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Active medical interventions at birth in primiparae have a linear association with maternal ages (Y= 1.4X)

Pierre-Yves Robillard[1,2*]; Thomas C Hulsey[3]; Malik Boukerrou[3,4]; Francesco Bonsante[1,2]; Gustaaf Dekker[5]; Silvia Iacobelli[1,2]

[1]Service de Néonatologie. Centre Hospitalier Universitaire Sud Réunion, BP 350, 97448 Saint-Pierre Cedex, La Réunion

[2]Centre d'Etudes Périnatales Océan Indien (CEPOI). Centre Hospitalier Universitaire Sud Réunion, BP 350, 97448 Saint-Pierre cedex, La réunion.

[3]Department of epidemiology, school of public health, West Virginia University

[4]Service de Gynécologie et Obstétrique. Centre Hospitalier Universitaire Sud Réunion, BP 350, 97448 Saint-Pierre cedex, La réunion.

[5]Department of Obstetrics & Gynaecology, University of Adelaide, Robinson Institute. Lyell McEwin Hospital

***Corresponding Author(s): Pierre-Yves Robillard**

Service de Néonatologie. Centre Hospitalier Universitaire Sud Reunion, BP 350, 97448 Saint-Pierre cedex, France

Email: robillard.reunion@wanadoo.fr

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Abstract

Background & objectives: To investigate the potential association between maternal age and obstructed labour or fetal distress in primiparas, defined as requiring active obsterical intervention (caesarean sections, vaginal operative procedures).

Methodology: 15 year-observational cohort study. All consecutive primiparous singleton births at the Centre Hospitalier Universitaire Hospitalier Sud Reunion's maternity (French overseas department, Indian Ocean).

Results: We identified in this large cohort of singleton human primiparous births, a linear association valid from 12 years of age to 42+: y = 1.4 x (χ^2 for linear trend, $p < 0.001$), where x is the age of the primipara and y the percentage of deliveries needing an active medical help. It is the resultant, among 22,862 singleton primiparous births, of 5 significant linear associations (χ^2 for linear trend, $p < 0.0001$) between maternal age and, a) vaginal deliveries without any medical intervention, b) rate of cesarean sections, c) rate of operative vaginal procedures, d) rate of spontaneous breech presentations, and e) rate of C-sections for placenta praevia.

Conclusions and implications: These 5 consistent linear laws concerning human first births are difficult to understand without hypothesizing an underlying biological principle. Before the start of modern obstetrics, young women were condemned to begin their reproductive lives during puberty, because of absence of any type of contraception

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and a very short expectancy of life. Amongst the debates on the high incidence of obstructed labor (disproportion between fetal size and the mother's pelvic dimensions) in humans which has puzzled evolutionary scientists for decades, the linear association between maternal age and obstructed labour should enlarge the discussion. An adaptation seems to have minimized the major dystocia risks (maternal death at birth) in the youngest primiparae, suggesting a relative mismatch between our biology and our modern life context in developed countries.

Introduction

Adolescent pregnancies are considered high risk or even dangerous in medical literature (90% from developed countries), as well as in some in evolutionary research. Writing on the subject demands to obligatorily cite the Fraser's seminal-considered paper on the subject [1]: in summary, adolescent pregnancies are a catastrophe, and these young women are somewhere unconscious (their parents and the societies tolerating this too). In a recent paper Wells [2] reports that 'under-age' marriage (< 18 years) which remains very common in the 21st century is significantly involved in obstructed labour, as "there are some indications that pelvic growth continues into adult life".

In Reunion island (French overseas department in the Indian ocean), 4% of deliveries are from adolescents (< 18 years), representing 11% of all primiparous deliveries [3]. From a global perspective, adolescent girls between 15 and 19 years still give birth to around 16 million babies each year, representing ap. 11% of births worldwide [4]. "Pregnancy among adolescents is not associated with worse maternal outcomes, but is associated with worse perinatal outcomes" [4] is now an accepted consensus [5-8]. We started more than a decade ago studies on adolescent pregnancies convinced by the common dogma that adolescent typically have complicated births [9], and we were in fact surprised of the findings indicating lower birth dystocia in adolescents [9-10]. In our experience, the preceding paradigm should rather be: "Pregnancy among adolescents is associated with very good maternal outcomes". The second set of surprises have been recently published in two different studies [11,12]: nonetheless, younger women deliver better but,, throughout the whole spectrum of ages in primiparae, there is a negative linear association between maternal age and physiological births (without any active medical help). The 4 significant linear associations between maternal age from 12 years of age to 42+ (all χ^2 for linear trend, $p < 0.0001$) are a) vaginal deliveries without any medical intervention (negative association), b) rate of cesarean sections, c) rate of operative vaginal procedures [11] and d) spontaneous breech presentation in term pregnancies [12] (these 3 last having a positive association) in primiparous deliveries. The present study completes this frame by a 5th linear association (see below), in the same population, with a longer survey (15 years instead of 14). In these four linear associations, maternal age is described as an independent factor controlling for other major risk factors e.g. gestational age, female sex, maternal BMI, maternal height and birthweights ≥ 3500g [11,12].

All together, these unexpected results (linearity) suggested a yet unidentified underlying physiological principle. Trying to interpret this regularity-linearity led us to the observation that everything happens like if an adaptation had lowered maternal deaths at first births in the youngest ages. If there was a biological adaptation of our genus, then we thought that the best frame of reflection should be to consider the problem as an adaptive phenomenon [13]. As compared with nowadays' knowledge in obstetrics, non-skilled attendants have been the rule during 99.98% of existence of our species (For example, the profession of midwife has been formalized in France only in 1556 by a Royal Edict [14]. However, in case of an uneventful vaginal birth, even a non-skilled birth attendant will be enough. In contrary, without obstetrical care cephalopelvic disproportion often results in maternal or neonatal deaths or severe morbidity [15,16]. The strinkingly high incidence of obstructed labour has puzzled evolutionary scientists for decades [15]. In science we have been living for decades with the anthropological hypothesis known as the "obstetrical dilemma" [17]. Because of bipedalism in mothers and the huge fetal brain size in humans, we had to face a contradiction between the mothers' pelvic dimensions and the size of the fetus. The compromise has been to give birth to neurologically premature newborns (with the minimal, in primates, 30% of the adult brain size in newborns), also called human altriciality [18].

The purpose of this study is 1) to complete the association with maternal age and uncomplicated physiologic birthing (after the linearities between age and rate of caesarean section, rate of rate of operative vaginal procedures and breech presentation), by testing the association between maternal ages and the very harmful placenta pravia (synonymous with maternal death prior to modern obstetrical care). 2) To give an evaluation of these findings by the resulting linear equation. And 3) to present our arguments for possible explanations. With survival of the mother as the main outcome and the core hypothesis (and not necessarily the survival of the newborn), if there is an adaptation against maternal deaths at birth, it should include all the main "mechanical" morbid causes which may induce the death of the mother: obstructed labour (severe dystocia, first by cephalopelvic disproportion, breech presentations), but also the highly threatening postpartum haemorrhage (including placenta praevia) [19,20].

Material and methods

From January 1st, 2001, to 31 December 2015, the hospital records of all women delivered at the maternity of the University South Reunion Island (ap. 4,300 births per year) were abstracted in standardized fashion. All data were entered into an 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 ultrasonographic examinations, and anthropological characteristics recorded in their maternity booklet. All health workers (midwives, paediatricians, obstetricians) filling the questionnaires could have access at these booklets.

In the general analysis (see Figure 1), there were two criteria of exclusion: multiple births, and multiparae. Other methods are detailed elsewhere [11,12].

Epidemiological data were recorded and analysed using EPI-INFO 7.1.5 (2008, CDC Atlanta, OMS) software, EPIDATA 3.0 and EPIDATA Analysis V2.2.2.183. Analysis consisted of the χ^2 for linear trend. For multiple regression logistic models, a stepwise backward strategy was applied to obtain the final model. The goodness of fit was assessed using the Hosmer-Lemeshow test. A p-value below 0.05 was considered significant. All analyses were performed using MedCalc software (version 12.3.0; MedCalc Software's, Ostend, Belgium).

We considered the following covariates as possible confounders in this analysis: maternal obesity (± 30 kg/m²), and "heavy newborns" (> 3500g). We included these variables and calculated the χ^2 for trend (Mantel extension), the odds ratios for each exposure level compared with the first exposure level.

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

Results

There were 63,584 deliveries (life births plus stillbirths) after 21 weeks gestation at the South Reunion maternity during the 15 year period (2001-2015). After exclusion of multiple births (1139 pregnancies), and multiparae, the study population consisted of 22,862 primiparae.

In our recently published studies [11,12], we performed a multiple logistic regression analysis in order to validate the independent association of maternal age and other confounding factors in the overall cohort. For the association between "dystocic deliveries" (need of caesarean section, vaginal operative procedures, 0= eutocic deliveries, 1= dystocic), the multiple logistic regression model used demonstrated that maternal BMI (OR 1.04, each increment of BMI enhances the risk by 4%) and birthweight ≥ 3500g (discrete 0-1) increases the risk (OR= 1.59, enhances the risk by 59%). Maternal height (negative coefficient) was found to be protective (height as a continuous variable, OR = 0.96, for each increment in centimetre of height, the dystocia risk diminishes by 4%). Controlling for all other factors, maternal age was found to be an independent factor (coefficient 1.08, increment of 8% per increment of 1 year, with age used as a continuous variable) [11].

Concerning spontaneous breech presentations [12], variables associated with breech presentation in bivariate analysis, with a p-value below 0.1 or known to be associated with the outcome in the literature were included in a model. A stepwise backward strategy was then applied to obtain the final models. For the association between maternal ages and spontaneous breech presentation (this study comprising also multiparae), controlling for all the variables, 4 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).

Using maternal age confirmed as an independent factor, table 1 depicts the rate of spontaneous vaginal deliveries, caesarean sections and need of vaginal operative medical interventions for all women and caesarean sections for the subgroups of obese women (30 kg/m²+) and those delivering "heavy babies (> 3500g). In all cases, there were significant χ^2s for linear trend associated with maternal ages in primiparas, $p< 0.0001$. Also, the risk of caesarean section for placenta praevia presented a linear trend beginning at the ages 18-19 (no cases between 12 and 17 years), and the spontaneous rate of breech presentations with also the best results at younger ages (χ^2 for linear trend < 0.001).

Figure 1 represents on the left side birthing without any medical intervention (vaginal extraction or caesarean section) by maternal ages, all births N= 22,862. (Y = -1.72 + 107). On the right part the rates of medical intervention at birth by maternal ages 1) caesarean section for all singleton births N= 22,8622) Rate of medical intervention in vaginal deliveries only, N= 18,719.

Figure 2 presents the linear law beginning at 12 years to 42 years+, the equation is: Y = 1.4 X (χ^2 for linear trend, $p < 0.001$), where x is the age of the primipara and y the percentage of deliveries needing active medical help (vaginal operative, caesarean section). It presents also an overview of all adverse maternal or fetal outcomes associated with maternal ages. Perinatal mortality, rate of early preterms (< 33 weeks), and fetal malformations are U curves plus or minus flat with the greatest risks at both extreme of ages. Concerning peri-partum hemorrhage, there was no significant differences between different maternal ages in our primiparas.

Table 2 represents the overall calculation of the χ^2 for linear trend for the entire cohort (N= 22,862 singleton primiparous pregnancies) for a) vaginal deliveries without medical help, b) caesarean section and c) rate of harmful placenta praevia. All χ^2 for linear trend were $p< 0.001$. d) In order to make the adjusted χ^2 for linear trend for possible confounders (maternal obesity -30kg/m²+-, and "heavy babies "3500g+-, we were obliged to skip the 18 girls aged 12-13 years. Therefore the results were on a cohort of 22,842 primiparas. Results of the adjusted χ^2 for these 2 criteria (maternal obesity, heavy babies) are similar to the crude OR for trend ($p< .001$) calculated for all parturients: 784 vs 576.

Discussion

Our data demonstrate the presence of a clear linear association Y = 1.4 X, predicting the need for obstetrical intervention with increasing maternal age in primipare. So, for example if you are 15 years old at your first birth, your risk of requiring obstetrical intervention is about 21% , if you are 30 years old (the current average age at first birth in Europe nowadays) 42% of active obstetrical interventions, while if you are 39 years old, critical obstetrical interventions will be required in 55%.

The Obstetrical Dilemma (OD) is subject of a lot of literature. Besides the physical constraints of the pelvic dimensions [15], Dunsworth et al proposed the metabolic hypothesis [18] where when the fetus demands more than 2.0 X BMR (basal metabolic rate) at the end of pregnancy, the birth will occur. OD is challenged by Stone arguing that current childbirth technologies are beyond biological needs [21]. Fundamentally, because during the major part of human history, women delivered standing up or sitting and not in the current supine position which is in fact for the convenience of the accoucheur who can have better visibility and monitor contractions and fetal heart rates. Delivering in upright position allows a much better labour and flexibility of the pelvis which is not static during birth (as well as the flexible fetal head with the sutures). In this study, during the 15 year period, all women delivered in the "modern" pattern of supine position. That, in our experience, adolescents deliver better than their (young) oldest counterparts challenges Well's hypothesis [2] where 'under-age' marriage (< 18 years) is an important cause of obstructed labour (as pelvic growth is not yet achieved). In a recent study in India, where teenage first births are very important, Sharma et al found that the average attained adult transverse pelvic outlet size is acquired at the age of 15 years (with menarche at 13.5 years) [22].

Lowering several major complications of natural human births (i.e. different dystocia, breech presentation, placenta praevia) induces evidently a minimization of potential maternal death at birth (not to speak of the new born). Second, the first birth is fundamental in a woman's life: if it is successful, the successive deliveries later are by far easier. In our context, Reunion, if you deliver vaginally at your first baby, you have a 8% chance to have a cesarean section at the second child, and 9% chance to have C-section in all the rest of your reproductive life (if you have a C-section at your first delivery, the C-section rate is of 42% at the second delivery. After 2 C-sections, of course, the rate becomes 100%). Basically, primiparous deliveries are more constraining. Dilation of the cervix during the active phase takes longer in primaparas (1.2 cm per hour vs 1.5 cm in multiparas), therefore this first stage of delivery lasts usually 11 hours, while in multiparas it is around 6.5 and 7.2 hours. The second stage of labor, where the fetus completes its descent through the pelvis and is expelled from the uterus usually lasts from 0.75 to 1.1 hours for primiparas and 0.32 to 0.39 hours from multiparas [19,20]. Third, the human female is sole among primates to typically need help for the extraction of the baby by a third party: In humans the typical delivery is occiput anterior, with the face of the baby away from the mother, while the typical pattern for nonhuman primates is occiput posterior [19,23]. In nonhuman primates, it is advantageous for an infant to emerge facing its mother if she is likely to use her hands in pulling the body out. At the opposite, it is difficult for a human female to deliver without help and assistance, somebody is present who helps to catch the infant after delivery of the shoulders, wipes the face of the newborn if the infant is born with fluids around its face and mouth, and, also, remove the umbilical cord if it is wrapped around the neck (nuchal cord, a relatively frequent event occurring in ap. 25% of births) [23,24]. "Because of this fundamental difference, not only is parturition more difficult (the length of labor in humans is three or four times as long as that in other mammals and primates), but humans became encumbered with a unique need of obligate midwifery, and it probably happened since the emergence of our genus *Homo* (beginning with *Homo erectus*), one million years ago" [19]. In a recent paper, Wenda Trevathan makes the point on current debates in this topic [24].

In this report, we found five linear trends (χ^2 for trend < 0.001) associated with maternal ages in primiparae. First, second and third, it is of note that we had consistently (and in mirror), 3 linear associations between maternal age and, a) vaginal deliveries without any medical intervention, "natural birthing" b) rate of cesarean sections, and also strikingly c) a surprising linear progressive rate of operative vaginal procedures (vacuum, forceps, spatules, Table1, Figures 1 and 2). Fourth, following the list that described by Trevathan et al concerning the situations which could lead to obstructed labour during the existence of our species [19,20], we thought to test the occurrence of dangerous placenta praevia. Placenta praevia necessitates nowadays urgent caesarean sections, but is synonymous of maternal death by severe bleeding if you deliver with just a 'midwife'. Fifth, breech presentations (notably at term), which have been harmful in ancient times [20]. To our surprise, placenta praevia, and spontaneous breech presentations also had linear trends with maternal ages, Table 1. The linear association for "natural birthing" persisted when controlling for maternal obesity (≥ 30 kg/m²) and "heavy babies" (≥ 3500g), Table 2. Calculating the $y = ax + b$ shape of "natural birthing" (first line of Table 1), leads to the result of a negative slope: $y = -1.72x + 107$ (e.g. a 19 year old primipara having 107-1.72X19= 74% chance of natural birthing, a 32 year old, 52%), left part of Figure 1. If we consider the opposite (to have a positive slope), i.e. need of active medical help, this formula becomes the simple equation: $Y = 1.4 X$ (Thomas Hulsey's idea).

Summarized in Figure 2, our data are in line with the literature: young adolescent primiparas deliver better than their young counterparts, but at the cost of worse neonatal outcomes [10, 25-29]. It is of note however, that, in our experience, as well as other reports, adolescents do not have a higher rate of post-partum haemorrhage compared with older women [25-34]. The linearity for caesarean sections rates with advancing maternal age is evidently present in the result tables of a recent Nationwide study in the USA (4 million births), even if the authors did not emphasize this fact, and did not test it by a specific calculation [32]. Another recent study on 26,000 nulliparas in Washington state, USA, looked especially at very young adolescents 11-14 years and found also better birthing as compared with older adolescents or young mothers in their twenties [26]. Similar results are reported in a recent study in Thailand where 298 early adolescents (15 years or less) are compared with 4456 late adolescents and 29,023 adults [33].

In a recent Swedish Nationwide study on 798000 primiparae [34] Blomberg et *al* reported that adolescent pregnancies (<17 years N= 2392, 17-19 years N= 29 816 representing 4.0% of their primiparous deliveries) had better vaginal deliveries, less caesarean section and also less vaginal operative births (forceps, spatules, ventouse) than their older counterparts. In this report, also a population-based study with prospectively collected data concerning singleton primiparous women, we confirm these findings in a different population in the Indian Ocean.

The Reproductive puzzle of the human species**:** Serious demographic evaluations have calculated that, since the beginning of mankind, 100 to 108 billions humans have existed on earth [35]. On a 24 hour scale, our genus lived during 21h 36 minutes as hunter gatherers until the emergence of agriculture about 8000 B.C. (invention of writings, i.e. "History" happened at 22h 34), and the shape of the growth of the human population of the world since the origin of the genus has been quite flat and it is estimated that the human species comprised some 5 million individuals. Agriculture permitted in 8000 years that our genus to reach some 300 million in 1 A.D [35]. In the mean time, and until the end of the 19th century the infant mortality (0-1year) has constantly been of 35%, while only 1 child out of two reached puberty and adult life [14,35-37]. Similarly, the adult expectancy of life at birth is well documented to have been of 35 years during millennia (until around the 18th century), and probably around 30 years when we were hunter-gatherers [35,38]. Several reports in demographic archaeology [38] show that in archaeological cemeteries there were typically 2 peaks in human skeletal remains: infants -children and the ages of 35, page 90 (Kulubnarti, Libben North American prehistoric, Ensay Scotland, Maryland North American prehistoric), peak mortality in Roman tombstones at 30 years in females (page 49). Our ancestors had then the obligation to have at least 4-5 children per couple to permit only the very survival of our genus during a small 12-20-year window of reproductive life, with a typical birth interval of 4 years between siblings [14,35-37]. Moreover, mankind has experienced during this interminable long time period the total absence of modern obstetrics. In these conditions, what could have been the best age, and notably in primiparas, to deliver the most safely as possible and to permit the survival of the mother to allow successive pregnancies? (the child and pre-adolescent mortality , 50%, being anyway enormous) .

Besides our presupposition of testing a biological adaptation in our genus, we currently don't have a specific understanding of why younger women appear to be protected from having a birth with major dystocia. In this study, we confirm like other authors a decreased risk of cesarean delivery in young adolescents [25-34], without clear explanations. The two main hypotheses found in the literature are possible factors which could include intrinsic biologic causes such as uterine contractility and physical endurance in young women, and also a kind of medical bias such as practice patterns in obstetricians hesitating to perform caesareans deliveries regarding the impact on future reproductive outcomes. These debates have been recently synthesized by Torvie et al [5]. We do not wish neither to join the debate if adolescent pregnancies are good or bad [1], nor the debate of why adolescent pregnancies still exist [39]. Very interesting arguments are debated among evolutionist psychologists saying for example that teenage motherhood is an adaptive response of an evolved reproductive strategy to conditions of risk and uncertainty [40]: Age at first reproduction appears to be strongly governed by extrinsic adult mortality risk, and where risks are low females will devote more time to growth and will mature at later age. The lower a female's life expectancy at birth, the earlier her reproductive life should begin [40], as in such environment it would not be wise to make long-term goals [39].

We would like to emphasize that we definitely don't advocate to young girls to have their first child at 14 years old. Even in our context in La Reunion, we have reported long-term social, educational and psychological problems in our young adolescent pregnancies [41]. The purpose of these findings is to describe these 5 amazing linear laws of "natural birthing in primiparas", beginning at 12 years to 42 years+. An adaptation seems to have minimized the major dystocia risks (maternal death at birth) in the youngest primiparae, suggesting a relative mismatch between our biology and our modern life context in developed countries.

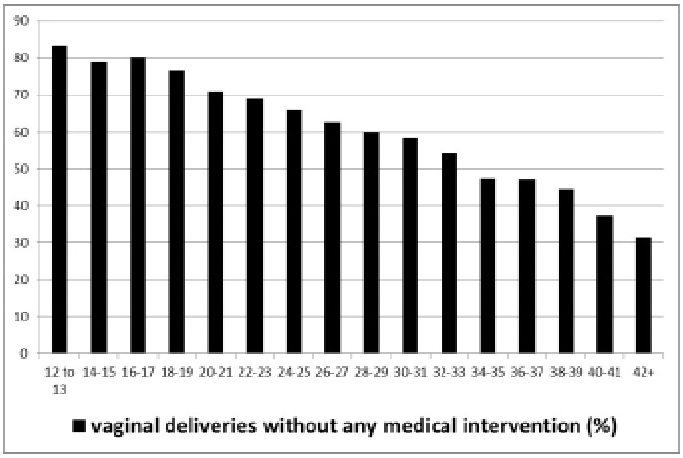
Conclusion

The human female seems to have been shaped by evolution to deliver without specialized help at young ages, vaginal deliveries without any medical intervention being over 80% before 18 years of age and around 45% after 40 years, with a striking highly significant linear trend for each category of ages. Primiparous women appear to be protected against maternal deaths at birth (severe dystocia by cephalopelvic disproportion, need for vaginal operative help, breech presentation and placenta praevia) at younger ages. A first successful birth leading the way for successive normal births, the law Y= 1.4 x in primiparae may explain how our genus could survive when we were hunter-gatherers and when our species could have disappeared [35].

Acknowledgment

We thank Dr Wenda Trevathan, Department of Anthropology, New Mexico State University, for her constructive comments and her permission for a citation Contributorship statement: PYR participated at all the stages of the study (data collection, analysis, writings et..). SI and FB participated at the data collection, analysis and writings. TH verified all the epidemiological calculations and participated deeply to the data analysis. GD and TC expertised the analysis, the text and the final writings (and the English Language). MB, as the head of the Universitary Sud-Réunion's maternity, is at the origin of the study: being worried of the low rate of cesarean sections in his maternity (16.4%, vs 21% in similar settings in France), he asked for a profound analysis of this fact. The answer is in the present paper: we have a 14% rate of c-sections in our primiparas, because our reproductive population is still very young This very low rate in primiparas of course influences the course of what happens afterwards.

Figures



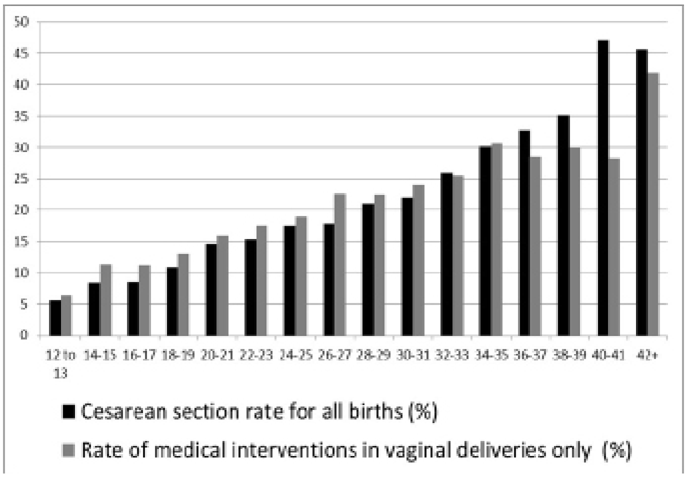


Figure 1: Birthing without any medical intervention (vaginal extraction or caesarean section) by maternal ages, all births N= 22,862. (Y = -1.72 + 107). . Rate of medical intervention at birth by maternal ages 1) caesarean section for all singleton births N= 22,8622) Rate of medical intervention in vaginal deliveries only, N= 18,719.

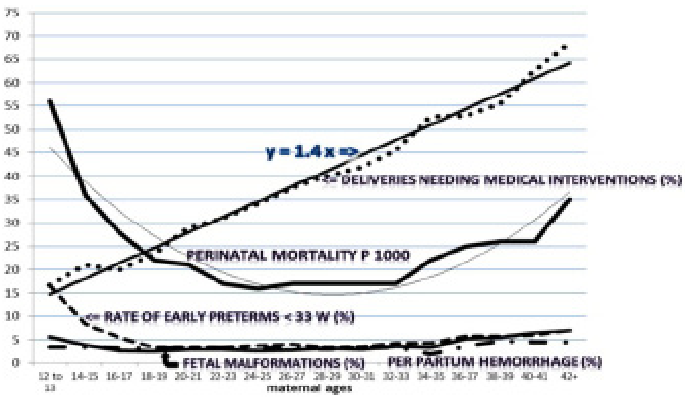


Figure 2: Deliveries needing medical interventions, perinatal mortality, per partum hémorrage, rate of early preterm birhs, fetal malformations by maternal ages at the Sud-Réunion's maternity 2001-2015.

Table 1a: Birthing in primiparae by age categories (vaginal deliveries, medical interventions, cesarean sections, spontaneous breech presentations, caesarean section for placenta-praevia)

Maternal ages	12 to 13 N= 20	14 to 15 N= 485	16 to 17 N= 1984	18 to 19 N= 3376	20 to 21 N= 3487	22 to 23 N= 3076	24 to 25 N= 2663	26 to 27 N= 2263	28 to 29 N= 1854	30 to 31 N= 1329
Cesarean section All women N= 21,235 (%)	2 (10.0)	41 (8.5)	166 (8.4)	366 (10.8)	510 (14.6)	473 (15.4)	459 (17.2)	409 (18.1)	391 (21.1)	295 (22.2)
Spontaneous vaginal deliveries All women N= 21,235 (%)	16 (80.0)	384 (79.2)	1582 (79.8)	2577 (76.3)	2466 (70.7)	2115 (68.8)	1759 (66.1)	1409 (62.3)	1109 (59.8)	769 (57.9)
Rate of Medical intervention in Vaginal deliv. (%) N= 17,427 ¤	1/17 (5.9)	47/431 (10.9)	206/1789 (11.5)	394/2971 (13.3)	477/2943 (16.2)	452/2567 (17.6)	414/2173 (19.1)	416/1825 (22.8)	319/1428 (22.3)	244/1013 (24.1)
Cesarean section Obese women (30 kg/m²+) N= 2189 (%)	0 (0)	1/14 (7.1)	23/105 (21.9)	54/289 (18.7)	92/387 (23.8)	91/417 (21.8)	95/346 (27.5)	76/285 (26.7)	68/207 (32.9)	47/143 (32.9)
Cesarean section Heavy babies (3500g +) N= 3700 (%)	0/2 (0)	4/64 (6.3)	34/311 (10.9)	69/504 (13.7)	116/615 (18.9)	121/582 (20.8)	117/497 (23.5)	97/407 (23.8)	86/337 (25.5)	62/246 (25.2)
C-sectionfor placenta praevia (p 10.000)	0 (0)	0 (0)	0 (0)	3 (8.8)	5 (14,3)	9 (29.2)	8 (30.0)	9 (39.8)	9 (48.5)	12 (90.2)
Spontaneous breech (%) presentations	0 (0)	13 (2.7)	41 (2.1)	79 (2.3)	90 (2.6)	91 (3.0)	81 (3.0)	74 (3.3)	87 (4.7)	69 (5.2)

¤ vacuum, forceps, spatules

Table 1b: (continued). Birthing in primiparae by age categories (vaginal deliveries, medical interventions, cesarean sections, spontaneous breech presentations)

Maternal ages	32 to 33 N= 884	34 to 35 N= 596	36 to 37 N= 391	38 to 39 N= 223	40 to 41 N= 123	42+ N= 68	TOTAL N= 22,862	Chi² for linear trend	P value
Cesarean section All women N= 22,822 (%)	226 (25.6)	179 (30.0)	127 (32.5)	75 (33.6)	57 (46.3)	26 (44.1)	3806 (16.7)	578	< 0.001
Spontaneous vaginal deliveries All women (%) N= 21,235	476 (53.8)	284 (47.7)	186 (47.6)	103 (46.2)	46 (37.4)	24 (35.3)	15,305 (67.1)	774	< 0.001
Rate of Medical intervention in Vaginal deliv. (%) N= 17,427 ¤	174/650 (26.8)	123/407 (30.2)	73/259 (28.2)	42/145 (29.0)	17/63 (27.0)	14/38 36.8)	3413/18719 (18.2)	289	< 0.001
Cesarean section Obese women N= 2189 (%)	34/93 (36.6)	26/64 (40.6)	17/40 (42.5)	13/31 (41.9)	14/18 (77.8)	6/8 (75.0)	658/2448 (26.9)	96	< 0.001
Cesarean section Heavy babies (3500g +) N= 3700 (%)	44/154 (28.6)	38/110 (34.5)	32/76 (42.1)	16/44 (36.4)	12/17 (70.6)	4/6 (66.6)	852/3972 (21.5)	112	< 0.001
C-sectionfor placenta praevia (p 10.000)	7 (79.2)	6 (100.6)	5 (127.9)	3 (134.5)	2 (166.2)	0 (0)	78 (34.1)	45.25	< 0.001
Spontaneous breech presentation. (%)	37 (4.2)	31 (5.2)	19 (4.9)	10 (4.5)	7 (5.7)	4 (5.9)	733 (3.2)	52.8	< 0.001

Table 2: Rate by maternal age. All primiparous singleton pregnancies N= 21,235. Crude and adjusted χ^2 for linear trend for deliveries by C-sections N= 21,217 (18 women of 12 to 13 years of age excluded)

Maternal Ages	Crude Odds Ratio Rate of vaginal deliveries without medical help All primiparas N= 22,862	Crude Odds Ratio Cesarean section for placenta praevia All primiparas N= 22,862	Crude Odds Ratio Cesarean section rate All primiparas N= 22,862	Crude Odds Ratio Cesarean section rate primiparas 12-13 years excluded (N=20) N= 22,842	Odds ratio adjusted# C- section primiparas 12-13 years excluded 22,842
12 to 13	1.00 (reference)	-	1.00 (reference)	-	-
14 to 15	0.75	-	1.55	1.00 (reference)	1.00 (reference)
16 to 17	0.80	-	1.57	1.01	1.17
18 to 19	0.65	1.00 (reference)	2.05	1.32	1.48
20 to 21	0.49	1.29	2.90	1.87	2.05
22 to 23	0.44	2.94	3.06	1.97	2.21
24 to 25	0.39	2.98	3.60	2.31	2.64
26 to 27	0.33	4.58	3.70	2.38	2.70
28 to 29	0.30	5.59	4.52	2.91	3.25
30 to 31	0.28	8.37	4.77	3.07	3.38
32 to 33	0.24	9.12	5.95	3.83	4.23
34 to 35	0.18	11.58	7.33	4.72	5.30
36 to 37	0.18	14.53	8.26	5.32	6.18
38 to 39	0.16	15.17	9.18	5.91	6.68
40 to 41	0.12	9.22	15.04	9.70	12.4
42+	0.09	-	14.25	9.18	10.6
P for linear trend	< 0.000001	< 0.000001	< 0.000001	< 0.000001	< 0.000001
χ^2 for linear trend	774	45.25	578	576	784

χ^2 for linear trend adjusted for maternal obesity (± 30 kg/m², yes/no), And "heavy" newborns (± 3500g, yes/no)

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