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# Linear association between maternal age and spontaneous breech presentation in singleton pregnancies after 32 weeks gestation

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## ABSTRACT

**Purpose:** To investigate the association between maternal age and spontaneous breech presentation.

**Material and methods:** Fifteen-year observational study over (2001–2015). All consecutive singleton births delivered at the Centre Hospitalier Universitaire Sud Réunion's maternity. The only single exclusion criterion was uterine malformations ( $N=123$ ) women.

**Results:** Of the 60,963 singleton births, there was a linear association ( $\chi^2$  for linear trend,  $p<0.0001$ ) between maternal age and spontaneous breech presentation. Overall rate of breech presentation was 2.7% in deliveries over 32 weeks gestation, while it was 1.9% in women aged 15 to 19 years and 4.0% in women aged 45+, with a linear progression for each 5-year age category. This linearity remained significant controlling for early prematurity (<33 weeks) and severe fetal malformations ( $\chi^2$  for linear trend = 64,  $p<0.0001$ ). Controlling in a multiple logistic regression model for other major risk factors gestational age, female sex, primiparity, maternal age remained significantly an independent risk factor,  $p<0.0001$ .

**Conclusion:** Maternal age ( $x$ ) is an independent factor for breech presentation in singleton pregnancies after 32 weeks gestation with a linear association that may be approximated at  $y=0.1x$ . ( $y$ : incidence, percent).

## Introduction

After several studies on primiparous adolescent pregnancies (<18 years of age) [1–3], we noticed that the incidence of spontaneous breech presentation was very rare among these very young women (around 1.5%), while verifying in primiparae older than 30 years of age, it was more than 4%. Therefore, we sought then to investigate the potential association between maternal age and spontaneous breech presentation at birth, investigating also multiparae.

In a seminal paper in 1946, Tompkins published a study "An inquiry into the causes of breech presentation" [4]. He cited a 1945 study by Keith Vartan listing a series of risk factors including prematurity, multiple gestation, multiparity, hydrocephalus, placenta previa and pelvic tumors. Tompkins added to the list uterine anomalies, hereditary tendency, uterine scars, elderly primiparae and polyhydramnios. Later studies

[5–10] discussed causes like oligohydramnios, polar placentation, gestational diabetes, short umbilical cord, a history of breech presentation, low birthweight and congenital anomalies. Cammu et al [10] in a recent study of 611,000 women in Flanders added also women giving birth to a female offspring to the list of risk factors, and, after controlling for confounding factors showed that gestational diabetes and pregnancies resulting from IVF were no more independent factors. Cammu et al [10] concluded that gestational age and birthweight (the lower, the higher the incidence of breech at birth) and on the maternal side the older the mother, the higher the odds for breech presentation. However, the frequency of breech decreased with increasing parity. In a more recent study by Zsirai et al. [11], on the Hungarian National obstetrical database during the period 1996–2011 (1,272,023 singleton births of which 41,796 breech presentations, 3%) shown also as independent factors primiparity, history of

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spontaneous abortions, stillbirths, hypertension and pre-eclampsia, hormone treatment and assisted reproduction. They confirmed also that breech presentation was independently associated with older maternal ages [11].

In this study, we will consider only singleton pregnancies, as fetal presentations have their specific patterns in multiple pregnancies [12]. We wanted to test the hypothesis if maternal age as such could be also an independent factor for breech presentation.

## Material and methods

Reunion island (French overseas Department in the Indian Ocean) has 890,000 inhabitants, with 14,000 births per year. The population is composed of approximately 45% of people from African origin, 10% of Europeans (coming from mainland France), 25% of people from Indian origin, 3% from Chinese origin, and the rest of Creoles (mixed population). The Centre Hospitalier Universitaire Sud-Reunion's maternity (Level 3, European standards of care) is the only public hospital in the southern part of Reunion Island. It serves the whole population of the area, and with 4300 births per year, represents 80–82% of all births in the South of the island, the remaining occurring in a single private clinic in the area (level 1).

From 1 January 2001 to 31 December 2015, the hospital records of all women delivered at the maternity of the University South Reunion Island (approximately 4300 births per year) were abstracted in standardized fashion. All data were entered into an electronic anonymized epidemiological perinatal data base which contained information on obstetrical risk factors, description of deliveries and neonatal outcomes. As participants in the French national health care system, all pregnant women in Reunion Island have their prenatal visits, biological and echographical examinations and anthropological characteristics recorded in their maternity booklet.

In the general analysis (Table 1), there were only one criterion of exclusion in singleton pregnancies: uterine malformations ( $n = 123$ , 0.2% of women). The study population was then 60,963 women.

Breech deliveries were defined as presentation at birth (vaginal or cesarean section). In addition, successful external cephalic version performed in our settings at 36 weeks gestation have been classified as "breech presentation".

Epidemiological data have been recorded and analyzed with the software EPI-INFO 7.1.5 (2008, CDC Atlanta, OMS), EPIDATA 3.0 and EPIDATA Analysis V2.2.2.183. Analysis consisted of the  $\chi^2$  for linear trend, coefficient of correlation  $r$ , and  $R^2$  coefficient of determination.

**Table 1.** Incidence of breech presentation in singleton pregnancies.

Maternal ages	Maternal ages							Total	Chi <sup>2</sup> for linear trend	R <sup>2</sup> c. determination	r coefficient correlation	p values
	10–14	15–19	20–24	25–29	30–34	35–39	40–44					
All women N = 60,963	3/144 (2.1)	155/7048 (2.2)	362/14,719 (2.5)	458/15,374 (3.0)	474/12,993 (3.6)	293/8107 (3.6)	101/2445 (4.1)	8/133 (6.0)	1854 (3.0)	68	r = 0.91 R <sup>2</sup> = 0.82	<0.001
Specific Situations												
Severe fetal malformations N = 804 <sup>a</sup>	0/2 (0.0)	5/69 (7.2)	13/197 (6.6)	9/186 (4.8)	20/186 (10.1)	15/147 (10.2)	9/82 (11.0)	1/7 (14.3)	72 (8.2)	-	-	NS
Early preterms <33 weeks N = 1981	1/12 (8.3)	28/281 (10.0)	64/456 (14.0)	54/443 (12.2)	49/386 (12.7)	29/294 (9.9)	14/100 (14.0)	3/9 (33.3)	242 (12.2)	-	-	NS
Early Preterms Excluded												
All women term N = 58,973	2/132 (1.5)	127/6766 (1.9)	298/14,261 (2.1)	404/14,929 (2.7)	425/12,604 (3.4)	264/7812 (3.4)	87/2345 (3.7)	5/124 (4.0)	1612 (2.7)	76	R = 0.98 R <sup>2</sup> = 0.97	<0.001
Primip. at term N = 21,883	2/129 (1.6)	109/5474 (2.0)	187/7646 (2.4)	182/5193 (3.5)	109/2453 (4.4)	37/810 (4.6)	9/171 (5.3)	1/7 (14.2)	636 (2.9)	60	R = 0.78 R <sup>2</sup> = 0.61	<0.001 (*)
Multip. at term N = 37,090	0/3 (0)	17/1292 (1.3)	111/6615 (1.7)	222/9736 (2.3)	316/10,151 (3.1)	227/7002 (3.2)	78/2174 (3.6)	4/117 (3.4)	975 (2.6)	59	R = 0.96 R <sup>2</sup> = 0.92	<0.001
BMI $\geq 30$ kg/m <sup>2</sup> N = 9024, term	0/5 (0)	10/548 (1.8)	41/2043 (2.0)	51/2476 (2.1)	60/2094 (3.0)	46/1380 (3.3)	22/456 (4.8)	1/22 (4.5)	231 (2.6)	75	R = 0.95 R <sup>2</sup> = 0.91	<0.001
Gestational diabetes, term N = 5581	0/3 (0)	5/156 (3.2)	12/657 (1.8)	34/1203 (2.8)	49/1559 (3.1)	47/1340 (3.5)	25/623 (4.0)	2/40 (5.0)	174 (3.1)	5.1	R = 0.79 R <sup>2</sup> = 0.63	0.02

One exclusion criterion: uterine malformations (N = 123).

Two exclusion criteria: uterine malformations and early preterm (N = 1981, 3.2% of total pregnancies) births.

<sup>a</sup>Severe fetal malformations: polymalformations, chromosomal abnormalities, severe cardiac and neurological malformations.

We considered the following covariates as possible confounders in this analysis: severe fetal malformations and early preterm birth (<33 weeks gestation). We included these variables and calculated the  $\chi^2$  for trend (Mantel extension), the odds ratios for each exposure level compared with the first exposure level (i.e. the entire cohort  $N=60,963$ ).

Further, to validate the independent association of maternal age and other confounding factors on breech presentation we realized a multiple regression logistic model.

Variables associated with breech presentation in bivariate analysis, with a  $p$  values below 0.1 or known to be associated with the outcome in the literature were included in the model. A stepwise backward strategy was then applied to obtain the final model. The goodness of fit was assessed using the Hosmer–Lemeshow test.

A  $p$  values below 0.05 was considered significant. All analyses were performed using MedCalc software (version 12.3.0; MedCalc Software's, Ostend, Belgium).

### Ethics approval

This study was exempt from approval of institutional review board (Comité de Protection des Personnes Sud-Ouest et Outre Mer III) and according to French legislation written consent.

### Results

During the 15-year period, there were 60,963 singleton consecutive births after 22 weeks gestation, we

identified 1854 breech presentations (of which 202 successful external cephalic versions performed in our settings at 36 weeks gestation have been counted as “breech presentation” – 202/567, success rate – 35.6%). The total women delivering after 32 weeks gestation (early preterm birth excluded, i.e. 3.2% of total births) was 58,973 (Table 1).

In Table 1:

1. Considering all terms after 22 weeks gestation (first line), we show that, globally in the total population, there is a significant linear associated with maternal ages ( $\chi^2$  for linear trend = 68,  $r = 0.91$ ,  $r^2 = 0.82$ ,  $p < 0.0001$ ), the global prevalence of breech presentations representing 3% of total births.
2. Below, “specific situations”, we notice that the highest prevalences of breech presentation occurred in early preterm birth: 12.2% (<33 weeks,  $N = 1981$ , 3.2% of births) and, second, for pregnancies complicated by severe fetal malformations: 8.2% ( $N = 804$ , 1.3% of births).
3. In bottom of the Table “early preterms excluded”, considering “extended term” (>32SA) pregnancies ( $N = 58,973$  births, 96.7% of total births),  $\chi^2$  for linear trends and coefficients of correlation and determination remained highly statistically significant,  $p < 0.0001$ , also in primiparae and multiparae (shown in Figure 1).

Figure 1 depicts the linear association between maternal ages and spontaneous breech presentations. The breech presentation rate was lowest in younger

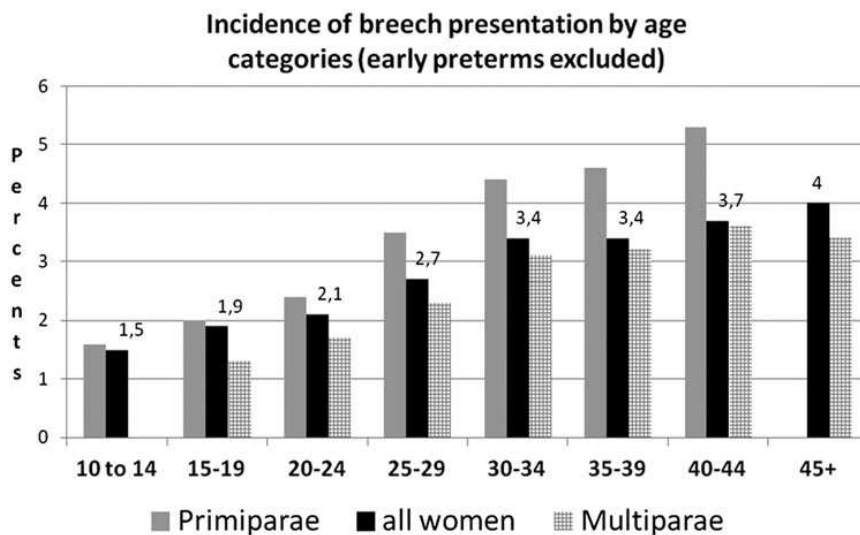


Figure 1. Incidence of breech presentation by age categories (early preterms excluded).

**Table 2.** Spontaneous breech presentations in primiparae, early premature excluded (age categories by 2 years).

Maternal ages	12–13 N = 17	14–15 N = 450	16–17 N = 1877	18–19 N = 3259	20–21 N = 3359	22–23 N = 2968	24–25 N = 2559	26–27 N = 2166	28–29 N = 1787	30 = 31 N = 1279
Spontaneous breech (%) presentations	0 (0)	10 (2.2)	33 (1.8)	68 (2.1)	75 (2.2)	80 (2.7)	72 (2.8)	64 (3.0)	78 (4.4)	61 (4.8)
Maternal ages	32–33 N = 847	34–35 N = 572	36–37 N = 366	38–39 N = 199	40–41 N = 115	42+ N = 63	Total N = 21,883	Chi <sup>2</sup> for linear trend	R f correlation R <sup>2</sup> determination	p values
Spontaneous breech presentation. (%)	34 (4.0)	24 (4.2)	18 (4.9)	9 (4.5)	6 (5.2)	3 (6.3)	636 (2.9)	61	R = 0.92 R <sup>2</sup> = 0.85	<0.001

**Table 3.** Rate of breech presentation by maternal age.

Maternal ages	Odds ratio crude All pregnancies N = 60,963	Odds ratio adjusted <sup>a</sup> All pregnancies N = 60,819	Odds ratio crude Pregnancies at "extended term" (>32w) N = 58,973
10–14	1.00 (reference)	–	1.00 (reference)
15–19	1.05	1.00 (reference)	1.2
20–24	1.18	1.16	1.4
25–29	1.44	1.33	1.8
30–34	1.78	1.63	2.26
35–39	1.76	1.57	2.27
40–44	2.02	1.83	2.5
45+	3.1	3.0	2.7
p for linear trend	<0.00001	<0.00001	<0.00001
χ <sup>2</sup> for linear trend	68.1	64.5	76.1

All singleton pregnancies N = 60,963.

Only one exclusion criterion: uterine malformations (N = 123). Crude and adjusted χ<sup>2</sup> for linear trend for severe fetal malformations and early preterms (<33 weeks).

<sup>a</sup>χ<sup>2</sup> for linear trend adjusted for severe fetal malformations (yes/no), grand prematurity (<33 weeks, yes/no).

women and increased linearly as maternal ages increased.

Table 2 represents in primiparae the incidence of breech presentation (early preterm excluded) by categories analyzed by 2-year maternal ages confirming the regular linear trend beginning in very young ages, (χ<sup>2</sup> for linear trends 78 and coefficients of correlation and determination remained highly statistically significant,  $p < 0.0001$ ).

Table 3 represents the overall calculation of the χ<sup>2</sup> for linear trend for the entire cohort (N = 60,963 singleton pregnancies) along with the adjusted χ<sup>2</sup> for possible confounders (fetus presenting severe malformations and early preterm birth). For the adjusted ORs, we were obliged to skip the 144 girls aged 10–14 years, because of lack of cases in severe malformations and early preterm births (see also Table 1). Results of the adjusted χ<sup>2</sup> for these two criteria (which are not themselves statistically significant for the linear trend, see Table 1) are very similar to the crude OR for trend (64 vs. 68,  $p < 0.0001$ ) calculated for all parturients.

In Table 4, to validate the independent association of maternal age and other confounding factors in all our cohort, we performed a multiple logistic regression model. Variables associated with breech presentation in bivariate analysis, with a p values below 0.1 or known to be associated with the

outcome in the literature were included in the model. A stepwise backward strategy was then applied to obtain the final model. Controlling for all the variables, four major items remained highly significant ( $p < 0.0001$ ): gestational age (negative coefficient,  $-0.16$ , breech presentation being increasing with lower gestational ages), Female sex of the baby, primiparity and maternal age (coefficient 0.04, i.e. 4% increase of the index incidence by each year of age).

## Discussion

In this study, we found a strong association between maternal age as such as an independent factor for breech presentation, controlling for other major associations (gestational age, female sex, primiparity, Table 4). But, further, we also show that this association is a linear one (χ<sup>2</sup> for linear trend,  $p < 0.0001$ ) all along the spectrum of maternal ages. We could have, like in the nationwide study by Zrirai et al [11], study only term pregnancies (≥37 weeks), as the association between prematurity and breech presentation is already well described in the literature [13]. In fact, it seems in our cohort that this association is present only for early preterm pregnancies (≥32 weeks), and not with moderate prematurity (33–36 weeks, which represent an important number of births, 8% of our

**Table 4.** Multiple logistic regression model to validate the independent association of maternal age and other confounding factors.

Multiple logistic regression for breech presentation			
	Coefficient	Std. Error	<i>p</i>
Gestational age	−0.16	12.0	<0.0001
Female sex	0.26	0.05	<0.0001
Primiparity	0.31	0.06	<0.0001
Maternal age	0.04	0.004	<0.0001
<i>Variables not included in the model</i>			
Severe malformation			

population vs. 3% for early preterms). Concerning maternal age Cammu et al [10] as well as Zsirai et al [11] confirmed that “on the maternal side: the older the mother, the higher odds for breech presentation” [10]. In the study of Zsirai et al, the incidence of breech presentation was of 2.8% in women <25 years, 3.5% for those 25–35 years, and 4.0% for 35 years and plus with an unadjusted odds ratio of 1.02 [1.02–1.03] and multiple adjusted odds ratio 1.04 [1.04–1.04] concerning maternal age. Concerning primiparity [10], we had enough primiparous women (almost 22,000), and also young ones aged from 12 to 18–20 years to split the categories by age of 2 years (instead of 5-year category in the general analysis including also multiparae) (Table 2). Thus, the linearity remained present.

Results shown in Table 1 depict statistically significant linear trends between maternal age and spontaneous breech presentation corrected for several considered risk factors, obesity, gestational diabetes, multiparity. However, the “linear law” was not identified in early preterm births [13] or in pregnancies where the fetus presented severe malformations [5–11], two situations with a great rate of breech presentation (12% and 8%, respectively, Table 1). However, these two important pregnancy complications accounted for only 4% of the total population, the adjusted  $\chi^2$  for linear trend remained very significant at a level of 64, while it was 68 for the entire cohort ( $p < 0.0001$ ) (Table 3). On the basis of these data, we conclude that maternal age should be added to the list of risk factor, as also identified by Cammu et al [10] and Zsirai et al [11]. However, the existence of a “linear law” is a new finding, and we may very roughly approximate the reality by memorizing “ $y = 0.1x$ ” (e.g. a woman of 19 years old presenting 1.9% incidence of breech presentation, while a woman of 34 years, 3.4%). The presence of this regular linear trend suggests a yet unidentified underlying physiological principle. We currently do not have a specific explanation why younger women appear to be protected from having a birth complicated by the presence of a fetus

in breech position. Better uterine muscular tone has been suggested, but we would be keen to receive other suggestions. However, breech presentation at term being an obstetrical problem for birthing, a lower incidence could had been advantageous in the human species in times when modern obstetrics (notably the safety of cesarean sections) did not existed.

## Conclusions

This study demonstrates maternal age as a strong independent risk of spontaneous breech presentations in singleton pregnancies after 32 weeks.

## Disclosure statement

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this article.

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