfödda barn 2016.*

Socialstyrelsen. [https://www.socialstyrelsen.se/publikationer/statistik-om-graviditeter-](https://www.socialstyrelsen.se/publikationer/statistik-om-graviditeter-forlossningar-och-nyfodda-barn-2016-2018-1-6/)

[forlossningar-och-nyfodda-barn-2016-2018-1-6/](https://www.socialstyrelsen.se/publikationer/statistik-om-graviditeter-forlossningar-och-nyfodda-barn-2016-2018-1-6/) [Accessed: 2025-10-28]

Socialstyrelsen. (2025d, June 17). *Statistik om graviditeter, förlossningar och nyfödda barn 2017.*

Socialstyrelsen. [https://www.socialstyrelsen.se/publikationer/statistik-om-graviditeter-](https://www.socialstyrelsen.se/publikationer/statistik-om-graviditeter-forlossningar-och-nyfodda-barn-2017--2019-5-2/)

[forlossningar-och-nyfodda-barn-2017--2019-5-2/](https://www.socialstyrelsen.se/publikationer/statistik-om-graviditeter-forlossningar-och-nyfodda-barn-2017--2019-5-2/) [Accessed: 2025-10-28]

Socialstyrelsen. (2025e, June 17). *Statistik om graviditeter, förlossningar och nyfödda barn 2018.*

Socialstyrelsen. [https://www.socialstyrelsen.se/publikationer/statistik-om-graviditeter-](https://www.socialstyrelsen.se/publikationer/statistik-om-graviditeter-forlossningar-och-nyfodda-barn-2018-2020-2-6622/)

[forlossningar-och-nyfodda-barn-2018-2020-2-6622/](https://www.socialstyrelsen.se/publikationer/statistik-om-graviditeter-forlossningar-och-nyfodda-barn-2018-2020-2-6622/) [Accessed: 2025-10-28]

Socialstyrelsen. (2025f, June 17). *Statistik om graviditeter, förlossningar och nyfödda barn 2019.*

Socialstyrelsen. [https://www.socialstyrelsen.se/publikationer/statistik-om-graviditeter-](https://www.socialstyrelsen.se/publikationer/statistik-om-graviditeter-forlossningar-och-nyfodda-barn-2019-2020-12-7051/)

[forlossningar-och-nyfodda-barn-2019-2020-12-7051/](https://www.socialstyrelsen.se/publikationer/statistik-om-graviditeter-forlossningar-och-nyfodda-barn-2019-2020-12-7051/) [Accessed: 2025-10-28]

Socialstyrelsen. (2025g, June 17). *Statistik om graviditeter, förlossningar och nyfödda barn 2020.*

Socialstyrelsen. [https://www.socialstyrelsen.se/publikationer/statistik-om-graviditeter-](https://www.socialstyrelsen.se/publikationer/statistik-om-graviditeter-forlossningar-och-nyfodda-barn-2020-2021-12-7651/)

[forlossningar-och-nyfodda-barn-2020-2021-12-7651/](https://www.socialstyrelsen.se/publikationer/statistik-om-graviditeter-forlossningar-och-nyfodda-barn-2020-2021-12-7651/) [Accessed: 2025-10-28]

Socialstyrelsen. (2025h, June 17). *Statistik om graviditeter, förlossningar och nyfödda barn 2021.*

Socialstyrelsen. [https://www.socialstyrelsen.se/publikationer/statistik-om-graviditeter-](https://www.socialstyrelsen.se/publikationer/statistik-om-graviditeter-forlossningar-och-nyfodda-barn-2021-2022-12-8275/)

[forlossningar-och-nyfodda-barn-2021-2022-12-8275/](https://www.socialstyrelsen.se/publikationer/statistik-om-graviditeter-forlossningar-och-nyfodda-barn-2021-2022-12-8275/) [Accessed: 2025-10-28]

Socialstyrelsen. (2025i, June 17). *Statistik om graviditeter, förlossningar och nyfödda barn 2022*.

Socialstyrelsen. <https://www.socialstyrelsen.se/publikationer/statistik-om-graviditeter-forlossningar-och-nyfodda-barn-2022-2023-12-8867/> [Accessed: 2025-10-28]

Socialstyrelsen. (2025j, June 17). *Statistik om graviditeter, förlossningar och nyfödda barn 2023*.

Socialstyrelsen. <https://www.socialstyrelsen.se/publikationer/statistik-om-graviditeter-forlossningar-och-nyfodda-barn-2023-2024-12-9357/> [Accessed: 2025-10-28]

Socialstyrelsen. (2025k, November 12). *Patientregistrets koder över sjukhus och kliniker*.

Socialstyrelsen. <https://www.socialstyrelsen.se/statistik-och-data/klassifikationer-och-koder/andra-kodverk/sjukhuskoder/> [Accessed: 2025-10-28]

Socialstyrelsen. (2025l, December 2). *Statistik om graviditeter, förlossningar och nyfödda barn 2024*.

Socialstyrelsen. <https://www.socialstyrelsen.se/publikationer/statistik-om-graviditeter-forlossningar-och-nyfodda-barn-2024-2025-12-9920/> [Accessed: 2025-12-04]

Socialstyrelsen. (2025m, December 4). *Statistik om graviditeter, förlossningar och nyfödda*.

Socialstyrelsen. <https://www.socialstyrelsen.se/statistik-och-data/statistik/alla-statistikamnen/graviditeter-forlossningar-och-nyfodda/> [Accessed: 2025-10-28]

Statistiska Centralbyrån. (2025a). *Folkmängd, antal efter ålder, kön och år*. PxWeb.

https://www.statistikdatabasen.scb.se/pxweb/sv/ssd/START_BE_BE0101_BE0101A/BefolkningR1860N/table/tableViewLayout1/ [Accessed: 2025-12-28]

Statistiska Centralbyrån. (2025b).

https://www.statistikdatabasen.scb.se/pxweb/en/ssd/START_BE_BE0101_BE0101C/BefolkningArealTathetKon/ Statistikdatabasen. [Accessed: 2026-01-01]
https://www.statistikdatabasen.scb.se/pxweb/en/ssd/START_BE_BE0101_BE0101C/BefolkningArealTathetKon/ [Accessed: 2026-01-01]

SvD. (2016, May 26). Extremt tryck efter BB-stängning. *Svenska Dagbladet*.

<https://www.svd.se/a/mBPLI/extremt-tryck-efter-bb-stangning> [Accessed: 2025-10-28]

Sveriges Radio, S. (2003, June 2). *Förlossningen i Lidköping läggs ner—P4 Skaraborg*.

<https://www.sverigesradio.se/artikel/240451> [Accessed: 2025-10-28]

SVT Nyheter. (2019, June 4). *Efter kritiken – nu presenteras fler orsaker till stängningen av*

förlossningsavdelningen i Karlskoga. SVT Nyheter.

<https://www.svt.se/nyheter/lokalt/orebro/krav-fran-barnlakare-bakom-stangningen-av-forlossningen-i-karlskoga> [Accessed: 2025-12-27]

SVT Nyheter. (2025, November 24). *Förlossningen i Lycksele håller stängt tre veckor under jul och*

nyår. SVT Nyheter. <https://www.svt.se/nyheter/lokalt/vasterbotten/forlossningen-i-lycksele-haller-stangt-tre-veckor-under-jul-och-nyar> [Accessed: 2025-12-27]

Sydöstran. (2003, February 14). *BB-Lätt i Karlshamn läggs ner*. Sydöstran.

<https://www.sydostran.se/nyheter/bb-latt-i-karlshamn-laggs-ner/> [Accessed: 2025-11-25]

Weilenmann, L. (2016, October 3). *Förlossningen i Sollefteå läggs ned*. Vårdfokus.

<https://www.vardfokus.se/yrkesroller/barnmorska/bb-solleftea/> [Accessed: 2025-11-06]

Öster K., & Nieminen, K. (n.d.). *Depression i samband med att du får barn*, 1177. Retrieved

December 10, 2025, from <https://www.1177.se/sjukdomar--besvar/psykiska-sjukdomar-och-besvar/depression/depression-i-samband-med-att-du-far-barn/> [Accessed: 2025-12-10]

11 Appendix

11.1 Health outcomes

This thesis will examine maternal health outcomes such as severe vaginal tears (OASIS), use of C-sections, instrumental assistance during vaginal delivery, psychological trauma associated with pregnancy or labor and induced delivery. While induced delivery in it is not always an adverse outcome and may be necessary in some cases, Karolinska institute reports that it can take a long time and statistics show an increased number of induced deliveries ending in C-section or the need to use instrumental assistance, compared to vaginal birth which started spontaneously. (Boijesen Linde, 2025)

While this study does not examine out-of-hospital deliveries, this may also be an adverse outcome associated with increased travel time. (Ovaskainen et al., 2015)

11.1.1 Vaginal tears, OASIS

One of the most common injuries is vaginal tears, which is a tear in the skin or muscle tissue around the vagina and perineum. The perineum is the area between the vagina and the anus. Vaginal tears are graded from 1 (least severe) to 4 (most severe):

- i. First degree tear: a shallow tear in the first layer of skin, which usually does not require stitches and heal on their own.
- ii. Second-degree tear: a tear that extends beyond the first layer of skin into the underlying muscle of the vaginal and perineum area, which requires stitches. It should also be noted that a vaginal cut given by a midwife to help get the baby out can be compared to a second-degree cut.²²
- iii. Third-degree tear: a tear that extends from the vagina to the anus, injuring skin and muscle tissue around the vagina, anus and the anal sphincter muscles. The patient will need stitches.
- iv. Fourth-degree tear: a tear that beyond a third-degree tear also extends into the rectum area. This is the most severe tear, causing some patients to be moved to an operating room for stitches.

First and second-degree tears are very common, risk factors include first time delivery, use of instrumental help in the form of forceps or vacuum, having a larger baby or a baby in an unfavorable position and quick or prolonged second stage²³. Third and fourth-degree tears are also known as Sphincter ruptures or OASIS²⁴ (1177, 2024a; Cleveland Clinic, 2023; Edqvist & Rubertsson, 2025).

²² Medically known as Episiotomy (Cleveland Clinic, 2022a)

²³ Also known as pushing stage

²⁴ Obstetric Anal Sphincter Injury

11.1.2 Cesarean section

A Cesarean section (C-section) is a major surgery, while serious complications are uncommon there are several associated risks. Complications associated with c-sections are: Infections in the surgery wound or in the uterus, urine tract infections (UTI), blood clots, injuries to the bowel or bladder, fetal injuries. It should also be noted that c-sections are associated with longer recovery compared to vaginal birth. (1177, 2024b; American College of Obstetricians & Gynecologists, 2022; March of Dimes, 2024)

11.1.3 Psychological health

Postpartum depression is defined as a period of 2 weeks or more where the mother has a hard time feeling joy, has feelings of guilt and hopelessness, has a hard time with energy and getting normal daily activities done. The mother can have a hard time taking care of the baby, seeing other people or even have thoughts about hurting themselves or their baby. (Öster, K., & Nieminen, K., n.d.)

In this study postpartum depression will be defined as having been clinically diagnosed by medical personnel, while non diagnosed depression will be referred to as non-clinical depression, anxiety, worry, stress or fear.

11.1.4 Induced start and instrumental help during vaginal birth

There are several methods for inducing labor, (Socialstyrelsen, 2022) reports that the most common method is medical induced labor.

Medically induced labor as stated previously can take a long time and be a trial of one's patience as it can end up taking several days before the infant is delivered. While induction usually leads to a normal delivery process, Karolinska Institute states that statistics show an increased number of deliveries that end in C-section or with instrumental help (Boijesen Linde, 2025).

Instrumental help indicates the use of vacuum or forceps during delivery. (Socialstyrelsen, 2022). If the delivery slows down, is stalled or if the mother is very tired, these instruments can be used to help guide the fetus through the birth canal, in hopes of avoiding C-sections. (Cleveland Clinic, 2022b, 2022c) When giving birth with vacuum a small vacuum cup is placed on the infant's head, the cup is then attached to a string which the doctor can pull as the mother pushes, to help. It is important to note that to prevent lacerations or infant trauma, this needs to happen in a calm and controlled manner (Fogelström, 2025; Lilliecreutz & Friedmann, 2023). Forceps are a medical tool that looks similar to salad tongs, which can be used to help guide the baby out through the birth canal (Cleveland Clinic, 2022b). While forceps are less commonly used there are situations where forceps are preferred over vacuum, this can be when

the baby is in a face presentation²⁵ or when the baby's head is stuck during a breech presentation²⁶. (Bäckenbotten-utbildning, n.d.; Cleveland Clinic, 2022b)

11.2 Hospital closures

Table 11. Maternity ward closures from 1993 to 2024

Hospital	Region	Last year active
Avesta maternity ward	Region Dalarna	1993
Köpings maternity ward	Region Västmanland	1994
Trelleborgs maternity ward	Region Skåne	1996
Sahlgrenska maternity ward including ABC clinic	Region Västra Götaland	1996
Lövenströmska maternity ward	Region Stockholm	1996
Nacka maternity ward	Region Stockholm	1996
Uddevalla maternity ward	Region Västra Götaland	1997
Kullbergska maternity ward	Sörmland	1998
Bollnäs maternity ward	Region Gävle	1999
Boden maternity ward	Region Norrbotten	1999
Luleå maternity ward	Region Norrbotten	1999
Ängelholm maternity ward	Region Skåne	1999
Torsby maternity ward	Region Värmland	2000
Piteå Älvdals maternity ward	Region Norrbotten	2001
Kalix maternity ward	Region Norrbotten	2001
Kiruna maternity ward	Region Norrbotten	2001
Lidköping maternity ward	Region Västra Götaland	2003
Motala maternity ward	Region Östergötland	2003
Ljungby maternity ward	Region Kronoberg	2007
Mora maternity ward	Region Dalarna	2009
Sollefteå maternity ward	Region Västernorrland	2017
Sahlgrenska maternity ward, Mölndal	Region Västra Götaland	2017
Karlskoga maternity ward	Region Örebro	2019
Lycksele maternity ward	Region Västerbotten	2023*

*Temporarily closed, reopened in 2024

²⁵ Face presentation is when a baby's face is facing the mother (Cleveland Clinic, 2024; Moldenhauer, 2024)

²⁶ When a baby is in a position to be born with buttocks or feet first (Cleveland Clinic, 2024; Moldenhauer, 2024)

11.3 Survey design

Survey on how travel time to the nearest maternity ward can affect the health of expecting mothers

Hello! My name is Natalie Skomp, and I am currently writing my bachelor's thesis in economics at the School of Business, Economics and Law at the University of Gothenburg. The purpose of the thesis is to investigate how travel time to childbirth can affect the health of pregnant women, from a health economic perspective.

The survey is aimed at those who gave birth in Sweden between 2010 and 2025.

You respond for one pregnancy/childbirth. If you have given birth multiple times and wish, you can fill out one questionnaire per pregnancy/birth. Every answer is valuable and contributes to a more reliable result. **It takes about 3-7 minutes to complete the survey.**

The survey is completely anonymous, no information that can be linked directly to you as a person is collected.

Participation is voluntary and you can cancel at any time.

Thank you for taking the time to contribute. Your answer is very valuable!

Do you want to read the results when the thesis is finished?

(The form is separate and cannot be linked to your survey responses. Expressing interest is completely voluntary and does not affect your participation in the survey.)

If you have questions or comments, you can reach me here: E-mail

* Indicates required question

When did childbirth take place?

Only the month and year are used in the analysis. Choose any day of the month. *

Date: XXXX-XX-XX

At which hospital was the birth planned?

If planned outside of a hospital, state the type of place and region, for example:

at home, Region Västra Götaland. *

How long was the trip to the hospital?

Estimate actual travel time at birth, including time for e.g., ferry and traffic. *

- ☐ <31 min
- ☐ 31-60 min
- ☐ 1-2 hours
- ☐ 2-3 hours
- ☐ >3 hours

Did you experience anxiety, stress or worry about not making it to the hospital? *

No anxiety, stress or worry

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ 6
- ☐ 7
- ☐ 8
- ☐ 9
- ☐ 10

A lot of anxiety, stress or worry

Did you make it to the hospital before the baby was born? *

- ☐ Yes
- ☐ No, the child was born before arrival

Were you admitted to the hospital or a patient hotel before the onset of labor, due to travel time? *

- ☐ Yes
- ☐ Yes, ≤ 3 days
- ☐ Yes, > 3 days

Which method was used to deliver your child?

Instrumental assistance refers to the use of a vacuum or forceps. *

- ☐ Vaginal delivery – spontaneous onset
- ☐ Vaginal delivery – spontaneous onset ending with instrumental assistance
- ☐ Vaginal delivery – induced
- ☐ Vaginal delivery – induced with ending with instrumental assistance
- ☐ Caesarean section – emergency
- ☐ Caesarean section – planned

Did you have at least one midwife with you throughout the active birth? *

- ☐ Yes
- ☐ No

How safe did you feel during labor and delivery? *

Not at all safe

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ 6
- ☐ 7
- ☐ 8
- ☐ 9
- ☐ 10

Very safe

How long did you stay in the maternity ward after giving birth? *

- ☐ <8 hours
- ☐ 8-24 hours
- ☐ 1-2 days
- ☐ 2-3 days
- ☐ >3 days

Did you experience any physical or mental complications related to childbirth? *

Select all the options that match. *

- ☐ No
- ☐ Vaginal tear (grade I-II)
- ☐ Vaginal tear (Grade III to IV)
- ☐ Postpartum depression
- ☐ Postpartum psychosis
- ☐ Postpartum anxiety or depression without a clinical diagnosis
- ☐ Bleeding which required a blood transfusion

Have you had to seek care for problems related to your childbirth? *

Select all the options that match. *

- ☐ Yes, before the birth due to fear of not making it to the hospital
- ☐ Yes, after childbirth due to mental health problems
- ☐ Yes, after childbirth due to physical ailments
- ☐ No

Have you been on sick leave due to problems related to childbirth? *

- ☐ No
- ☐ Yes, ≤2 weeks
- ☐ Yes, >2 weeks

How satisfied are you with your labor and delivery experience, as a whole? *

Not at all satisfied

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ 6
- ☐ 7
- ☐ 8
- ☐ 9
- ☐ 10

Very satisfied

Duration of pregnancy: *

- ☐ ≤31 weeks
- ☐ 32-36 weeks
- ☐ 37-41 weeks
- ☐ ≥42 weeks

Was this your first birth? *

- ☐ Yes
- ☐ No, earlier vaginal delivery
- ☐ No, previous caesarean sections

Was the pregnancy a singleton or multiple births? *

- ☐ Single birth (one child)
- ☐ Multiple births (twins, triplets, or more)

How old were you at the time of delivery? *

- ☐ ≤24 years
- ☐ 25-29 years
- ☐ 30-34 years
- ☐ 35-39 years
- ☐ ≥40 years

In what range was your BMI at the time of enrolment in maternity care? *

- ☐ <18.5 Underweight
- ☐ 18.5 - 24.9 Normal weight
- ☐ 25 - 29.9 Overweight
- ☐ ≥30 Obesity

Were you born in Sweden? *

- ☐ Yes
- ☐ No

What is your highest completed education? *

- ☐ No completed education
- ☐ Compulsory school
- ☐ Upper secondary school
- ☐ University or college degree 2-3 years
- ☐ University or college degree ≥ 4 years

Did the child require any kind of medical help or supervision during its first day?

e.g., oxygen, resuscitation attempts, blood transfusions, monitoring in the neonatal ward or similar *

- ☐ Yes
- ☐ No
- ☐ Cannot remember

If the opportunity existed, would you consider giving birth at a midwife-led maternity clinic (without an on-site doctor) to halve your travel time?

Provided that you were deemed to have a low-risk pregnancy after a medical assessment. *

- ☐ Yes
- ☐ No

11.4 Robustness

11.4.1 Robustness results event study – Regional-level

Table 12 ATT Regional-level, not-yet-treated

	(1) All C-section	(2) Emergency C- section (estimated)	(3) Induced labor	(4) Instrumental assistance	(5) OASIS (Vaginal tears grade III-IV)
ATT	0.716 (1.07)	-0.646 (-1.18)	-0.151 (-0.52)	-0.0873 (-0.59)	0.388 (0.65)

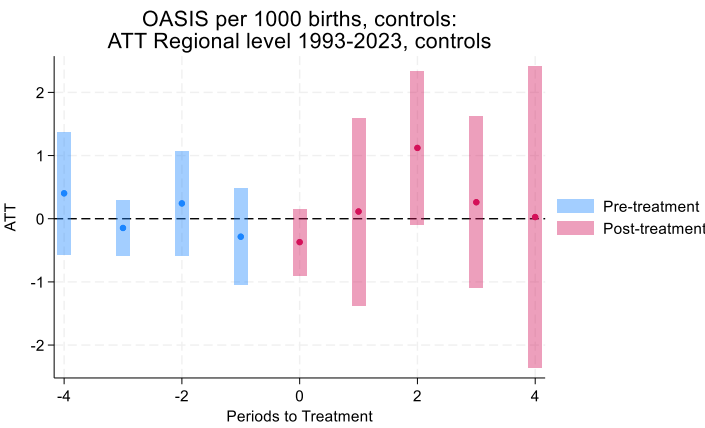
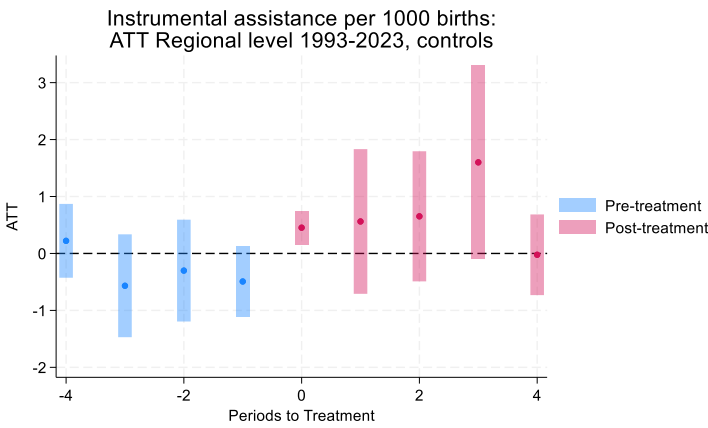
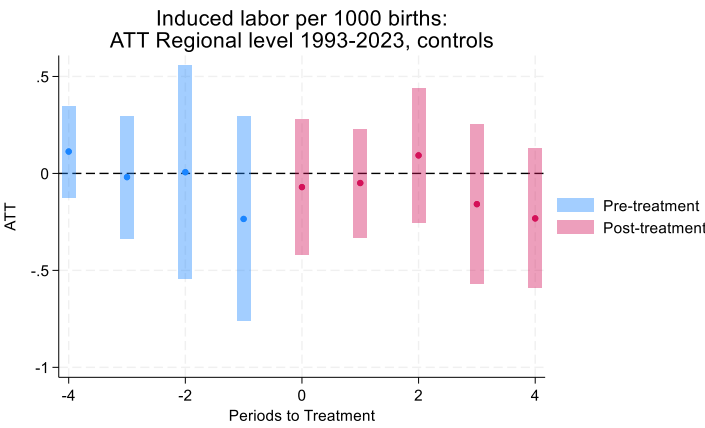
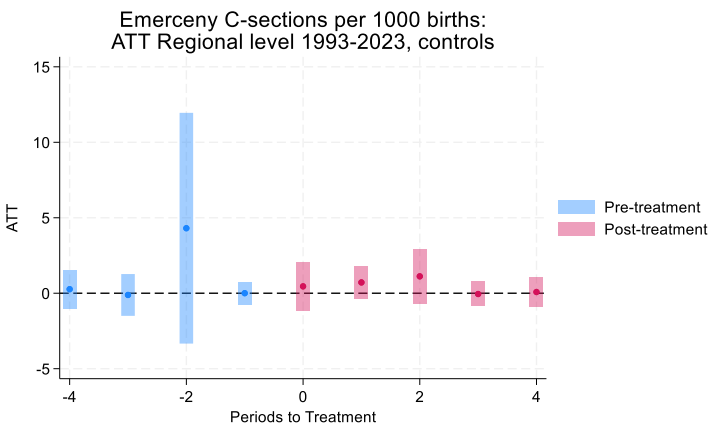
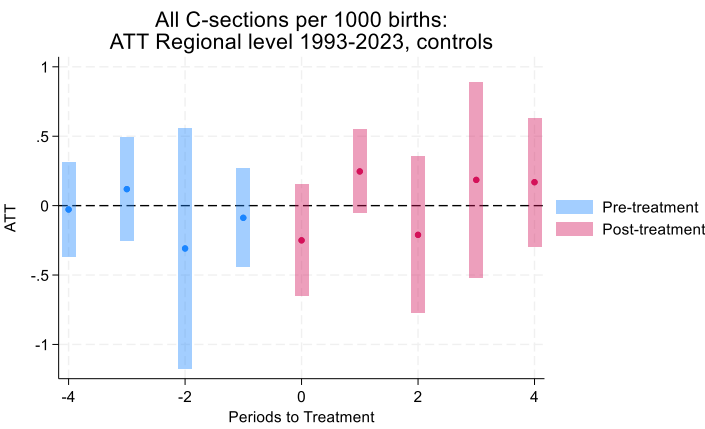
t statistics in parentheses

* p<0.05, ** p<0.01, *** p<0.001

All outcome variables were log-transformed and should be interpreted as approximate percentage changes.

- (1) Control variables: Birth weight, multiple fetuses, maternal age, parity and BMI ≥ 30
- (2) Control variables: Birth weight, multiple fetuses, maternal age, parity and BMI ≥ 30
- (3) Control variables: Maternal age, parity, LGA and Gestational age ≥ 42 weeks
- (4) Control variables: Birth weight ≥ 4500 g, LGA, maternal age, induced onset and parity
- (5) Control variables: Instrumental assistance, Birth weight ≥ 4500 g and parity, BMI

Figure 6 Event study figures, Regional-level, not-yet-treated



11.4.2 Robustness results event study – Hospital-level

Table 13 ATT Hospital-level, not-yet-treated

	(1) All C-section	(2) Emergency C-section	(3) Planned C- section	(4) Instrumental assistance	(5) OASIS (Vaginal tear grade III-IV)	(6) Number of births
ATT	0.0673* (2.39)	0.0694 (1.47)	0.0220 (0.45)	-0.0453 (-0.34)	0.145* (2.48)	149.7* (2.08)

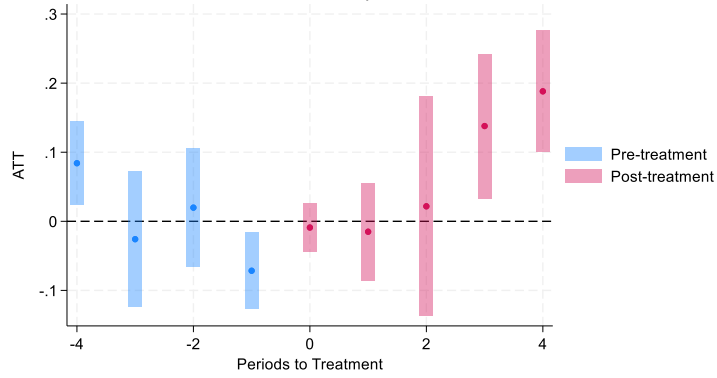
t statistics in parentheses

* p<0.05, ** p<0.01, *** p<0.001

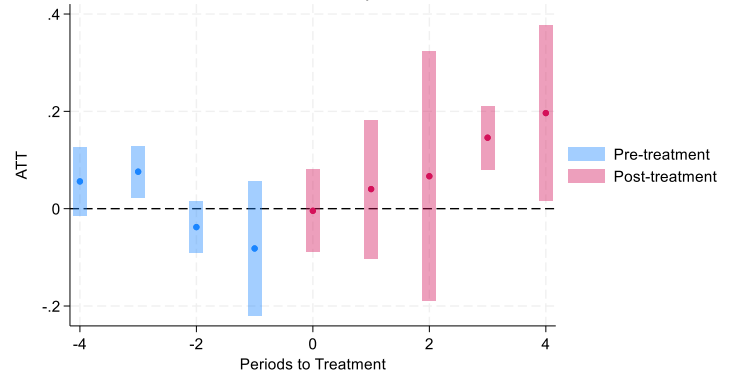
- (1) Outcome variable: Log-transformed
Control variables: Instrumental assistance, Multiple features, EDA
- (2) Outcome variable: Log-transformed
Control variables: Instrumental assistance, Multiple features, EDA
- (3) Outcome variable: Log-transformed
Control variables: Instrumental assistance, Multiple features, EDA
- (4) Outcome variable: Log-transformed
Control variables: Perineotomy, Vaginal delivery
- (5) Outcome variable: Log-transformed
Control variables: Instrumental assistance, EDA
- (6) Outcome variable: In absolute numbers
No control variables

Figure 7 Event study figures: Hospital-level, not-yet-treated

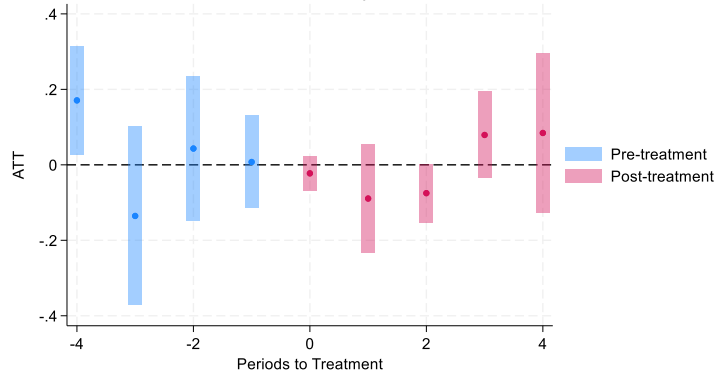
C-sections (all) per 1000 births:
ATT 2015-2024, Hospital level



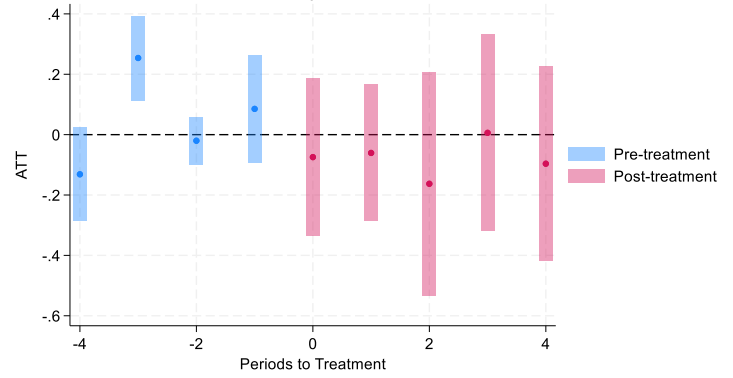
C-sections (emergency) per 1000 births:
ATT 2015-2023 Hospital level



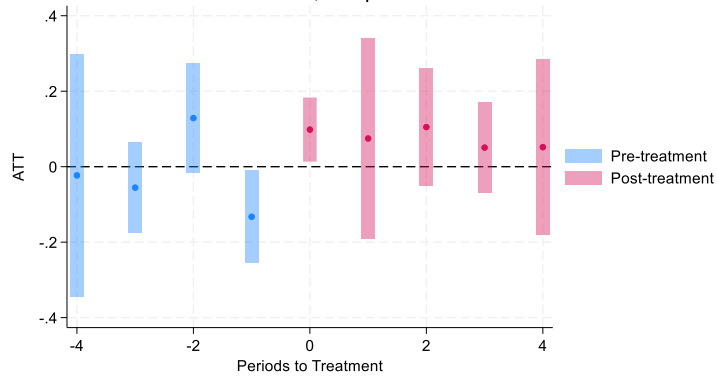
C-sections (Planned) per 1000 births:
ATT 2015-2024 Hospital level



Instrumental assistance per 1000 live births:
ATT Hospital level



OASIS per 1000 births log:
ATT 2015-2024, Hospital level



Number of births

