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Title

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

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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 to 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 to 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.

Keywords

Nulliparous, caesarean delivery, duration of labour, labour outcome, advanced maternal age, trial of labour

Funding sources

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Introduction

Advanced maternal age has been defined as an age ≥ 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[13,14].

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

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 to 34 (n=8,993; 84.8%) and nulliparous women aged over 35 (n=1,618; 15.2%) (Figure 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 [15]. 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 was painful, and in cases of abnormalities on CTG. Cardiotocography, 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^2 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 ≤ 0.05 defined as statistically significant. STATA 13 software (StataCorp LP, College Station, TX) was used for the descriptive and multivariate analyses.

Results

Our study population included 10,611 women: 8,993 (84.8%) aged 20 to 34 and 1,618 (15.2%) aged over 35. In the [20-34] years old group, 2,066 (23.0%) were aged 20 to 24, 3,688 (41.0%) were aged 25 to 29, 3,239 (36.0%) were aged 30 to 34. In the ≥35 years old group, 1,251 (77.3%) were aged 35 to 39, 338 (20.9%) were aged 40 to 44 and 29 (1.8%) were aged 45 or more. Women aged ≥ 35 years old, compared with women aged 20 to 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 ≥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 ≥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 ≥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 to 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 [16]. 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 [17] and low rates of 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 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 [18,19]. 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 [20]. 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 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

227 as a separate group with good precision, but it is the case for numerous other studies. In
228 addition, studies which have found an increased risk of caesarean delivery with advanced
229 maternal age have shown a linear increase and an absence of cut-off.
230 This study was conducted in France, which may limit the external validity of the results for
231 other countries. However, the rate and practices of caesarean delivery in France are similar to
232 those in other high resource countries [21].

233

234 **Clinical impact**

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

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

246

247 **Disclosure of interest**

248 The authors declare that they have no competing interest.

249

250

251 **References**

252 [1] Martin JA, Hamilton BE, Osterman MJK. Births in the United States, 2016. NCHS data
253 brief, no 287. Hyattsville, MD: National Center for Health Statistics. 2017. n.d.

254 [2] Blondel B, Coulm B, Bonnet C, Goffinet F, Le Ray C. Trends in perinatal health in
255 metropolitan France from 1995 to 2016: Results from the French National Perinatal
256 Surveys. J Gynecol Obstet Hum Reprod 2017. doi:10.1016/j.jogoh.2017.09.002.

257 [3] Office for National Statistics. Live births in England and Wales by characteristics of
258 mother 1, 2011. November 2013. http://www.ons. gov.uk/ons/dcp171778_296157.pdf
259 n.d.

260 [4] Berkowitz GS, Skovron ML, Lapinski RH, Berkowitz RL. Delayed childbearing and the
261 outcome of pregnancy. N Engl J Med 1990;322:659–64.
262 doi:10.1056/NEJM199003083221004.

263 [5] Bianco A, Stone J, Lynch L, Lapinski R, Berkowitz G, Berkowitz RL. Pregnancy
264 outcome at age 40 and older. Obstet Gynecol 1996;87:917–22.

265 [6] Kort DH, Gosselin J, Choi JM, Thornton MH, Cleary-Goldman J, Sauer MV. Pregnancy
266 after age 50: defining risks for mother and child. Am J Perinatol 2012;29:245–50.
267 doi:10.1055/s-0031-1285101.

268 [7] Ecker JL, Chen KT, Cohen AP, Riley LE, Lieberman ES. Increased risk of cesarean
269 delivery with advancing maternal age: indications and associated factors in nulliparous
270 women. Am J Obstet Gynecol 2001;185:883–7. doi:10.1067/mob.2001.117364.

271 [8] Crawford BS, Davis J, Harrigill K. Uterine artery atherosclerotic disease: histologic
272 features and clinical correlation. Obstet Gynecol 1997;90:210–5. doi:10.1016/S0029-
273 7844(97)00225-1.

[9] Bayrampour H, Heaman M, Duncan KA, Tough S. Comparison of perception of pregnancy risk of nulliparous women of advanced maternal age and younger age. J Midwifery Womens Health 2012;57:445–53. doi:10.1111/j.1542-2011.2012.00188.x.

[10] Treacy A, Robson M, O'Herlihy C. Dystocia increases with advancing maternal age. Am J Obstet Gynecol 2006;195:760–3. doi:10.1016/j.ajog.2006.05.052.

[11] Klemetti R, Gissler M, Sainio S, Hemminki E. Associations of maternal age with maternity care use and birth outcomes in primiparous women: a comparison of results in 1991 and 2008 in Finland. BJOG Int J Obstet Gynaecol 2014;121:356–62. doi:10.1111/1471-0528.12415.

[12] Vaughan D, Cleary B, Murphy D. Delivery outcomes for nulliparous women at the extremes of maternal age - a cohort study. BJOG Int J Obstet Gynaecol 2014;121:261–8. doi:10.1111/1471-0528.12311.

[13] Main DM, Main EK, Moore DH. The relationship between maternal age and uterine dysfunction: A continuous effect throughout reproductive life. Am J Obstet Gynecol 2000;182:1312–20. doi:10.1067/mob.2000.106249.

[14] Ecker JL, Chen KT, Cohen AP, Riley LE, Lieberman ES. Increased risk of cesarean delivery with advancing maternal age: Indications and associated factors in nulliparous women. Am J Obstet Gynecol 2001;185:883–7. doi:10.1067/mob.2001.117364.

[15] Zhang J, Landy HJ, Branch DW, Burkman R, Haberman S, Gregory KD, et al. Contemporary patterns of spontaneous labor with normal neonatal outcomes. Obstet Gynecol 2010;116:1281–7. doi:10.1097/AOG.0b013e3181fdef6e.

[16] Luke B, Brown MB. Elevated risks of pregnancy complications and adverse outcomes with increasing maternal age. Hum Reprod 2007;22:1264–72. doi:10.1093/humrep/del522.

[17] Gibbons L, Belizan JM, Lauer JA, Betran AP, Merialdi M, Althabe F. The global numbers and costs of additionally needed and unnecessary cesarean sections performed per year: overuse as a barrier to universal coverage. Nov. 17, 2010 [cited; 1e32]. Available from: http://www.who. int/healthsystems/topics/financing/healthreport/ 30C-sectioncosts.pdf. Accessed May 5, 2015 n.d.

[18] Crankshaw DJ, O'Brien YM, Crosby DA, Morrison JJ. Maternal Age and Contractility of Human Myometrium in Pregnancy. Reprod Sci 2015;22:1229–35. doi:10.1177/1933719115572483.

[19] Smith GC, Cordeaux Y, White IR, Pasupathy D, Missfelder-Lobos H, Pell JP, et al. The effect of delaying childbirth on primary cesarean section rates. PLoS Med 2008;5:e144.

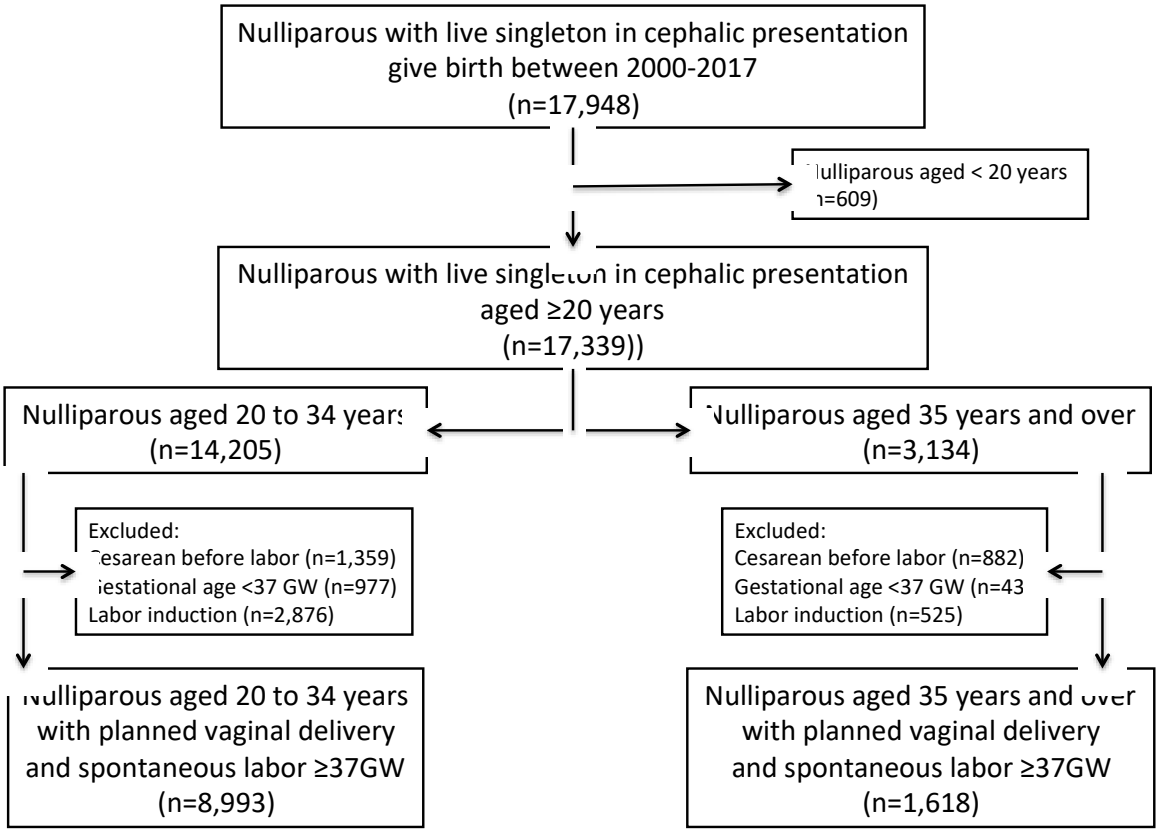
[20] Arrowsmith S, Robinson H, Noble K, Wray S. What do we know about what happens to myometrial function as women age? J Muscle Res Cell Motil 2012;33:209–17. doi:10.1007/s10974-012-9300-2.

[21] European Perinatal Health Report 2010 [Internet]. [http://www.europeristat.com/reports/european-perinatal-health-report-2010.html]. n.d.

317

318 **Figure 1: Flow chart**

319



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323 **Table 1: Maternal, pregnancy and labour characteristics**

	< 35 years N=8993 n (%)	≥ 35 years N=1618 n (%)	P
Maternal characteristics			
Age (years) (mean ± SD)	28.2 ± 3.8	38.2 ± 2.6	<0.0001
Body mass index before pregnancy (kg/m²)			
Mean ± SD	22.1 ± 4.1	22.5 ± 4.3	0.0002
<18,5	1149 (13.6)	160 (10.2)	
[18.5-24]	5606 (66.2)	1060 (67.5)	0.001
[25-29]	1232 (14.5)	242 (15.4)	
≥30	478 (5.6)	108 (6.9)	
Weight gain (kg) (mean ± SD)	12.7 ± 5.8	12.00 ± 5.3	< 0.001
< 9	1224 (19.3)	267 (21.5)	
[9-11]	1394 (21.9)	291 (23.4)	0.048
≥ 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
Diabetus mellitus	70 (0.8)	19 (1.2)	0.108
Characteristics of current pregnancy			
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
Supected intrauterine growth restriction	26 (0.3)	4 (0.25)	0.77
Suspected macrosomia	546 (7.1)	109 (7.6)	0.517
Labor characteristics			
Gestational age at delivery (weeks)			
Mean (± SD)	39.9 ± 1.2	40.0 ± 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)	
≥ 42 0/7	272 (3.0)	83 (5.1)	
Cervical dilation at first examination (cm)			
Mean (± SD)	3.2 ± 1.4	3.1 ± 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 (± SD)	4.2 ± 1.8	4.2 ± 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 (± SD)	38.3 ± 24.1	38.5 ± 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

Table 2: Delivery characteristics

	< 35 years N=8993 n (%)	≥ 35 years N=1618 n(%)	P
Delivery mode			0.27
Vaginal	8026 (89.2)	1459 (90.2)	
Caesarean section	967 (10.7)	159 (9.8)	
Caesarian section			
Indications			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)	
Cervical dilation at CS (cm)			
Mean (± SD)	6.1 ± 2.5	6 ± 2.3	0.642
Median (Q1-Q3)	6 (4-8)	6 (4-7)	0.561
Labor duration (minutes)			
Total labor			
Mean (± SD)	430.8 ± 220.1	428 ± 212.2	0.654
Median (Q1-Q3)	422 (274-570)	420 (284-554)	0.689
Latent phase			
Mean (± SD)	191.9 ± 131.9	190.2 ± 130.5	0.651
Median (Q1-Q3)	182.5 (84-275)	180 (85-271)	0.611
Active phase			
Mean (± SD)	150.1 ± 110.4	148.0 ± 104.8	0.498
Median (Q1-Q3)	125 (70-201)	120 (69-198)	0.510
Second phase			
Mean (± SD)	55.3 ± 57.3	56.35 ± 57.0	0.510
Median (Q1-Q3)	40 (0-110)	42.8 (0-110)	0.445
Vaginal delivery			
Total labor duration (minutes)			
Mean (± SD)	421.6 ± 213.6	419.5 ± 209.0	0.723
Median (Q1-Q3)	414 (271-557)	409 (277-543)	0.614
Latent phase duration (minutes)			
Mean (± SD)	191.9 ± 131.9	190.2 ± 130.5	0.651
Median (Q1-Q3)	182.5 (84-275)	180 (85-271)	0.611
Active phase duration (minutes)			
Mean (± SD)	150.1 ± 110.4	148.0 ± 104.8	0.498
Median (Q1-Q3)	125 (70-201)	120 (68.5-198)	0.510
Second phase duration (minutes)			
Mean (± SD)	55.3 ± 57.3	56.3 ± 57.0	0.510
Median (Q1-Q3)	40 (0-110)	42.8 (0-110)	0.457
Operative vaginal delivery	3368 (42.0)	603 (41.3)	0.652
Indications			0.101
Abnormal cardiac fœtal rate	1904 (57.0)	352 (58.9)	
Slow progression	1433 (42.9)	244 (40.8)	
Other	2 (0.1)	2 (0.3)	
Third or fourth perineal laceration	23 (0.3)	3 (0.2)	0.887
Postpartum complications			

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

Table 3: Neonatal outcomes

	< 35 years N=8993 n (%)	**≥ 35 years N=1618** n(%)	**P**
Gender			0.721
Feminine	4352 (48.4)	795 (49.1)	
Masculine	4639 (51.6)	823 (50.9)	
Birth weight (grams)			
Mean (±) SD	3282.6 ± 439.1	3292 ± 451.3	0.407
< 2500	271 (3.0)	57 (3.5)	
[2500-3799]	7649 (85.1)	1334 (82.4)	0.027
≥ 3800	1072 (11.9)	227 (14.0)	
SGA < 10th percentile	1011 (11.2)	202 (12.5)	0.148
pH at ombilical cord			
< 7.10	116 (1.3)	24 (1.5)	0.550
< 7.00	19 (0.2)	2 (0.1)	0.459
Respiratory resuscitation			
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)*	-

* Severe malformations affecting heart and brain function

SGA : small for gestational age

Appendix A.1: Subgroup analysis: maternal, pregnancy and labor characteristics

	< 35 years N=8993 n (%)	**≥ 40 years N=367** n (%)	**P**
Maternal characteristics			
Age (years)			
Mean ± SD	28.2 ± 3.8	42.1 ± 2.6	<0.001
Body mass index before delivery (kg/m²)			
Mean ± SD	22.1 ± 4.1	22.9 ± 4.3	<0.001
<18,5	1149 (13.6)	30 (8.4)	
[18.5-24]	5606 (66.2)	238 (66.7)	0.006
[25-29]	1232 (14.5)	59 (16.5)	
≥30	478 (5.6)	30 (8.4)	
Weight gain (kg)			
Mean ± SD	12.7 ± 5.8	11.5 ± 5.3	<0.001
< 9	1224 (19.3)	78 (26.3)	
[9-11]	1394 (21.9)	74 (25.0)	0.001
≥ 12	3737 (58.8)	144 (48.6)	
Smoker	1294 (14.4)	61 (16.6)	0.004
Chronic hypertension	65 (0.7)	9 (2.4)	<0.001
Diabetus mellitus	70 (0.8)	6 (1.6)	0.073
Characteristics of current pregnancy			
In vitro fertilisation	271 (3.0)	80 (20.8)	<0.001
Gestational diabetes	277 (3.1)	33 (9)	<0.001
Hypertensive gestational diseases	206 (2.3)	22 (6)	<0.001
Preterm labour	649 (7.2)	30 (8.2)	0.488
Premature rupture of membrane	82 (0.9)	6 (1.6)	0.159
Prenatal corticotherapy	373 (4.1)	13 (3.5)	0.567
Supected intrauterine growth restriction	26 (0.3)	0	0.302
Suspected macrosomia	546 (7.1)	25 (7.6)	0.699
Labor characteristics			
Gestational age at delivery (weeks)			
Mean ± SD	39.9 ± 1.2	40.2 ± 1.2	<0.001
37 0/7 - 38 6/7	1859 (20.7)	59 (16.1)	<0.001
39 0/7 - 40 6/7	5279 (58.7)	189 (51.5)	
41 0/7 - 41 6/7	1583 (17.6)	94 (25.6)	
≥ 42 0/7	272 (3.0)	25 (6.8)	
Cervical dilation at first examination			
Mean ± SD	3.2 ± 1.4	3.1 ± 1.4	0.499
Median (Q1-Q3)	3 (2-3)	3 (2-3)	0.175
Peridural anesthesia	7818 (86.9)	327 (89.1)	0.226
Cervical dilation at pose of peridural anesthesia (cm)			
Mean ± SD	4.2 ± 1.8	4.0 ± 1.8	0.310
Median (Q1-Q3)	4 (3-5)	4 (3-5)	0.191
Oxytocin use	4810 (53.5)	197 (53.7)	0.942
Maximal oxytocin dose (UI)			
Mean ± SD	38.3 ± 24.1	39.4 ± 23.6	0.516
Median (Q1-Q3)	30 (20-50)	30 (20-50)	0.432

Amniotic fluid color			0.729
Clear	6903 (77.2)	282 (78.3)	
Tainted	1423 (15.9)	57 (15.8)	
Meconial	617 (6.9)	21 (5.9)	
Manual rotation	878 (9.8)	33 (9)	0.879

Appendix A.2: Subgroup analysis: delivery characteristics

	< 35 years N=8993 n (%)	≥ 40 years N=367 n(%)	P
Delivery mode			0.810
Vaginal	8026 (89.2)	329 (89.6)	
Caesarian section	967 (10.7)	38 (10.3)	
Caesarian section			
Indications			0.485
Abnormal fetal heart rate	389 (40.2)	19 (50.0)	
Arrest of labor	547 (56.6)	18 (47.4)	
Others	31 (3.2)	1 (2.6)	
Cervical dilation at CS (cm)			
Mean ± SD	6.1 ± 2.5	5.9 ± 2.3	0.715
Median (Q1-Q3)	6 (4-8)	5.5 (4-7)	0.610
Labor duration (minutes)			
Total labor			
Mean ± SD	430.8 ± 220.1	426.9 ± 214.1	0.733
Median (Q1-Q3)	422 (274-570)	410.5 (283-556)	0.749
Latent phase			
Mean ± SD	191.9 ± 131.9	189.1 ± 132.7	0.707
Median (Q1-Q3)	182.5 (84-275)	165 (90-270)	0.511
Active phase			
Mean ± SD	150.1 ± 110.4	145.2 ± 103.7	0.422
Median (Q1-Q3)	125 (70-201)	117.5 (60-200)	0.338
Second phase			
Mean ± SD	55.3 ± 57.3	57.7 ± 57.9	0.449
Median (Q1-Q3)	40 (0-110)	45 (0-115)	0.363
Vaginal delivery			
Total labor duration (minutes)			
Mean ± SD	421.6 ± 213.6	416.1 ± 209.5	0.645
Median (Q1-Q3)	414 (271-557)	405.5 (278-536)	0.546
Latent phase duration (minutes)			
Mean ± SD	191.9 ± 131.9	189.1 ± 132.7	0.707
Median (Q1-Q3)	182.5 (84-275)	165 (90-270)	0.511
Active phase duration (minutes)			
Mean ± SD	150.1 ± 110.4	145.2 ± 103.7	0.422
Median (Q1-Q3)	125 (70-201)	117.5 (60-200)	0.338
Second phase duration (minutes)			
Mean ± SD	55.3 ± 57.3	57.7 ± 57.9	0.449
Median (Q1-Q3)	40 (0-110)	45 (0-115)	0.363
Operative vaginal delivery	3368 (42.0)	149 (45.3)	0.231
Indications			0.525
Abnormal cardiac fœtal rate	1904 (57.0)	90 (61.6)	
Slow progression	1433 (42.9)	56 (38.4)	
Other	2 (0.1)	0	
Third or fourth perineal laceration	23 (0.3)	1 (0.3)	0.942
Postpartum complications			

Postpartum hemorrhage	358 (4)	16 (4.4)	0.716
Blood transfusion	118 (1.3)	8 (2.2)	0.157
Nalador	317 (3.5)	14 (3.8)	0.768
Uterine arteries embolisation	2 (0.02)	0	0.775
Vascular ligation	2 (0.02)	1 (0.3)	0.009
Compressive uterine sutures	11 (0.1)	1 (0.3)	0.431
Hysterectomy	0 (0)	0 (0)	-

Appendix A.3: Subgroup analysis: neonatal outcomes

	< 35 years N=8993 n (%)	**≥ 40 years N=367** n(%)	**P**
Gender			0,905
Feminine	4352 (48,4)	181 (49,3)	
Masculine	4639 (51,6)	186 (50,7)	
Birth weight (grams)			
Mean ± SD	3282,6 ± 439,1	3270 ± 447,3	0,783
< 2500	271 (3,0)	13 (3,5)	
[2500-3799]	7649 (85,1)	308 (83,9)	0,027
≥ 3800	1072 (11,9)	46 (12,5)	
SGA < 10th percentile	1011 (11,2)	53 (14,4)	0,058
pH at ombilical cord			
< 7.10	116 (1,3)	4 (1,1)	0,737
< 7.00	19 (0,2)	0	0,378
Respiratory resuscitation			
Ventilatory assistance	476 (5,3)	33 (9)	0,002
Mask ventilation	294 (3,3)	20 (5,4)	0,023
Nasal ventilation	31 (0,3)	2 (0,5)	0,526
Continuous positive pressure	99 (1,1)	7 (1,9)	0,152
Tracheal intubation	117 (1,3)	9 (2,4)	0,061
Neonatal death in labor ward	0 (0)	0 (0)	-

SGA: small for gestational age