

## Influence of maternal age on caesarean delivery – experience in a tertiary hospital

### A influência da idade materna na via de parto – experiência num hospital terciário

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#### Abstract

Caesarian section (C-section) is a worrisome issue due to its increasing incidence and associated risks, especially in low risk pregnancies. Maternal age has an increasing tendency in modern societies and appears to be contributing to the rise in the C-section rates – due to co-morbidities, "high risk labeling" or an intrinsic biological cause related to aging. Our aim is to evaluate the association between maternal age and delivery mode in low risk pregnancies.

Retrospective observational study using electronic medical records, ICD-9-CM coding system and unit database software Obscare. Data from low risk singleton term labors occurred from January 2008 to December 2012 was included. We assessed 10411 cases, divided in three age groups (<20, 20-34, ≥35 years old) - women with 20 to 34 years old were considered the reference group. Parity, presentation, delivery mode, induction, C-section indication and timing were assessed.

Women with ≥35 years old have a higher probability of C-section, 30.7% vs. 22.3%, OR 1.527 [1.371-1.700]. This odd remains higher in non-induced labors, OR 1.367 [1.221-1.531], but loses its significance in the subset of only induced labors. In both multiparous and nulliparous the probability of C-section remains higher for women >35 years old, OR 1.581 [1.356-1.843] and 2.098 [1.742-2.527]. This age group has a higher probability of having a C-section due to "previous C-section" OR 3.121 [2.519-3.865], and a lower probability due to "labor arrest" and "non-reassuring fetal tracing", OR .559 [.457-.685] and .724 [.563-.931], respectively. For the older group, the odd of having an elective C-section was higher, OR 1.844 [1.509-2.254] and of having an urgent C-section lower, OR, .644 [.537-.774].

Older women have a higher probability of having a C-section, even in the absence of identifiable comorbidities. Elective interventions and previous C-sections seem to play a crucial role in this association.

**Keywords:** Delivery; Obstetric; Cesarean Section; Maternal age.

#### INTRODUCTION

Caesarian section (C-section) rates have been rising worldwide, especially in the most developed countries<sup>1-4</sup>. It seems that only now the rates have plateaued,

but a steep increase happened from 1996 to 2011<sup>1,2,4</sup>.

The caesarian section is, in selected cases, the safest way to deliver, being the only way to save both mother and newborn<sup>5</sup>. Regardless, when performed without clinical indication in low risk pregnancies, which represent the vast majority of pregnancies, it appears to pose a significantly greater risk when compared to vaginal delivery, in terms of maternal morbidity and mortality<sup>6,7</sup>. In 1985, a panel of reproductive health experts at a meeting organized by the World Health Organization (WHO) about the C-section rates stated that "there's no justification for any region to have a rate higher than 10-15%". This statement was reviewed since then, due to the steep increases in the C-section rates across

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the world, but the same conclusion was achieved – “At population level, caesarean section rates higher than 10% are not associated with reductions in maternal and newborn mortality rates”<sup>8</sup>.

Furthermore, although primary C-section is itself associated with some significant increases in maternal and perinatal morbidity and mortality, the downstream effects are even greater in future pregnancies, since the risk of placental abnormalities increases with each subsequent C-section<sup>9</sup>. As previous C-section predisposes for subsequent C-section in the following pregnancies, it is of major importance to prevent primary caesarian delivery<sup>10</sup>.

According to Barber et al, the main indications contributing to caesarian delivery, in order of frequency, are: labor arrest, non-reassuring fetal tracing, malpresentation, multiple gestation, maternal-fetal indications, macrosomia, other obstetric indications, preeclampsia and maternal request<sup>11</sup>.

The rise in the C-section rates is multifactorial, but there is growing evidence suggesting that maternal age may have a significant contribution<sup>2</sup>. It is widely known that an advanced maternal age brings worst pregnancy outcomes, traditionally being the age of 35 years old the cut-off considering a higher risk. Nevertheless, the age associated risk factor is much more of a continuous variable than a threshold one. The increased risk of congenital abnormalities, gestational diabetes, placenta previa, macrosomia, abruption and preterm delivery<sup>12</sup> are likely to induce higher rates of C-section in older woman, being the association between the maternal age and C-section a possible product of these confounding factors. The subfertility and use of assisted reproductive techniques and multiple gestations resulting are also conditions associated with older woman that will induce higher C-section rates. The pre-existing medical comorbidities such as diabetes, essential hypertension and a higher body mass index are also independent risk factors to C-section<sup>2</sup>. It is also postulated that clinicians have a lower threshold for intervention in older women, due to the “high risk labeling” and maternal anxiety, influencing both mother’s and obstetrician’s preferences in the mode of delivery<sup>1,12</sup>. Furthermore, older women still have higher C-section rates when compared to younger mothers with the same health conditions or obstetrical complications<sup>10</sup>. However, studies are conflicting on whether there is an association between advanced maternal age alone and C-section, apart from every other comorbidity. The myometrium incompetency in

conjunction with a lack of previous labor -induced gap junction formations and decreased number of oxytocin receptors are argued as possible physiological factors explaining the higher C-section rates in older woman<sup>1</sup>.

This matter has a growing importance and needs special attention, given the widespread trend for woman to delay childbearing. Due to numerous reasons, such as economic stability, social status, career progression and later marriages – the average age of women at childbirth has been steadily rising for approximately 35 years, especially in the more developed countries<sup>3</sup>. In 1980, in Portugal, the medium primiparous age was 23.6, having risen to 30.3 in 2016<sup>13</sup>, now being above the mean in the OECD countries<sup>3</sup>.

The aim of this study is to evaluate the association between maternal age and delivery mode in low risk pregnancies.

## METHODS

The study conducted was observational and retrospective. Data were collected using the hospital electronic medical records, ICD -9-CM coding system and unit database software Obscare.

Ethics approval was obtained from the ethics committee of our hospital– reference number – 260-16; date of approval – October 18<sup>th</sup> 2016.

We included every birth from January 1<sup>st</sup> 2008 to December 31<sup>st</sup> 2012 in a tertiary hospital and excluded cases without information on maternal age or mode of delivery, gestational age <37 or >42 weeks, multiple pregnancies, maternal diabetes mellitus, maternal hypertensive disease, placenta previa, intra-uterine growth restriction, fetal malformations, C-section conducted due to maternal or fetal disease that contraindicates vaginal delivery and C-section conducted due to pregnancy disorders.

Maternal age was categorized in 3 groups: under 20 years old (<20), from 20 to 34 (20-34) and 35 or older (35+). The maternal age reference group was 20-34. The delivery mode was assessed as spontaneous vaginal, instrumented vaginal or C-section. The outcome C-section vs vaginal delivery (spontaneous vaginal plus instrumented vaginal) was assessed. Labor induction (yes vs no), parity status (multiparous vs primiparous) and presentation (cephalic vs other) were also assessed. The variable C-section timing was coded as “elective” (before labor), “urgent” (during labor) and “emergent” (a condition that implies the birth must oc-

**TABLE I. DEMOGRAPHIC AND OBSTETRIC CHARACTERISTICS BY MATERNAL AGE GROUP**

	<20 (n = 466)	20-34 (n = 7879)	35+ (n = 2066)	Total (n = 10411)	Missing
Vaginal delivery	409 (87.8)	6108 (77.5)	1432 (69.3)	7949 (76.4)	0 (0.0)
Cesarean section	57 (12.2)	1771 (22.5)	634 (30.7)	2462 (23.6)	0 (0.0)
C-section timing					
Elective	9 (15,8)	377 (23.1)	211 (34.8)	597 (26.1)	275 (11.1)
Urgent	35 (61,4)	1107 (67.8)	228 (54.1)	1470 (64.3)	
Emergent	5 (8,8)	148 (9.1)	67 (11.1)	220 (9.6)	
Labor induction	59 (12.7)	1495 (19.0)	345 (16.7)	1899 (18.2)	0 (0.0)
Multiparous	63 (16.4)	2981 (44.0)	1343 (71.1)	4387 (48.4)	1355 (13.0)
Vertex	451 (97.4)	7529 (95.8)	1947 (94.7)	9927 (95.6)	29 (0.2)

Data shown as: n (%).

cur in under 20 minutes). C-section indications were coded as “abnormal situation/presentation”, “previous C-section”, “non-reassuring fetal tracing”, “suspected fetopelvic incompatibility”, “failed attempt of labor induction”, “labor arrest”, “maternal refusal for vaginal delivery”, “failed attempt of instrumented vaginal delivery” and “other”.

The primary outcome was the delivery mode; we also evaluated this outcome in subgroups concerning labor induction and parity. Secondary outcomes also assessed were: C-section indication and C-section timing.

The analysis was made using SPSS IBM Statistics 24. Continuous variables were described using mean  $\pm$  standard deviation. Frequencies were described as absolute number (n) and percentage (%). Normality was checked using skewness and kurtosis. Independent samples t-test was used to assess differences among groups in normal continuous variables. Chi-square goodness of fit and X<sup>2</sup> test with Odds Ratio (OR) with a 95% confidence interval were used to compare categorical data. The level of statistical significance was set at  $p < 0.05$ .

## RESULTS

There were 14.462 births from January 1<sup>st</sup> 2008 to December 31<sup>st</sup> 2012; we excluded 4051 cases. A total of 10,411 cases were assessed.

Mean maternal age was  $29.79 \pm 5.51$  years old. Demographic and obstetric characteristics by maternal age group showed in Table I.

In the 35+ age group, when compared to the refer-

ence group, the odd of C-section was significantly higher, OR 1.527 [1.371-1.700].

The odd of C-section was higher in all women who had a labor induction, OR 1.367 [1.221 - 1.531]. When assessing the odd for induction, both 35+ and <20 age groups had lower probability of induction, OR .856 [0.753-0.974] and .619 [.468-.818], relative to the reference group. When we consider only the subgroup of labor induced women, the odd of C-section in the 35+ age group is not significantly different. When we consider only the subgroup of women without induction of labor, the 35+ age group still have higher probability of having a C-section, OR 1.620 [1.439- 1.825].

When dividing women for parity, the odd of C-section is significantly smaller in the multiparous group, OR .735 [.666-.811]. In the 35+ age group, both multiparous and nulliparous women still had a higher odd of C-section, OR 1.581 [1.356-1.843] and OR 2.098 [1.742-2.527], respectively, when compared to the reference age group.

Presentation and birth weight do not differ significantly between age groups.

The main indications for cesarean delivery are illustrated in Figure 1. When compared to the group reference, the 35+ age group had a higher odd of C-section due to “previous C-section”, OR 3.121 [2.519-3.865], and a lower odd for C-section due to “labor arrest” and “non-reassuring fetal heart tracing”, OR .559 [.457-.685] and .724 [.563-.931], respectively.

The 35+ age group had a higher odd of an elective C-section, OR 1.844 [1.509-2.254] and a lower odd of an urgent C-section, OR .644 [.537-.774], when compared to the group reference (Figure 2).

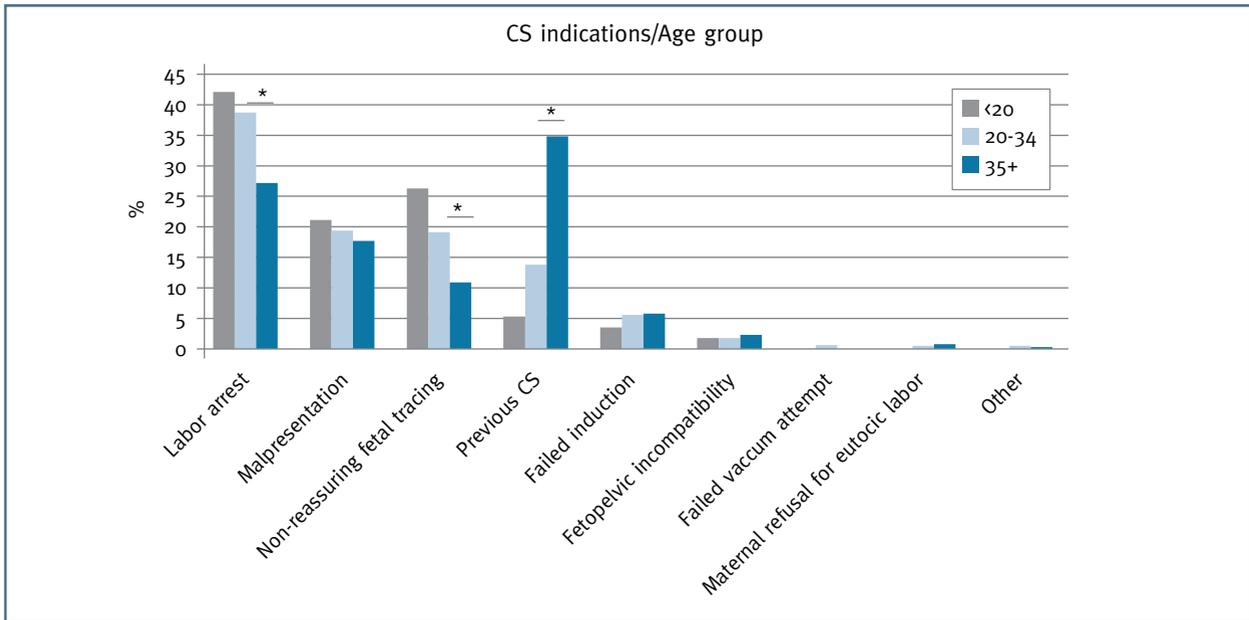


FIGURE 1. C-section indications by maternal age group. \*p<0.05

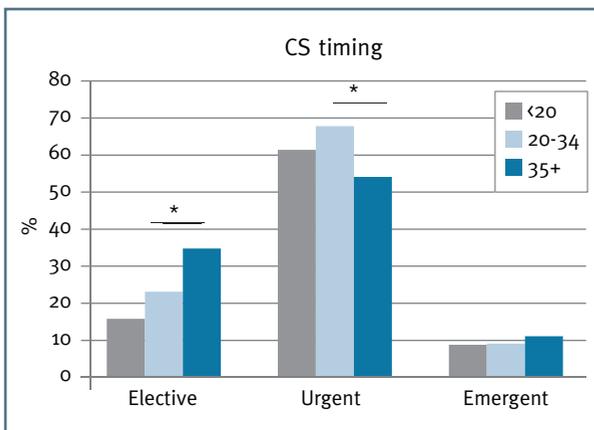


FIGURE 2. C-section timing by maternal age group. \*p<0.05

## DISCUSSION

Our total C-section rate was 23.6%, which is higher than recommended by the WHO<sup>8</sup>, especially considering we are only assessing low risk pregnancies. We chose to assess only pregnant women with no labeled risk factors or comorbidities that could be related to aging, trying to exclude possible reasons behind higher C-section rates in older women. However, even when assessing these healthy women with otherwise low risk pregnancies, we found a higher risk for C-section in older women. This supports the hypothesis that

there is either a different approach from physicians towards older women, due to the “high risk labeling”<sup>1,12</sup> and/or a biological factor associated with aging that impairs the ability of older women to have a vaginal delivery<sup>1</sup>. Supporting the “high risk labeling” hypothesis, we also found that being older was a risk factor for having an elective C-section and a protective factor for having an urgent C-section. Although literature suggests that older women have a higher risk of emergency C-section<sup>2</sup>, most studies included women with the comorbidities knowingly associated with aging and that pose a higher risk for emergency procedures. The fact that we did not find this association reinforces that maternal age alone is not a risk factor. Additionally, we found no differences in birth weight or presentation among age groups.

Indication for C-section due to “labor arrest” or “non-reassuring fetal heart rate” is lower in older women, being only higher the indication due to “previous C-section”, which is indicative of the need to reduce rates of primary C-section and once again it supports that clinicians may be mistakenly labeling older women as high risk patients due only to their age. The importance of vaginal birth after cesarean section (VBAC) cannot be underestimated and it has a major impact in C-section rates – for each 1% increase in VBAC, an estimated 0.58% decrease in C-section occurs. Regarding maternal outcomes, the risk of a trial of labor

after C-section is lower than the risk of repetitive elective C-section and may, thus, be attempted in women with 1 or even 2 prior C-sections, with prior individualized risk assessment, especially concerning uterine rupture – there is no clear evidence that maternal age poses a greater risk of uterine rupture<sup>14</sup>.

There is conflicting evidence concerning the influence of maternal age on labor progression. Smith et al reported that older maternal age was associated with a reduced degree of spontaneous contraction of human myometrium and an increased likelihood of multiphasic spontaneous contractions, which is associated with prolonged labor<sup>15</sup>. However, Arrowsmith et al have reported that, although the lack of contractility does happen in older non-pregnant uterus, in pregnant myometrial tissue, there is an hormonal response of myocytes with hyperplasia and hypertrophy, compensating any age-related differences<sup>16</sup> and Crankshaw et al demonstrated that there was no evidence that the contractility of human myometrium obtained during pregnancy had any variation with advancing maternal age<sup>17</sup>. Response to oxytocin appears to be decreased in older women, leading to increased needs of oxytocin-augmentation – the reason behind this can be the high content of cholesterol in myometrium cells of older women, influencing the oxytocin-receptor function – both serum LDL cholesterol and body mass index could, therefore, be important factors concerning the evolution of labor<sup>16</sup>. Our results show that older women had fewer C-sections due to labor arrest, when compared to the reference age group, supporting that there is no direct effect of age on labor progression. Further research is needed to clarify the physiology of the aging pregnant myometrium and possibly provide targets to intervene and reduce the need for C-section.

We found rates of C-section significantly higher in labor induced women. It is still not clear whether there is or not an increased risk associated with induction – traditionally it was considered a risk factor for C-section<sup>18,19</sup>, but there are some recent studies suggesting induction might have no effect on the C-section rates<sup>18</sup> or even be a protective measure for it<sup>20</sup>. Further investigation is needed to establish the true contribution of induction in the delivery mode, since an elective C-section has lower risks than an urgent one, the latter possibly potentiated by induction<sup>21</sup>. When analyzing only the subgroup of labor induced women, older age stops being a risk factor for C-section. A possible explanation is that the augmented risk due to the induction itself supplants the risk of maternal age,

since there is a higher risk of induction in the reference group. Adding to it, the option of inducing denotes a preference of the physician for a vaginal labor, instead of an elective C-section, which can further decrease the risk of C-section in older women due to the “high risk labeling” itself. The subgroup of non-induced women statistically behaves the same way as the total group – with an even higher risk for C-section in older women, possibly related to the higher odd of elective C-sections.

Regarding women's parity, significant differences were found – multiparous had, as expected, lower risk of C-section. However, older women when compared to the reference age group still had a higher risk of C-section in both parity groups. The higher risk in the multiparous group may to some extent be due to previous C-section accounting for the multiparous status, which was in fact the major indication for C-section in the older group.

We had some limitations in this study, regarding missing information on whether there had been a previous C-section in multiparous women, medically assisted reproduction, increased body mass index and smoking status, all of them likely to have a higher prevalence in older women and possibly affecting the outcome “delivery mode”.

In conclusion, our study supports that advanced maternal age contributes to the elevated C-section rates in singleton low risk pregnancies at term. Physicians' sensitization to this concerning matter may help to lower the C-section rates, by removing the high risk labeling associated with this age group and increasing the threshold for decision making regarding cesarean delivery. Focus should also be given on lowering the primary C-section rates, given the fact that “previous C-section” was the most frequent reason leading to C-section in older women. Another important concern that as to be addressed is that it seems the risk of having a C-section in older women is being overestimated due to elective C-sections, and an effort to figure the reason behind this is pivotal. Further studies are needed to evaluate the biology of the aging myometrium to establish new targets for intervention.

## REFERENCES

1. Bayrampour H, Heaman M. Advanced maternal age and the risk of cesarean birth: a systematic review. *Birth*. 2010;37(3):219-226.
2. Moore EK, Irvine LM. The impact of maternal age over forty years on the caesarean section rate: Six year experience at a busy District General Hospital. *J Obstet Gynaecol (Lahore)*. 2014;34(3):

238-2340.

3. OECD - Social Policy Division - Directorate of Employment L and SA. Age of Mothers at Childbirth and Age-Specific Fertility. 2015.

4. PORDATA - Cesarianas nos hospitais [online] Available at: [http://www.pordata.pt/Portugal/Cesarianas+nos+hospitais+\(percentagem\)-1985](http://www.pordata.pt/Portugal/Cesarianas+nos+hospitais+(percentagem)-1985) [Accessed at Feb 10th 2017]:1-3.

5. Everett J. Obstetric care. *Br Med J (Clin Res Ed)*. 1984;288(6430):1600-1602

6. Clark SL, Belfort MA, Dildy GA, Herbst MA, Meyers JA, Hankins GD. Maternal death in the 21st century: causes, prevention, and relationship to cesarean delivery. *Am J Obstet Gynecol*. 2008;199(1).

7. Liu S, Liston RM, Joseph KS, Heaman M, Sauve R, Kramer MS. Maternal mortality and severe morbidity associated with low-risk planned cesarean delivery versus planned vaginal delivery at term. *CMAJ*. 2007;176(4):455-460.

8. Human Reproduction Programme. WHO Statement on Caesarean Section Rates. 2015:1-8.

9. Silver RM, Landon MB, Rouse DJ, Leveno KJ, Spong CY, Thom EA, et al. Maternal morbidity associated with multiple repeat cesarean deliveries. *Obstet Gynecol*. 2006;107(6):1226-1232.

10. Janoudi G, Kelly S, Yasseen A, Hamam H, Moretti F, Walker M. Factors Associated With Increased Rates of Caesarean Section in Women of Advanced Maternal Age. *J Obs Gynaecol Can*. 2015;37(6):517-526.

11. Barber EL, Lundsberg LS, Belanger K, Pettker CM, Funai EF, Illuzzi JL. Indications contributing to the increasing cesarean delivery rate. *Obstet Gynecol*. 2011;118(1):29-38.

12. Cleary-Goldman J, Malone FD, Vidaver J, Ball RH, Nyberg DA, Comstock CH, et al. Impact of Maternal Age on Obstetric Outcome. *Obstet Gynecol*. 2005;105(5, Part 1):983-990.

13. PORDATA - Idade média da mãe ao nascimento do primeiro filho [online] Available at: <http://www.pordata.pt/Portugal/Idade+m%C3%A9dia+da+m%C3%A3e+ao+nascimento+do+primeiro+filho-805> [Accessed at May 7th 2017]. (624):2-5.

14. Sabol B, Denman MA, Guise J-M. Vaginal Birth After Cesarean: An Effective Method to Reduce Cesarean. *Clin Obstet Gynecol*. 2015;58(2):309-319.

15. Smith GCS, 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(7):1123-1132.

16. 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(3-4):209-217.

17. Crankshaw DJ, O'Brien YM, Crosby D, Morrison JJ. Maternal Age and Contractility of Human Myometrium in Pregnancy. *Reprod Sci*. 2015;22(10):1-7.

18. Walker KF, Bugg GJ, Macpherson M, McCormick C, Grace N, Wildsmith C, et al. Randomized Trial of Labor Induction in Women 35 Years of Age or Older. *N Engl J Med*. 2016;374(9):813-822.

19. Davey M-A, King J. Caesarean section following induction of labour in uncomplicated first births- a population-based cross-sectional analysis of 42,950 births. *BMC Pregnancy Childbirth*. 2016;16(1):92.

20. Wood S, Cooper S, Ross S. Does induction of labour increase the risk of caesarean section? A systematic review and meta-analysis of trials in women with intact membranes. *BJOG An Int J Obstet Gynaecol*. 2014;121(6):674-685.

21. Allen VM, O'Connell CM, Baskett TF. Maternal morbidity associated with cesarean delivery without labor compared with induction of labor at term. *Obstet Gynecol*. 2006;108(2):286-294.

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