CEPREMAP

CENTRE POUR LA RECHERCHE ECONOMIQUE ET SES APPLICATIONS

Document de travail (Docweb) n°2407

Discontinuity in General Physician Care During Pregnancy

Louis FRÉGET

Décembre 2024

Discontinuité dans les soins de médecine générale pendant la grossesse [1]

Louis FRÉGET[2],

Résumé : Avec le vieillissement de la population médicale dans les pays développés, les fermetures de cabinets sont de plus en plus fréquentes, en particulier dans les zones rurales ou sous-dotées en professionnels de santé. Ceci est source de vives inquiétudes, notamment pour la continuité des soins pendant des périodes critiques comme la grossesse. Pourtant, il n'existe pas d'étude causale sur l'effet des fermetures de cabinet de médecin généraliste durant la grossesse. Dans cette étude, j'évalue les effets de telles fermetures pendant la grossesse sur les issues de naissance entre 2006 et 2018 au Danemark. Je compare les issues de naissance des mères confrontées à des fermetures de cabinets dans les neuf mois post-conception à celles faisant face à des fermetures neuf mois avant la conception. Je trouve un effet moyen négatif de petite ampleur de la discontinuité des soins sur le poids à la naissance. Néanmoins, de manière plus préoccupante, les fermetures augmentent d'environ 10% la proportion d'enfants dont le poids est faible pour leur âge gestationnel lorsqu'elles se produisent durant le troisième trimestre de grossesse. Ceci laisse à penser qu'elles nuisent à la santé néonatale des naissances les plus à risque. Les mères subissant des fermetures de cabinet de MG pendant la grossesse connaissent également des perturbations dans l'accès aux soins prénatals, comme moins de consultations au troisième trimestre de grossesse ainsi qu'une baisse du nombre de tests pratiqués le plus couramment par les médecins durant la grossesse. L'ampleur de ces perturbations demeure cependant limitée. Dans d'autres pays où l'accès aux soins est moins garanti après la fermeture d'un cabinet qu'au Danemark, les effets négatifs sur la santé des fermetures de cabinets de médecin généraliste pourraient être encore plus prononcés.

Mots-clés : Politiques de santé, Déserts médicaux, Economie de la naissance

Discontinuity in General Physician Care During Pregnancy

Abstract: The aging of the general physician workforce in developed countries is expected to lead to increased practice closures. Hence, concerns arise regarding the health effects of such closures, particularly for patients facing them during critical life stages such as pregnancy. However, no study exists to date on the health effects

[1] I gratefully acknowledge financial support from Danish Council for Independent Research (grant DFF:0218-00003B). I also warmly thank my advisors, Miriam Wüst and Hans Henrik Sievertsen, for their decisive feedback and unwavering support.

[2] Cepremap et Center for Economic Behavior and Inequality (CEBI), University of Copenhagen louis.freget@econ.ku.dk

of general physicians' (GP) practice closures during pregnancy. I assess the effects of such closures during pregnancy on birth outcomes in Denmark. I compare the birth outcomes of mothers experiencing practice closures within nine months post-conception to those facing closures nine months pre-conception. I find a small to medium-sized adverse effect of discontinuity in care on birth outcomes. Closures increase the share of births of fetuses who are small for their gestational age. The negative effect on birth weight is especially pronounced when the closure happens in the last trimester of pregnancy. Consistently, mothers affected by GP practice closures during pregnancy experience small disruptions in healthcare provision at the extensive and at the intensive margin.

Keywords : Health Policies, Practice closures, Antenatal care.

JEL Codes: I10, I12, I14, I18

1 Introduction

Understanding the impact of practice closures during pregnancy in a developed country setting is a central stake. In Europe, 40 percent of medical doctors are already aged 55 years or older in 13 of 44 surveyed countries that reported data on this issue (World Health Organization, 2022). The WHO refers to this situation as a potential "ticking-bomb" for European healthcare systems (World Health Organization, 2022). In the US, practice closures are also expected to increase in coming years, particularly in areas with relatively socioeconomically disadvantaged groups (Young et al., 2017). Concerns are acute regarding future closures of General Physicians (GPs) practices. Through counseling, health monitoring, prescribing medications, and specialist referrals, GPs play a key role in preventing the escalation of medical conditions. Still, while the literature documents the effects of GP practice closures on late-life outcomes, it is absent on their impact on birth outcomes. More generally, GP closures during pregnancy provide a precious natural experiment to identify the margins at which prenatal care matters the most, a question that is still a vivid area of inquiry in the medical and health economics literature. Thus, in this paper, I study the effects of GP practice closures during pregnancy on birth outcomes in Denmark. As in Jensen (2014), I focus on first-time mothers, who may be especially vulnerable to disruption in care because of a lack of prior experience with pregnancy and childbirth.

In a Danish setting, GP practice closures could interfere with the pivotal role GPs hold during pregnancy through three channels. First, GPs refer mothers-to-be to the midwife and other specialists. Switching frictions due to the closure could delay such referrals. Second, GPs can oversee important blood and urine tests and prescribe drugs. Closures could reduce the monitoring and treatment intensity because of switching frictions, or overcrowding of the practices hosting the new patients. Conversely, discontinuity in care could increase monitoring post-closure if GPs reassess the health of their new patients (Kwok, 2019; Simonsen et al., 2021). Third, GPs can trigger important behavioural modifications for the mother. For instance, they can convince the mother to cease smoking, or to drink less alcohol. Yet, compliance with such medical advice depends on trust in the physician (Kao et al., 1998; Mainous et al., 2001). Since such trust seems to build over time (Piette et al., 2005; Thom et al., 2011), the destruction of the GP-patient match could result in riskier pregnancy behaviors.

Using rich Danish administrative data, I link data on birth outcomes from the universe of births in the country between 2006 and 2018 to a wide set of socioeconomic and healthcare usage variables. Using an event-study approach, I compare the birth outcomes of mothers experiencing practice closures within nine months post-conception to those facing closures nine months prior to conception. This strategy rests upon the assumption that the exact date of conception relative to the closure of the practice is as-good-as-random. I show that this hypothesis is plausible using a series of balance of observables and placebos tests, and by providing descriptives and institutional details about GP practice closures in Denmark.

I find a small to medium-sized adverse effect of discontinuity in care on birth outcomes. On average, mothers experiencing practice closures during pregnancy give birth to infants weighing approximately 20 grams less than those facing a practice closure before pregnancy. The effect is of the same order of magnitude as that of the mother losing a parent during pregnancy (Persson and Rossin-Slater, 2018). GP Closures during the first and second trimesters of pregnancy do not affect birth weight. The average effect is driven by closures occurring during the last pregnancy trimester. Such dip in birth weight for mothers facing a closure in their last pregnancy trimester is pronounced enough to be readily seen in the descriptive data. This reduction in birth weight is not attributable to shorter pregnancies: I also find an effect on fetal growth rate (grams per week of gestation). Finally, closures increase the share of births of fetuses who are small for their gestational age. Such result hints at closures harming the neonatal health of the most at-risk births.

These findings are consistent with the reduction in healthcare following closure at both the extensive and intensive margins. At the extensive margin, I find that practice closures cause no significant variation in the frequency of midwife visits nor in that of obstetrician-gynecologist visits, though the impact of closures on both referral outcomes, if anything, is negative. Yet, closures cause a small drop in the total number of GP contacts during pregnancy. Closures also significantly reduce the number of GP visits and contacts during the second and third pregnancy trimesters.

One potential channel linking reduced GP visits to this adverse birth outcomes effect is reduced prenatal testing. Blood tests are significantly reduced for mothers facing a closure at any stage during the pregnancy, whereas urine tests decrease for mothers who face a closure in the last pregnancy trimester. Still, my setting provides no exogenous variation in testing. It is therefore impossible to know if reduced tests are the driving force behind the adverse birth outcomes effects of closure. It is possible that this reduction in testing is at least partly explained by substitution with the midwife who can also perform blood and urine tests. Another candidate explanation for the adverse effect of closures on birth outcomes would be delayed or reduced prescribing. For instance, it is possible the closure delays the prescription of antibiotics to treat urinary tract infections which can result in severe adverse birth outcomes if they are not treated in time. Since my dataset does not include prescription information, I am unable to test for the relevance of this prescription channel.

Finally, it is hard to assess the behavioral impact of GP practice closures, for data on risky behaviors is scarce. Still, I am able to exploit unique population level on smoking cessation, as reported by the mother to the GP. I do not find any impact of closures on the likelihood to quit smoking. It is, however, important to keep in mind that mothers in both my treatment and control group undergo a practice closure around conception. Hence, my design is unable to capture effects due to the breakdown of a long-established trust between the mother and her physician, which may take years of GP-patient interaction to rebuild.

These findings carry two implications beyond the specific Danish context. First, while the birth weight effect I find is rather modest, it could very well be a lower bound. In this setting, the disruption in care following the discontinuity in care is rather small. That breaks in care remained limited is perhaps unsurprising given the institutional setting at hand. Denmark is one of the wealthiest countries per capita with a highly publicly-funded system and stringent regulations ensuring that each patient has access to at least two practices accepting new patients within a 15 km radius. By contrast, closures might have more sizable health effects in countries in which care is significantly more disrupted following a practice closure. Second, policies aiming at increasing prenatal monitoring and timely treatment following closure may help mitigate the harmful consequences of discontinuity in care.

This work feeds into two strands of the literature. First, it fits in the literature on the impact of closing GP practices. The existing research has primarily concentrated on the effect of such closures on later-life health outcomes (Simonsen et al., 2021; Kristiansen and Sheng, 2022; Monsees and Westphal, 2024). Studying the impact of GP closures in Denmark, Simonsen et al. (2021) document a 17 percent increase in fee-for-service per visit, as well as a sizable increase in the probability that the patient initiates drug therapy targeting chronic and underdiagnosed diseases (hypertension, hyperlipidemia, and diabetes). By contrast, my study examines the impact of closures on birth outcomes. In contrast to Simonsen et al. (2021), I find a negative health effect of discontinuity in care in Denmark. I do not find evidence of a reassessment shock following closure either: quite in the contrary, I find that closures lead to decreased testings. The discrepancy between the results of Simonsen et al. (2021) and mine might stem from the fact that maternal health is supposed to be assessed in any case during pregnancy. By the official guidelines, mothers are expected to be offered three scheduled pregnancy visits and at least one blood test. Thus, there might be less underdiagnosed conditions than for later outcomes.

Second, it echoes the economic literature using quasi-experimental methods to study the impact of shocks to prenatal care (Evans and Lien, 2005; Jensen, 2014) on birth outcomes. Evans and Lien (2005) leverage bus strikes in the US to show that prenatal care is especially important for birth outcomes when performed early in pregnancy. By contrast, most of the effects I find are for mothers who face a discontinuity in care in the third pregnancy trimester. Jensen (2014) shows the introduction of capitation contracts had a negative birth outcomes effect in Denmark for first-time mothers who are less than 27. Capitation contracts reducing the share of GP income due to fee-for-service, one key mechanism could be reduced testing because of lower financial incentives to test. Reduced monitoring could also be a mechanism explaining the adverse birth effects in my setting.

2 Institutional setting

2.1 The GP in Denmark and their role during pregnancy

The setting is that of Denmark with universal care. Mothers-to-be have free access to doctors and midwives. The GP can affect birth outcomes through three channels: a behavioral channel, a prescription and monitoring channel, and a referall or gatekeeping channel.

First, GPs actively engage in counseling pregnant women on critical lifestyle modifications—such as cessation of smoking and alcohol consumption, or the take-up of nutritional supplements like iron and folic acid—to promote healthy fetal development. This is what I label the 'behavioral channel'.

Second, there is a prescription and monitoring channel. GPs oversee routine blood and urine tests to detect complications like anemia and gestational diabetes. During the 20 first weeks of pregnancy, mothers are expected to be offered at least one blood test. Moreover, GP practices are responsible for 85.3 percent of all outpatient prescriptions in Denmark (Simonsen et al., 2021). Because of several physiological and immunological changes that occur during pregnancy, pregnant mothers are more susceptible to certain infections. Treating these infections in time is crucial. Urinary Tract Infections (UTIs) can for example lead to kidney infections, which may cause preterm labor and low birth weight if left untreated. Interestingly, the physician receives no fee when writing prescriptions in Denmark. Physician income is generated from a mixed payment system from the government: a fixed capitation fee per patient listed with them (DKK 445 per year or around USD 70 in 2018) together with fee-for-service payments. Around one-third of the income stems from the fixed capitation and two-thirds from fee-for-service (Simonsen et al., 2021). Hence, physicians have a strong incentive not to announce closures in advance to retain income. This reduces the likelihood that patients' decisions to switch are influenced by the timing of the closure.

Third and perhaps more importantly, GPs are gatekeepers to the remainder of the health-care system. They begin the pregnancy health journal and refer mothers-to-be to midwives for regular check-ups and obstetricians for more complex pregnancy issues, such as the management of pre-eclampsia.

By official guidelines (see Appendix A2), the GPs are required to meet the mother-to-be three times during pregnancy: once between 6 and 10 weeks of gestation, another time around the 25th week of gestation, and a final time around the 32th week of gestation I refer to these three pregnancy visits which are officially recommended as scheduled visits in the remainder of this paper.

By contrast, the mother-to-be is planned to have significantly more required contacts with the midwife, at least from the third trimester of the pregnancy when she is expected to meet her once every two weeks. From the third trimester, the midwife is on the first line to counsel and monitor the health of the mothers. She performs blood and urine tests (Danish Patient Safety Authority, 2024). However, *"a midwife must refer to a doctor or call a doctor in case of pathological conditions, complications or in case of increased suspicion of this in the woman, the fetus or the child in connection with pregnancy, birth or maternity" (Danish Patient Safety Authority, 2024)* . When a condition develops, the GP can take part in its monitoring, choose to refer the mother to a specialist or begin the treatment by prescribing drugs. By contrast, the midwife is not allowed to prescribe drugs in my sample period, between 2006 and 2018. Hence, midwives and general physicians are not perfect substitutes. Even when happening from the third trimester of pregnancy, a closure is still susceptible to affect birth outcomes by slowing the monitoring of serious conditions, delaying treatments or disrupting the network of care.

2.2 Practice and practice closures in Denmark

There are around 2000 GP practices in Denmark (Simonsen et al., 2021). Around one practice out of two is single-physician. Each GP serves around 1600 patients a year. Those practices are identified by their *ydernummer* (external number), a practice authorization number that is required to receive reimbursement from the national insurance.

In my analysis, I only keep patients from Group 1 which make up 98 percent of all patients in Denmark. Unlike group 2 patients, group 1 are linked to one specific practice which is the only one they can visit. Still, it is possible to change practice for a rather small fee (DKK 225 in 2024, around 33 USD or 30 euros). When turning to a new practice, patients are free to apply to any practice open for new patients which are located within 15km of the patient's home. On the supply side, physicians have to accept new patients unless they have at least 1600 patients per physician in the practice. Symmetrically, GPs need to apply to the authorities to terminate the relationships with patients which can only happen in case the patient does not comply with treatment, or is aggressive toward the provider.

As in the rest of the literature (Simonsen et al., 2021; Kristiansen and Sheng, 2022), I identify the closing date as the last date of service with a given external number. External numbers are terminated in case of retirement, death, succession, relocation of the physician(s) using this external number, but also in cases of merging. As Kristiansen and Sheng (2022) explains in this setting, the vast majority of clinic closures in Denmark (74 percent) are due to retirement [1].

When a practice closes, the exact reallocation of patients depends on whether the GP patient's list was sold or not. If the GP patient was sold with the practice, the patients are automatically allocated to the new GP. In case the patient list was not sold, patients are distributed randomly to nearby practices with available capacity. However, patients are informed by email that they are allowed to choose a new practice within their choice set without incurring any fee. When making their choice online, patients are able to observe the

[1] Kristiansen and Sheng (2022) defines retirement as "the average age in the clinic being over 60 years at the time of clinic closure following Simonsen et al. (2021)"

gender, and the age of the general physician. It is important to note that closing physicians are in no way mandated to warn their patients of the upcoming closure of the practice.

Finally, a piece of key institutional information is that the Danish regulation is stringent in ensuring continuity in care. Local governments are obligated by law (the Danish Health Act, Chapter 13) to guarantee that all citizens have access to care. They are legally responsible for ensuring that each patient has at least two practices open to new patients within 15 km. In the rare cases in which no practices are open for intake within this radius, the local government itself must establish a practice and contract with physicians to see patients. This situation is however very rare in the period studied (Simonsen et al., 2021), although anecdotal evidence suggests it has become more common in Denmark in recent years - see for instance (Ugeskriftet.dk, 2023).

3 Methodology

3.1 Design

I aim to study the impact of discontinuity in care on birth outcomes. My strategy is to compare the birth outcomes of mothers experiencing practice closures within nine months post-conception to those facing closures nine months pre-conception. This approach is inspired by Persson and Rossin-Slater (2018) in that it leverages randomness in the precise timing of pregnancy relative to a key event - the death of a relative in their study, a practice closure in mine- to study its impact on birth outcomes.

More specifically, I leverage exogenous variations in the exact timing of closure with respect to conception of the child to isolate the impact of discontinuity in care on birth outcomes. If the closure occur 3 months after conception, it will affect the mother during her pregnancy. However, if it happens 3 months before conception, the mother will by definition not undergo a closure during her pregnancy. Moreover, whether closure happens right before or after conception is likely as-good-as-random, as further argued in subsection 3.3. In this case, differences in birth outcomes between mothers who faced a closure right after conception rather than right before can only be explained by the closure itself. Hence, to recover the effect of GP practice closures on birth outcomes, one can compare the outcomes of mothers who faced a GP practice closure between conception and 9 months *after* conception (the treatment group) to that of mothers who were affected by a clinic closure up to 9 months *before* conception (the control group). The definition of the control and treatment groups is visually represented on Figure 1.

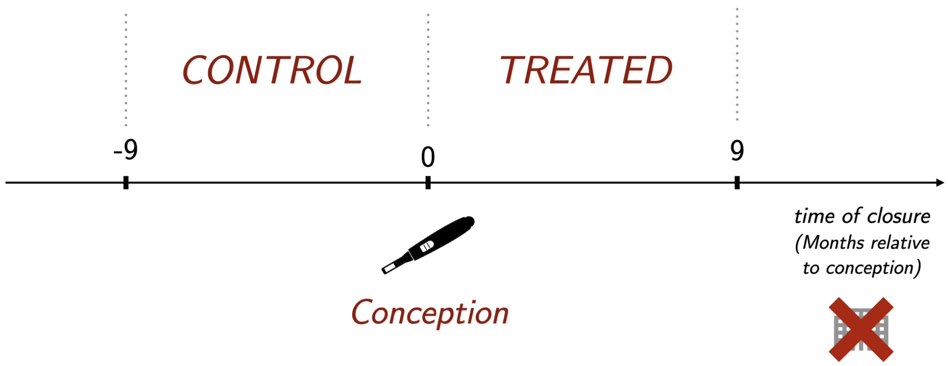


Fig. 1 Identification strategy

I use the expected pregnancy (conception date + 9 months) instead of the actual pregnancy length to define treatment status. Using the expected pregnancy allows to avoid the endogeneity issues stemming from a potential effect of closures on the probability of preterm birth. For instance, closures could cause premature births if they lead to lower testings or antibiotics prescription which could prevent the detection and the treatment of anemia or infections.

To assess the differences in outcomes between the treatment and control group, I first run a simple descriptive analysis: I plot the average outcomes for mothers experiencing a closure at different periods relative to conception. If there is an effect of closures on birth outcomes, there should be a spike or a drop in outcomes for mothers who were affected by closures during pregnancy relative to mothers who faced closures before or after pregnancy. In the next subsections, I turn to regression analyses. They allow me to formally test for differences in birth outcomes between my treatment and control group. Moreover, I run further tests to ensure that exogeneity in the exact timing of closure with respect to conception is plausible.

3.2 Estimating the Average Treatment Effect (ATE) of closures on birth outcomes and healthcare usage

To estimate the average treatment effect of practice closures, I set up the following model which I estimate using OLS:

$$y_i = \beta_0 + \beta_1 \text{Treated}_i + X_i + \sum_{m=1}^{12} \theta_m \cdot \text{Month}_i + \sum_{y=2006}^{2018} \gamma_y \cdot \text{Year}_i + \epsilon_i \tag{1}$$

where:

- y_i is the birth outcome for birth i.
- Treated_i is a dummy which equals one if the closure happened up to 9 months after conception, and zero if the closure happened up to 9 months before conception.
- X_i is a vector of observable variables.
- $\sum_{m=1}^{12} \theta_m \cdot \text{Month}_i$ represents the month of conception effects.
- $\sum_{y=2006}^{2018} \gamma_y \cdot \text{Year}_i$ represents the year of conception effects.
- ϵ_i is the error term.

$treated_i$ is the coefficient of interest. It captures the difference between the outcome for mothers who underwent a practice closure during pregnancy (the treatment group) and the same outcome for mothers who faced a practice closure 9 months prior to pregnancy. The key identification assumption in this setting is that the exact date of conception with respect to the closure of the practice is as-good-as-random, such that $\mathbb{E}[\epsilon \mid Treated_i] = 0$. Under this assumption, the coefficient captures the average treatment effect of practice closure across all trimesters of pregnancy. Standard errors are clustered at the level of the closing practice, for it is the level at which the treatment is allocated.

The observable controls are maternal age, parental ethnicity, parent's income, education level, marriage status, cohabitation of the parents, maternal weight, and sex of the child.

Income and education variables are measured one year before birth i to avoid any bad control issues. The maternal weight is measured at the first pregnancy visit (on average 1.5 months after conception). Hence, it is measured conditional on a GP contact. To circumvent potential selection-out-of-sample problems, I include a dummy for missing maternal weight. I also add year of birth fixed effects to the equation to flexibly account for yearly trends in birth weight.

I also enriched the specification with month-of-conception fixed effects. They account for seasonal trends around closure. As shown on Figures 3 and 6 in section 4.3.2, closures are more likely to happen in December and January, and healthcare usage varies depending on the month of conception. This generates a seasonality in healthcare usage these month-of-conception fixed effects aim at correcting. In the descriptive analysis, I plot the predicted outcome using these fixed effects and the controls from the observable variables vector. If differences in outcomes are driven by observable selection, then the predicted outcome curve should closely track the outcome one.

Along with the fixed effects, the observable variable X_i vector allows to increase the precision of the estimation of the effect. Under the assumption of the exogeneity of timing of closure relative to conception, adding or removing them into the equation cannot substantially affect the estimated average treatment effect.

3.3 Threats to identification

My identification strategy relies on two key hypotheses. The first one is the absence of selection into facing a practice closure a few before months conception rather than a few months after conception. In case of selection, differences in birth outcomes between the treatment and control group would not solely be explained by the closure. They would also stem from the fact mothers in the control and treatment differ on a range of variables that also correlate with birth outcomes. Thus, selection can create a bias in either direction. The second one is the absence of spillovers from the treatment to the control: closures must not affect control mothers. Should this assumption not be met, then estimates would be biased downward.

The first main concern is selection into facing a closure during pregnancy. GPs could delay their retirement to ensure higher-risk pregnancies do not have to face discontinuity in care. Conversely, they could also fasten their retirement to avoid dealing with too demanding patients. However, the estimates are rather stable when adding the pre-birth parental controls. Moreover, I run a balance of the observables test in the next section. I show that mothers in my control and treatment groups have statistically similar pre-birth observables. This similarity in characteristics between treated mothers and others may stem from physicians' incentive to avoid communicating their upcoming closure in advance, as their income relies on capitation and fee-for-service payments.

There might also be an impact on closure on the exact conception timing. 'Natural' conception decisions are unlikely to be affected by the prospect of a GP practice closure. However, it could be that they affect the timing of In-Vitro Fertilizations (IVF): overcrowding could delay referals to fertility clinics. If such overcrowding is more likely in the countryside or in poorer areas, then this could create a source of selection into treatment. However, and more generally, if there was somehow an impact of closures on the exact conception date, there should be a bunching in conceptions around closure. Appendix A3 shows no such bunching. The number of conceptions by months is smoothly, uniformly distributed between the year before closure and the year after closure in my final sample.

The second assumption is that closures do not affect healthcare provision for control mothers - those who face a closure right before conception. Control mothers could be treated because of switching frictions. If the closure happens two weeks before conception, the mother might still be in the switching process when the pregnancy begins. To test for the existence of such externalities, I run another regression using a placebo closure to define treatment status. The placebo closure dummy equals one (placebo treatment) if the closure happened up to 9 months before conception. It equals zero (placebo control) if the closure happened between 18 months and 9 months before conception. Since closures happening either in placebo treated or the placebo control periods happened before conception there should be no difference in outcomes between those two groups, unless practice closures also significantly affect the outcomes for control mothers. Another strength of such placebo regressions is that they allow to check if systematic trends in the features of mothers who faced closure at different times around pregnancy are not confounding the estimate. Overall, if the coefficient of the placebo dummy is statistically zero and small, it pleads for the absence of treatment externalities or pretrends.

3.4 Assessing heterogeneity of the effect of closure by trimester of pregnancy: an event study approach

A straightforward way to assess if closures produce differential effects depending on the pregnancy trimester at which they occur is to trim the sample. In the main regression tables, I present the estimates when omitting mothers who faced a closure during the first pregnancy trimester (t=0), and then omitting mothers who faced a closure during the first and second trimester of pregnancy (t=0 and t=1). Moreover, to visualize the difference in coefficients across the pregnancy trimester the closure occurs at as well as the absence of pretrends in outcomes, I also turn to the following event-study regression model that I estimate using OLS:

$$y_i = \alpha + \sum_{t=-6}^{2} \delta_t \cdot D_i(t) + X_i + \sum_{m=1}^{12} \theta_m \cdot \text{Month}_i + \sum_{y=2006}^{2018} \gamma_y \cdot \text{Year}_i + \epsilon_i \quad (2)$$

where:

- y_i is the outcome for birth i.
- $\sum_{t=-6}^{2} \delta_t \cdot D_i(t)$ represents the event-time dummies. They capture the effect of the closure for mothers who faced closures at different times relative to the conception date. The reference period is set when the closure happens two trimesters before the closure.

- X_i is a vector of pre-birth observable variables described in the former section.

- $\sum_{m=1}^{12} \theta_m \cdot \text{Month}_i$ represents the month of conception fixed effects.

- $\sum_{y=2006}^{2018} \gamma_y \cdot \text{Year}_i$ represents the year of conception fixed effects.

- ϵ_i is the error term.

In the event study, I will be plotting the δ_t coefficients. They capture the difference between the level of the outcome for mothers who faced a practice closure at t trimesters after conception and that of the same outcome for mothers who faced a closure two trimesters before conception, conditional on the other variables of the equation. The reference period is set when the closure happens two trimesters before closure to leave the possibility for switching frictions to affect birth outcomes when the closure happens the trimester right before conception.

Event time is hence defined such that $t = 0$ when the closure happens during the same trimester as conception which is then the first pregnancy trimester. Similarly, $t = 1$ indicates the mother faced a practice closure during the second trimester of pregnancy and so on. Note that this event study does not rely on following a cohort whose outcomes are observed repeatedly across time. It relies on comparing the outcomes of *different* first-time mothers who faced a closure at different times relative to conception.

Comparing the values of the δ_t coefficients when t$\geq$0 allows to know if closures produce different effects at different stages of the pregnancy. Such heterogeneous effects could arise if closures have on average a different effect depending on when they happen during pregnancy, conditional on the composition of the mother of the population. For instance, it could be that closures happening in the very beginning of the pregnancy, before the mother has been referred to his midwife or hardly started prenatal care have little impact. Alternatively, differences in outcomes between treated trimesters could be observed because the population of mothers differs between trimesters. Such change in composition could happen because of differential switching behavior between mothers within the treatment group. It might be that more informed, strategic mothers are more likely to switch practice earlier for instance.[2]

In an effort to tease out the two explanations for varying effects of closures at different stages of pregnancy, I enrich the equation with the pre-birth control and fixed effect described in the former subsection. They allow to account for changes in observable features of the mothers and unobservable features which are constant by month-year. Under the assumption that these controls and fixed effects capture the evolution in the features of treated mothers correctly, the variation in δ_t coefficients when $0 \leq t \leq 2$ (the pregnancy trimesters) can then be interpreted as changes in the average impact of practice closures depending on the stage of pregnancy at which they occur.

When $t < 0$, the δ_t coefficients are placebo coefficients. They should be statistically indistinguishable from 0 and small, unless closures happening before conception affect the outcomes of control mothers. In this sense, ensuring placebo coefficients are zero allows to check for the absence of spillovers and pretrends in a more granular manner than by simply regressing the outcome on the placebo closure dummy.

[2]The fact that the predicted outcomes using pre-birth observables and fixed effects follow flat trends around closure reduces the plausibility of such differential switching patterns. At the very least, these flat trends show that if such patterns exist, they are driven by unobservable selection.

4 Data

4.1 Data structure

This study exploits comprehensive Danish administrative data available at the population level, covering the period from 2005 to 2018. The final dataset combines birth records, administrative records and health insurance register data.

I begin by finding the first-time [3] mothers in the birth records who gave birth between 2006 and 2018 such that each row in my dataset contains a mother-child duet. I then seek to find which subset of these mothers was affected by a practice closure around conception.

The first step is to identify all GP practice closures that occurred during the analysis period from 2005 to 2018. As in the rest of the literature, closure dates are identified as the date of the last registered service in the practice. I use the health insurance register which contains the universe of all contacts from patients with general practitioners to find the date of the last registered service with a given external number. External numbers are terminated due to various reasons such as retirement, death, succession, relocation, or the merging of physicians associated with the number. However, retirement accounts for the vast majority of external numbers terminations in my setting (Simonsen et al., 2021; Kristiansen and Sheng, 2022). As in Simonsen et al. (2021); Kristiansen and Sheng (2022), I only analyse the effects of the first practice closure mothers face. One of the strengths of this choice is that it reduces the risk that mothers adopt a more strategic attitude at the second or third closure, having had experienced the consequences of the first practice closure.

Then, one key challenge to identify mothers who are affected by such practice closures around conception is that information about the GP the patient is assigned to is not available in my data. Hence, as in previous literature (Simonsen et al., 2021; Kristiansen and Sheng,

[3] Parity appeared to be highly noisily measured in the Danish birth records. A significant number of births are noted as from nulliparous (first-time) mothers whereas they actually are from multiparous mothers. Hence, I am here using a corrected parity measure. I compute this corrected parity measure by adding the order of birth in birth records to the minimal parity found in birth records and substracting one from this number.

2022), I use patient-physician interaction to infer the identification number of the assigned GP practice. One common method in the literature is to use Kjaersgaard et al. (2016)'s algorithm. More details are provided about the algorithm in Appendix A1. In my study, I rely on a more straightforward method: I restrict my sample to mothers who had at least one contact with a closing practice up to a year before closure. However, in Appendix A1, I show that both Kjaersgaard et al. (2016)'s algorithm and the current method produce two very similar populations with equally balanced observables across treatment and control groups.

Again, I use the Health Insurance Register data to know which mothers had a contact with the closing practice up to a year before closure. My final sample is made of 48,960 births (combining those in treatment, control, and the two placebo groups) distributed across 1134 closing practices. [4]

I then merge my final sample of mothers who had a contact with a closing practice at least one year before closure with population-level register data. This allows me to extract control variables: maternal age, parental ethnicity, income, education level, marital and cohabitation status, as well as parity, maternal weight, and the child's sex. All controls but maternal weight and maternal age are measured one year before birth to alleviate bad control concerns. Maternal weight is measured during the first pregnancy visit, and maternal age is measured at birth. I also extract my outcomes from register data as explained in the next subsection.

[4] This number of closures is fairly higher than in other papers studying the effect of GP closures in Denmark. For instance, Kristiansen and Sheng (2022) use contacts from patients between ages 30-70 between from years 1995 to 2016 to infer that these patients were affected by 776 practices closures. Aside from the fact that our respective studies do not include closures occurring exactly in the same years, the most likely explanation behind my higher number of clinic closures lies in the usage of different methods to define which patients are affected by a practice closure. (Kristiansen and Sheng, 2022) use (Kjaersgaard et al., 2016) which switches the assigned practice of the patient as soon as she has a contact with her new practice. Hence, with the algorithm from Kjaersgaard et al. (2016), a patient who switches practice before closure will not be counted as affected by a practice closure in this setting. The closing practice is then less likely to be included in the final set of closing practices. By contrast, I define patients as affected by a practice closure if they had at least one contact with a practice up to a year before its closure. As a consequence, with this method, if a patient switches before closure she will still be 'matched' or 'assigned' to the closing practice, in an intention-to-treat spirit. Under the assumption that the closures do not cause mothers to switch practices before conception rather than right after, this intention-to-treat approach creates a classical measurement error whose correction would then render my main results more significant.

4.2 Building the final set of outcomes

As for the birth outcomes, the Danish birth records provide information on birth weight (in grams) and gestational age (in days). I extract both of these outcomes. To enrich the set of neonatal outcomes, I build a fetal growth measure (birth weight by week of gestation) in the spirit of Jensen (2014), a dummy for preterm birth (gestational age <37 weeks), and a dummy for a fetus weight which is small for its gestational age (10th percentile of fetal growth).

I also create measures for healthcare usage at the extensive margin. I collect the total number of midwife contacts and special visits during pregnancy from the birth records - the coverage of these outcomes is not universal (70 percent of my final sample). It is important to note that while the birth records document the total number of midwife visits during pregnancy, they do not include the dates of these visits or details of specific procedures, such as blood or urine tests. From the health insurance register (SSY), I compute the number of GP contacts (with any GP) during the predicted pregnancy period, that is excluding visits before the conception month or after the predicted birth month. GP contacts include visits but also in-person telephone, or email consultations. Alternatively, I also restrict my measure to total GP in-person visits. I also create three measures for in-person GP visits and contacts for each of the three pregnancy trimesters.

At the intensive margin, I can measure the tests prescribed by GPs from the health insurance data. I use a data-driven approach to define the relevant set of exams. I extract the three most common blood tests and the three most common urine tests billed by any GP during pregnancy. The three most common blood tests are a B-hemoglobin (Photometry) tests (billing number:807108), a biological material test (billing number: 802133), and a general code for blood test in the vein (billing number: 812101) [5]. The three more common urine tests are bacteria culture (billing number: 807105), urine stick (billing number: 807101),

[5] Another measure of hemoglobin by photometry tests (billing number:838164) is also in the top 15 of the most common health insurance spells for pregnant mothers. My results are robust to aggregating both measures of hemoglobin tests. The results are also robust to excluding the generic code for blood tests from the set of outcomes, and replacing it by the next most common 'specific' spell: c-reactive protein testing.

and urine resistance to antibiotics (billing number: 807189) tests. Finally, I pool all these six tests in one single measure to proxy the overall testing activity of GPs.

Table 1 presents the means of these healthcare usage variables in both control and treatment groups. The six tests selected using the data-driven approach I described in the former paragraph are fairly common: 65 percent of mothers have had at least one of these six tests in the control group.

Tab. 1 Healthcare usage outcomes means, control and treatment groups

Variable	Control	N	Treatment	N	Diff
$\geq$ 1 of the six tests	0.65	11805	0.65	13850	0.00
Total 6 tests	2.72	11805	2.63	13850	-0.09*
$\geq$ 1 blood test	0.50	11805	0.49	13850	-0.01*
Sum 3 blood tests	1.13	11805	1.05	13850	-0.08***
Test Blood vein	0.42	11805	0.38	13850	-0.04***
Biological material tests	0.46	11805	0.42	13850	-0.04**
Hemoglobin test	0.25	11805	0.25	13850	-0.01
$\geq$ 1 urine test	0.51	11805	0.51	13850	0.00
Sum 3 urine tests	1.59	11805	1.58	13850	-0.01
Urine sticks	0.93	11.805	0.92	13850	-0.01
Bacterial culture tests	0.31	11805	0.31	13850	0.00
Antibio. resistance tests	0.35	11805	0.35	13850	-0.00
Total GP contacts	8.38	11805	8.37	13850	-0.00
Total GP visits	5.28	11805	5.33	13850	0.04
GP visits (1st trim.)	1.19	11805	1.21	13850	0.02
GP visits (2nd trim.)	1.90	11805	1.90	13850	0.00
GP visits (3rd trim.)	2.06	11805	2.08	13850	0.02
Midwife visits	3.97	8278	3.96	9781	-0.00
Specialist doctor visits	2.10	8192	2.06	9781	-0.05

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

Notes: This table displays variable means in the treatment and control group, as well as the p-value from a two-tailed t-test comparing the two subgroups. Treated mothers faced a GP practice closure up to 9 months after conception, whereas control mothers faced a closure to 9 months before conception. Unless otherwise specified, all variables are computed for the whole pregnancy. The sample includes Danish first-time mothers who faced a GP practice closure from 18 months before conception to 9 months after conception and who gave birth between 2006 and 2018.

Finally, the records also include information on smoking cessation during pregnancy, which I code as 1 for mothers who stopped smoking at any point during pregnancy and 0 for those who continued. Around 10 percent of mothers smoke before pregnancy in my sample. Smoking cessation is reported by the GP. This measure reflects a risk-related maternal behavior that the GP can influence through counseling and prescribing smoking cessation aids.

4.3 Descriptives

4.3.1 Contrasting the final sample and the general population

Table 2 shows birth, and parental outcomes for all births in Denmark between 2006 and 2018, and then for the mothers in my final sample. Mothers in my final sample are younger, poorer, and less likely to be college-educated, and less likely to cohabit with the father. Their offspring's birth weight is also significantly smaller (-31g). That mothers in my final sample are from a lower socioeconomic status than the general population echoes the international literature pointing that closures target more vulnerable groups disproportionally - see for instance (Young et al., 2017).

Tab. 2 Variable means, all births vs final sample

variable	General population	Final sample	diff
Any parent went to college	0.52	0.48	-0.04***
Any parent is Danish	0.89	0.90	0.00***
Parents cohabit	0.68	0.58	-0.11***
Preterm birth (<37 weeks gest.)	0.07	0.07	0.00
Birth weight<2500g	0.05	0.06	0.00
Birth weight (grams)	3467	3436	-31***
Income father, dkk (monthly)	28209	26943	-1266***
Income mother, dkk (monthly)	21156	20213	-943***
Maternal age at birth	28	27	-1***
Maternal weight (kg)	69	69	0

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

Notes: This table shows the means of variables for the whole sample of births between 2006 and 2018 in Denmark (left column) and the means of the same variables in the final sample (right column). The final sample is made of all births in Denmark between 2006 and 2018 for which the mother faced a GP closure from 18 months before conception to 9 months after conception. Income, education, parental cohabitation status variables are measured a year prior to birth. Maternal weight is measured during the first pregnancy visit (around 2 months of pregnancy).

4.3.2 GP Healthcare usage during pregnancy

Figure 2 shows the distribution of GP contacts in my final sample which are summed by week of pregnancy, distinguishing between all GP contacts and those recorded as one of the three scheduled GP visits. Danish GPs seem compliant with official guidelines regarding pregnancy visits. There are notable spikes in the periods at which GP visits are recommended by the official guidelines: between 6 and 10 weeks of gestation, at 25th week of gestation, and at the 32th week of gestation.

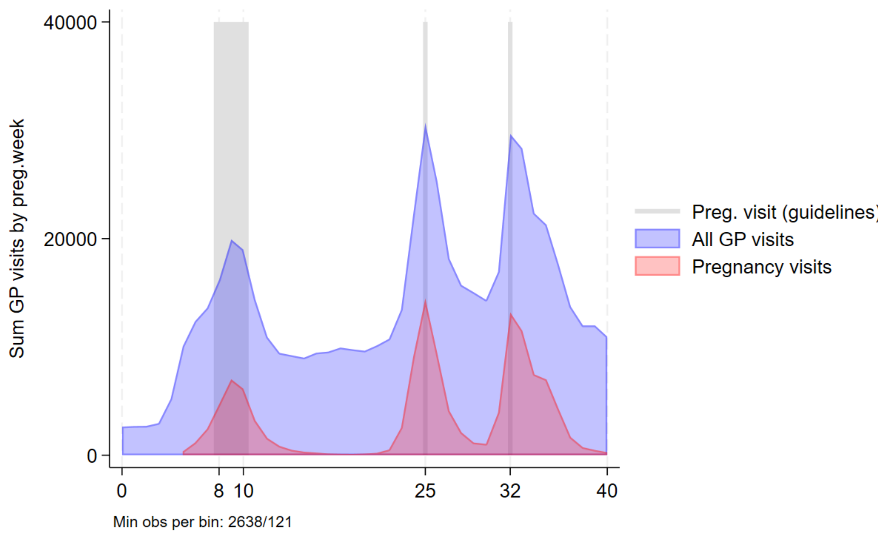


Fig. 2 Distribution of GP contacts across pregnancy weeks

Notes: This figure plots the distribution of GP contacts throughout the course of pregnancy. These distributions are computed in the final sample, which is made of all births in Denmark between 2006 and 2018. Values of each variable are summed for each pregnancy week. The periods in which GP visits are recommended are visualized by grey bars. The blue curve is the distribution of all GP Visits recorded in the health insurance registry (SSY) - excluding pregnancy visits. The red curve is the distribution of visits that are recorded as one of the three scheduled pregnancy visits using the dedicated code in the register.

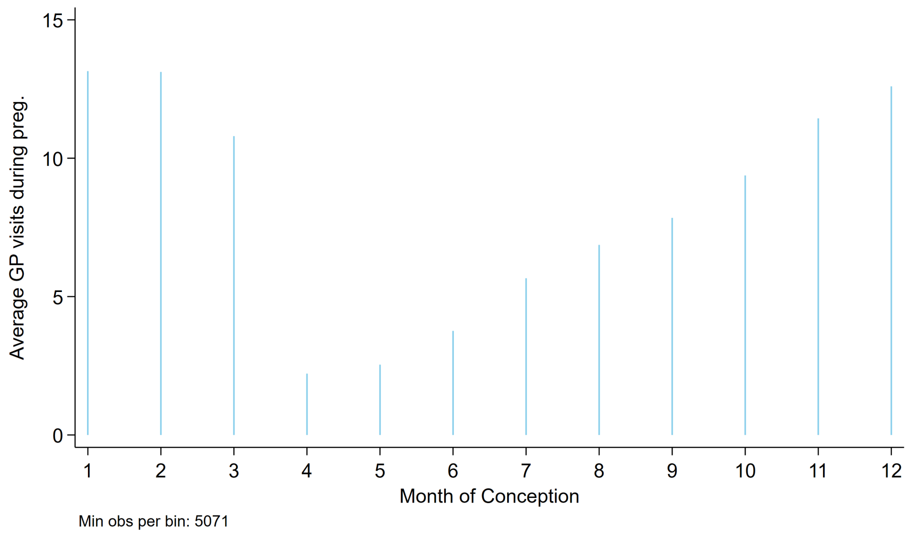


Fig. 3 Average GP contacts during pregnancy.

Notes: This figure plots the average total number of GP contacts during pregnancy by month of conception for mothers in my final sample. Contacts include GP in-person visits but also telephone and email consultations. The sample includes Danish first-time mothers who faced a GP practice closure from 18 months before conception to 9 months after conception and who gave birth between 2006 and 2018.

Figure3 shows the average total number of GP contacts through pregnancy by month of conception for mothers in my final sample. Mothers in my final sample who conceive their child during late fall and winter have on average more contacts with their GPs than those who conceive their child during spring.

This finding echoes the literature on seasonality in birth outcomes - see for instance (Currie and Schwandt, 2013). This stream of work shows that mothers with lower socioeconomic status are more likely to give birth in months that are associated with poorer birth outcomes, which could result in higher healthcare usage. [6]

As for test usage, Figure 4 shows the distribution of tests performed by GPs in my final sample which are summed by week of pregnancy, distinguishing between the three most common blood tests (hemoglobin, c-reactive, biological material) and the three most

[6]However, in my sample, the variation in healthcare usage during pregnancy across months of conception seems more pronounced than that in birth outcomes. Many explanations could be put forward to explain this heightened seasonality in healthcare usage. For instance, mothers beginning their pregnancy in winter are more exposed to seasonal health shocks associated with the colder months: influenza, conditions like vitamin D deficiency, or seasonal affective disorder (SAD) ... In this sense, they could necessitate more frequent medical consultations.

common urine tests (urine sticks, bacterial culture tests, antibiotics resistance). Urine tests peak in frequency during the second and last trimester of pregnancy. Blood tests initially spike during the first trimester of pregnancy and are then are more uniformly distributed between the second and third pregnancy trimesters, albeit with a moderate increase in the last trimester. Figures A4 and A5 in the Appendix show the sum of the six tests by pregnancy trimester. Figure A5 shows all urine tests follow an individual trend which is similar to that of the three summed: they increase with the pregnancy semester. Yet, Figure A4 shows that the pattern of the sum of blood tests in Figure 4 is mostly driven by the generic code "blood tests in the vein". Hemoglobin tests and biological material tests tend to follow the same trends as urine tests: more of these two tests are performed during the second and third trimesters of pregnancy.

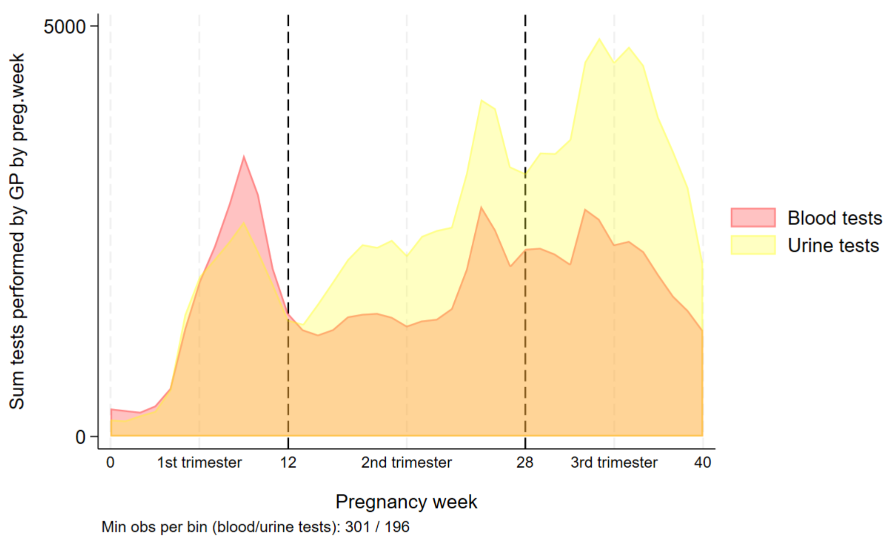


Fig. 4 Distribution of GP contacts across pregnancy weeks

Notes: This figure plots the distribution of GP contacts throughout the course of pregnancy. These distributions are computed in the final sample, which is made of all births in Denmark between 2006 and 2018. Values of each variable are summed for each pregnancy week. The red curve is the distribution of the sum of three most common blood tests (hemoglobin, c-reactive, biological material) and the yellow curve the sum of the three most common urine tests (urine sticks, bacterial culture tests, antibiotics resistance) recorded in the health insurance registry (SSY). The sample includes Danish first-time mothers who faced a GP practice closure from 18 months before conception to 9 months after conception and who gave birth between 2006 and 2018.

Figure 5 shows the sum of fee-for-services by trimester of pregnancy. Fees-for-service are payments made to GPs for each individual service or procedure performed. In the Danish setting, they are offered for visits, for tests, but not for prescriptions. Fees-for-service remain constant across trimesters. Overall, this suggests that although midwives take on a more prominent role as the primary caregivers from the third trimester of pregnancy, GPs continue to play an important role, at least for a subset of pregnancies. These pregnancies could be the highest-risk ones and those in which the mother exhibits some symptoms of a given pregnancy condition such as anemia. The institutional guidelines designate GPs as responsible for managing suspected medical conditions.

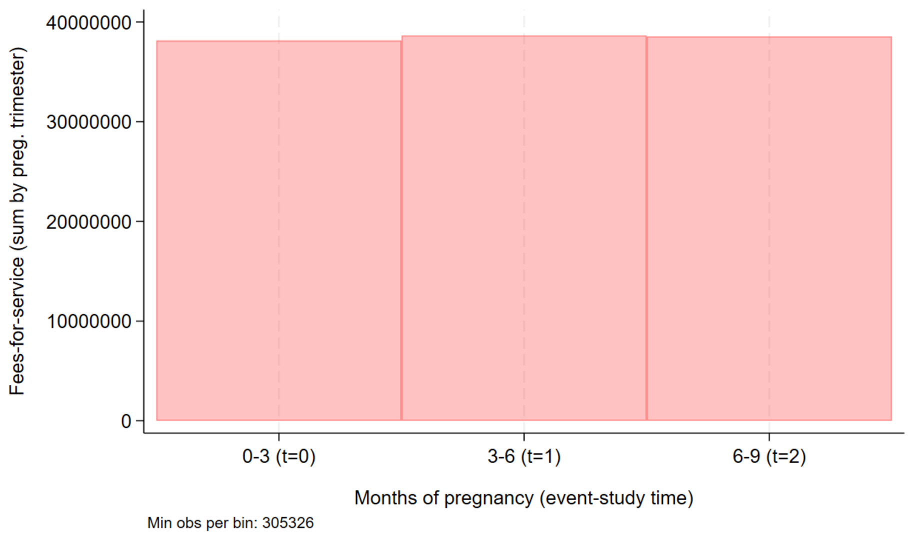


Fig. 5 Fees-for-service summed by trimester of pregnancy

Notes: This figure displays the sums of fees-for-services (in dkk) summed at the pregnancy trimester at which the billed medical act was performed level. The sample includes Danish first-time mothers who faced a GP practice closure from 18 months before conception to 9 months after conception and who gave birth between 2006 and 2018.

4.3.3 GP closures descriptives

Figure 6 shows the distribution of GP practice closures by month of the year in Denmark (2006-2018). There is a peak in closures at the end of the civil year, in December. Combined with the heterogeneity in GP Contacts by month of conception (see Figure3), this creates cyclical patterns depending on the time of closure relative to conception.

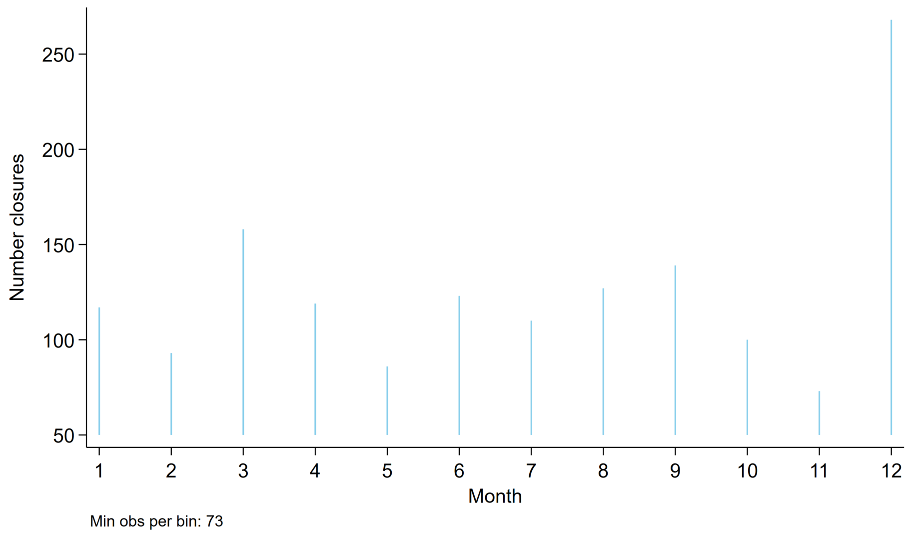


Fig. 6 Distribution of GP practice closures by month of the year in Denmark

Notes: This figure plots the total number of closures by month of conception for mothers in my final sample. Contacts include GP in-person visits but also telephone and email consultations. The sample includes Danish first-time mothers who faced a GP practice closure from 18 months before conception to 9 months after conception and who gave birth between 2006 and 2018.

Figure 7 shows the number of visits to a GP practice over the months leading up to its closure. Initially, there is a relatively high level of visits, which slightly fluctuates over time. A noticeable decline occurs around two months before closure, reaching the lowest point, followed by a sharp increase in the final month, indicating a significant surge in healthcare usage as the practice's closure looms. One explanation for this final peak could be that certain patients rush to visit the GP practice to complete their healthcare needs before it ceases operations.

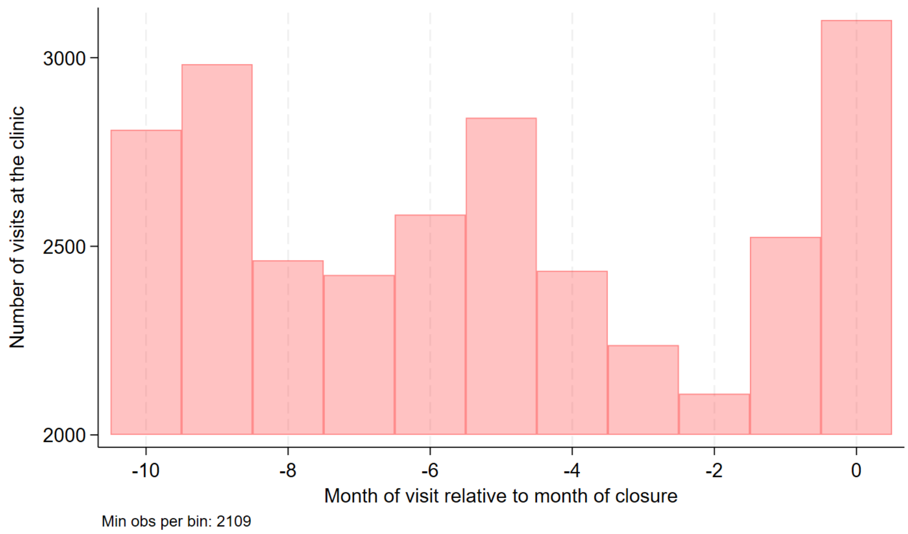


Fig. 7 GP visits at the closing practice up to 10 months before closure

Notes: This table displays the sums of GP Visits summed at the pregnancy trimester-closing practice level up to 10 months before closure. The sample includes Danish first-time mothers who faced a GP practice closure from 18 months before conception to 9 months after conception and who gave birth between 2006 and 2018. The mothers were considered affected by the GP practice closure if they had contact with the closing practice within a year prior to the closure.

4.3.4 Balancing test

Having described my main sample and notable patterns in the raw data, I turn to a very important test to validate my design. If the precise time of birth relative to a practice closure is indeed as-good-as-random, mothers in control and treatment groups must have statistically similar pre-birth observables. To test this hypothesis, Table 3 allows to assess the balance in observables which are plausibly not affected by the closure between my treatment and control groups. The coefficients are never significant and sizable. Mothers in the treatment and control groups have statistically similar education levels and age. They are statistically as likely to cohabit with their partners or to be Danish. Mothers in the treatment group have a significantly lower income but the difference is not economically significant (-90 US dollars per month relative to the control group). Thus, Table 3 provides strong support for the hypothesis that the exact timing of birth with respect to the time of closure is random.

Tab. 3 Variable means, treatment and control group (without Kjaersgaard et al. (2016) algorithm)

Variable	Treatment	Control	Diff
Any parent went to college	0.48	0.47	-0.00
Any parent is Danish	0.90	0.90	-0.00
Parents cohabit	0.56	0.57	0.00
Income father, dkk (monthly)	26765	27454	689*
Income mother, dkk (monthly)	20128	20329	201
Maternal weight (kg)	69	69	0.46
Maternal age at birth	27	27	-0.06

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

Notes: This table displays variable means in the treatment and control group, as well as the p-value from a two-tailed t-test comparing the two subgroups. Treated mothers faced a GP practice closure up to 9 months after conception, whereas control mothers faced a closure to 9 months before conception. The sample includes Danish first-time mothers who faced a GP practice closure from 18 months before conception to 9 months after conception and who gave birth between 2006 and 2018. The mothers were considered affected by the GP practice closure if they had contact with the closing practice within a year prior to the closure, meaning Kjaersgaard et al. (2016) was not used to build the sample.

5 Results

After validating my design, I now apply this identification strategy to study the impact of practice closures on key birth and healthcare usage outcomes.

5.1 'First-stage': switching practices during pregnancy

Measuring the share of mothers switching GPs during pregnancy is perhaps the most natural test to see if my treatment group has undergone discontinuity in prenatal care compared to the control group. Hence, in this subsection, I check whether treated mothers were more likely to have contacts with several general practitioners during pregnancy than control mothers.

Figure 8 shows that mothers who experience practice closures within nine months post-conception (highlighted by the gold bars) are significantly more likely to switch GPs during pregnancy compared to those who face closures nine months pre-conception (highlighted by the blue bars). Specifically, the probability the mother has had scheduled pregnancy visits with more than one general physician practice increases sharply when the closure happens from the month of conception. It continues to rise as the closure occurs later in pregnancy, peaking in at 7 months after conception, that is during the third pregnancy trimester.

This peak in the second half of pregnancy is unsurprising. When the closure happens in the very first month(s) of pregnancy, most mothers are likely able to switch GPs before their first scheduled pregnancy visit (between 6 and 10 weeks of pregnancy). Symmetrically, if the closure happens from 7 months of pregnancy, then it is likely to have happened after the last scheduled pregnancy visit at the closing GP practice (around 8 months of pregnancy).

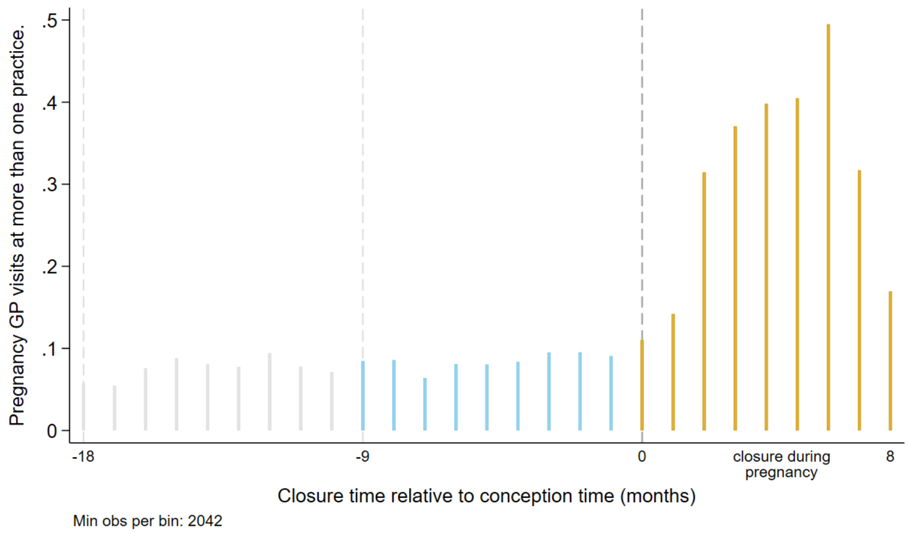


Fig. 8 Probability mother has had scheduled pregnancy visits with more than one general physician practice

Notes: This figure presents the probability that the mother has had her scheduled pregnancy visits with more than one general physician practice. The x-axis represents the difference between conception and practice closure in months. The blue bars represent the control period, including mothers who faced a GP practice closure up to nine months pre-conception. The golden bars indicate the treatment period, covering mothers who experienced practice closures up to nine months post-conception. The sample includes Danish first-time mothers who faced a GP practice closure from 18 months before conception to 9 months after conception and who gave birth between 2006 and 2018.

Still, the three scheduled pregnancy visits are not the only relevant GP contacts mothers can have throughout their pregnancy. Figure 9 is a similar figure, but in which all GP contacts during pregnancy are used as the outcome to define the number of GP practitioners mothers see during their pregnancy. A comparable switching pattern appears. However, as expected, the share of mothers who switched decreases slower as the closure happens later from conception than when using the narrower definition of GP contact from Figure 8. With this alternative definition of switching, a mother who has had a contact with a new GP during her pregnancy but after the last scheduled pregnancy visit at 32 weeks will still be counted as having seen two different GPs during her pregnancy.

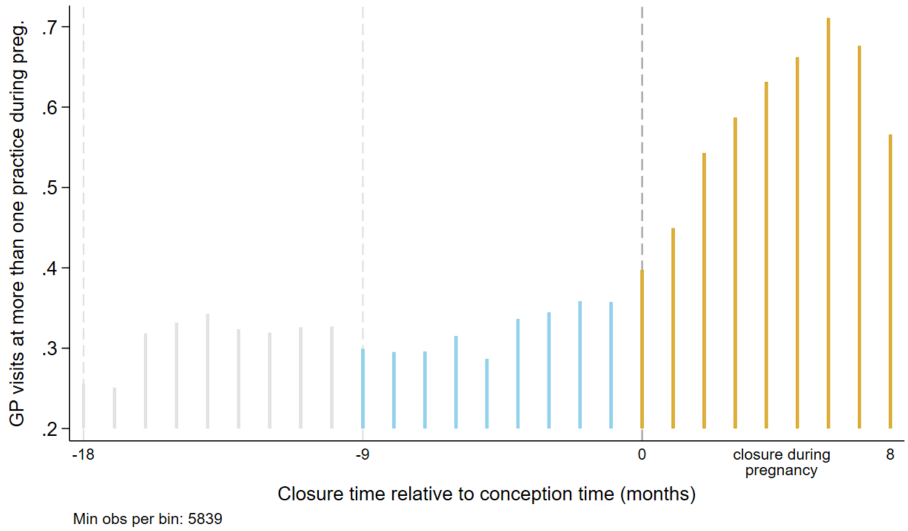


Fig. 9 Probability mother has contact with more than one general physician practice during pregnancy (all visits)

Notes: This figure presents the probability that mothers had contact with at least two general practitioners (GPs) during their pregnancy. The x-axis represents the difference between conception and practice closure in months. The blue bars represent the control period, including mothers who faced a GP practice closure up to nine months pre-conception. The golden bars indicate the treatment period, covering mothers who experienced practice closures up to nine months post-conception. The sample includes Danish first-time mothers who faced a GP practice closure from 18 months before conception to 9 months after conception and who gave birth between 2006 and 2018.

5.2 Impact of closures on birth outcomes

Figure 10 shows mothers experiencing practice closures during pregnancy give birth to infants weighing approximately 20 grams less than those facing a closure before pregnancy. This drop occurs when the closure happens at the third trimester of pregnancy - that is at t=2, t=0 denoting when the closure happens during the first trimester of pregnancy. No effect is found if the closure happens at the first and second trimesters of pregnancy. The dip in birth weight when the closure happens in the last pregnancy trimester is not tracked by the predicted birth weight curve, meaning it is not driven by observable selection.

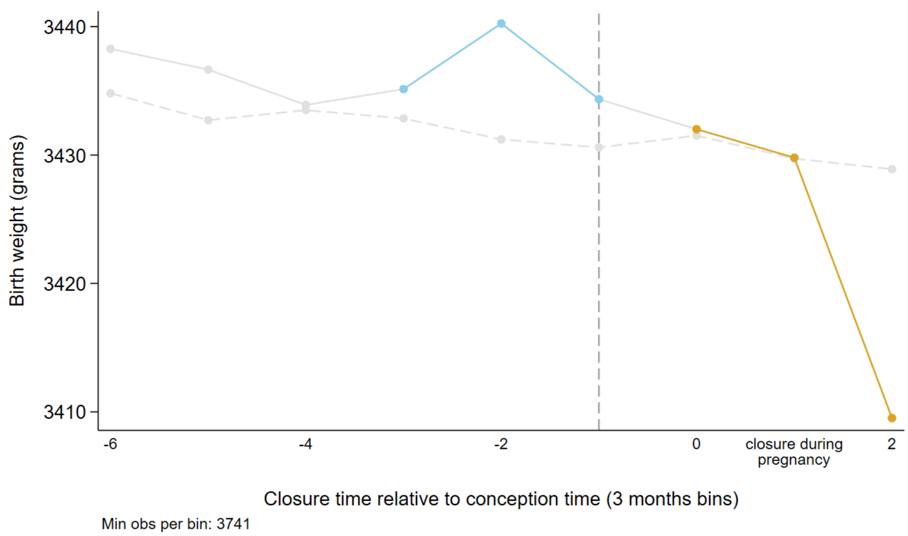


Fig. 10 Average birth weight for mothers facing a practice closure around conception

Notes: The y-axis represents the average birth weight, with blue dots for the control period (up to nine months pre-conception) and golden dots for the treatment period (up to nine months post-conception). The sample includes Danish first-time mothers who faced a GP practice closure from 18 months before conception to 9 months after conception and who gave birth between 2006 and 2018. The grey dashed connected line represents the predicted fetal outcome using a range of fixed effects and pre-pregnancy parental variables described in Section 3. The vertical dashed line marks the $t = -1$ period in which the closure happens in the three months period prior to conception. All outcomes to the left of this line are for mothers who faced a closure before their pregnancy, whereas outcomes to the right are for mothers who faced a closure after conception. Thus, event time is defined such that $t = 0$ indicates a practice closure occurred during the first trimester of pregnancy, $t = 1$ during the second trimester, and $t = 2$ during the third trimester.

Table 4 displays the average effect of practice closures on birth outcomes when the closure happens in any of three pregnancy trimesters, and then when are omitted from the sample the mothers who faced a closure from the first trimester of pregnancy (">1") and from the second semester of pregnancy (">2"). When the whole sample is considered, the effect on birth weight is not significant (-13 grams) when adding controls, even though the coefficient is higher than in the placebo closure specification (0 gram). However, this non-significant average result conceals substantial heterogeneity across the pregnancy trimesters during which the closure occurs. Consistent with the pattern observed in the descriptives, in the event study (Figure 11) which includes all controls, the 90 percent confidence intervals overlap zero for all periods except when the closure occurs in the third semester of pregnancy (t=2). One explanation to the fact the effect on birth weight is most marked when the closure occurs in the third trimester of pregnancy is the varying intensity of treatment. The dip in birth weight occurs at the trimester relative to conception in which the share of mothers facing discontinuity in care during pregnancy was the most sizable relative to the control group, as shown in the previous section.

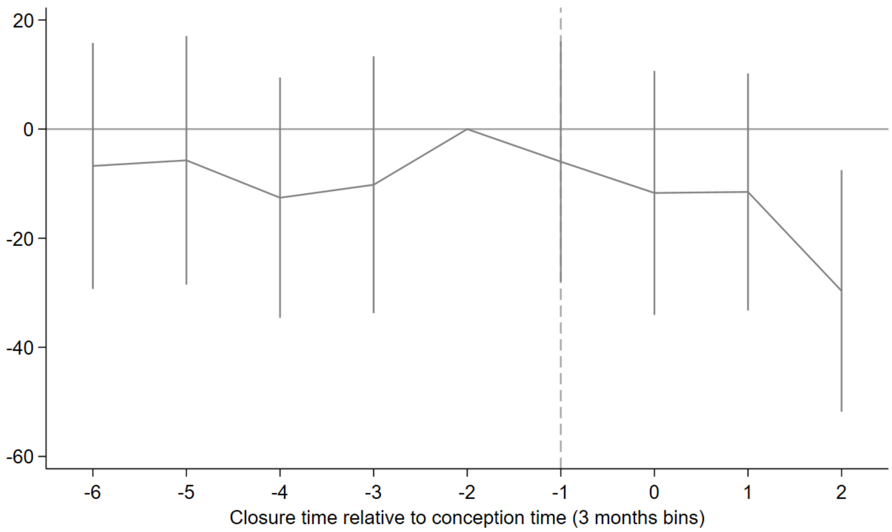


Fig. 11 Event study: the effect of GP practice closures on birth weight

Notes: The figure plots coefficients along with 90 percent confidence intervals from an event study analysis and includes the full set of covariates and fixed effects described in Section 3. The sample includes Danish first-time mothers who faced a GP practice closure from 18 months before conception to 9 months after conception and who gave birth between 2006 and 2018. The x-axis represents the time of practice closure relative to the time of conception (in 3-months bins). The vertical dashed line marks the $t = -1$ period in which the closure happens in the three months period prior to conception. All estimates to the left of this line are outcomes for mothers who faced a closure before their pregnancy, whereas estimates after this line are outcomes for mothers who faced a closure after conception. Event time is hence defined such that t=0 indicates the mother faced a closure during the first pregnancy trimester, t=1 indicates the closure occurred during the second pregnancy trimester, and t=2 corresponds to a practice closure during the third trimester of pregnancy.

When the closure occurs during the last pregnancy trimester, the adverse effect on birth weight is of the same order of magnitude as that of the mother losing a parent during pregnancy (Persson and Rossin-Slater, 2018). It is however around half of that found by Jensen (2014) who examines the impact of the introduction of lower incentives to test and monitor pregnancy in Denmark and who found an impact of the policy of around -35 grams on the overall population.

This reduction in birth weight is not attributable to shorter pregnancies: an effect on fetal growth rate (grams per day of gestation) is also apparent on Figure 12 when the closure occurs during the third pregnancy trimester. As shown in Table 4, the effect is again around half of that found in Jensen (2014) in her whole sample (-0.45 grams per week in my setting against -0.9 in hers). Unlike in Jensen (2014) however, the closure has no significant impact on gestational age when used as a continuous outcome, or when building dummies for birth earlier than 37 weeks. It has however the predicted negative sign (-0.3 day of gestation) when restricting to treated mothers who faced a closure during the third trimester of pregnancy.

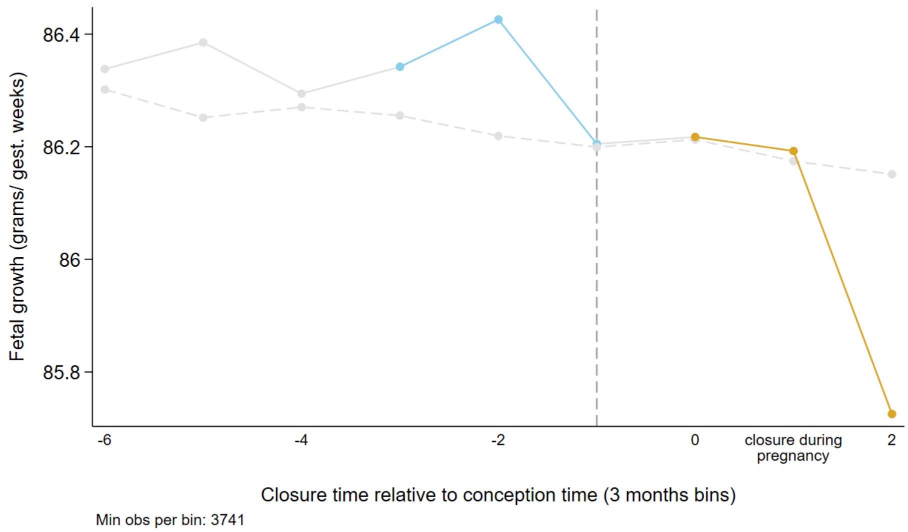


Fig. 12 Average fetal growth (gram/week) for mothers facing a practice closure around conception

Notes: The y-axis represents the average fetal growth, with blue dots for the control period (up to nine months pre-conception) and golden dots for the treatment period (up to nine months post-conception). The sample includes Danish first-time mothers who faced a GP practice closure from 18 months before conception to 9 months after conception and who gave birth between 2006 and 2018. The grey dashed connected line represents the predicted fetal outcome using a range of fixed effects and pre-pregnancy parental variables described in Section 3. The vertical dashed line marks the $t = -1$ period in which the closure happens in the three months period prior to conception. All outcomes to the left of this line are for mothers who faced a closure before their pregnancy, whereas outcomes to the right are for mothers who faced a closure after conception. Thus, event time is defined such that $t = 0$ indicates a practice closure occurred during the first trimester of pregnancy, $t = 1$ during the second trimester, and $t = 2$ during the third trimester. Standard errors are clustered at the closing practice level. The corresponding event study is found in Appendix C.1.

Turning to the bottom of the fetal growth distribution (Figure 13), there is a 10 percent increase in births of fetuses who are small for their gestational age when the closure happens during the third pregnancy trimester. This effect is significant at the 10 percent level in regressions (see Table 4). The spike when the closure happens in the third pregnancy trimester is also distinguishable in the event study (Figure 14). On the other hand, no significant effect is found on the share of newborns with low birth weight (2500g), although this share increases if anything. Reassuringly, the placebo coefficient on low birth weight has the opposite sign.

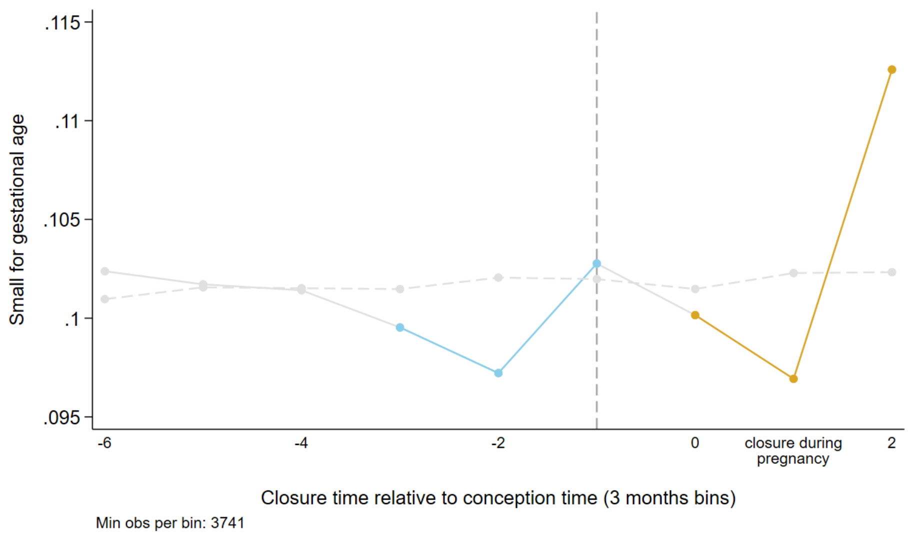


Fig. 13 Average share of fetuses who are for their gestational age for mothers facing a practice closure around conception

Notes: The y-axis represents the average share for births which are small for their gestational age (10th percentile of fetal growth), with blue dots for the control period (up to nine months pre-conception) and golden dots for the treatment period (up to nine months post-conception). The sample includes Danish first-time mothers who faced a GP practice closure from 18 months before conception to 9 months after conception and who gave birth between 2006 and 2018. The grey dashed connected line represents the predicted fetal outcome using a range of fixed effects and pre-pregnancy parental variables described in Section 3. The vertical dashed line marks the $t = -1$ period in which the closure happens in the three months period prior to conception. All outcomes to the left of this line are for mothers who faced a closure before their pregnancy, whereas outcomes to the right are for mothers who faced a closure after conception. Thus, event time is defined such that $t = 0$ indicates a practice closure occurred during the first trimester of pregnancy, $t = 1$ during the second trimester, and $t = 2$ during the third trimester.

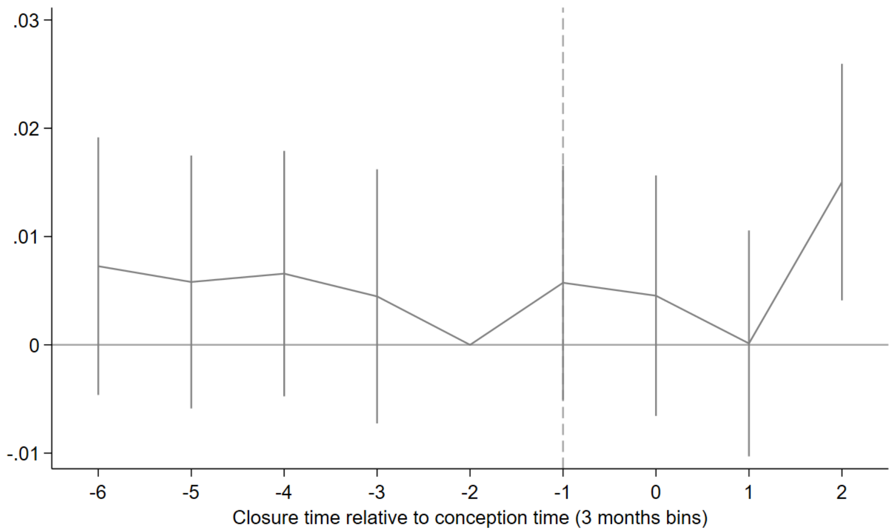


Fig. 14 Event study: the effect of GP practice closures on the share of fetuses who are small for their gestational age

Notes: The figure plots coefficients along with 90 percent confidence intervals from an event study analysis and includes the full set of covariates and fixed effects described in Section 3. The sample includes Danish first-time mothers who faced a GP practice closure from 18 months before conception to 9 months after conception and who gave birth between 2006 and 2018. The x-axis represents the time of practice closure relative to the time of conception (in 3-months bins). The vertical dashed line marks the $t = -1$ period in which the closure happens in the three months period prior to conception. All estimates to the left of this line are outcomes for mothers who faced a closure before their pregnancy, whereas estimates after this line are outcomes for mothers who faced a closure after conception. Event time is hence defined such that t=0 indicates the mother faced a closure during the first pregnancy trimester, t=1 indicates the closure occurred during the second pregnancy trimester, and t=2 corresponds to a practice closure during the third trimester of pregnancy.

Tab. 4 Effect of closures on birth outcomes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Birth weight	0	-13*	-12	-16*	-14	-27**	-21*
	(8.10)	(7.86)	(7.99)	(8.69)	(8.69)	(10.84)	(10.97)
Fetal growth (grams/week)	-0.016	-0.282	-0.253	-0.353*	-0.289	-0.598**	-0.450*
	(0.18)	(0.18)	(0.18)	(0.19)	(0.20)	(0.24)	(0.24)
Small for gest. age (10th percentile)	-0.002	0.003	0.003	0.004	0.004	0.013**	0.010*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)
Low birth weight (<2500 grams)	-0.002	0.003	0.002	0.002	0.002	0.006	0.004
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Gestation days	0.118	-0.123	-0.112	-0.123	-0.153	-0.303	-0.230
	(0.18)	(0.18)	(0.18)	(0.20)	(0.20)	(0.26)	(0.26)
Preterm birth (<37 weeks)	0.001	0.002	0.002	0.002	0.002	0.005	0.004
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Controls	No	No	Yes	No	Yes	No	Yes
Trimester closure	Placebo	All	All	>1	>1	>2	>2
Observations	23295	25655	25655	21152	21152	16530	16530

Notes: This regression estimates the average treatment effect of GP practice closures on various birth outcomes using the specification described in section 3. The sample includes Danish first-time mothers who faced a GP practice closure from 18 months before conception to 9 months after conception and who gave birth between 2006 and 2018. The controls are maternal age, parental ethnicity, parent's income, education level, marriage, cohabitation status of the parents, maternal weight, sex of the child, as well as dummies for missing maternal age and weight. Income and education variables are measured one year before birth. Maternal weight is measured at the first pregnancy visit (on average 1.5 months after conception). Because of the seasonality in healthcare usage, month and year of conception FE are added. The row "Trimester closure" indicates if the whole sample is considered ("All"), or if are omitted from the sample the mothers who faced a closure during the first trimester of pregnancy (">1") or the mothers who faced a closure during the first and second trimester of pregnancy (">2"). « Placebo » closure means the closure happened up to 9 months before the closure - the control group is then made of mothers a closure from 18 months to 9 months before conception.

5.3 Mechanisms

5.3.1 Reduced healthcare usage and referral channels

At the extensive margin, Table 5 shows that practice closures do not significantly affect the number of midwife visits or obstetrician-gynecologist referrals, although the effect if anything, is slightly negative. However, closures lead to a small reduction in the total number of GP contacts during pregnancy. The effect is however quite small and only marginally significant when adding controls. On average, each treated mother experiences a reduction of 0.1 GP contacts compared to the control. This represents a one percent drop in GP visits.

Still, the total number of visits or contacts during pregnancy might not be the most relevant proxy of disruption in care. It can be interesting to measure whether a closure occurring in a given pregnancy trimester leads to reduced GP in-person visits in the same pregnancy semester. [7] GP visits can be hypothesized to be imperfect temporal substitutes in the health capital production function. No amount of additional visits before a condition develops can compensate for a missed visit after the condition has emerged. Symmetrically, a condition that has escalated because of delayed GP contacts might require more GP visits to be treated.

In Table 5, no effect is found on visits during the first trimester, irrespective of when the closure happens during the pregnancy. One explanation might be that discontinuity in care is low when the closure occurs during the first pregnancy trimester. GP visits during the second semester significantly drop on average in the treated group, and the coefficients are negative when further restricting the sample to mothers who faced closures during the second and third trimesters of pregnancy, whereas the placebo coefficient is positive. Finally, mothers who faced a practice closure during the third trimester indeed faced a significant decrease in the number of GP visits during this trimester (-0.07**).

The drop in GP visits during the third semester is directly visible in the descriptives

[7] In Table 5, I display the results for GP *in-person visits* per pregnancy trimester. The results are similar when using GP *contacts* (which also include telephone and email consultations) per pregnancy semester.

(Figure 15), although it seems somewhat masked by the cyclicality of healthcare usage. To render this pattern more apparent, the event study displayed on Figure 16 includes month-of-conception fixed effects, which accounts for such cyclicality. Thus, such event study reveals a clearer pattern: the pretrends now appear distinctly flat, making the decline in GP visits at t=2 for mothers who experienced a practice closure in the last trimester even more visible.

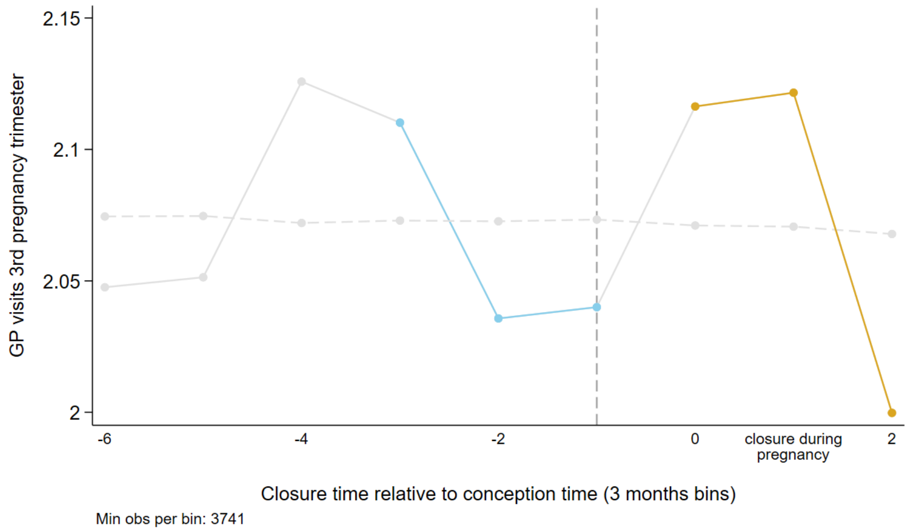


Fig. 15 Average number of pregnancy visits during the third trimester for mothers facing a closure around conception

Notes: The y-axis represents the average number of GP visits during the third trimester of pregnancy, with blue dots for the control period (up to nine months pre-conception) and golden dots for the treatment period (up to nine months post-conception). The sample includes Danish first-time mothers who faced a GP practice closure from 18 months before conception to 9 months after conception and who gave birth between 2006 and 2018. The grey dashed connected line represents the predicted fetal outcome using a range of fixed effects and pre-pregnancy parental variables described in Section 3. The vertical dashed line marks the $t = -1$ period in which the closure happens in the three months period prior to conception. All outcomes to the left of this line are for mothers who faced a closure before their pregnancy, whereas outcomes to the right are for mothers who faced a closure after conception. Thus, event time is defined such that $t = 0$ indicates a practice closure occurred during the first trimester of pregnancy, $t = 1$ during the second trimester, and $t = 2$ during the third trimester.

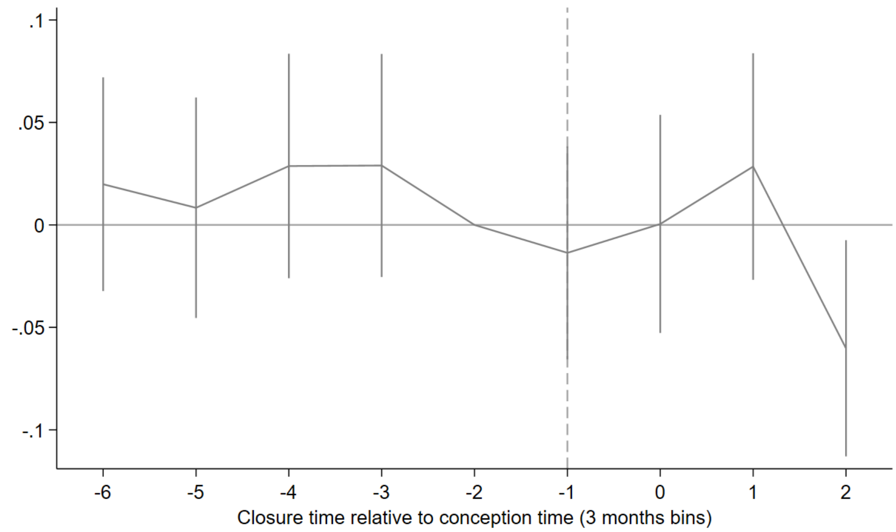


Fig. 16 Event study: the effect of GP practice Closures on number of third-trimester GP visits

Notes: The figure plots coefficients along with 90 percent confidence intervals from an event study analysis and includes the full set of covariates and fixed effects described in Section 3. The sample includes Danish first-time mothers who faced a GP practice closure from 18 months before conception to 9 months after conception and who gave birth between 2006 and 2018. The x-axis represents the time of practice closure relative to the time of conception (in 3-months bins). The vertical dashed line marks the $t = -1$ period in which the closure happens in the three months period prior to conception. All estimates to the left of this line are outcomes for mothers who faced a closure before their pregnancy, whereas estimates after this line are outcomes for mothers who faced a closure after conception. Event time is hence defined such that t=0 indicates the mother faced a closure during the first pregnancy trimester, t=1 indicates the closure occurred during the second pregnancy trimester, and t=2 corresponds to a practice closure during the third trimester of pregnancy.

Tab. 5 Effect of closures on healthcare usage (extensive margin)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Midwife visits	0.03	-0.06	-0.06	-0.07	-0.07	0.01	-0.10
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.07)	(0.07)
Observations	16038	18059	18059	14879	14879	11589	11589
Obstetrician-gynecologist visits	-0.059	-0.055	-0.046	-0.050	-0.041	-0.081	-0.110*
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.06)	(0.06)
Observations	15884	17848	17848	14712	14712	11462	11462
Total GP contacts	-0.099	-0.157**	-0.124*	-0.144*	-0.105	-0.323**	-0.149
	(0.07)	(0.07)	(0.07)	(0.08)	(0.08)	(0.16)	(0.10)
Total GP visits	-0.013	-0.069*	-0.058	-0.055	-0.043	-0.168*	-0.086
	(0.04)	(0.04)	(0.04)	(0.05)	(0.05)	(0.10)	(0.06)
GP Visits (1st trim.)	0.000	-0.001	0.000	0.002	0.004	-0.024	0.001
	(0.02)	(0.01)	(0.01)	(0.02)	(0.02)	(0.04)	(0.02)
GP Visits (2nd trim.)	0.011	-0.053***	-0.047**	-0.040*	-0.033	-0.092**	-0.034
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.05)	(0.03)
GP Visits (3rd trim.)	-0.017	-0.018	-0.015	-0.022	-0.018	-0.062**	-0.066**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)
Observations	23295	25655	25655	21152	21152	16530	16530
Controls	No	No	Yes	No	Yes	No	Yes
Trimester closure	Placebo	All	All	>1	>1	>2	>2

Notes: Each row in this table is a regression estimate of the average treatment effect of GP practice closures on various healthcare usage outcomes using the specification described in section 3. The sample includes Danish first-time mothers who faced a GP practice closure from 18 months before conception to 9 months after conception and who gave birth between 2006 and 2018. The controls are maternal age, parental ethnicity, parent's income, education level, marriage, cohabitation status of the parents, maternal weight, sex of the child, as well as dummies for missing maternal age and weight. Income and education variables are measured one year before birth. Maternal weight is measured at the first pregnancy visit (on average 1.5 months after conception). Because of the seasonality in healthcare usage, month and year of conception FE are added in all specifications. The row "Trimester closure » indicates if the whole sample is considered ("All"), or if are omitted from the sample the mothers who faced a closure during the first trimester of pregnancy (">1") or the mothers who faced a closure the first and second trimester of pregnancy (">2"). « Placebo » closure means the closure happened up to 9 months before the closure - the control group is then made of mothers who faced a closure from 18 months to 9 months before conception.

One potential channel linking reduced GP visits to this adverse birth outcomes effect is reduced prenatal testing. Figure 17 shows a pronounced drop in the probability of having at least one blood or urine test during pregnancy when the closure happens during the third trimester of pregnancy which is also the event-time in which the drop in birth weight and in GP visits were the most marked. This drop is small however (3 percent). However, Table 6 and Figure A8 show a drop in the sum of all tests performed, irrespective of when during pregnancy the closure occurs. The coefficient is the most negative when the closure happens during the last trimester of pregnancy, in which case the total number of tests decreases by around 8 percent. While the total number of blood tests consistently declines with closures at any stage of pregnancy (see Figure A9 in the Appendix), the number of urine tests is significantly affected only when the closure occurs in the last trimester - see (see Figure A10 in the Appendix). This variation by test type aligns with the pattern that the three most common urine tests chosen peak in frequency during the last trimester, whereas the three most common blood tests are more evenly distributed throughout the pregnancy - see Figure 4 in section 4.3.2.

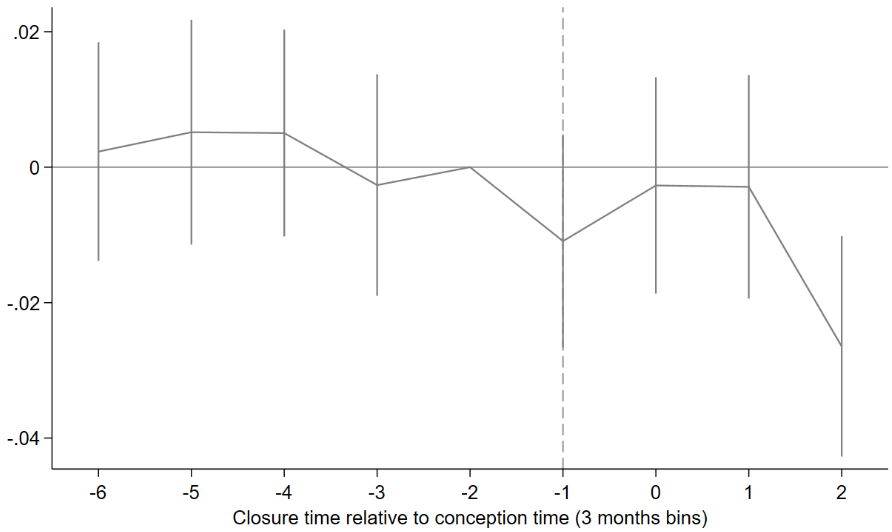


Fig. 17 Event study: the effect of GP practice closures on the probability to have had at least one blood or urine test from a GP during pregnancy

Notes: The figure plots coefficients along with 90 percent confidence intervals from an event study analysis and includes the full set of covariates and fixed effects described in Section 3. The sample includes Danish first-time mothers who faced a GP practice closure from 18 months before conception to 9 months after conception and who gave birth between 2006 and 2018. The x-axis represents the time of practice closure relative to the time of conception (in 3-months bins). The vertical dashed line marks the $t = -1$ period in which the closure happens in the three months period prior to conception. All estimates to the left of this line are outcomes for mothers who faced a closure before their pregnancy, whereas estimates after this line are outcomes for mothers who faced a closure after conception. Event time is hence defined such that t=0 indicates the mother faced a closure during the first pregnancy trimester, t=1 indicates the closure occurred during the second pregnancy trimester, and t=2 corresponds to a practice closure during the third trimester of pregnancy.

Tab. 6 Effect of closures on healthcare usage (intensive margin)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
At least any of 6 tests	-0.01	-0.01	-0.01	-0.01	-0.01	-0.03***	-0.02**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Sum 6 tests	-0.002	-0.122***	-0.112***	-0.138***	-0.127***	-0.281***	-0.213***
	(0.05)	(0.04)	(0.04)	(0.05)	(0.05)	(0.07)	(0.06)
$\geq$ 1 blood test	-0.011	-0.016**	-0.016**	-0.019***	-0.019***	-0.047***	-0.030***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Sum 3 blood tests	-0.021	-0.078***	-0.077***	-0.091***	-0.089***	-0.165***	-0.119***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.04)	(0.03)
$\geq$ 1 urine test	-0.007	-0.004	-0.003	-0.007	-0.006	-0.021**	-0.013
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Sum 3 urine tests	0.019	-0.043	-0.036	-0.046	-0.038	-0.116**	-0.094**
	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)	(0.05)	(0.04)
Controls	No	No	Yes	No	Yes	No	Yes
Trimester clos.	Placebo	All	All	>1	>1	>2	>2
Observations	23295	25655	25655	21152	21152	16530	16530

Notes: Each row in this table is a regression estimate of the average treatment effect of GP practice closures on various healthcare usage outcomes using the specification described in section 3. The sample includes Danish first-time mothers who faced a GP practice closure from 18 months before conception to 9 months after conception and who gave birth between 2006 and 2018. The controls are maternal age, parental ethnicity, parent's income, education level, marriage, cohabitation status of the parents, maternal weight, sex of the child, as well as dummies for missing maternal age and weight. Income and education variables are measured one year before birth. Maternal weight is measured at the first pregnancy visit (on average 1.5 months after conception). Because of the seasonality in healthcare usage, month and year of conception FE are added in all specifications. The row "Trimester closure » indicates if the whole sample is considered ("All"), or if are omitted from the sample the mothers who faced a closure during the first trimester of pregnancy (">1") or the mothers who faced a closure the first and second trimester of pregnancy (">2"). « Placebo » closure means the closure happened up to 9 months before the closure - the control group is then made of mothers who faced a closure from 18 months to 9 months before conception.

5.3.2 Behavioral channel: impact of closure on smoking cessation

One final explanation for reduced birth outcomes is that closures might reduce the effectiveness of medical advice regarding the prevention of risky pregnancy behaviors. In particular, general physicians can convince and help the mother to improve her diet, to drink less alcohol, and to cease smoking. While my dataset does not include prenatal drinking or diet data, the Danish birth records do contain data on smoking cessation.

There is some ground for thinking that GP practice closures might decrease smoking cessation. Closures might cause doctors to be overcrowded by a flow of new patients. In turn, overcrowding might force GPs to allocate less time per patient. Yet, a qualitative study of patients pointed out that lack of time during the visit is a factor that could impede smoking cessation (Buczkowski et al., 2013). Moreover, closures might reduce trust in the GP. Correlational studies tend to show that trust in the practitioners grows with the duration of patient-physician relationship (Kao et al., 1998; Mainous et al., 2001)[8], and there is also a positive association between trust in the physician and compliance with advises and treatments (Piette et al., 2005; Thom et al., 2011). Finally, patients who trust their physician less might be less likely to require new treatments (Thom et al., 2002), and in this setting willingness to ask for treatments like nicotine-replacement therapy might act as an important smoking-cessation channel.

However, the event study shown on Figure 18 displays no effect of practice closure on the average probability of ceasing smoking. Still, three caveats are in order. First, to cease smoking, the mother needs to be smoking before pregnancy. Since only 10 percent of mothers smoke before pregnancy, the number of observations is shrunk to a few thousands. All regressions performed in this subsection might be underpowered. Second, this outcome is measured by the GP. Because closures reduce the number of contacts, they could give the mothers less occasions to inform their respective GP they ceased smoking when they actually have. Third, by my design, mothers in both my treatment and control group undergo a

[8]Concerns of reverse causality are naturally high in these studies.

practice closure around conception. Hence, these regressions are unable to capture effects due to the breakdown of a slowly established trust between the mother and her physician, which build over years of repeated GP-patient interaction.

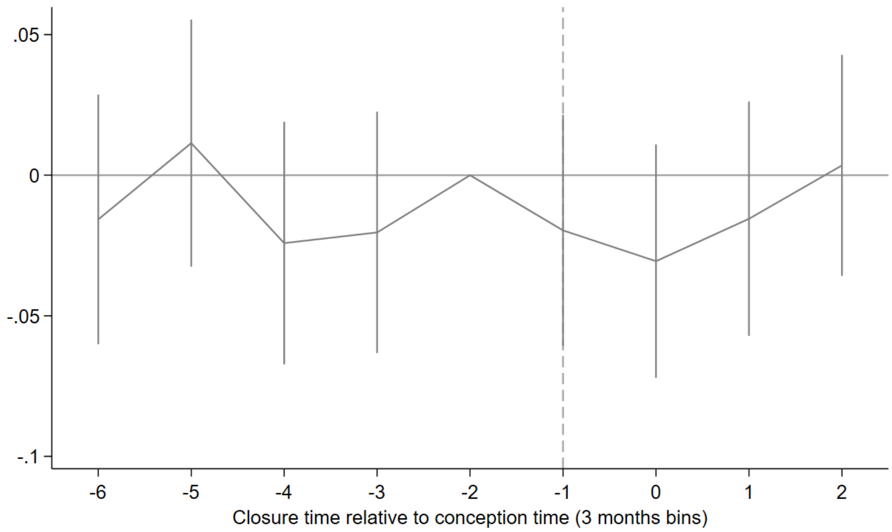


Fig. 18 Event study: the effect of GP practice closures on smoking cessation

Notes: The figure plots coefficients along with 90 percent confidence intervals from an event study analysis and includes the full set of covariates and fixed effects described in Section 3. The sample includes Danish first-time mothers who faced a GP practice closure from 18 months before conception to 9 months after conception and who gave birth between 2006 and 2018. The x-axis represents the time of practice closure relative to the time of conception (in 3-months bins), while the y-axis shows the total number of hemoglobin blood tests during pregnancy. The vertical dashed line marks the $t = -1$ period in which the closure happens in the three months period prior to conception. All estimates to the left of this line are outcomes for mothers who faced a closure before their pregnancy, whereas estimates after this line are outcomes for mothers who faced a closure after conception. Event time is hence defined such that t=0 indicates the mother faced a closure during the first pregnancy trimester, t=1 indicates the closure occurred during the second pregnancy trimester, and t=2 corresponds to a practice closure during the third trimester of pregnancy.

6 Discussion

I find that GP practice closures cause a small to medium-sized adverse effect on birth outcomes, and consistently, mothers affected by GP practice closures during pregnancy experience small disruptions in healthcare provision at the extensive and at the intensive margin. The two patterns are likely to be related. Still, it is uncertain whether my set of outcomes is rich enough to capture the specific dimensions of care whose reductions are responsible for the adverse closure effects.

Can the small drop in GP visits and contacts be the key force behind the negative effects I find? Alternatively, it could be that closures affect birth outcomes through delaying care (for example through delayed prescriptions) rather than through a pure reduction in the number of GP contacts. Moreover, even assuming the small drop in GP contacts plays a central role in explaining the adverse birth outcomes effect I find, that the causal path between reduced visits and birth outcomes is unclear. Is the drop in GP visits causing the drop in GP testing? In turn, is decreased GP testing responsible for decreased birth weight? It is possible that the drop in tests performed by GP is offset by an increase in the average number of tests performed per visit by midwives. If so, there would be no drop in 'total monitoring' as performed by all healthcare practitioners.

Overall, my analysis highlights possible channels. However, it is impossible to draw firmer causal conclusions regarding the mechanisms explaining my core result in the absence of an exogenous variation in the number of visits, and without prescription data.

7 Conclusion

This study reveals that GP practice closures during pregnancy can significantly impact birth outcomes. Analysis of Danish data from 2006 to 2018 showed that closures lead to an average reduction in birth weight, particularly when they occur during the third trimester. The findings suggest that closures result in fewer GP visits and reduced testing, which may contribute to the observed decline in neonatal health. Although the effect size is relatively modest, it may represent a lower bound, with potentially more significant impacts in contexts with less robust healthcare systems. These results could provide a rationale for policies that ensure continuity of care and enhance prenatal monitoring. This could include providing further information to closing GPs who have pregnant patients, or to mothers who face a closure during the last trimester of their pregnancy. For instance, it could be important to emphasize to these mothers the need to promptly select a new GP, even though they are in frequent contact with their midwife.

Four main avenues for further analysis remain with the available data. First, I will construct pre-pregnancy healthcare usage outcomes to ensure they are balanced between the treatment and control groups. Second, I will extract condition diagnoses from Danish hospital records. If closures significantly disrupt monitoring, an increase in condition diagnoses such as preeclampsia should be observed in the treatment group compared to the control group. Third, I will explore the heterogeneity in the effect of practice closures across different demographic groups. For instance, the impact of closures could be more sizable for mothers living in rural areas where medical density is lower. Fourth, I will investigate whether the gender and age of the new GP interact with the effect of closures on birth outcomes and healthcare usage. Specifically, I will assess whether patients who choose a female GP after closure experience a lesser impact on birth outcomes or reduced disruptions in care.

References

Buczkowski, K., L. Marcinowicz, S. Czachowski, E. Piszczek, and A. Sowinska (2013). "what kind of general practitioner do i need for smoking cessation?" results from a qualitative study in poland. *BMC Family Practice 14*, 1–10.

Currie, J. and H. Schwandt (2013). Within-mother analysis of seasonal patterns in health at birth. *Proceedings of the National Academy of Sciences 110*(30), 12265–12270.

Danish Patient Safety Authority (2024). Extended reserved business area for midwives. Accessed: 2024-08-02.

Evans, W. N. and D. S. Lien (2005). The benefits of prenatal care: evidence from the pat bus strike. *Journal of Econometrics 125*(1-2), 207–239.

Jensen, V. M. (2014). Happy doctor makes happy baby? incentivizing physicians improves quality of prenatal care. *Review of Economics and Statistics 96*(5), 838–848.

Kao, A. C., D. C. Green, N. A. Davis, J. P. Koplan, and P. D. Cleary (1998). Patients' trust in their physicians: effects of choice, continuity, and payment method. *Journal of general internal medicine 13*(10), 681–686.

Kjaersgaard, M. I. S., P. Vedsted, E. T. Parner, B. H. Bech, M. Vestergaard, K. R. Flarup, and M. Fenger-Grøn (2016). Algorithm linking patients and general practices in denmark using the danish national health service register. *Clinical epidemiology*, 273–283.

Kristiansen, I. L. and S. Y. Sheng (2022). Doctor who? the effect of physician-patient match on the ses-health gradient. *The Effect of Physician-Patient Match on The SES-Health Gradient (July 8, 2022).*

Kwok, J. (2019). How do primary care physicians influence healthcare? evidence on practice styles and switching costs from medicare. *Evidence on Practice Styles and Switching Costs from Medicare (July 22, 2019).*

Mainous, A. G., R. Baker, M. M. Love, D. P. Gray, and J. M. Gill (2001). Continuity of care and trust in one's physician: evidence from primary care in the united states and the united kingdom. *Fam Med 33*(1), 22–27.

Monsees, D. and M. Westphal (2024). Discontinuity in primary care and its effects on healthcare utilization – evidence from resigning german general practitioners. RWI Essen and Leibniz Science Campus Ruhr, Germany.

Persson, P. and M. Rossin-Slater (2018). Family ruptures, stress, and the mental health of the next generation. *American economic review 108*(4-5), 1214–1252.

Piette, J. D., M. Heisler, S. Krein, and E. A. Kerr (2005). The role of patient-physician trust in moderating medication nonadherence due to cost pressures. *Archives of internal medicine 165*(15), 1749–1755.

Simonsen, M., L. Skipper, N. Skipper, and P. R. Thingholm (2021). Discontinuity in care: Practice closures among primary care providers and patient health care utilization. *Journal of Health Economics 80*, 102551.

Thom, D. H., R. L. Kravitz, R. A. Bell, E. Krupat, and R. Azari (2002). Patient trust in the physician: relationship to patient requests. *Family practice 19*(5), 476–483.

Thom, D. H., S. T. Wong, D. Guzman, A. Wu, J. Penko, C. Miaskowski, and M. Kushel (2011). Physician trust in the patient: development and validation of a new measure. *The Annals of Family Medicine 9*(2), 148–154.

Ugeskriftet.dk (2023). Millioner til nye licensklinikker skal tiltrække unge læger til områder med lægemangel. Accessed: 2024-08-18.

World Health Organization (2022). Ticking timebomb: Without immediate action, health and care workforce gaps in the european region could spell disaster. `https://www.who.int/europe/news/item/`

`14-09-2022-ticking-timebomb--withoutimmediate-action--health-and-care-workforce-gaps-`
Accessed: 11 March 2024.

Young, A., H. J. Chaudhry, X. Pei, K. Arnhart, M. Dugan, and G. B. Snyder (2017). A census of actively licensed physicians in the united states, 2016. *Journal of Medical Regulation 103*(2), 7–21.

Table 1 Outline of the steps in the algorithm linking patients and general practices in Denmark using data from the National Health Service Register and the Civil Registration System

Step number	Title and description
Step 1	**Restrict services and recode time of services.** Restrict data from the National Health Service Register and recode time of service as described in the sections on "Selection of services" and "Recoding the time of services."
Step 2	**Exclude services coded during emigration and after death.** Exclude invoices on or after patients' date of death or emigration until reimmigration, if applicable.
Step 3	**Exclude service weeks with multiple practices.** If invoices pertaining to more than one general practice are registered for the same patient within the same week, exclude all the invoices for the patient during that week.
Step 4	**Code preliminary practice time intervals.** Code preliminary practice time intervals for each patient–general practice relationship, starting from the date of first contact with a practice until the day before contact with another practice or end of follow-up.
Step 5	**Recode practice time intervals taking into account emigration and death.** If a patient emigrates (including moving to Greenland) or dies within a preliminary practice time interval, recode the end date of the interval to the date of emigration or death, whichever came first.
Step 6	**Recode practice time intervals taking into account practice closure.** For each general practice, define the closure date as the last date with registered services, unless the date falls within the last month before end of follow-up. Recode the end date to closure date for all patient intervals concerning this general practice and including this date. If applicable, recode the starting date for the same patient's subsequent practice time interval to the next day.
Step 7	**Recode practice time intervals taking into account patients moving.** For patients moving between municipalities in Denmark (codes 101-861; 275 municipalities) within an interval, recode the end date to the moving date and the subsequent starting date to the following day. For patients moving more than once, use the latest moving date.
Step 8	**Drop small (<31 days) practice time intervals.** Drop patient–general practice intervals shorter than 31 days, unless the interval starts on the first of a month and ends on the last day of a month, and include the time in the preceding interval.
Step 9	**Recode practice time intervals to monthly intervals.** Recode the starting date to the first date of the month. Recode the end date to the last date of the preceding month, unless the interval ends on the date of death or emigration or on the last day of the month.

Fig. A1 Structure of the Kjaersgaard et al. (2016) algorithm to infer assigned physicians from GP contacts, from Kjaersgaard et al. (2016)

Doctors and midwives

All pregnant women have free access to doctors and midwives throughout the pregnancy. Your doctor and midwife will examine you and make sure both you and your baby are well, and that your baby is growing and developing as expected. You will also be offered blood tests and ultrasound examinations early in your pregnancy. The examinations will show if there are any abnormalities.

A normal pregnancy lasts between 37 and 42 weeks. You will be offered the following examinations:

Pregnancy week	Doctor examination	Midwife examination	Ultrasound and blood tests
6–10	x		
8–13			Blood test
11–13			Ultrasound examination
10–15		x	
18–20		x	Ultrasound examination
25	x		
29		x	
32	x		
35		x	
37		x	
39		x	
(41)		x	
4–5 days after birth			Home visit from health visitor
1–10 days after birth		x	
5 weeks after birth (baby)	x		
8 weeks after birth (mother)	x		

Fig. A2 Official guidelines for pregnant mothers

Source: Danish ministry of health [LINK]

A Additional Descriptive analyses

Tab. A1 Variable means, treatment and control group (sample built with the algorithm from Kjaersgaard et al. (2016))

Variable	Treatment	Control	Diff
Any parent went to college	0.48	0.47	-0.010
Any parent is Danish	0.87	0.86	-0.010*
Parents cohabit	0.58	0.59	0.005
Income father, dkk (monthly)	27168	26880	-288.179
Income mother, dkk (monthly)	20253	19945	-307.980*
Maternal weight (kg)	68	69	0.385
Maternal age at birth	27	27	-0.013

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

Notes: This table displays the variable means in the treatment and control group. The sample includes Danish first-time mothers who faced a GP practice closure from 18 months before conception to 9 months after conception and who gave birth between 2006 and 2018. The mothers were considered affected by the GP practice closure if they were matched with the practice using the algorithm created by Kjaersgaard et al. (2016) described in A1 . Treated mothers faced a GP practice closure up to 9 months after conception, whereas control mothers faced a closure to 9 months before conception.

A.1 Assessing bunching in conceptions around closure

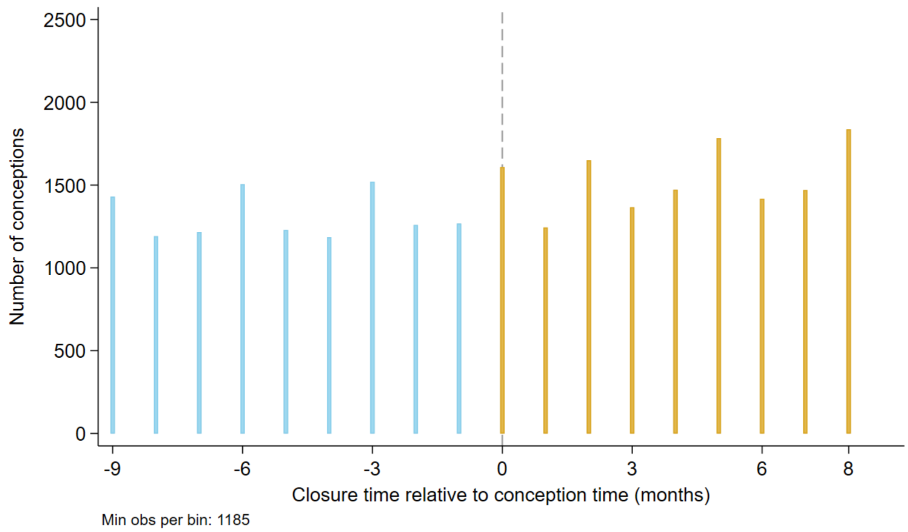
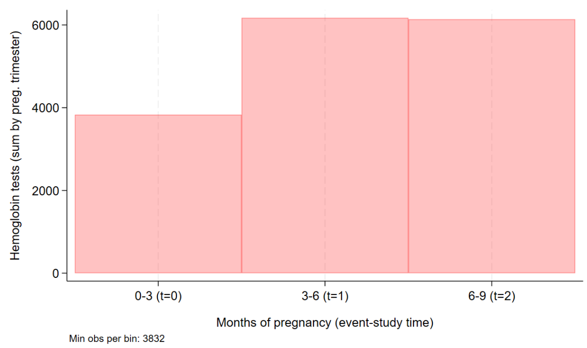


Fig. A3 Number of conceptions around practice closure

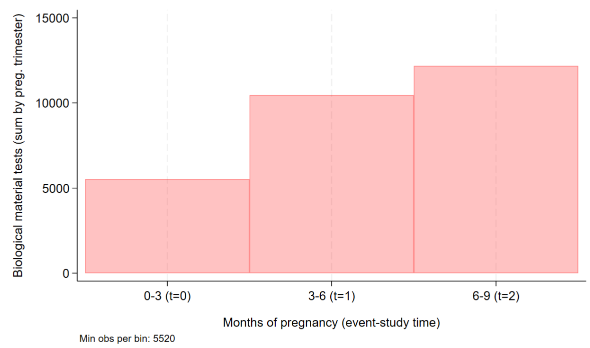
Notes: This figure presents the number of conceptions summed at the month of conception relative to the GP practice closure date. The x-axis represents the difference between conception and practice closure in months. The blue bars represent the control period, including mothers who faced a GP practice closure up to nine months prior to conception. The golden bars indicate the treatment period, covering mothers who experienced practice closures up to nine months post-conception. The sample includes Danish first-time mothers who faced a GP practice closure from 18 months before conception to 9 months after conception and who gave birth between 2006 and 2018.

B Tests during pregnancy

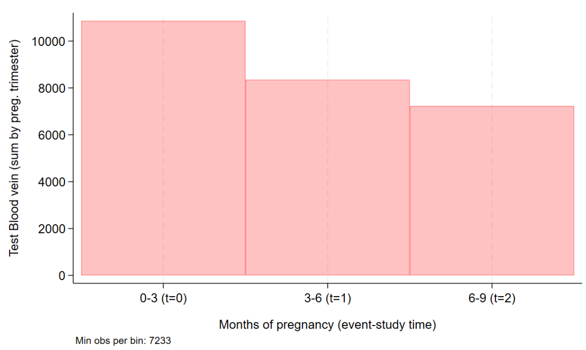
B.1 Blood Tests



(a) Hemoglobin tests (photometry)



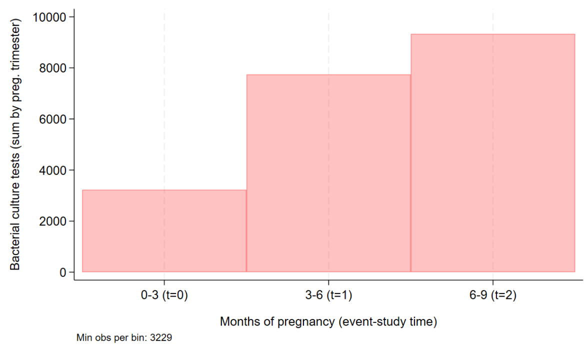
(b) biological material tests



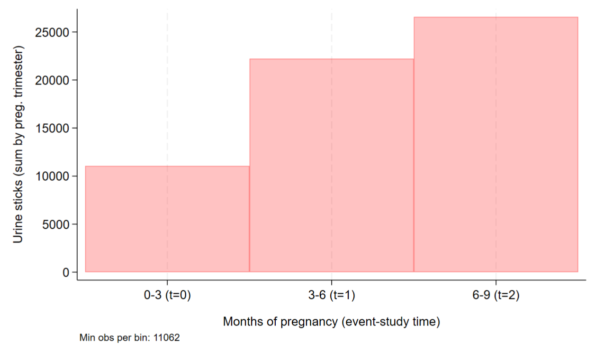
(c) Blood tests in the vein

Fig. A4 Sums of the three most common blood tests in sample by pregnancy trimester
Notes: These figures display the respective sums of the three most common blood tests in sample by pregnancy trimester. The sample includes Danish first-time mothers who faced a GP practice closure from 18 months before conception to 9 months after conception and who gave birth between 2006 and 2018.

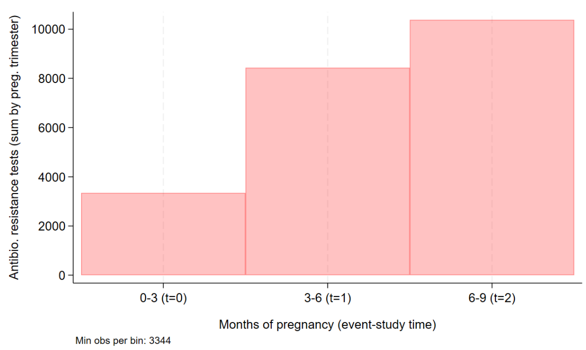
B.2 Urine Tests



(a) Bacterial culture



(b) Urine sticks



(c) Antibiotic resistance testing

Fig. A5 Sums of the three most common urine tests in sample by pregnancy trimester
Notes: These figures display the respective sums of the three most common blood tests in sample by pregnancy trimester. The sample includes Danish first-time mothers who faced a GP practice closure from 18 months before conception to 9 months after conception and who gave birth between 2006 and 2018.

C Additional event-studies

C.1 The effect of GP practice closure on fetal growth (grams per week)

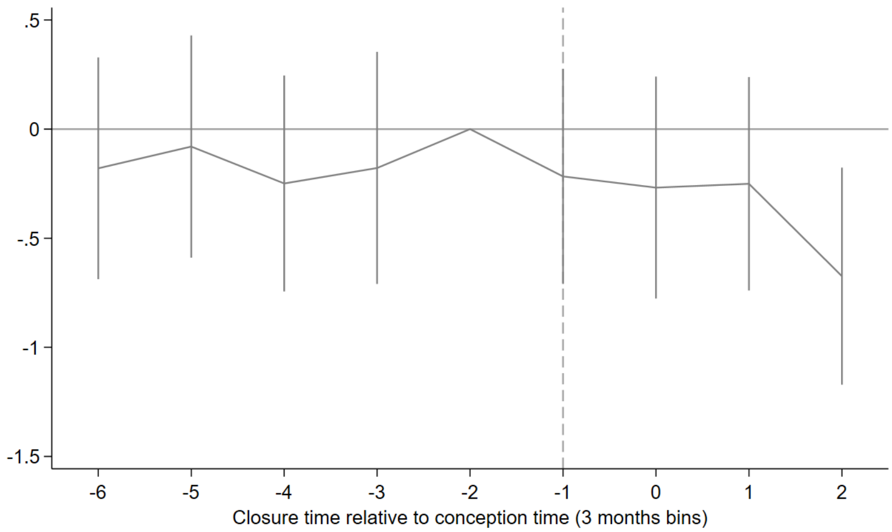


Fig. A6 Event study: the effect of GP practice closures on fetal growth (grams per week)

Notes: The figure plots coefficients along with 90 percent confidence intervals from an event study analysis and includes the full set of covariates and fixed effects described in Section 3. The sample includes Danish first-time mothers who faced a GP practice closure from 18 months before conception to 9 months after conception and who gave birth between 2006 and 2018. The x-axis represents the time of practice closure relative to the time of conception (in 3-months bins). The vertical dashed line marks the $t = -1$ period in which the closure happens in the three months period prior to conception. All estimates to the left of this line are outcomes for mothers who faced a closure before their pregnancy, whereas estimates after this line are outcomes for mothers who faced a closure after conception. Event time is hence defined such that t=0 indicates the mother faced a closure during the first pregnancy trimester, t=1 indicates the closure occurred during the second pregnancy trimester, and t=2 corresponds to a practice closure during the third trimester of pregnancy.

C.2 The effect of GP practice closure on the total number of GP visits during pregnancy

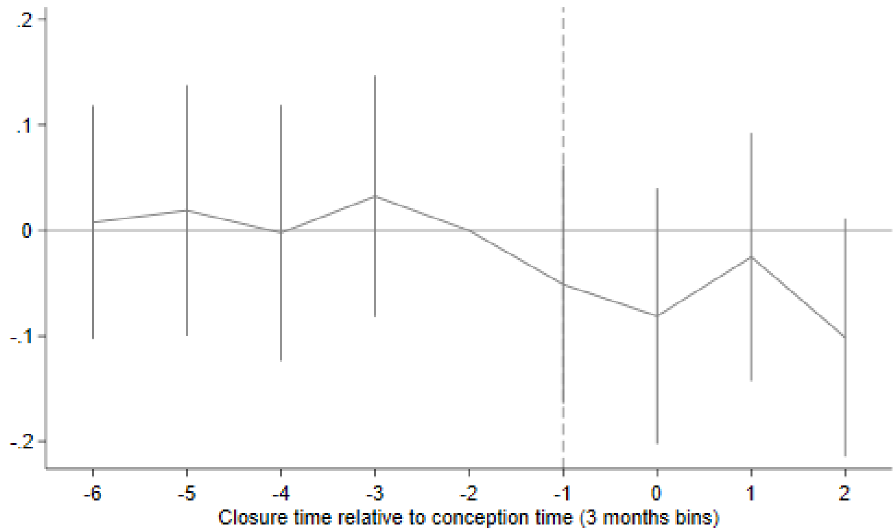


Fig. A7 Event study: the effect of GP practice closures on the total number of GP visits during pregnancy

Notes: The figure plots coefficients along with 90 percent confidence intervals from an event study analysis and includes the full set of covariates and fixed effects described in Section 3. The sample includes Danish first-time mothers who faced a GP practice closure from 18 months before conception to 9 months after conception and who gave birth between 2006 and 2018. The x-axis represents the time of practice closure relative to the time of conception (in 3-months bins). The vertical dashed line marks the $t = -1$ period in which the closure happens in the three months period prior to conception. All estimates to the left of this line are outcomes for mothers who faced a closure before their pregnancy, whereas estimates after this line are outcomes for mothers who faced a closure after conception. Event time is hence defined such that t=0 indicates the mother faced a closure during the first pregnancy trimester, t=1 indicates the closure occurred during the second pregnancy trimester, and t=2 corresponds to a practice closure during the third trimester of pregnancy.

C.3 The effect of GP practice closure on the sum of the 6 most common blood and urine tests performed during pregnancy

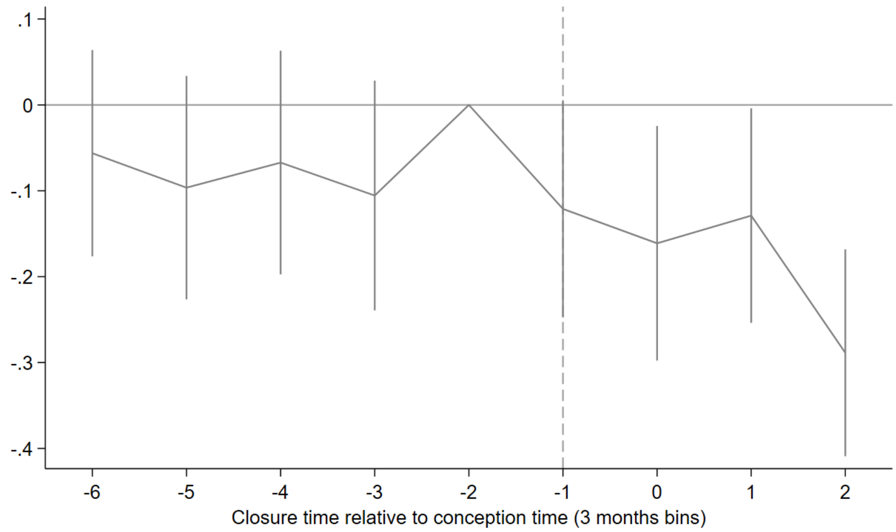


Fig. A8 Event study: the effect of GP practice closures on the sum of the 6 most common blood and urine tests performed during pregnancy

Notes: The figure plots coefficients along with 90 percent confidence intervals from an event study analysis and includes the full set of covariates and fixed effects described in Section 3. The sample includes Danish first-time mothers who faced a GP practice closure from 18 months before conception to 9 months after conception and who gave birth between 2006 and 2018. The x-axis represents the time of practice closure relative to the time of conception (in 3-months bins). The vertical dashed line marks the $t = -1$ period in which the closure happens in the three months period prior to conception. All estimates to the left of this line are outcomes for mothers who faced a closure before their pregnancy, whereas estimates after this line are outcomes for mothers who faced a closure after conception. Event time is hence defined such that t=0 indicates the mother faced a closure during the first pregnancy trimester, t=1 indicates the closure occurred during the second pregnancy trimester, and t=2 corresponds to a practice closure during the third trimester of pregnancy.

C.4 The effect of GP practice closure on the probability to have had at least one of the three most common blood tests

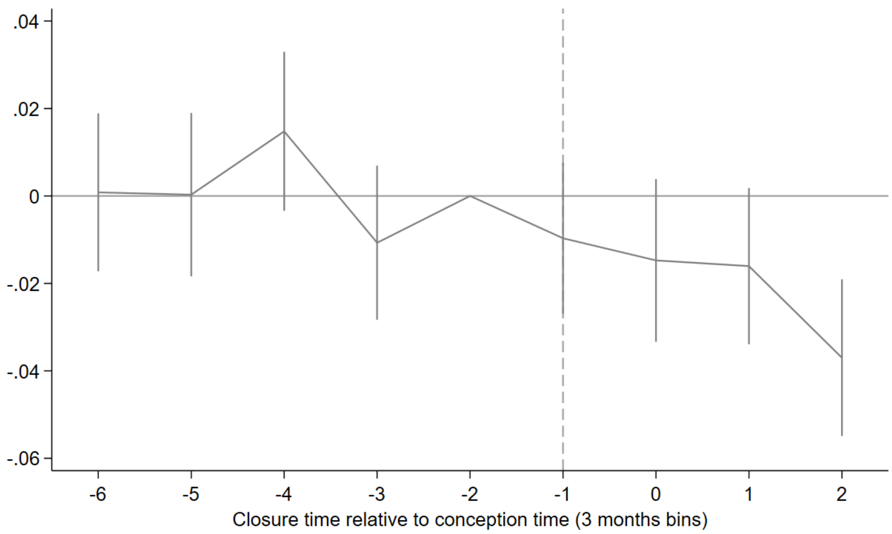


Fig. A9 Event study: the effect of GP practice closures on the probability to have had at least one of the three most common blood tests

Notes: The figure plots coefficients along with 90 percent confidence intervals from an event study analysis and includes the full set of covariates and fixed effects described in Section 3. The sample includes Danish first-time mothers who faced a GP practice closure from 18 months before conception to 9 months after conception and who gave birth between 2006 and 2018. The x-axis represents the time of practice closure relative to the time of conception (in 3-months bins). The vertical dashed line marks the $t = -1$ period in which the closure happens in the three months period prior to conception. All estimates to the left of this line are outcomes for mothers who faced a closure before their pregnancy, whereas estimates after this line are outcomes for mothers who faced a closure after conception. Event time is hence defined such that t=0 indicates the mother faced a closure during the first pregnancy trimester, t=1 indicates the closure occurred during the second pregnancy trimester, and t=2 corresponds to a practice closure during the third trimester of pregnancy.

C.5 The effect of GP practice closure on the probability to have had at least one of the three most common urine tests

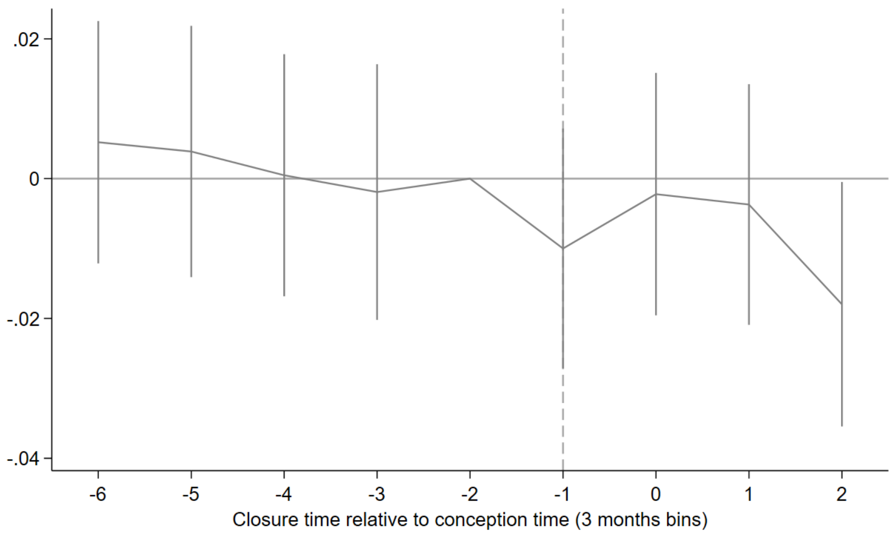


Fig. A10 Event study: the effect of GP practice closures on the probability to have had at least one of the three most common urine tests

Notes: The figure plots coefficients along with 90 percent confidence intervals from an event study analysis and includes the full set of covariates and fixed effects described in Section 3. The sample includes Danish first-time mothers who faced a GP practice closure from 18 months before conception to 9 months after conception and who gave birth between 2006 and 2018. The x-axis represents the time of practice closure relative to the time of conception (in 3-months bins). The vertical dashed line marks the $t = -1$ period in which the closure happens in the three months period prior to conception. All estimates to the left of this line are outcomes for mothers who faced a closure before their pregnancy, whereas estimates after this line are outcomes for mothers who faced a closure after conception. Event time is hence defined such that t=0 indicates the mother faced a closure during the first pregnancy trimester, t=1 indicates the closure occurred during the second pregnancy trimester, and t=2 corresponds to a practice closure during the third trimester of pregnancy.