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**JEL Codes:**

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# **Home-based postnatal coordinated care after hospital discharge: a PRADO French experiment**

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## **Abstract**

**Objective:** To determine the factors that affect enrollment and full participation (adherence) in the PRADO home-based postnatal coordinated care program in France after hospital discharge.

**Methods:** A population-based retrospective study was performed using the public health insurance database for the Yvelines district in France. The study population included all affiliated women admitted for delivery and classified as low risk in 2013. These women were eligible for home-based midwifery support after their discharge from the hospital. The enrollment and full participation of the women in home-based postnatal coordinated care were modeled using a simple probit model. Full participation in the home-based postnatal coordinated care was also modeled using a probit Heckman selection model in order to assess the self-selection process of enrollment in the program. The control variables were the characteristics of the patients, the municipalities, and the hospitals.

**Results:** 2,859 (68.3%) of the 4,189 eligible women chose to participate in the home-based postnatal coordinated care program, of whom 2,496 (59.6% of the eligible women) subsequently took part in the entire PRADO program. On the one hand, enrollment in the home-based postnatal coordinated care was influenced mostly by family context variables including the woman's age at the time of her pregnancy and the number of children in the household, the woman's level of information including prenatal education and prenatal information regarding postpartum care, as well as hospital variables including characteristics and organization of the maternity units. On the other hand, full participation in the home-based postnatal coordinated care was influenced by the accessibility to health professionals, particularly midwives.

Furthermore, both the woman's level of information and accessibility to health professionals correlated with the socioeconomic environment.

**Conclusion:** Women who become pregnant at a very early or late stage of their life as well as women with low levels of prenatal education and prenatal information regarding postpartum care have a relatively low rate of participation in home-based postnatal coordinated care. A public health policy promoting awareness of prenatal as well as postnatal issues could increase the participation in this coordinated community care. In addition, reducing regional inequality is likely to have a positive impact, as the availability of midwives is a key factor for participation in home-based postnatal coordinated care.

**Keywords:** Postnatal care; Home-based coordinated care; Information; Health professional accessibility; Inequity

# Introduction

The length of hospital stay following delivery has gradually decreased in most high-income countries over the past 40-50 years as a result of medical, economic, social, cultural, and political changes [1, 2]. The main factors underlying this trend of reduced reliance on postnatal care in the hospital setting include increased efforts to reduce the risk of nosocomial infections, stress, and sleeping disorders for women and their newborns [3], to improve satisfaction during this period by supporting parental requests to return home soon after the childbirth [4], and to limit the cost to the healthcare system [5].

A consensus has not been reached to date regarding the appropriate length of postpartum stay in the hospital. The World Health Organization (WHO) recommends that all women should remain in the hospital at least 24 hours after childbirth. This recommendation is mainly intended for low-income countries, as it allows identification of any serious complications that require emergency care [6]. However, postpartum care is an important preventive support that should not be limited to the immediate postpartum period. It allows monitoring and treatment of complications in the mother and/or the newborn, the provision of support to facilitate the woman's transition to going home, counseling regarding infant feeding, parent education processes for newborn care, and health promotion indications [7]. Although it varies considerably, the average length of the hospital stay for low-risk mothers and newborns recommended in several high-income countries is approximately three days [8, 9, 10].

The current trend of healthcare services to encourage early hospital discharge of women following delivery has led to a number of concerns. These are centered on the notion that hospitals may not be providing sufficient appropriate services or infrastructure support to

women as a result of this trend of early discharge from the hospital after childbirth. Reduction in the length of stay underscores the need for home-based postnatal coordinated care to support women who are discharged from the hospital before they have received adequate education regarding being a new parent. Several learned societies in the Western World have suggested that postnatal management should incorporate well-established home-based postnatal coordinated care after discharge from the hospital [8, 9, 11]. However, while hospital care is provided to all admitted patients, some women may end up not continuing with the postpartum coordinated care once they have been discharged.

Our study objective was to identify the determinants of the use, both in terms of enrollment and full participation (adherence), of home-based postnatal coordinated care after being discharged from the hospital. We focused not only on patient-level variables including household characteristics and prenatal and postnatal care characteristics but also on factors related to the hospitals and to the healthcare system including the accessibility to health professionals. Our study tested the hypothesis that specific patient, municipality, and/or hospital characteristics can impact the initial enrollment and/or full participation in home-based postnatal coordinated care. As a first step, we considered the initial enrollment in the program as a random process. As a second step, we considered a selection model where we first modeled the patient decision for enrollment in the program; Secondly, we identified the determinants impacting the women's full participation in the program.

# **Materials and methods**

## **Data source**

This was a French population-based retrospective study of women eligible for coordinated postnatal care after discharge from the hospital. Since 2010, the single-payer public health insurance system has provided home-based coordinated care to support women once they have been discharged from the hospital after having given birth. First, a public health insurance advisor at the maternity ward assists the woman with getting in touch with a midwife. If the woman is interested in participating in the home-based postpartum coordinated care program (PRADO), two visits are scheduled between day 0 (day of delivery) and day 7, and the first visit has to be on the first day after the woman's return home. The hospital discharge under the PRADO program depends on the approval of the maternity medical team (doctor or midwife).

The data were from three linked administrative datasets for the year 2013. The main dataset was extracted from the public health insurance dataset of the Yvelines district, which contains all of the insured people of the district (100% of the population). The data comprised the information regarding the women's individual demographic, socioeconomic, and location data, as well as the characteristics of the prenatal and the postnatal care of the women, and information regarding the hospital of admission. The second dataset, compiled by the French National Institute of Statistics, was extracted from population census data and it provided information regarding the socioeconomic situation of all French municipalities. The third dataset, compiled by the Ministry of Health, provided information regarding the accessibility to health professionals for all French municipalities. The three datasets were merged using the denomination and the code of the municipality of residence of the women.



## **Study population**

The study population consisted of all women affiliated with the public health insurance agency of the Yvelines district and who were eligible for home-based postnatal coordinated care (N=4,189). To be eligible, women had to be at low clinical risk and admitted to a hospital for delivery: women aged 18 years and older, without any co-morbidity or complications, giving birth by vaginal delivery at full term to a singleton infant not requiring maintenance in a medical environment nor a particular feeding mode.

## **Study variables**

Our variables included individual characteristics of the women including characteristics of their household and of their prenatal and postnatal care, municipality characteristics, and the hospital characteristics and organization.

The patient-level variables considered were age (five age brackets: 18 to 23 years, 24 to 29 years, 30 to 35 years, 36 to 41 years, and 42 years or older), the number of children in the household (four categories: 1, 2, 3, and 4 children or more), the type of healthcare coverage (two categories: policyholder and person eligible for benefits, referred to here as the beneficiary), the number of antenatal visits (three categories: 0 to 5, 6 or 7, and 8 visits or more), prenatal follow-up by a gynecologist (two categories: yes and no, "yes" if at least one antenatal visit), prenatal follow-up by a general practitioner (two categories: yes and no, "yes" if at least one antenatal visit), prenatal follow-up by a midwife (two categories: yes and no, "yes" if at least one antenatal visit), prenatal hospital follow-up (two categories: yes and no, "yes" if at least one antenatal visit), prenatal community follow-up (two categories: yes and no, "yes" if at least one antenatal visit), the number of obstetric ultrasounds (three categories: 0 to 1, 2 or 3, and 4 ultrasounds or more), prenatal education (two categories: yes and no), prenatal information regarding postnatal care (two categories: yes and no), and postnatal

hospital readmission of the woman or the newborn until day 7 (two categories: yes and no). The municipality-level variables considered were the location of the municipality (urban, rural), household deprivation as assessed by the median annual income (four categories at regular intervals based on the variable values and not the variable distribution in the population: least deprived (from 37,300 to 46,100 euros), less deprived (from 28,500 to 37,299 euros), more deprived (from 19,700 to 28,499 euros), and most deprived (from 10,900 to 19,699 euros)), accessibility to a gynecologist as assessed by the index of spatial accessibility (ISA) (four categories at regular intervals based on the variable values: lowest (1 to 4.7), low (4.8 to 8.5), high (8.6 to 12.3), and highest (12.4 to 16)), accessibility to a general practitioner as assessed by the ISA (four categories at regular intervals based on the variable values: lowest (7 to 31.9), low (32 to 56.9), high (57 to 81.9), and highest (82 to 106)), and accessibility to a midwife as assessed by the ISA (four categories at regular intervals based on the variable values: lowest (1 to 2.4), low (2.5 to 3.9), high (4 to 5.4), and highest (5.5 to 7)). The hospital-level variables considered were funding of the hospital (two categories: public and private), hospital university status (two categories: teaching and non-teaching), level of care of the maternity ward (three categories: no neonatology unit, neonatology unit, and neonatal intensive care unit), staffing levels for obstetricians as measured by the number of obstetricians in full-time equivalents (FTEs) per 100 deliveries, staffing levels for midwives as measured by the number of midwives in FTEs per 100 deliveries, the day of delivery (two categories: working day and non-working day), and the day of hospital discharge (two categories: working day and non-working day).

The index of spatial accessibility (ISA) used here was developed by the French Ministry of Health (*indicateur d'accessibilité potentielle localisée (APL)*). This index provides a measure of the spatial adequacy between supply and demand for primary care at a local level. It aims to improve the usual indicators of accessibility to care. It is captured, on the supply side, by

the density of health professionals while taking into account their practice rates in the health area and, on the demand side, by the geographical distance between patients and the professionals in the zone defined above while considering differences in patient age groups and in the observed rates of attendance by professionals [12]. This index is based on the "two-step floating catchment area" method and it is interpreted as a density [13].

## **Statistical analysis**

We studied the main factors that affect the use of home-based postnatal coordinated care. As a first model, we assessed the probability of choosing to participate in home-based postnatal coordinated care. Using a probit regression, we estimated the probability of the initial enrollment in the PRADO program for all of the eligible women as a function of the household and prenatal care characteristics, the municipality characteristics, as well as the hospital characteristics and organization. Enrollment was defined as a dummy variable equal to 1 with enrollment in the PRADO program and equal to 0 when the woman did not wish to participate in the PRADO program.

We then estimated the probability of full participation in home-based postnatal coordinated care. Full participation in the coordinated program was defined as agreeing to partake in the two home-based postnatal visits, with the first visit in the first 24 hours after being discharged. Full participation was defined as a dummy variable equal to 1 with full participation in the PRADO program and equal to 0 when the woman did not partake in the entire PRADO program. Only one woman was available for the first visit for the program but then declined further participation. As the independent variables, we considered a vector of explanatory variables with household characteristics, prenatal care variables, postnatal hospital readmission, and the municipality characteristics including indicators of the

accessibility to health professionals. First, we studied the population of women enrolled in this postpartum care program. In the sample, 68% of the patients eligible for this program decided to participate. We thus estimated a probit regression for the probability of full participation in the PRADO program (second model). The results obtained here were conditional on the decision to participate. In case the selection process to enroll or not to enroll was non-exogenous, we used a Heckman probit model to assess the probability of full participation in the PRADO program (third model) [14]. We assumed that the hospital characteristics affect the decision to participate but that they do not affect full participation once the woman has decided to participate in the program [15].

Finally, when relevant, we measured the correlation between any determinant factor(s) that significantly impacted the initial enrollment and/or full participation in the home-based postnatal care program and the socioeconomic environment as measured by the median annual income of the municipality.

All probit models were performed using the cluster-robust variance that accounted for the dependence between the observations at the municipality level. The results are reported as coefficients with their 95% confidence intervals (CIs). The significance levels are two-sided with a probability threshold of  $p < 0.05$ . The analyses were performed using Stata software (Stata Corporation, College Station, TX, USA) [16].

## **Ethics statement**

The extraction and analysis of the data for scientific research were conducted with permission from the public health insurance agency of the Yvelines district, which is the entity responsible for this data. Informed consent was not required as the study was based on routinely collected de-identified administrative data, as regulated by French law. The data used for this study were reported to the National Data Protection Authority.

## Results

A total of 4,189 eligible women were included in the analysis. Of these, 2,859 women chose to participate in the home-based postnatal coordinated care after their discharge from the hospital, thus amounting to 68.3% of the total (95% CI [66.8;69.6]). Of the women who opted for the home-based postnatal coordinated care, 2,496 participated in the full PRADO program, thus amounting to 87.3% (95% CI [86.0;88.5]) of the women who chose to participate and 59.6% (95% CI [58.1;61.1]) of the total number of eligible women. Table 1 presents the descriptive statistics.

Table 2 shows the determinants of the initial enrollment in the home-based postnatal coordinated care (PRADO) for all of the eligible women. The results are reported in terms of coefficients. We found several groups of observable factors that were significantly associated with enrollment in the home-based coordinated postnatal care program. The first group of factors was the household characteristics: women with a pregnancy at a very early or late stage of their life, those having three children or more, and women who were not health insurance policyholder but were eligible for benefits (referred to here as a beneficiary) had a lower probability of enrollment in the PRADO program. These variables, especially healthcare coverage variable, may capture socioeconomic aspects such as occupation or employment status. The second group of factors was the prenatal and postnatal information collected: participation in a prenatal education program and participation in a communication program for prenatal information on postpartum care. These programs aimed at providing information are organized and presented by the medical staff during the pregnancy. We found that the women who attended a prenatal education program and those who had received information regarding postnatal care were more likely to enroll in the PRADO program. The

third group of factors was the hospital unit characteristics: women admitted to private hospitals, non-teaching hospitals, those with a high level of care (based on the presence of a specific neonatology care unit), and those with a high level of staffing of both obstetricians and midwives (as measured by the FTE appointments per 100 deliveries over the average) had a relatively low probability of enrollment in the program. Furthermore, women who delivered on non-working days and those who were discharged on working days were more likely to enroll in the PRADO program.

These results highlight the conditions that affect the initial enrollment of women in the PRADO program. As a result, the conditions for home-based postnatal coordinated care enrollment were: 1- the household's intrinsic characteristics, 2- the extent to which the woman had been informed regarding the delivery and the post-delivery period, 3- the hospital characteristics and organization.

The impact of accessibility to a gynecologist was only observed for women living in areas with a high level of accessibility to a gynecologist. This variable may capture other aspects of the women or the municipality.

Table 3 provides the probit model estimates of the full participation in the home-based postnatal coordinated care for the sample of women who opted for the PRADO program. The results are reported in terms of coefficients. A prenatal education program impacted the probability of full participation. Indeed, the women who participated in a prenatal education program were more likely to fully participate in the postnatal coordinated program. As expected, hospital readmission up to 7 days after childbirth decreased the probability of full participation. In terms of factors related to the healthcare system, we found that the accessibility to midwives impacted the probability of full participation in the PRADO program. Using the index of spatial accessibility (ISA), we observed that increased

accessibility to a midwife increased the probability of full participation. Accessibility to a gynecologist and accessibility to a general practitioner were not associated with any change in the PRADO program follow-up. Unexpectedly, although the number of children in the household affected full participation in the program before adjustment on other variables, we found that the number of children did not affect full participation in the program after controlling for healthcare accessibility and the prenatal education program. As robustness checks, presented in Table A1 in the Appendix, we also included the hospital characteristics variables and hospital organization variables, and we found that the characteristics and the organization of the hospitals were not associated with the women's full participation in the home-based postnatal coordinated care.

Thus far, we assumed that the enrollment in the PRADO program was a random process. We then considered the self-selection bias in the decision to participate in the PRADO program. Table 4 shows the results regarding the probability of full participation in the home-based postnatal coordinated care program for all of the eligible women when taking into account this potential self-selection. We thus regressed a probit Heckman selection model. The results are reported as coefficients. Taking into account the initial enrollment of women in the PRADO program, we controlled for the same entire set of observable characteristics as used before. The impact of the accessibility to a midwife on full participation in the home-based postnatal coordinated care program remained statistically significant, that is to say, women with a higher level of accessibility to a midwife were more likely to fully participate in the PRADO program. Moreover, the effect of postnatal readmission to the hospital during the first seven days was still significant. However, the effect of a prenatal education program was no longer significant after taking into account the self-selection bias. The results of the selection equation are reported in Table A2 in the Appendix. The independent significant

variables of the selection equation were quite similar to what was found when the probability of PRADO program enrollment was estimated without accounting for self-selection (Table 2). We did not interpret Rho because its nature is extremely sensitive to model specification.

Thus, these results show that a number of patient-, municipality- and hospital-level factors impacted the use of the home-based postnatal coordinated care program (PRADO).

We also computed the correlation between the woman's level of information and the socioeconomic environment (measured as the median annual income in the municipality). The correlation was significantly positive for both prenatal education and prenatal information regarding postpartum care (coefficient = 0.17,  $p < 0.001$ , and coefficient = 0.13,  $p < 0.001$ , respectively). Thus, the higher the median annual income in the municipality, the higher the woman's level of information. We also estimated the correlation between the accessibility to a midwife and the socioeconomic environment on the subsample of all of the women's municipalities ( $n = 279$ ). The correlation was significantly positive (coefficient = 0.35,  $p < 0.001$ ). Thus, the higher the median annual income, the greater the accessibility to a midwife. As a sensitivity analysis, we also computed the same correlation at the national level using all French municipalities. The results remained unchanged (Table A3 in the Appendix).



# **Discussion**

## **Key findings**

Of the total pool of eligible low-risk women giving birth in hospitals in the Yvelines district, 59.6% of them enrolled and subsequently fully participated in the home-based postnatal coordinated care program after discharge. Controlling for the full set of independent factors, the household's intrinsic characteristics, the woman's level of information, and the hospital characteristics and organization impacted enrollment in the PRADO program, while accessibility to health professionals impacted full participation in the PRADO program. Furthermore, the level of information and accessibility to healthcare professionals correlated with a higher socioeconomic environment.

## **Strengths and limitations**

To the best of our knowledge, this study is the first research analysis of access to the PRADO program. On the one hand, our study has many strengths. First, we had access to a large dataset of women eligible for the home-based PRADO program and who had given birth in different hospitals of the Yvelines district. Also, the dataset used for the analysis was checked by the statistics department of the public health insurance of the Yvelines district. Notably, it did not include any missing values for the variables considered in the study. Both the large scale and the high quality of the data allowed us to obtain reliable and accurate results. Secondly, we used many available variables, which enabled us to consider different characteristics of the women throughout their maternity trajectories at the patient, municipality, and hospital levels. This reduced the risk of confusion bias. Thirdly, we considered the entire population of eligible women with respect to the postnatal coordinated

care rather than just the subset of women who chose to participate in the PRADO program. This allowed us to address the possible individual self-selection in enrollment in this program, as we employed a Heckman selection model to manage self-selection bias. Fourthly, in order to estimate the accessibility to primary health professionals, we used the index of spatial accessibility (ISA), which made it possible to simultaneously consider healthcare supply, demand, and access. Indeed, this new indicator is more accurate than the usual indices of healthcare accessibility such as access time, access distance, and density by living area including health professional population ratios.

On the other hand, our analysis could also have some limitations. The study involved women affiliated with a French local public health insurance system. However, the single-payer structure of the French healthcare system (100% of the population) eliminated the potential for program choice to be dictated by the type of health insurance coverage and thus provided a good setting in which to carry out this study. Moreover, the Yvelines district includes differences in terms of socioeconomic environment and accessibility to health professionals [17]. The diversity of geographic conditions covered by the Yvelines district supports the representativeness of the study and, therefore, the transferability of our results to the French situation. Finally, we used the index of spatial accessibility (ISA) produced by the French Ministry of Health. This indicator is estimated at the municipality level. However, this multidimensional index is assessed using different parameters of healthcare supply and demand that allows disparities in access to healthcare to be captured that a standard density indicator will tend to mask [18].

## **Interpretation**

The first finding of our study was that only a portion of the women eligible for the home-based postnatal coordinated care decided to enroll and fully participated in this program after their hospital discharge. During the hospital stay, similar healthcare services are offered to all patients. However, once they have been discharged from the hospital, the patient is expected to be active and responsible for their health. They should, therefore, understand the medical recommendations and organize their care pathway accordingly. This raises the role of the patient and their environment in the use of ambulatory healthcare services [19].

This observation led us to consider why some patients did not use the recommended home-based postnatal coordinated care. We sought to identify the determinant factors that explain both the initial enrollment and full participation in this postpartum care program. We considered a wide range of different patient, area-based, and hospital variables, and we found that the household's intrinsic characteristics including demographic and family-context variables, the woman's level of information including prenatal education and prenatal information regarding postpartum care, and hospital variables including characteristics and organization of maternity units impacted enrollment in the PRADO program, while we found that accessibility to primary healthcare professionals, particularly accessibility to a midwife, impacted full participation in the PRADO program. Notably, pregnancy in middle age, a low number of children, a high level of information, and some hospital characteristics increased enrollment in the home-based postnatal coordinated care program, while greater accessibility to a midwife increased full participation in the program. A number of previous studies have reported the same findings for different community medical care services. A US study has observed substantial differences in diagnostic practices across regions that could be explained by patient characteristics but that could also be related to local conditions [20]. A German study has found that differences in demography and the supply of services explained part of

the variation in the utilization of ambulatory services for general practitioner, specialist, and psychotherapist consultations [21]. A Swedish study has indicated that demography could explain a considerable part of the regional variation in visits to outpatient specialists, while basic supply-side factors, including the proportion of providers and physicians per inhabitants, could explain part of the regional variation in primary physician visits [22]. Another US study found that patient information regarding integrated care was associated with outpatient utilization but not inpatient utilization [23]. A German study has reported that cancer-screening services were significantly higher in areas with higher physician density [24]. Another German study found that supply-side factors accounted for most of the regional inequities in the actual utilization of outpatient health services [25].

Finally, we observed that the woman's level of information and the area-based accessibility to professionals correlated with the socioeconomic environment. That is to say, a higher level of information and accessibility to a midwife correlated with a higher socioeconomic environment. Past analyses have shown that socioeconomic factors impact women's participation in prenatal education during their maternity pathway [26]. Furthermore, a number of recent studies have reported a relationship between local socioeconomic conditions, the distribution of healthcare professionals, and the efficiency of healthcare provision [27, 28]. The French healthcare system, although it has a high level of favorable health outcomes and patient satisfaction, still suffers from socioeconomic, geographic, and cultural health inequalities, including iniquity in terms of access to relevant health information and to healthcare professionals, which could both be major barriers to health equity [29]. This is also the current situation in many other developed countries [30, 31]. Moreover, the issue of socioeconomic disparities is the focus of much attention in reproductive health and still needs to be addressed more thoroughly [26].

## **Policy implication and prospects**

In recent years, ambulatory care has been promoted as an effective healthcare service that could replace unnecessary hospital stay care, which should only be reserved for patients requiring continuous medical surveillance. This ambulatory shift has accentuated the need for adequate investment in patient empowerment and community infrastructure to ensure continuity of care.

The results of our study may have a number of public policy implications. A straightforward implication would be that health policies promoting the level of information of patients or accessibility to primary health professionals, which are possibly editable components of the healthcare system, could lead to better follow-up of community care, especially after hospital discharge. Furthermore, since these two factors differ across different socioeconomic environments, patient and spatial needs along with social characteristics should be considered in order to improve the allocation of medical services.

The French public insurance system recently implemented financial incentives to promote the appointment and retention of independent health professionals, including midwives, in areas where the supply of care is insufficient or the access to care is difficult [32]. Future research should study the impact of such experimentations on the use of outpatient care. Moreover, other interventions that may enhance access to healthcare professionals should be investigated. For instance, in the National Health Service, one study on home-based postnatal care that involved a series of home visits reported that small increases in travel time of midwives boosted continuity of care and, therefore, access to community midwifery services [33]. Financial incentives can also be used to promote the degree to which women are informed. As an example, the financial aid usually allocated to future parents to prepare for

the arrival of their child, which is more important for the socially disadvantaged population, could be modulated according to the degree of the woman's use of prenatal care.

## **Conclusion**

In conclusion, enrollment in the PRADO home-based postnatal coordinated care program was determined primarily by the household intrinsic characteristics, the woman's level of information, and hospital characteristics and organization; while full participation (adherence) in the program was determined primarily by the accessibility to health professionals. These findings emphasize the importance of improving the level of information and the accessibility to professionals, which are both lower for less affluent women, as potential ways to get more women to use community postnatal care. Future high-quality studies are needed to evaluate the effect of interventions that increase patient empowerment or healthcare access on postnatal care use.

### **Author Contributions:**

PR provided the data. CM and SZ analyzed the data. CM and SZ interpreted the results and wrote up the manuscript. CM, PR, and SZ read and reviewed the final manuscript.

### **Data Availability Statement:**

The data were not generated by the authors but are compiled, maintained, and distributed by the public health insurance agency of the Yvelines district. The authors confirm that access to the data is subject to certain restrictions, thus rendering some of the data not publicly available.

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### **Competing Interests:**

The authors declare that there are no competing interests.



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# Tables

**Table 1.** Descriptive characteristics of the study population.

	<b>Women opting to participate in the PRADO program</b> (n = 2,859)	<b>All of the women eligible for the PRADO program</b> (n = 4,189)
<b>Household characteristics</b>		
Woman's age at pregnancy (years), n (%)		
18 - 23	176 (6.16)	312 (7.45)
24 - 29	978 (34.21)	1,413 (33.73)
30 - 35	1,196 (41.83)	1,711 (40.85)
36 - 41	473 (16.54)	685 (16.35)
≥ 42	36 (1.26)	68 (1.62)
Number of children, n (%)		
1	1,720 (60.16)	2,348 (56.05)
2	713 (24.94)	1,056 (25.21)
3	286 (10.00)	518 (12.37)
≥ 4	140 (4.90)	267 (6.37)
Woman's healthcare coverage, n (%)		
Policyholder	2,625 (91.82)	3,751 (89.54)
Beneficiary	234 (8.18)	438 (10.46)
<b>Prenatal care</b>		
Antenatal visits, n (%)		
0 - 5	769 (26.90)	1,205 (28.77)
6 - 7	666 (23.29)	974 (23.25)
≥ 8	1,424 (49.81)	2,010 (47.98)
Follow-up by a gynecologist <sup>a</sup> , n (%)		
No	765 (26.76)	1,156 (27.60)
Yes	2,094 (73.2)	3,033 (72.40)
Follow-up by a general practitioner <sup>a</sup> , n (%)		
No	835 (29.21)	1,256 (29.98)
Yes	2,024 (70.79)	2,933 (70.02)
Follow-up by a midwife <sup>a</sup> , n (%)		
No	1,257 (43.97)	1,907 (45.52)
Yes	1,602 (56.03)	2,282 (54.48)
Hospital follow-up <sup>a</sup> , n (%)		
No	898 (31.41)	1,309 (31.25)
Yes	1,961 (68.59)	2,880 (68.75)
Community follow-up <sup>a</sup> , n (%)		
No	388 (13.57)	605 (14.44)
Yes	2,471 (86.43)	3,584 (85.56)
Obstetric ultrasound, n (%)		
0 - 1	761 (26.62)	1,213 (28.96)
2 - 3	1,346 (47.08)	1,913 (45.67)
≥ 4	752 (26.30)	1,063 (25.38)
Prenatal education, n (%)		
No	1,583 (55.37)	2,631 (62.81)
Yes	1,276 (44.63)	1,558 (37.19)
Prenatal information regarding postpartum, n (%)		
No	2,416 (84.51)	3,709 (88.54)
Yes	443 (15.49)	480 (11.46)
<b>Postnatal care</b>		
Hospital readmission, n (%)		
No	2,811 (98.32)	4,123 (98.42)
Yes	48 (1.68)	66 (1.58)
<b>Municipality characteristics</b>		
Location, n (%)		
Urban	2,647 (92.58)	3,890 (92.86)

Rural	212 (7.42)	299 (7.14)
Household deprivation <sup>b</sup> , n (%)		
Least deprived	70 (2.45)	96 (2.29)
Less deprived	745 (26.06)	971 (23.18)
More deprived	1,371 (47.95)	1,966 (46.93)
Most deprived	673 (23.54)	1,156 (27.60)
Accessibility to a gynecologist <sup>c</sup> , n (%)		
Lowest	560 (19.59)	819 (19.55)
Low	1,771 (61.94)	2,661 (63.52)
High	439 (15.36)	602 (14.37)
Highest	89 (3.11)	107 (2.55)
Accessibility to a general practitioner <sup>c</sup> , n (%)		
Lowest	73 (2.55)	104 (2.48)
Low	1,091 (38.16)	1,526 (36.43)
High	1,166 (40.78)	1,677 (40.03)
Highest	529 (18.50)	882 (21.06)
Accessibility to a midwife <sup>c</sup> , n (%)		
Lowest	78 (2.73)	118 (2.82)
Low	1,518 (53.10)	2,275 (54.31)
High	1,101 (38.51)	1,588 (37.91)
Highest	162 (5.67)	208 (4.97)
<b>Hospital characteristics</b>		
Funding, n (%)		
Public	2,398 (83.88)	3,531 (84.29)
Private	461 (16.12)	658 (15.71)
University status, n (%)		
Non-teaching	1,423 (49.77)	2,303 (54.98)
Teaching	1,436 (50.23)	1,886 (45.02)
Level of care, n (%)		
No neonatology unit	376 (13.15)	611 (14.59)
Neonatology unit	816 (28.54)	1,173 (28.00)
Neonatal intensive care unit	1,667 (58.31)	2,405 (57.41)
Obstetricians <sup>d</sup> , mean ± SD	0.47 ± 0.12	0.48 ± 0.12
Midwives <sup>d</sup> , mean ± SD	1.73 ± 0.31	1.71 ± 0.30
Day of delivery, n (%)		
Working	2,776 (97.10)	4,082 (97.45)
Non-working	83 (2.90)	107 (2.55)
Day of discharge, n (%)		
Working	2,790 (97.59)	4,074 (97.25)
Non-working	69 (2.41)	115 (2.75)

<sup>a</sup> At least one antenatal visit

<sup>b</sup> Based on the median annual income

<sup>c</sup> Based on the index of spatial accessibility (ISA)

<sup>d</sup> FTEs (full-time equivalents) per 100 deliveries

**Table 2.** Factors associated with initial enrollment in the home-based postnatal coordinated care (PRADO) for all of the women eligible for this program. Probit regression model (n = 4,189).

	Coefficient	[95% CI]
<b>Household characteristics</b>		
Woman's age at pregnancy (years)		
18 - 23	-0.31***	[-0.44;-0.18]
24 - 29	-0.04	[-0.13;0.05]
30 - 35	reference	
36 - 41	0.07	[-0.04;0.18]
≥ 42	-0.42**	[-0.69;-0.14]
Number of children		
1	reference	
2	-0.09	[-0.20;0.02]
3	-0.28***	[-0.40;-0.17]
≥ 4	-0.31***	[-0.47;-0.15]
Woman's healthcare coverage		
Policyholder	reference	
Beneficiary	-0.15*	[-0.28;-0.01]
<b>Prenatal care</b>		
Antenatal visits		
0 - 5	-0.05	[-0.19;0.09]
6 - 7	reference	
≥ 8	-0.02	[-0.13;0.09]
Follow-up by a gynecologist <sup>a</sup>		
No	reference	
Yes	-0.09	[-0.23;0.06]
Follow-up by a general practitioner <sup>a</sup>		
No	reference	
Yes	0.09	[-0.03;0.21]
Follow-up by a midwife <sup>a</sup>		
No	reference	
Yes	-0.10	[-0.24;0.04]
Hospital follow-up <sup>a</sup>		
No	reference	
Yes	-0.06	[-0.23;0.11]
Community follow-up <sup>a</sup>		
No	reference	
Yes	-0.07	[-0.23;0.10]
Obstetric ultrasound		
0 - 1	-0.07	[-0.22;0.08]
2 - 3	reference	
≥ 4	0.03	[-0.09;0.14]
Prenatal education		
No	reference	
Yes	0.46***	[0.36;0.56]
Prenatal information regarding postpartum		
No	reference	
Yes	0.72***	[0.51;0.93]
<b>Municipality characteristics</b>		
Location		
Urban	reference	
Rural	0.07	[-0.14;0.28]
Household deprivation <sup>b</sup>		
Least deprived		
Least deprived	reference	
Less deprived	0.24	[-0.09;0.56]
More deprived	0.07	[-0.27;0.42]
Most deprived	-0.04	[-0.40;0.32]

Accessibility to a gynecologist <sup>c</sup>		
Lowest	reference	
Low	-0.08	[-0.24;0.09]
High	0.09	[-0.14;0.33]
Highest	0.53**	[0.20;0.86]
Accessibility to a general practitioner <sup>c</sup>		
Lowest	reference	
Low	0.00	[-0.30;0.30]
High	0.06	[-0.26;0.37]
Highest	0.06	[-0.26;0.38]
Accessibility to a midwife <sup>c</sup>		
Lowest	reference	
Low	0.16	[-0.06;0.39]
High	0.15	[-0.09;0.39]
Highest	-0.09	[-0.39;0.21]
<b>Hospital characteristics</b>		
Funding		
Public	reference	
Private	-0.39*	[-0.73;-0.06]
University status		
Non-teaching	reference	
Teaching	0.41***	[0.24;0.59]
Level of care		
No neonatology unit	reference	
Neonatology unit	-0.43***	[-0.66;-0.19]
Neonatal intensive care unit	-0.48**	[-0.83;-0.12]
Obstetricians <sup>d</sup>	-2.07**	[-3.56;-0.57]
Midwives <sup>d</sup>	-0.82**	[-1.45;-0.19]
Day of delivery		
Working	reference	
Non-working	0.28*	[0.01;0.55]
Day of discharge		
Working	reference	
Non-working	-0.25*	[-0.48;-0.02]

CI, confidence interval. \*: p < 0.05; \*\*: p < 0.01; \*\*\*: p < 0.001

<sup>a</sup> At least one antenatal visit

<sup>b</sup> Based on the median annual income

<sup>c</sup> Based on the index of spatial accessibility (ISA)

<sup>d</sup> FTEs (full-time equivalents) per 100 deliveries

**Table 3.** Factors associated with full participation in the home-based postnatal coordinated care (PRADO) for the women enrolled in this program. Probit regression model (n = 2,859).

	<b>Coefficient</b>	<b>[95% CI]</b>
<b>Household characteristics</b>		
Woman's age at pregnancy (years)		
18 - 23	0.01	[-0.27;0.29]
24 - 29	0.09	[-0.04;0.22]
30 - 35	reference	
36 - 41	0.05	[-0.09;0.19]
≥ 42	-0.02	[-0.47;0.43]
Number of children		
1	reference	
2	-0.07	[-0.23;0.08]
3	-0.07	[-0.27;0.13]
≥ 4	-0.18	[-0.47;0.10]
Woman's healthcare coverage		
Policyholder	reference	
Beneficiary	-0.16	[-0.37;0.06]
<b>Prenatal care</b>		
Antenatal visits		
0 - 5	-0.01	[-0.23;0.21]
6 - 7	reference	
≥ 8	0.12	[-0.04;0.28]
Follow-up by a gynecologist <sup>a</sup>		
No	reference	
Yes	-0.04	[-0.17;0.10]
Follow-up by a general practitioner <sup>a</sup>		
No	reference	
Yes	-0.13	[-0.32;0.06]
Follow-up by a midwife <sup>a</sup>		
No	reference	
Yes	0.00	[-0.16;0.17]
Hospital follow-up <sup>a</sup>		
No	reference	
Yes	0.15	[-0.01;0.31]
Community follow-up <sup>a</sup>		
No	reference	
Yes	0.14	[-0.08;0.36]
Obstetric ultrasound		
0 - 1	-0.02	[-0.22;0.17]
2 - 3	reference	
≥ 4	-0.13	[-0.27;0.01]
Prenatal education		
No	reference	
Yes	0.21**	[0.06;0.35]
Prenatal information regarding postpartum		
No	reference	
Yes	0.15	[-0.03;0.34]
<b>Postnatal care</b>		
Hospital readmission		
No	reference	
Yes	-0.67***	[-1.04;-0.30]
<b>Municipality characteristics</b>		
Location		
Urban	reference	
Rural	-0.01	[-0.27;0.25]
Household deprivation <sup>b</sup>		
Least deprived	reference	
Less deprived	0.01	[-0.26;0.28]



More deprived	0.09	[-0.24;0.42]
Most deprived	-0.13	[-0.50;0.24]
Accessibility to a gynecologist <sup>c</sup>		
Lowest	reference	
Low	-0.21	[-0.45;0.03]
High	-0.29	[-0.66;0.09]
Highest	0.04	[-0.51;0.60]
Accessibility to a general practitioner <sup>c</sup>		
Lowest	reference	
Low	0.26	[-0.15;0.66]
High	0.18	[-0.26;0.61]
Highest	0.38	[-0.12;0.88]
Accessibility to a midwife <sup>c</sup>		
Lowest	reference	
Low	0.58 <sup>***</sup>	[0.27;0.90]
High	0.62 <sup>***</sup>	[0.25;0.98]
Highest	0.72 <sup>**</sup>	[0.21;1.24]

CI, confidence interval. \*: p < 0.05; \*\*: p < 0.01; \*\*\*: p < 0.001

<sup>a</sup> At least one antenatal visit

<sup>b</sup> Based on the median annual income

<sup>c</sup> Based on the index of spatial accessibility (ISA)

<sup>d</sup> FTEs (full-time equivalents) per 100 deliveries

**Table 4.** Factors associated with full participation in the home-based postnatal coordinated care (PRADO) for all of the women eligible for this program. Probit Heckman regression model allowing self-selection into women enrolled in this program (n = 4,189).

	<b>Coefficient</b>	<b>[95% CI]</b>
<b>Household characteristics</b>		
Woman's age at pregnancy (years)		
18 - 23	0.10	[-0.16;0.35]
24 - 29	0.09	[-0.03;0.21]
30 - 35	reference	
36 - 41	0.02	[-0.11;0.16]
≥ 42	0.11	[-0.32;0.54]
Number of children		
1	reference	
2	-0.05	[-0.20;0.10]
3	0.01	[-0.16;0.19]
≥ 4	-0.05	[-0.33;0.22]
Woman's healthcare coverage		
Policyholder	reference	
Beneficiary	-0.08	[-0.28;0.13]
<b>Prenatal care</b>		
Antenatal visits		
0 - 5	-0.01	[-0.20;0.18]
6 - 7	reference	
≥ 8	0.11	[-0.03;0.25]
Follow-up by a gynecologist <sup>a</sup>		
No	reference	
Yes	0.00	[-0.12;0.12]
Follow-up by a general practitioner <sup>a</sup>		
No	reference	
Yes	-0.14	[-0.30;0.03]
Follow-up by a midwife <sup>a</sup>		
No	reference	
Yes	0.00	[-0.14;0.14]
Hospital follow-up <sup>a</sup>		
No	reference	
Yes	0.15	[0.00;0.29]
Community follow-up <sup>a</sup>		
No	reference	
Yes	0.15	[-0.05;0.35]
Obstetric ultrasound		
0 - 1	0.00	[-0.18;0.17]
2 - 3	reference	
≥ 4	-0.13*	[-0.26;-0.01]
Prenatal education		
No	reference	
Yes	0.08	[-0.06;0.22]
Prenatal information regarding postpartum		
No	reference	
Yes	0.01	[-0.17;0.19]
<b>Postnatal care</b>		
Hospital readmission		
No	reference	
Yes	-0.62***	[-0.98;-0.27]
<b>Municipality characteristics</b>		
Location		
Urban	reference	
Rural	-0.01	[-0.25;0.23]
Household deprivation <sup>b</sup>		

Least deprived	reference	
Less deprived	-0.02	[-0.28;0.23]
More deprived	0.09	[-0.22;0.39]
Most deprived	-0.07	[-0.41;0.26]
Accessibility to a gynecologist <sup>e</sup>		
Lowest	reference	
Low	-0.18	[-0.40;0.04]
High	-0.28	[-0.61;0.06]
Highest	-0.05	[-0.55;0.46]
Accessibility to a general practitioner <sup>c</sup>		
Lowest	reference	
Low	0.24	[-0.14;0.62]
High	0.15	[-0.25;0.55]
Highest	0.36	[-0.10;0.81]
Accessibility to a midwife <sup>e</sup>		
Lowest	reference	
Low	0.48**	[0.17;0.80]
High	0.53**	[0.18;0.88]
Highest	0.65**	[0.17;1.14]
Rho	-0.74	[-0.97;0.20]

CI, confidence interval. \*:  $p < 0.05$ ; \*\*:  $p < 0.01$ ; \*\*\*:  $p < 0.001$

<sup>a</sup> At least one antenatal visit

<sup>b</sup> Based on the median annual income

<sup>c</sup> Based on the index of spatial accessibility (ISA)

<sup>d</sup> FTEs (full-time equivalents) per 100 deliveries

# Appendices

**Table A1.** Factors associated with full participation in the home-based postnatal coordinated care (PRADO) for the women enrolled in this program. Probit regression model. Hospital characteristics included (n = 2,859).

	Coefficient	[95% CI]
<b>Household characteristics</b>		
Woman's age at pregnancy (years)		
18 - 23	-0.02	[-0.29;0.26]
24 - 29	0.09	[-0.04;0.21]
30 - 35	reference	
36 - 41	0.06	[-0.08;0.20]
≥ 42	-0.02	[-0.47;0.42]
Number of children		
1	reference	
2	-0.12	[-0.28;0.04]
3	-0.13	[-0.34;0.07]
≥ 4	-0.22	[-0.50;0.05]
Woman's healthcare coverage		
Policyholder	reference	
Beneficiary	-0.16	[-0.37;0.05]
<b>Prenatal care</b>		
Antenatal visits		
0 - 5	-0.02	[-0.23;0.20]
6 - 7	reference	
≥ 8	0.12	[-0.04;0.27]
Follow-up by a gynecologist <sup>a</sup>		
No	reference	
Yes	0.02	[-0.12;0.15]
Follow-up by a general practitioner <sup>a</sup>		
No	reference	
Yes	-0.12	[-0.31;0.08]
Follow-up by a midwife <sup>a</sup>		
No	reference	
Yes	0.00	[-0.16;0.15]
Hospital follow-up <sup>a</sup>		
No	reference	
Yes	0.06	[-0.12;0.23]
Community follow-up <sup>a</sup>		
No	reference	
Yes	0.14	[-0.08;0.36]
Obstetric ultrasound		
0 - 1	-0.03	[-0.23;0.16]
2 - 3	reference	
≥ 4	-0.15*	[-0.29;-0.01]
Prenatal education		
No	reference	
Yes	0.21**	[0.06;0.36]
Prenatal information regarding postpartum		
No	reference	
Yes	0.11	[-0.09;0.30]
<b>Postnatal care</b>		
Hospital readmission		
No	reference	
Yes	-0.72***	[-1.09;-0.35]
<b>Municipality characteristics</b>		
Location		

Urban	reference	
Rural	0.00	[-0.26;0.26]
<b>Household deprivation<sup>b</sup></b>		
Least deprived	reference	
Less deprived	0.11	[-0.16;0.38]
More deprived	0.15	[-0.18;0.48]
Most deprived	-0.14	[-0.47;0.20]
<b>Accessibility to a gynecologist<sup>c</sup></b>		
Lowest	reference	
Low	-0.21	[-0.46;0.03]
High	-0.19	[-0.59;0.21]
Highest	0.15	[-0.40;0.70]
<b>Accessibility to a general practitioner<sup>c</sup></b>		
Lowest	reference	
Low	0.23	[-0.17;0.63]
High	0.19	[-0.24;0.61]
Highest	0.39	[-0.10;0.88]
<b>Accessibility to a midwife<sup>c</sup></b>		
Lowest	reference	
Low	0.64 <sup>***</sup>	[0.33;0.96]
High	0.68 <sup>***</sup>	[0.32;1.05]
Highest	0.72 <sup>**</sup>	[0.24;1.21]
<b>Hospital characteristics</b>		
<b>Funding</b>		
Public	reference	
Private	0.05	[-0.40;0.51]
<b>University status</b>		
Non-teaching	reference	
Teaching	-0.03	[-0.28;0.23]
<b>Level of care</b>		
No neonatology unit	reference	
Neonatology unit	-0.23	[-0.51;0.05]
Neonatal intensive care unit	0.15	[-0.24;0.54]
<b>Obstetricians<sup>d</sup></b>	0.84	[-0.83;2.51]
<b>Midwives<sup>d</sup></b>	0.27	[-0.59;1.13]
<b>Day of delivery</b>		
Working	reference	
Non-working	-0.16	[-0.47;0.16]
<b>Day of discharge</b>		
Working	reference	
Non-working	-0.31	[-0.64;0.01]

CI, confidence interval. \*: p < 0.05; \*\*: p < 0.01; \*\*\*: p < 0.001

<sup>a</sup> At least one antenatal visit

<sup>b</sup> Based on the median annual income

<sup>c</sup> Based on the index of spatial accessibility (ISA)

<sup>d</sup> FTEs (full-time equivalents) per 100 deliveries

**Table A2.** Factors associated with full participation in the home-based postnatal coordinated care (PRADO) for all of the women eligible for this program. Probit Heckman regression model allowing self-selection into women enrolled in this program. Results of the selection equation (n = 4,189).

	Coefficient	[95% CI]
<b>Household characteristics</b>		
Woman's age at pregnancy (years)		
18 - 23	-0.32***	[-0.45;-0.18]
24 - 29	-0.05	[-0.14;0.04]
30 - 35	reference	
36 - 41	0.07	[-0.03;0.18]
≥ 42	-0.41**	[-0.69;-0.14]
Number of children		
1	reference	
2	-0.10	[-0.20;0.01]
3	-0.29***	[-0.41;-0.18]
≥ 4	-0.31***	[-0.47;-0.15]
Woman's healthcare coverage		
Policyholder	reference	
Beneficiary	-0.15*	[-0.28;-0.01]
<b>Prenatal care</b>		
Antenatal visits		
0 - 5	-0.05	[-0.19;0.09]
6 - 7	reference	
≥ 8	-0.02	[-0.13;0.09]
Follow-up by a gynecologist <sup>a</sup>		
No	reference	
Yes	-0.08	[-0.23;0.06]
Follow-up by a general practitioner <sup>a</sup>		
No	reference	
Yes	0.09	[-0.03;0.22]
Follow-up by a midwife <sup>a</sup>		
No	reference	
Yes	-0.09	[-0.23;0.05]
Hospital follow-up <sup>a</sup>		
No	reference	
Yes	-0.07	[-0.23;0.10]
Community follow-up <sup>a</sup>		
No	reference	
Yes	-0.06	[-0.23;0.10]
Obstetric ultrasound		
0 - 1	-0.07	[-0.22;0.08]
2 - 3	reference	
≥ 4	0.03	[-0.09;0.14]
Prenatal education		
No	reference	
Yes	0.46***	[0.36;0.56]
Prenatal information regarding postpartum		
No	reference	
Yes	0.71***	[0.50;0.92]
<b>Municipality characteristics</b>		
Location		
Urban	reference	
Rural	0.08	[-0.13;0.29]
Household deprivation <sup>b</sup>		
Least deprived	reference	
Less deprived	0.23	[-0.10;0.57]
More deprived	0.07	[-0.28;0.42]

Most deprived	-0.05	[-0.41;0.31]
Accessibility to a gynecologist <sup>c</sup>		
Lowest	reference	
Low	-0.07	[-0.23;0.09]
High	0.12	[-0.12;0.35]
Highest	0.56 <sup>**</sup>	[0.23;0.90]
Accessibility to a general practitioner <sup>c</sup>		
Lowest	reference	
Low	0.01	[-0.29;0.31]
High	0.07	[-0.24;0.38]
Highest	0.06	[-0.26;0.37]
Accessibility to a midwife <sup>c</sup>		
Lowest	reference	
Low	0.16	[-0.07;0.40]
High	0.16	[-0.10;0.41]
Highest	-0.10	[-0.41;0.21]
<b>Hospital characteristics</b>		
Funding		
Public	reference	
Private	-0.40 <sup>*</sup>	[-0.73;-0.08]
University status		
Non-teaching	reference	
Teaching	0.41 <sup>***</sup>	[0.23;0.59]
Level of care		
No neonatology unit	reference	
Neonatology unit	-0.46 <sup>***</sup>	[-0.69;-0.23]
Neonatal intensive care unit	-0.49 <sup>**</sup>	[-0.84;-0.13]
Obstetricians <sup>d</sup>	-2.02 <sup>**</sup>	[-3.47;-0.58]
Midwives <sup>d</sup>	-0.81 <sup>**</sup>	[-1.41;-0.21]
Day of delivery		
Working	reference	
Non-working	0.23	[-0.05;0.51]
Day of discharge		
Working	reference	
Non-working	-0.28 <sup>*</sup>	[-0.51;-0.06]

CI, confidence interval. \*: p < 0.05; \*\*: p < 0.01; \*\*\*: p < 0.001

<sup>a</sup> At least one antenatal visit

<sup>b</sup> Based on the median annual income

<sup>c</sup> Based on the index of spatial accessibility (ISA)

<sup>d</sup> FTEs (full-time equivalents) per 100 deliveries

**Table A3.** Correlation between accessibility to health professionals and the socioeconomic environment. All French municipalities (n = 32,948).

	<b>Accessibility to a gynecologist<sup>a</sup></b>	<b>Accessibility to a general practitioner<sup>a</sup></b>	<b>Accessibility to a midwife<sup>a</sup></b>
<b>Socioeconomic environment</b>			
Household median annual income	0.39***	0.02***	0.12***

\*, p < 0.05; \*\*, p < 0.01; \*\*\*, p < 0.001

<sup>a</sup> Based on the index of spatial accessibility (ISA)