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## Original Article

# Impact of maternal age on intrapartum caesarean delivery rate in nulliparas with spontaneous labour



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## ARTICLE INFO

*Article history:*

Received 17 November 2018  
 Received in revised form 24 January 2019  
 Accepted 19 February 2019  
 Available online 21 February 2019

*Keywords:*

Nulliparous  
 Caesarean delivery  
 Duration of labour  
 Labour outcome  
 Advanced maternal age  
 Trial of labour

## ABSTRACT

**Background:** The advanced maternal age rate increases in developed countries. Older women have more pre-existing condition than youngest women and develop more frequently obstetrical pathologies responsible for a higher rate of caesarean delivery before labour and labour induction. For aged nulliparous without pathology who experience spontaneous labour, there is few data on the mode of delivery and on physiological labour according to maternal age.

**Objective:** To compare the intrapartum caesarean delivery rate according to maternal age, for nulliparous with planned vaginal delivery and spontaneous labour at term.

**Methods:** Retrospective cohort in a single academic institution between January 2000 and June 2017. All nulliparous women with planned vaginal delivery with live singleton in cephalic presentation at and after 37 weeks of gestation with spontaneous labour were included (n = 10,611). Two groups were compared: nulliparous women aged 20–34 and nulliparous women aged 35 and over. The main outcome was the intrapartum caesarean delivery rate. A subgroup analysis was performed for nulliparous with more advanced maternal age defined as women over 40.

**Results:** Among the 10,611 women included in this analysis, 8,993 (84.8%) were aged 20–34 and 1,618 (15.2%) were aged over 35. From the latter 367 (22.7%) were over 40 years old. The intrapartum caesarean delivery rate was similar between women aged between 20 and 34 and women aged over 35 (10.8% compared to 8.8%; cOR 0.91, 95% CI 0.76–1.08; aOR 0.91, 95% CI 0.76–1.09). The indications of caesarean were similar in both groups. No differences were found between both groups for mean labour duration (430.9 min for the [20–34] years group compared to 428.0 min for the over 35 years group, p = 0.654). The subgroup analysis performed on nulliparous with more advanced maternal age yielded similar results.

**Conclusion:** For nulliparous at term in spontaneous labour, an advanced maternal age was not associated with an increased intrapartum caesarean delivery rate.

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## Introduction

Advanced maternal age has been defined as an age  $\geq 35$  years at the time of delivery. The proportion of births in women aged 35 and over has been steadily rising in recent years in developed countries [1–3]. In France it accounted for about 21.3% of all births in 2016 compared with 15.9% in 2003 [2]. The increased caesarean rate observed recently has been explained by the increased maternal age. Indeed pregnancy among older women is associated with a variety of adverse obstetric diseases [4–6] partly because these women have pre-existing medical conditions. These latter are responsible for a

higher rate of planned caesarean before labor and induction of labor. In this population of aged women, the induction of labor has been associated with a high rate of failure and so of caesarean [7]. A biologic plausibility was advanced to explain that: the aged uterus function differently in labor, contributing to labor dysfunction and ultimately to a caesarean delivery [8–10].

Aged parturients constitute a heterogenous group stratified by different obstetrical complications and modes of onset of labour. Indeed, few studies analyzed the physiological labour outcomes for women without pathology requiring a planned caesarean or a labour induction [11,12]. Furthermore, very few studies stratify the risk of caesarean delivery by parity and even fewer studies report whether a trial of labour was attempted [7,13].

Our aim was to compare the intrapartum caesarean delivery rate between nulliparous aged over 35 and nulliparous aged 20–34, with planned vaginal delivery and spontaneous labour at term.

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## Material and methods

### Study population

Using hospital birth records, we identified all nulliparous delivering at a single academic institution between January 2000 and June 2017, of live singleton in cephalic presentation. The study was limited to nulliparous women to remove the potential confounding effects of multiparity and previous caesarean section on the risk of caesarean delivery. Nulliparas aged less than 20 were excluded. Women with planned caesarean delivery, preterm labour before 37 weeks of gestation and labour induction were excluded.

This analysis included 10,611 women. Two groups were compared: nulliparous women aged 20–34 ( $n=8,993$ ; 84.8%) and nulliparous women aged over 35 ( $n=1,618$ ; 15.2%) (Fig. 1).

Social and demographic characteristics, pregnancy characteristics, obstetrical, maternal and neonatal outcomes were collected prospectively. All data were prospectively reported in a computerized database at each consultation, during pregnancy, labour and after delivery by health professional including midwives and obstetrician in care of the patient. These data were checked for validity for each parturient in staff during the following day after delivery.

### Outcomes

The main outcome was the intrapartum caesarean delivery rate. It was treated as a binary variable. Secondary outcomes were total labour duration, and labour phases duration. In agreement with the last recommendation we chose as the latent phase the period between the onset of labour and 6 cm of cervical dilation, the active phase was between 6 cm and complete dilation [14]. The second phase was defined as the duration between complete dilation and expulsion. Labour phases duration were analysed regardless of the mode of delivery (caesarean or vaginal delivery) and then specifically for vaginal deliveries. These different phases were determined from the partographs. Partographs were prospectively filled during labour by practitioners. Once the labour started, the partograph started, and all women were examined every hour or before if progress dilatation was suspected, if women were painful, and in cases of abnormalities on CTG. Cardiocography, with

continuous electronic fetal heart rate and uterine contraction registration, was applied to all women. The whole management of each labor and delivery was undertaken by the physician on duty. Oxytocin was administered in case of labor arrest with a lack of uterine contractility. Caesarean section for arrest of labor was indicated in case of stagnation of cervical dilation despite ruptured membranes and a correct uterine activity in term of frequency and intensity, without a threshold of duration being predetermined. In case of abnormal fetal heart rate, a second-line exam was not systematic to decide a caesarean, and its indication was left to the obstetrician in care of the patient. During the study period, the obstetrical practices have not been modified. In this maternity, maternal age is not an element considered in the management of labor and in the decision of caesarean section.

### Subgroup analysis

In subgroup analysis, we focused specifically on the older part of the study population and defined more advanced maternal age group as women aged at least 40. This analysis included 367 women.

### Statistical analysis

We compared the characteristics of the women, pregnancies, labors and neonates, according to maternal age, based on Chi<sup>2</sup> or Fisher exact tests for categorical variables and Student's or Wilcoxon rank sum tests for quantitative variables, as appropriate. To assess the relation between maternal age and the caesarean delivery rate, while controlling for confounding by indication, we first used multivariate logistic regression to estimate OR and 95% CI to adjust for prognostic covariates. Potential confounders determined from the previous literature included: body mass index before pregnancy (continuous variable), gestational diabetes (binary variable), gestational hypertensive pathologies (binary variable), gestational age at delivery (continuous variable), and birth weight (continuous variable).

All tests were two-sided with  $P$ -values  $\leq 0.05$  defined as statistically significant. STATA 13 software (StataCorp LP, College Station, TX) was used for the descriptive and multivariate analyses.

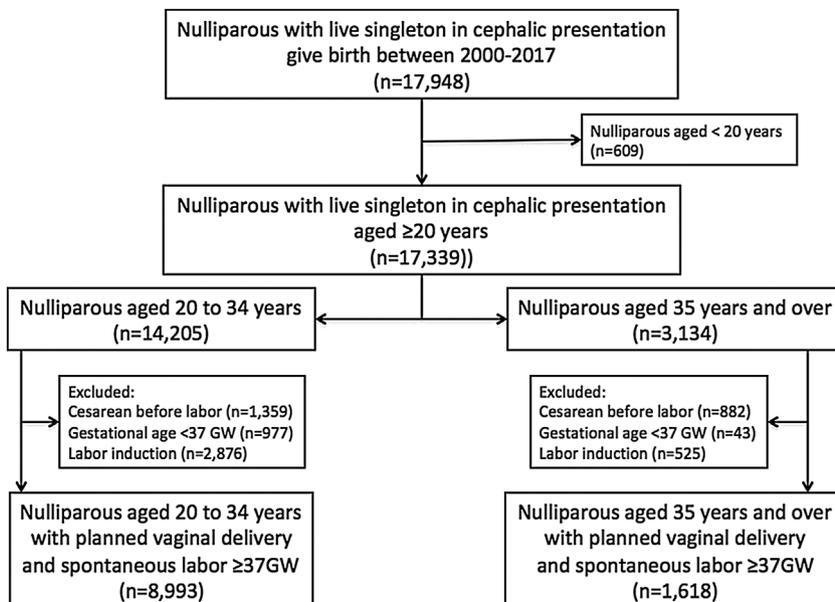


Fig. 1. Flow chart.

## Results

Our study population included 10,611 women: 8,993 (84.8%) aged 20–34 and 1,618 (15.2%) aged over 35. In the [20–34] years old group, 2,066 (23.0%) were aged 20–24, 3,688 (41.0%) were aged 25–29, 3,239 (36.0%) were aged 30–34. In the  $\geq 35$  years old group, 1,251 (77.3%) were aged 35–39, 338 (20.9%) were aged 40–44 and 29 (1.8%) were aged 45 or more. Women aged  $\geq 35$  years old, compared with women aged 20–34 were more often obese, smokers and had more pre-existing hypertension, pregnancies obtained by in vitro fertilisation, gestational diabetes and gestational hypertensive pathologies (Table 1). They also gave birth at a later gestational age. Both groups had similar labour characteristics.

The caesarean delivery rate was 10.8% in the [20–34] years old group and 8.8% in the  $\geq 35$  years old group (cOR 0.91, 95% CI 0.76–1.08), indications and cervical dilation at intervention were similar in both groups (Table 2). After adjustment for confounders, no association was found between maternal age and caesarean delivery rate (aOR 0.91, 95% CI 0.76–1.09).

Labour mean duration was 430.9 min in the [20–34] years old group and 428.0 min in the  $\geq 35$  years old group ( $p=0.654$ ) (Table 2). The different phases of labour mean duration did not differ between both groups. Similar results were found for the analysis of labour duration for women who gave birth vaginally after exclusion of caesarean delivery.

No differences for maternal and neonatal outcomes were found between both groups (Table 2 and 3).

### Subgroup analysis

The subgroup analysis performed on women aged over 40 yielded similar results: the caesarean delivery rate was similar in both groups: 10.8% in [20–34] years group compared to 10.3% in  $\geq 40$  years group (cOR 0.96, 95% CI 0.68–1.35; aOR 0.94, 95% CI 0.66–1.34) as well as labour duration (430.8 min compared to 426.9 min;  $p=0.733$ ; Appendix A.1 to A.5).

## Discussion

### Main finding

This study found a similar caesarean delivery rate between women aged 20–34 and women with advanced maternal age defined by an age over 35 years old in case of spontaneous labour at term. Moreover, labour outcomes were similar in the two groups.

### Interpretation

Despite the exclusion of women with planned caesarean section or labour induction due to pathologies, like in previous studies, we found that women over 35 years old had more pregnancy complications than youngest women: macrosomia, gestational diabetes, gestational hypertensive pathologies and prolonged pregnancies [15]. Therefore, our selection criteria consisting in excluding caesarean section before labour and labour induction did not over-select a low-risk population of nulliparous with advanced maternal age.

Concerning the management of labour, our two groups displayed the same characteristics, particularly for epidural use and oxytocin use, which confirms a management independent of maternal age. This resulted in a similar rate of intrapartum caesarean delivery in the two groups without resorting to more intrapartum intervention. Furthermore, this same rate is obtained despite a low intrapartum caesarean delivery rate in line with goals set by the World Health Organization [16] and low rates of

**Table 1**

Maternal, pregnancy and labour characteristics.

	<35 years N = 8993 n (%)	$\geq 35$ years N = 1618 n (%)	P
<b>Maternal characteristics</b>			
Age (years) (mean $\pm$ SD)	28.2 $\pm$ 3.8	38.2 $\pm$ 2.6	<0.0001
Body mass index before pregnancy (kg/m <sup>2</sup> )			
Mean $\pm$ SD	22.1 $\pm$ 4.1	22.5 $\pm$ 4.3	0.0002
<18,5	1149 (13.6)	160 (10.2)	0.001
[18.5–24]	5606 (66.2)	1060 (67.5)	
[25–29]	1232 (14.5)	242 (15.4)	
$\geq 30$	478 (5.6)	108 (6.9)	
Weight gain (kg) (mean $\pm$ SD)	12.7 $\pm$ 5.8	12.00 $\pm$ 5.3	< 0.001
< 9	1224 (19.3)	267 (21.5)	0.048
[9–11]	1394 (21.9)	291 (23.4)	
$\geq 12$	3737 (58.8)	685 (55.1)	
Smoker	1294 (14.4)	282 (17.4)	<0.001
Chronic hypertension	65 (0.7)	25 (1.5)	0.001
Diabetes mellitus	70 (0.8)	19 (1.2)	0.108
<b>Characteristics of current pregnancy</b>			
In vitro fertilisation	271 (3.0)	216 (13.4)	<0.001
Gestational diabetes	277 (3.1)	106 (6.5)	<0.001
Hypertensive gestational diseases	206 (2.3)	62 (3.8)	<0.001
Preterm labour	649 (7.2)	115 (7.1)	0.876
Premature rupture of membrane	82 (0.9)	20 (1.2)	0.218
Prenatal corticotherapy	373 (4.1)	61 (3.8)	0.48
Suspected intrauterine growth restriction	26 (0.3)	4 (0.25)	0.77
Suspected macrosomia	546 (7.1)	109 (7.6)	0.517
<b>Labor characteristics</b>			
Gestational age at delivery (weeks)			
Mean ( $\pm$ SD)	39.9 $\pm$ 1.2	40.0 $\pm$ 1.2	<0.001
37 0/7–38 6/7	1859 (20.7)	288 (17.8)	<0.001
39 0/7–40 6/7	5279 (58.7)	904 (55.9)	
41 0/7–41 6/7	1583 (17.6)	343 (21.2)	
$\geq 42$ 0/7	272 (3.0)	83 (5.1)	
Cervical dilation at first examination (cm)			
Mean ( $\pm$ SD)	3.2 $\pm$ 1.4	3.1 $\pm$ 1.4	0.303
Median (Q1–Q3)	3 (2–3)	3 (2–3)	0.175
Peridural anesthesia	7818 (86.9)	1432 (88.5)	0.082
Cervical dilation at pose of peridural anesthesia (cm)			
Mean ( $\pm$ SD)	4.2 $\pm$ 1.8	4.2 $\pm$ 1.8	0.852
Median (Q1–Q3)	4 (3–5)	4 (3–5)	0.3
Oxytocin use	4810 (53.5)	874 (54.0)	0.693
Maximal oxytocin dose (UI)			
Mean ( $\pm$ SD)	38.3 $\pm$ 24.1	38.5 $\pm$ 23.5	0.855
Median (Q1–Q3)	30 (20–50)	30 (20–50)	0.689
Clear amniotic fluid color	6903 (77.2)	1252 (78.2)	0.57
Manual rotation	878 (9.8)	156 (9.6)	0.879

induction and caesarean before labour for nulliparas with advanced age.

It is the first time that no association was found between maternal age and caesarean rate in a low-risk population. It can be explained by the fact that our results were stronger than previous studies in terms of methodological limits. Indeed, to avoid confounding factors we selected a population including nulliparas only to dodge the effect of parity. We excluded labor induction that

**Table 2**  
Delivery characteristics.

	<35 years N = 8993 n (%)	≥35 years N = 1618 n(%)	P
<b>Delivery mode</b>			0.27
Vaginal	8026 (89.2)	1459 (90.2)	
Caesarean section	967 (10.7)	159 (9.8)	
<b>Caesarian section</b>			
<b>Indications</b>			0.896
Abnormal fetal heart rate	389 (40.2)	64 (40.3)	
Arrest of labor	547 (56.6)	91 (57.2)	
Others	31 (3.2)	4 (2.5)	
<b>Cervical dilation at CS (cm)</b>			
Mean (±SD)	6.1 ± 2.5	6 ± 2.3	0.642
Median (Q1–Q3)	6 (4–8)	6 (4–7)	0.561
<b>Labor duration (minutes)</b>			
<b>Total labor</b>			
Mean (±SD)	430.8 ± 220.1	428 ± 212.2	0.654
Median (Q1–Q3)	422 (274–570)	420 (284–554)	0.689
<b>Latent phase</b>			
Mean (±SD)	191.9 ± 131.9	190.2 ± 130.5	0.651
Median (Q1–Q3)	182.5 (84–275)	180 (85–271)	0.611
<b>Active phase</b>			
Mean (±SD)	150.1 ± 110.4	148.0 ± 104.8	0.498
Median (Q1–Q3)	125 (70–201)	120 (69–198)	0.510
<b>Second phase</b>			
Mean (±SD)	55.3 ± 57.3	56.35 ± 57.0	0.510
Median (Q1–Q3)	40 (0–110)	42.8 (0–110)	0.445
<b>Vaginal delivery</b>			
<b>Total labor duration (minutes)</b>			
Mean (±SD)	421.6 ± 213.6	419.5 ± 209.0	0.723
Median (Q1–Q3)	414 (271–557)	409 (277–543)	0.614
<b>Latent phase duration (minutes)</b>			
Mean (±SD)	191.9 ± 131.9	190.2 ± 130.5	0.651
Median (Q1–Q3)	182.5 (84–275)	180 (85–271)	0.611
<b>Active phase duration (minutes)</b>			
Mean (±SD)	150.1 ± 110.4	148.0 ± 104.8	0.498
Median (Q1–Q3)	125 (70–201)	120 (68.5–198)	0.510
<b>Second phase duration (minutes)</b>			
Mean (±SD)	55.3 ± 57.3	56.3 ± 57.0	0.510
Median (Q1–Q3)	40 (0–110)	42.8 (0–110)	0.457
<b>Operative vaginal delivery</b>	3368 (42.0)	603 (41.3)	0.652
<b>Indications</b>			0.101
Abnormal cardiac foetal rate	1904 (57.0)	352 (58.9)	
Slow progression	1433 (42.9)	244 (40.8)	
Other	2 (0.1)	2 (0.3)	
<b>Third or fourth perineal laceration</b>	23 (0.3)	3 (0.2)	0.887
<b>Postpartum complications</b>			
Postpartum hemorrhage	358 (4.0)	76 (4.7)	0.181
Blood transfusion	118 (1.3)	35 (2.2)	0.008
Nalador	317 (3.5)	66 (4.1)	0.271
Uterine arteries embolisation	2 (0.02)	1 (0.06)	0.383
Vascular ligation	2 (0.02)	1 (0.06)	0.383
Compressive uterine sutures	11 (0.1)	5 (0.3)	0.075
Hysterectomy	0 (0)	0 (0)	–

SD: standard deviation Q1–Q3 : first quartile, third quartile.

CS: caesarean section.

is a recognized risk factor of caesarean delivery and adjusted for many confounding factors.

Our results are consistent with recent fundamental research on human uterus muscle showing the same trend: two studies on uterine strips collected during planned caesarean delivery has shown no differences between young and older women concerning spontaneous or pharmacologically induced contractility [17,18]. Another one demonstrated that uterine muscle efficiency was diminished in older non-pregnant women but was restored during pregnancy probably due to the remaining high hormonal response ability of the aging myometrium [19]. The absence of a change in the contractile function of the uterus with maternal age is supported by the fact that we observe the same caesarean rate at the same dilatation, with a same arrest of labour rate in both

**Table 3**  
Neonatal outcomes.

	<35 years N = 8993 n (%)	≥35 years N = 1618 n(%)	P
<b>Gender</b>			0.721
Feminine	4352 (48.4)	795 (49.1)	
Masculine	4639 (51.6)	823 (50.9)	
<b>Birth weight (grams)</b>			
Mean (±) SD	3282.6 ± 439.1	3292 ± 451.3	0.407
<2500	271 (3.0)	57 (3.5)	0.027
[2500–3799]	7649 (85.1)	1334 (82.4)	
≥3800	1072 (11.9)	227 (14.0)	
<b>SGA &lt;10<sup>th</sup> percentile</b>	1011 (11.2)	202 (12.5)	0.148
<b>pH at umbilical cord</b>			
<7.10	116 (1.3)	24 (1.5)	0.550
<7.00	19 (0.2)	2 (0.1)	0.459
<b>Respiratory resuscitation</b>			
Ventilatory assistance	476 (5.3)	115 (7.1)	0.003
Mask ventilation	294 (3.3)	67 (4.1)	0.075
Nasal ventilation	31 (0.3)	11 (0.7)	0.048
Continuous positive pressure	99 (1.1)	25 (1.5)	0.126
Tracheal intubation	117 (1.3)	34 (2.1)	0.012
Neonatal death in labor ward	0 (0)	1 (0.06) <sup>a</sup>	–

SGA: small for gestational age.

<sup>a</sup> Severe malformations affecting heart and brain function.

groups; as well as the same duration of labour and the same use of oxytocin.

Consequently, the increase in the caesarean delivery rate with maternal age observed in previous studies can be associated with practitioner's behaviour who tend to either diagnose labour dystocia (more frequently or earlier during labour) in aged women or accept these women preference to perform caesarean delivery. Indeed, older nulliparous women have been found to have a more positive attitude towards caesarean section a higher perception of pregnancy risk, even in older women without known risk factors [9]. These considerations are reinforced by the fact that the rate of caesarean delivery observed in our study population is lower than the overall rate of caesarean delivery that occurred in the same maternity during the study period, which was about 16–17%. Thus, the increase in the caesarean delivery rate in women with advanced maternal age observed in previous studies is probably due to non-rigorous or uncontrolled indications to perform caesarean section.

### Strengths

Our study has several strengths. The long period data collection allowed the inclusion of a large number of women, which gave a substantial power to highlight a difference between both groups of maternal age if it exists. Attending practitioners prospectively collected the data about the management of the pregnancy, labor and delivery, and these data were ascertained routinely by medical staff the day after the delivery, so that thorough and accurate information was available. We have detailed information about the patients labour. The hospital database allowed us the collection of numerous covariates to address many potential confounding factors in the logistic regression models and to estimate the association between maternal age and caesarean delivery rate with greater precision. This study was limited to nulliparous women to eliminate the confounding effects of multiparity and previous caesarean delivery.

### Limitations

This study is not without limitation. Its retrospective design can limit the generalization of the results, but the characteristics of

women and labor are similar to these described in the ENP suggesting a good external validity [2]. Furthermore, the unicentric design of the study allowed having a homogeneous management of the women in the follow-up of the pregnancy and the management of labor and delivery, by a team for whom maternal age is not taken into account in labor management. The sample size did not allow us to study women aged over 40 as a separate group with good precision, but it is the case for numerous other studies. In addition, studies which have found an increased risk of caesarean delivery with advanced maternal age have shown a linear increase and an absence of cut-off.

This study was conducted in France, which may limit the external validity of the results for other countries. However, the rate and practices of caesarean delivery in France are similar to those in other high resource countries [20].

#### Clinical impact

For aged women, planned vaginal delivery must be encouraged because the rate of success is high. Moreover, maternal and neonatal complications are scares while caesarean delivery is associated with more severe acute maternal morbidity, especially if maternal age is high. Consequently, planned caesarean delivery and induction of labour must be limited to strict medical indications only and the possibility of few or no subsequent pregnancies for these aged women should not contribute to the easy achievement of a caesarean delivery.

These results emphasize that any woman should be managed in a way that results in the best possible outcomes for both mother and baby, irrespective of age. The group of women aged over 35 should be managed during labour as their younger counterparts, with finally the same caesarean delivery rate without compromising the health and wellbeing of mothers and babies.

#### Funding sources

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

#### Disclosure of interest

The authors declare that they have no competing interest.

#### Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:<https://doi.org/10.1016/j.jogoh.2019.02.008>.

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