Original Article

Trends in perinatal health in metropolitan France from 1995 to 2016: Results from the French National Perinatal Surveys

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A B S T R A C T

Objective. – To study trends in the main indicators of perinatal health, medical practices and risk factors in France since 1995.
Population and method. – All live births during one week in 1995 (*n* = 13,318), 2003 (*n* = 14,737), 2010 (*n* = 14,903) and 2016 (*n* = 13,384). Data were from interviews of women in postpartum wards and from medical records and were compared between years.
Results. – Between 1995 and 2016, maternal age and body mass index increased steadily. Pregnancies that occurred with use of contraception increased from 7.4% in 2010 to 9.3% in 2016. Smoking during pregnancy (16.6%) did not decrease since 2010. The frequency of more than three ultrasounds during pregnancy was 48.5% in 1995 and 74.7% in 2016. Deliveries in large public hospitals increased steadily. The caesarean section rate has been relatively stable since 2003 (20.4% in 2003, 21.1% in 2010 and 20.4% in 2016). The rate of induction of labour was 22% in 2010 and 2016. Overall, 83.8% of women had epidural analgesia/anaesthesia in 2016. Rates of pre-term birth in 2016 ranged from 7.5% among all live births to 6.0% among live born singletons; for singletons, this rate increased steadily from 1995 to 2016, whereas there was no clear trend for low birth weight. Exclusive breastfeeding decreased from 60.3% in 2010 to 52.2% in 2016.
Conclusion. – Routine national perinatal surveys highlight successful policies and recommendations but also point out some health indicators, practices, preventive behaviours and risk factors that need special attention.

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Introduction

Practices in the perinatal field change constantly as mothers' characteristics evolve, scientific knowledge improves, and medical guidelines, the organisation of care and health policy are modified. In such a setting, we need reliable perinatal data that are regularly updated and available at the national level. Routine statistics on all births in France are provided every year, mainly from hospital discharge statistics [1,2] and the first health certificate for newborns [3], but they cover a limited set of indicators to guide health policies.

The French national perinatal surveys were designed to meet these needs, providing data on a wide range of topics. The surveys are based on the principle of collecting information about health status, perinatal care, maternal behaviour and risk factors from a representative sample of births. Five surveys were conducted, using the same protocol, in 1995, 1998, 2003, 2010 and 2016 [4].

The objectives of these surveys are to:

- measure the main indicators of health status, medical practices during pregnancy and delivery, and perinatal risk factors to

allow comparison with data from other countries and to follow trends over time;

- contribute information to guide decision making in public health and assess health actions in the perinatal field, mainly regulations and medical guidelines, based on specific questions in each survey;
- provide a reference national sample for research projects or comparisons with other sources, such as data from maternity units.

The objectives of this article were to describe the perinatal situation in 2016 in metropolitan France (overseas territories excluded); compare it to that from earlier surveys in 1995, 2003 and 2010; and focus on some specific topics that were introduced in the last two surveys in 2010 and 2016.

Methods

All surveys followed the same design, which was chosen after a pilot survey conducted in 1988–1989 in several volunteer regions [5]. Data collection took place over a one-week period in public and private maternity units and covered all live births and stillbirths with a gestational age of at least 22 weeks or a birth-weight of at least 500 g. In 2010 and 2016, maternity units with more than 2000 annual deliveries were allowed to spread data collection out over two weeks by collecting data for all births every other day. Data came from three sources: (1) an interview with women in the postpartum ward to obtain information about their social and demographic characteristics and antenatal care; (2) data from medical files about complications of pregnancy, delivery and the child's health status at birth; and (3) a form completed by the head of the maternity unit describing its principal institutional characteristics.

Several institutions were involved in these surveys. In 2016, the general organisation and development of the questionnaire were provided by the National Institute for Health and Medical Research (Institut national de la santé et de la recherche médicale (INSERM), Epopé team), three directorates within the Ministry of Health (Health, Health Services, and Statistics) and the National Institute of Public Health (Santé publique France) as well as a committee including representatives from district-level maternal and child health services (physicians or midwives), ministry of health directorates responsible for health care services and social services, regional and district social and health services bureaus, regional health observatories, professional societies (anaesthetists, midwives, obstetricians and paediatricians), and user groups. INSERM coordinated the study at the national level, and district Maternal and Child Health Protection Services, perinatal health networks, or INSERM coordinated the study at the district level. INSERM produced a detailed report in which the complete set of descriptive results from the 2010 and 2016 surveys are presented [6].

The surveys were approved by the National Council on Statistical Information (Comité du Label), the French Data Protection Authority (CNIL) and the INSERM ethics committee. The 2016 approval numbers were 2016X703SA (Comité du Label), 915197 (CNIL) and IRB00003888 no. 14-191 (INSERM ethics committee).

For this manuscript, we excluded the 1998 survey because of the short interval between the first two surveys, but data are available in an earlier publication [4].

In 2016, among the 497 maternity units operating in metropolitan France, four refused to participate, corresponding to about 120 missing births. In addition, 579 women (594 births) did not participate in the study; minors (n = 56; 0.4%), and women with a stillborn baby (n = 127; 0.9%) were not interviewed in 2016 because of concerns raised by the data protection committee; other women were discharged before the investigator could see them or they refused participation because of a language problem or the mother's or child's health status). For non-respondents, basic descriptive information, corresponding to the core indicators used by the Euro-Peristat Project [7] was collected from medical records. Earlier publications describe the samples used in the previous surveys [4,8].

Because of restrictions in 2016 concerning minors and women having stillbirths, our study population for this manuscript does not include these groups and therefore the sample sizes for the 1995, 2003 and 2010 surveys are slightly lower than in previous publications [4]. In the present study, the sample included 13,147 women and 13,318 children in 1995, 14,482 women and 14,737 children in 2003, 14,681 women and 14,903 children in 2010 and 13,148 women and 13,384 children in 2016.

We compared maternal risk factors, preventive behaviour, antenatal and perinatal care and pregnancy outcome for each of the four surveys. To assess the proportion of birth-weights under the 10th centile, we used two gestational age and sex-specific reference curves: the Audipog curves use the birth-weight distribution of births between 1999 and 2005 in this network [9] and the Epopé curves use the birth-weight distribution of the 2010 National Perinatal Survey and a model of intrauterine growth [10].

We used Chi^2 tests to compare percentages and trend tests when we observed small but regular changes between surveys. Because the large number of tests performed and the sample size create a risk of erroneously concluding that several indicators have significantly increased or decreased, we defined differences in global comparisons as significant only with $P < 0.01$. We indicate in the tables that tests were not significant (NS) below this threshold. Analyses involved use of SAS 9.3.

Results

Between 1995 and 2016, the proportion of mothers ≥ 35 years old rose steadily from 12.5% to 21.3%; the proportion with education beyond high school rose from 32.8% to 55.4% (Table 1).

The use of the contraceptive pill before pregnancy decreased between 2010 and 2016 and the use of other contraceptive methods increased (eg, intrauterine device, implants, condoms, and natural methods of birth regulation) (Table 2). We observed a slight increase in the proportion of women who were pregnant while using a contraceptive method, and the proportion of women who would have liked to get pregnant later.

The pre-conceptional use of folic acid increased, but only 23.2% of women in 2016 had this preventive measure (Table 3). The proportion of women who smoked during the third trimester of their pregnancy decreased from 24.8% in 1995 to 17.0% in 2010, but did not decrease further in 2016. Attendance in antenatal classes increased steadily from 1995 to 2016 in nulliparous women.

In 2016, 74.7% of women had more than 3 ultrasounds and 35.9% had six or more; a gynaecologist or obstetrician in private practice was the main care provider in the first six months of pregnancy for more than half of the women (Table 4).

The coverage of serum screening for Down syndrome increased between 2010 and 2016 (Table 5), but the proportion of amniocenteses greatly decreased, especially in women ≥ 38 years old (41.0% to 9.7%).

The proportion of obese women (body mass index [BMI] ≥ 30 kg/m^2) rose from 7.5% in 2003 to 11.8% in 2016

Table 1
Maternal characteristics between 1995 and 2016.

	1995	P^a	2003	P^b	2010	P^c	2016
	% (n)		% (n)		% (n)		% (n)
Age (years)[d]							
18–19	1.9	< 0.001	2.1	< 0.001	2.0	< 0.001	1.6
20–24	19.1		16.2		14.6		12.0
25–29	38.5		33.5		33.3		31.3
30–34	28.0		32.3		30.8		33.8
35–39	10.2		13.2		15.8		17.3
40 or more	2.3		2.7		3.5		4.0
	(12,850)		(14,037)		(14,342)		(12,941)
Parity[d,e]							
0	41.0	< 0.001	43.0	NS	43.1	NS	42.2
1	35.1		35.2		34.6		35.6
2	15.0		14.2		14.5		14.3
3 or more	8.9		7.6		7.8		7.9
	(12,763)		(14,032)		(14,332)		(12,945)
Lives with partner							
Yes, in the same residence	92.9	NS	92.7	NS	93.0	–	91.6
Yes, in different residences							3.2
Alone	7.1		7.3		7.0		5.2
	(12,779)		(13,883)		(13,887)		(11,736)
Foreign nationality	11.8	NS	11.8	< 0.001	13.3	NS	14.1
	(12,770)		(13,845)		(13,985)		(11,735)
Level of education							
Middle school or less	46.7	< 0.001	35.6	< 0.001	28.1	< 0.001	22.9
High school	20.5		21.6		19.8		21.7
Beyond high school	32.8		42.8		52.1		55.4
Some college	–		–		21.4		19.3
College	–		–		17.8		18.2
Post-graduate	–		–		12.9		17.9
	(12,247)		(13,611)		(13,933)		(11,661)
Employment during pregnancy	60.4	< 0.001	66.4	< 0.001	70.4	NS	70.8
	(12,679)		(13,763)		(13,973)		(11,733)
Household resources							
Social benefits[f]	23.0	–	21.3	–	25.8	–	27.6
Income from work only	76.1		77.7		73.5		71.8
None	0.9		1.0		0.7		0.6
	(12,391)		(13,655)		(13,739)		(11,730)

NS: not significant if $P > 0.01$; no test if questions or formatted answers were not comparable.
[a] Comparison 1995–2003.
[b] Comparison 2003–2010.
[c] Comparison 2010–2016.
[d] Core indicator collected for all births.
[e] Obtained by interviews in 1995 and from medical records thereafter.
[f] Social benefits or other financial support because of unemployment or very low income.

(Table 6). We also observed an increase in gestational diabetes prevalence (both *insulin* and *diet-treated diabetes*). With births before 34 weeks, 77.4% of newborns had received corticosteroids for fetal maturation in 2010 and 90.2% in 2016.

Deliveries took place more often in the public sector in 2016, in very large maternity units and in level III units (Table 7). The proportion of deliveries in maternity units with 3000 or more annual deliveries increased from 2.4% in 1995 to 29.0% in 2016.

The proportion of caesarean sections before labour decreased between 2003 and 2016. The increase in caesarean section rates observed in the mid-1990s slowed between 2003 and 2010, and the rates did not significantly differ between 2010 and 2016: in 2016, 20.4% of births occurred by caesarean section.

Oxytocin used for managing labour and episiotomies became less frequent (Table 8). Among women with spontaneous onset of labour, 57.6% received oxytocin for augmentation of labour in 2010 and 44.3% in 2016. Among women with a vaginal delivery, 27.1% had an episiotomy in 2010 and 20.1% in 2016. The use of epidural or spinal analgesia/anaesthesia increased progressively, from 53.9% in 1995 to 83.8% in 2016 (Table 9); at the same time, the frequency of general anaesthesia decreased from 5.3% to 1.2%.

The proportion of births at 41 weeks or later decreased between 2003 and 2016 (Table 10). There was no clear time trend for mean birth weight. The proportion of newborns with 5 min Apgar score < 7 increased slightly between 2010 and 2016. The frequency of breastfeeding in the maternity unit increased strongly from 1995 to 2010 and decreased thereafter; in 2016, 52.2% of women exclusively breastfed their baby and 33.3% exclusively formula-fed their babies.

The rates of pre-term deliveries, low-birth-weight and small-for-gestational-age (SGA) newborns varied strongly by the population in which they were calculated (Table 11). In 2016, the pre-term birth rate ranged from 7.5% among all live births to 6.0% among live-born singletons; similarly the rate of neonates weighing < 2500 g was 7.5% and 5.7% in these two populations.

The rates of pre-term and low-birth-weight newborns followed different trends. Among all live-born infants, as among live-born singletons, pre-term births increased regularly, slightly but significantly over the entire period 1995–2016 ($P < 0.001$, trend tests), whereas there was no clear trend for the proportion of birth weights < 2500 g and birth weight < 10th percentile.

Discussion

The results of the four surveys show general trends in different directions. Some risk factors, including maternal age and obesity, increased in frequency. Two maternal preventive behaviours did not improve: smoking during pregnancy continued to be high and

Table 2
Fertility treatment and birth control between 2010 and 2016.

	2010	Pa	2016
	% (n)		% (n)
Fertility treatment[b]			
No	94.3	<0.001	93.1
In vitro fertilization	2.3		3.3
Intrauterine insemination	1.0		1.0
Ovulation induction alone	2.4		2.6
	(13,587)		(11,701)
Last method of contraception[c]			
No method	8.4	<0.001	8.3
Pill	73.8		62.8
Intra-uterine device	5.6		9.6
Implant, patch, vaginal ring	2.6		4.9
Condom	8.2		11.1
Withdrawal	0.6		1.9
Periodic abstinence	0.5		1.1
Other method	0.3		0.3
	(13,444)		(11,727)
Reasons for stopping birth control			
Wish to have a child	80.1	<0.001	78.1
Was pregnant	7.4		9.3
Other reason	12.5		12.6
	(12,580)		(10,401)
Pregnancy intention[d]			
Wanted now	75.5	<0.001	72.5
Wanted sooner	11.1		11.8
Wanted later	10.3		12.2
Unwanted	3.1		3.5
	(13,814)		(11,718)

NS: not significant if $P > 0.01$.
[a] Comparison 2010–2016.
[b] No fertility treatment: 95.0% in 2003.
[c] If several methods, classified in this order.
[d] Reaction at the beginning of pregnancy.

Table 3
Preventive behaviour and practice between 2010 and 2016.

	2010	Pa	2016
	% (n)		% (n)
Folic acid before pregnancy[b]	14.8	<0.001	23.2
	(12,767)		(11,154)
No. of cigarettes smoked (3rd trimester)[c]			
0 a day	83.0	NS	83.4
1–9	12.2		12.3
≥10	4.8		4.3
	(13,952)		(11,744)
Advice for smoking cessation[d]	–		46.3
			(3124)
Antenatal classes[e]	74.0	<0.001	77.9
(nulliparas)	(6015)		(4971)
4th-month interview[f]			
No	75.9	<0.001	68.5
Yes	21.4		28.5
Doesn't know	2.7		3.0
	(13,735)		(11,735)
Flu vaccination			
No	–		92.1
Yes	–		7.4
Doesn't know	–		0.5
			(11,716)

NS: not significant if $P > 0.01$.
[a] Comparison 2010–2016.
[b] To prevent neural tube defects.
[c] Zero cigarette a day: 75.2% in 1995 and 79.2% in 2003.
[d] In women who were smoking during pregnancy.
[e] Antenatal classes in nulliparas: 65.4% in 1995 and 67.5% in 2003.
[f] Appointment with a midwife or a doctor who would identify problems and provide prevention information.

did not decrease, while breastfeeding initiation decreased. Medical practices during labour and delivery were closer to professional best practice guidelines in 2016 than in earlier years. The rate of caesarean delivery was stable. Pre-term birth rates continued to increase after 1995 at a slow but constant rate, whereas rates of SGA showed no clear trend.

Strengths and limitations

Because, in some large hospitals, the sample was derived from births during two weeks by collecting data for all births every other day, the number of live births in our samples cannot be directly compared to the number of births recorded in March in the French vital statistics. Nonetheless, this number in 2016 was very close to the mean number of weekly births in March [6]. In addition, the core indicators of the overall sample of births in 2016 were very similar to those available in the annual hospital statistics [6]. However, other characteristics of mothers, antenatal care and medical conditions of women and children may be slightly biased because of the non-participation of some women.

Variations between years must be interpreted cautiously. Some differences might be due to chance; in addition, the questions or how they are answered sometimes changed because of the evolution of practices and the context of pregnancy.

Changes in population characteristics

The educational level of mothers changed in a positive direction throughout the studied period. Other changes in social characteristics were less favourable. The increase in women's employment rates observed between 1995 and 2010 stopped afterward; in the meantime, the unemployment rate for husbands or partners rose from 8.7% in 2010 to 9.9% in 2016 [6], which reflects the general job market situation for men in France [11]. More generally, in 2016, 28% of women or their partner had social benefits or support from their family or non-governmental associations because of unemployment or very low or no income. Studies from the previous survey showed that the social situation of the most disadvantaged groups had a strong impact on inadequate antenatal care, unfavourable preventive behaviour, poor maternal mental health and adverse pregnancy outcome [12–17].

Other worrisome trends include the increasing proportion of mothers ≥ 35 years old and of overweight or obese women, as observed in many other countries [7]. These characteristics have important repercussions on reproductive health by increasing the risks of infertility, complications during pregnancy and delivery, and morbidity for mothers and children [17–22].

Preventive behaviour before, during and after pregnancy

Contraceptive behaviour before pregnancy has changed over the last 6 years, with less frequent use of the pill and more diversified contraceptive methods. This trend for the pill was observed in the overall population in the mid-2000s [23] and therefore cannot be attributed solely to the more recent debate on the third- and fourth-generation contraceptive pills. The diversification is in line with French recommendations to adapt the choice of contraceptive methods to the situation for each woman [24]. Some changes were toward less effective methods, such as withdrawal or natural methods [25]; these changes may have contributed in part to the observed increase in pregnancies while using contraception and more generally the proportion of unintended pregnancies.

Two maternal behaviours that benefit child health, not smoking and breastfeeding, did not improve between 2010 and 2016, whereas France was already performing poorly on these two

Table 4
Antenatal visits and ultrasounds between 1995 and 2016.

	1995	P^a	2003	P^b	2010	P^c	2016
	% (n)		% (n)		% (n)		% (n)
Medical certification after the 1st trimester[d]	4.1 (12,456)	0.009	4.8 (13,339)	<0.001	7.6 (13,658)	NS	7.3 (11,611)
No. of visits[e]							
0–3	0.9	NS	1.0	–	1.0	<0.001	0.8
4–6	8.3		7.9		7.4		7.1
7–8	37.6		40.0		29.2		28.6
9–10	36.1		33.8		32.4		33.4
>10	17.1		17.3		30.0		30.1
Mean ± SD	8.9 ± 2.8 (12,575)		8.9 ± 2.8 (13,636)		9.9 ± 3.7 (13,665)		10.0 ± 3.8 (11,610)
No. of ultrasounds							
≤ 3	51.5	<0.001	42.9	<0.001	32.9	<0.001	25.3
4–5	32.7		35.6		38.4		38.8
≥ 6	15.8 (12,651)		21.5 (13,792)		28.7 (13,997)		35.9 (11,669)
Main care provider[f]							
General practitioner	–		–		4.7	–	6.5
Ob-Gyn (private)	–		–		66.9		49.7
Ob-Gyn (public)[g]	–		–				16.0
Midwife (private)	–		–		11.6		8.5
Midwife (public)[g]	–		–				14.8
MCH center[h]	–		–		–		2.3
Several professionals	–		–		– (13,695)		2.2 (11,645)

NS: not significant if $P > 0.01$; no test if questions or formatted answers were not comparable.
[a] Comparison 1995–2003.
[b] Comparison 2003–2010.
[c] Comparison 2010–2016.
[d] Medical certificate, required to be submitted in the 1st trimester to the health insurance fund.
[e] Including visits to the emergency department in 2010 and 2016.
[f] In the 1st 6 months of pregnancy.
[g] In public maternity unit.
[h] Maternal and child health center.

Table 5
Screening procedures during pregnancy between 2010 and 2016.

	2010	P^a	2016
	% (n)		% (n)
Serum screening for Down syndrome			
Yes	84.2	<0.001	88.2
No, not offered	1.9		0.6
No, refused	5.5		4.9
No, other or unknown	5.7		5.9
Doesn't know	2.7 (13,729)		0.4 (11,506)
Invasive diagnosis			
None	88.8	<0.001	93.3
Amniocentesis	8.7		3.6
Trophoblast biopsy	0.5		0.6
Doesn't know	2.0 (12,536)		2.5 (10,726)
Amniocentesis			
Women <38 years old	5.9 (11,515)	<0.001	3.0 (9814)
Women ≥38 years old	41.0 (1010)	<0.001	9.7 (912)
Screening for gestational diabetes			
Yes	86.0	<0.001	73.2
No	12.2		25.9
Doesn't know	1.8 (13,800)		0.9 (11,738)

NS: not significant if $P > 0.01$.
[a] Comparison 2010–2016.

indicators in 2010 compared with other European countries [7]. The recent general public health campaigns against tobacco use or more specific programs targeting pregnancy [26] have apparently not impacted the behaviour of pregnant women. In addition, women may lack support services during pregnancy. Indeed, in 2016, only 46% of smokers said that they received advice about smoking cessation. Trends in breastfeeding during the stay in the postpartum ward are also a cause for concern; the proportion of exclusive breastfeeding decreased substantially between 2010 and 2016, whereas we had observed an increase in breastfeeding at the end of the 1990s [27] with the progressive establishment of a policy promoting breastfeeding. Our results suggest the need to strengthen breastfeeding promotion policies, by giving information to women during pregnancy, more support during the hospital stay and assurance that this support will continue after discharge, insofar as the length of stay in hospital is becoming shorter [28,29].

Compliance with health policies and guidelines during pregnancy

Compliance with policies varied widely depending on the type of measure and the duration of application. Screening for Down syndrome has been in place for several decades and almost all women are aware of this screening. Fetal karyotyping for only maternal age has not been justified since 2008 [30], and the frequency of women ≥ 38 years old undergoing amniocenteses decreased substantially from 61.4% in 2003 [4] to 9.7% in 2016. We also observed that the widespread use of the first-trimester

Table 6

Body mass index (BMI) before pregnancy and complications during pregnancy between 2003 and 2016.

	2003	P^a	2010	P^b	2016
	% (n)		% (n)		% (n)
BMI (kg/m²) before pregnancy					
< 18.5	9.2	< 0.001	8.2	< 0.001	7.4
18.5–24.9	68.0		64.6		60.8
25.0–29.9	15.3		17.4		20.0
≥ 30.0	7.5		9.8		11.8
	(13,471)		(13,551)		(11,588)
Hypertension					
No	95.9	< 0.001	95.2	NS	95.7
With proteinuria	1.2		2.0		2.0
Without proteinuria	2.9		2.8		2.3
	(14,030)		(14,322)		(12,477)
Gestational diabetes					
No	–		92.8	< 0.001	89.2
Yes, insulin treatment	–		1.6		3.2
Yes, diet	–		5.2		7.2
Yes, unknown treatment	–		0.4		0.4
			(14,130)		(12 492)
Prenatal hospitalisation	18.4	NS	18.6	NS	18.1
	(13,817)		(14,127)		(11,734)
Threatened pre-term delivery with hospitalisation	–		5.9	NS	5.4
			(14,243)		(12,499)
Corticosteroid therapy for fetal maturation					
Newborns < 34 weeks' gestation[c]	77.9	NS	77.4	< 0.001	90.2
	(235)		(217)		(255)
All women	3.8	< 0.001	5.2	NS	5.9
	(14,008)		(14,135)		(12,419)

NS: not significant if $P > 0.01$.

[a] Comparison 2003–2010.

[b] Comparison 2010–2016.

[c] Percentage of births.

combined test (nuchal translucency and serum marker) did not lead to an increase in rate of trophoblast biopsies.

Screening guidelines for gestational diabetes were defined in 2010 and recommend targeted screening of high-risk women [31]. These guidelines have led to a decrease in the proportion of screened women, but this proportion still seems high in 2016, given the eligibility criteria for screening (> 35 years old, overweight, first-degree family history of diabetes, history of gestational diabetes or macrosomia). Finally, the rise of gestational diabetes prevalence may reflect the increase in population risk factors, but may also be explained by the new criteria for diagnosis (one-step oral glucose tolerance test and lower thresholds of blood glucose) [31].

The flu vaccination is an example of difficulties in implementing new policies. We found that very few women had this vaccination, although their pregnancy was during the vaccination period, and vaccination for every pregnant woman has been recommended since 2012 [32]. We already observed the failure of the systematic vaccination policy against influenza A(H1N1) for pregnant women in 2009 [14]. Special measures would be useful to implement this vaccination and more generally to promote vaccinations, because a very high proportion of the French population is not confident in vaccine safety [33].

Compliance with health policies and guidelines before and during delivery

Our surveys show that decisions made before or during delivery tend to follow clinical practice guidelines and evidence-based medicine, even if there is still room for improvement.

We found that almost all children born before 34 weeks had received corticosteroids for fetal lung maturation in accordance with medical guidelines on threatened pre-term deliveries

[34]. This result is reassuring, because in 2011, an international study on very pre-term newborns showed that some European regions reached higher coverage rates than did French regions [35].

The use of oxytocin for preventing postpartum haemorrhage is an example of the rapid adherence to a guideline defined in 2004 and updated in 2014 [36]; indeed, more than 80% of women had this injection in 2010, 6 years after the guideline publication. Other guidelines may be more difficult to implement if they do not provide a rule for the systematic use (or non-use) of an intervention but recommend limiting the use of an intervention.

Monitoring the caesarean section rate has been a major concern for a long time, in view of the high risk of repeat caesarean section and the risk of morbidity for both the mother and the child [37]. In 2010, the caesarean section rate was rather low as compared with other European countries [38,39]. However, some caesarean sections were potentially avoidable, and non-medical reasons may have interfered in the decision process [40,41]. Caesarean section rates were stable between 2010 and 2016. This stability is confirmed in annual hospital statistics (20.3% in 2013 and 20.2% in 2016) [1]. The main changes since 2010 were a decrease in caesarean sections before labour and in women with one previous caesarean section (57.5% in 2010 and 50.2% in 2016) [6]. The close attention paid by obstetricians to limiting caesarean deliveries and the medical guidelines in 2012 on planned caesarean sections [42] and on women with a previous caesarean section [43] may have contributed to the observed trend.

Our results show that episiotomy rates continue to decline, which raises questions about the optimal target rate. The experts in 2005 recommended avoiding systematic episiotomy and suggested a rate < 30% from the review of the literature [44]. This level was reached in 2010 [4] and the rate is now 20.1%. Rates vary widely between regions and maternity units and may be much lower than the suggested rate in the guidelines [6,45,46]. However,

Table 7
Characteristics of birth place and delivery between 1995 and 2016.

	1995 % (n)	P^a	2003 % (n)	P^b	2010 % (n)	P^c	2016 % (n)
Maternity unit status[d]							
Public	55.7	< 0.001	60.9	< 0.001	64.1	< 0.001	69.2
ESPIC[e]	4.7		5.0		7.5		7.4
Other private	39.6		34.1		28.4		23.4
	(12,982)		(14,237)		(14,474)		(12,869)
Maternity unit size (deliveries/year)[d]							
< 500	14.4	< 0.001	4.6	< 0.001	2.5	< 0.001	2.6
500–999	30.4		20.8		15.0		14.9
1000–1499	24.7		22.7		20.7		15.9
1500–1999	14.5		16.3		14.0		14.8
2000–2999	13.6		27.7		29.1		22.8
3000–3999	2.4		6.0		14.3		20.2
≥ 4000	0.0		1.9		4.4		8.8
	(12,927)		(14,237)		(14,474)		(12,871)
Level of care[d]							
I	–		36.5	< 0.001	29.9	< 0.001	22.5
IIA	–		26.0		27.0		29.2
IIB	–		18.3		20.8		21.9
III	–		19.2		22.3		26.4
			(14,237)		(14,465)		(12,865)
Onset of labour[d]							
Spontaneous	71.2	< 0.001	68.1	< 0.001	66.9	< 0.001	68.6
Induced	20.3		19.2		22.1		22.0
Caesarean	8.5		12.7		11.0		9.4
	(12,882)		(14,218)		(14,423)		(12,936)
Mode of delivery[f,g]							
Spontaneous vaginal delivery	69.9	< 0.001	68.5	0.004	66.7	NS	67.4
Instrumental delivery	14.1		11.1		12.2		12.2
Caesarean	16.0		20.4		21.1		20.4
	(13,039)		(14,462)		(14,522)		(13,164)
Instrumental extraction method[f,g]							
Forceps	–		–		32.6	< 0.001	27.6
Spatula	–		–		23.7		22.6
Ventouse	–		–		43.7		49.8
					(1767)		(1561)

NS: not significant if $P > 0.01$; distribution in the sample of women.
[a] Comparison 1995–2003.
[b] Comparison 2003–2010.
[c] Comparison 2010–2016.
[d] Percentage of women.
[e] Private non-profit hospital.
[f] Percentage of births.
[g] Core indicator collected for all births.

Table 8
Characteristics of delivery between 2010 and 2016.

	2010 % (n)	P^a	2016 % (n)
Oxytocin during labour[b] (spontaneous onset of labour)	57.6 (9488)	< 0.001	44.3 (8536)
Episiotomy (vaginal delivery)[b]			
Primiparous women	44.8 (4677)	< 0.001	34.9 (4083)
Multiparous women	14.4 (6510)	< 0.001	9.8 (5899)
Oxytocin to prevent postpartum haemorrhage[b]	83.3 (14,080)	< 0.001	92.7 (12,428)
Professional attending childbirth[c] (if spontaneous vaginal delivery)			
Midwife[d]	81.8	< 0.001	87.4
Obstetrician-gynaecologist	18.1		12.5
Other	0.1		0.1
	(9172)		(7993)

NS: not significant if $P > 0.01$.
[a] Comparison 2010–2016.
[b] Percentage of women.
[c] Percentage of births.
[d] In private sector: 45.4% in 2010 and 57.6% in 2016.

the optimal rate is unknown and whether very low rates of episiotomies (i.e. < 10% of overall vaginal deliveries) are beneficial is unclear [47,48].

When assessing the implementation of new guidelines, one should note that changes in medical practice might occur before their publication. For instance, we observed that oxytocin use during labour decreased between 2010 and 2016, whereas guidelines on this topic were published after the survey [49]. Such a trend before guidelines are published was previously observed for episiotomies in France [50]. This situation may be explained by the fact that recommendations are produced after opinion leaders become aware of the need for change and begin to modify their practices.

Organization of health services and place of delivery

Obstetricians have the leading role in antenatal care, from the beginning of pregnancy [6]. Nonetheless, an important change took place after 2003 in the distribution of roles between providers, with the role of midwives increasing [4]. For instance, in 2016, 41% of women consulted a midwife at least once in a public maternity unit and 25% consulted a private midwife at least once [6]. This trend could be explained by changes in the

Table 9
Analgesia, anaesthesia and women's satisfaction between 1995 and 2016.

	1995	P^a	2003	P^b	2010	P^c	2016
	% (n)		% (n)		% (n)		% (n)
Wish for epidural analgesia before delivery[d]							
Yes, absolutely	–		–		86.4		64.3
Yes, maybe	–		–				21.1
No	–		–		13.6		14.6
					(10,744)		(10,509)
Analgesia or anaesthesia at birth[e]							
None	38.4	< 0.001	22.6	< 0.001	16.7	< 0.001	14.8
Epidural (or combined spinal epidural) analgesia/anaesthesia	48.7		62.5		69.8		73.0
Spinal analgesia/anaesthesia	5.2		12.4		11.9		10.8
General anaesthesia	5.3		1.6		1.2		1.2
Other analgesia/anaesthesia	2.4		0.9		0.4		0.2
	(12,870)		(14,182)		(14,363)		(12,500)
PCEA[d,f,g]	–		–		35.6	< 0.001	53.8
					(8690)		(8423)
Non-medical methods for pain relief[d]	–		–		14.3	< 0.001	35.5
					(11,567)		(10,321)
Satisfaction with method used for pain relief and contractions[d]							
Very satisfied	–		–		–		61.3
Moderately satisfied	–		–		–		27.0
Slightly satisfied	–		–		–		7.7
Not at all satisfied	–		–		–		4.0
							(10,270)

NS: not significant if $P > 0.01$; no test if questions or formatted answers were not comparable.
 [a] Comparison 1995–2003.
 [b] Comparison 2003–2010.
 [c] Comparison 2010–2016.
 [d] Percentage of women (caesarean sections before labour excluded).
 [e] Percentage of women.
 [f] From medical records in 2010 and from women's interviews in 2016.
 [g] Patient Controlled Epidural Analgesia.

organisation of antenatal visits in maternity units and by the increasing number of private midwives [51]. We also observed that midwives have increasing responsibilities in labour wards: the proportion of spontaneous vaginal deliveries attended by midwives in private maternity units increased between 2010 and 2016.

A major restructuring of maternity units occurred in the late 1990s and 2000s: the number of maternity units decreased from 816 in 1995 to 618 in 2003, 535 in 2010 and 497 in 2016. Despite the rather small decrease in number of units between the last two surveys [52], the trend in births in very large public units is continuing. A review of the impact of the closing of small maternity units gave a rather reassuring conclusion on the situation in 2010 regarding access to units, staff, content of care, interventions, compliance with medical guidelines and health [53]. However, given the continuing centralization of births in large maternity units, it is important to verify that these hospitals have sufficient human and financial resources to provide quality care and to respect women's choices and preferences regarding childbirth, especially for women with low-risk pregnancies.

Pregnancy outcome

Pre-term birth rates increased in France between 1995 and 2016 and this trend has been observed since the late 80s [8]. While pre-term birth rates are rising in many countries globally, some European countries have maintained stable rates or even achieved decreases as, for example, the Netherlands and Finland [54]; it is important to elucidate the causes of the increasing rates in France, as pre-term birth is a principal risk factor for infant mortality and morbidity and poor long-term health and development. The proportion of SGA infants also increased between 2010 and 2016, but trends in this indicator have been variable, which may result from changes in population characteristics affecting birth-weight,

preventive behaviour or the clinical management of fetal growth restriction [55].

Some other indicators point toward a slight worsening of infant health status at birth between 2010 and 2016 in terms of low Apgar scores, neonatal transfers and resuscitation [6]. These trends are consistent with the increase in pre-term infants who face higher risks of these outcomes than term infants, but further analyses by gestational age require larger sample sizes than available in the national perinatal surveys. These trends may also reflect differences in health care or measurement of outcomes. For instance, the increasing number of births in specialized units may facilitate newborn transfers to on-site neonatal units and may not result from worse health per se. Regarding the Apgar score, its assessment is subjective and scoring practices may have evolved over this period [56]. However, data from other sources showing high rates of spontaneous fetal death [57] and neonatal death [38], in combination with the results from this survey call for action to understand and to mitigate these negative trends.

Place of the national perinatal surveys in the health information system

The national perinatal surveys provide information at regular intervals to monitor perinatal indicators and assess health policies. These surveys are not appropriate for studying rare events, analysing small incremental trends or describing situations at regional or district levels. For those purposes, data are required on much larger samples and we need to use other data sources that have been providing some core indicators, estimated on all births, for a few years [1,2]. National perinatal surveys fulfil other objectives by covering a wide range of topics according to current concerns and providing high quality data based on interviews with mothers and abstraction from medical records using a common

Table 10
Newborns' health status between 1995 and 2016.

	1995	P^a	2003	P^b	2010	P^c	2016
	% (n)		% (n)		% (n)		% (n)
Gestational age (weeks)[d]							
< 37	5.4	< 0.001	6.3	<0.001	6.5	<0.001	7.5
37	7.0		6.4		6.8		7.2
38	16.1		14.7		16.6		15.7
39	28.5		24.6		24.6		26.8
40	26.5		27.1		27.2		25.5
41	15.0		19.8		18.0		16.8
≥ 42	1.5		1.1		0.3		0.5
	(13,041)		(14,433)		(14,644)		(13,155)
Birth weight (g)[d]							
< 2 500	5.7	< 0.001	7.2	0.002	6.3	<0.001	7.5
2500–2999	20.1		20.5		19.6		20.6
3000–3499	40.9		39.9		40.8		39.4
3500–3999	26.3		25.7		26.2		25.7
4000–4499	6.2		5.8		6.4		6.1
≥ 4500	0.8		0.9		0.7		0.7
Mean ± SD	3273.6 ± 520.5		3251.8 ± 543.9		3273.3 ± 529.5		3246.6 ± 556.8
	(13,133)		(14,458)		(14,643)		(13,158)
5 min Apgar score < 7[d]	0.9	NS	0.7	NS	0.8	0.003	1.2
	(13,000)		(14,396)		(14,531)		(13,143)
Umbilical cord pH							
< 7.00	–		–		–		0.6
7.00–7.15	–		–		–		8.9
> 7.15	–		–		–		90.5
							(11,074)
Neonatal transfer[d,e]	8.7	0.008	7.9	NS	8.5	<0.001	10.4
	(13,107)		(14,238)		(14,652)		(13,171)
Infant feeding[f]							
Breastfeeding	40.5	< 0.001	55.5	<0.001	60.3	<0.001	52.2
Breast milk and formula	11.1		6.9		8.4		14.5
Formula	48.4		37.6		31.3		33.3
	(12,462)		(13,749)		(14,106)		(11,820)

NS: not significant if *P* > 0.01.
^a Comparison 1995–2003.
[a] Comparison 1995–2003.
[b] Comparison 2003–2010.
[c] Comparison 2010–2016.
[d] Core indicator collected for all births.
[e] Transfers to neonatal unit or special care section of the maternity unit (Kangaroo unit).
[f] When mothers were interviewed.

Table 11
Preterm delivery and low birthweight of singletons and twins between 1995 and 2016 (live births).

	1995	P^a	2003	P^b	2010	P^c	2016
	% (n)		% (n)		% (n)		% (n)
Gestational age < 37 weeks[d]							
Singletons[e]	4.5 (12,713)	NS	5.0 (13,934)	NS	5.5 (14,211)	NS	6.0 (12,696)
Twins	39.2 (316)	NS	44.0 (496)	NS	41.9 (430)	NS	47.5 (444)
All[e,f]	5.4 (13,041)	0.001	6.3 (14,433)	NS	6.5 (14,644)	0.002	7.5 (13,155)
Birthweight < 2500 g[d]							
Singletons	4.6 (12,803)	0.002	5.5 (13,963)	NS	5.0 (14,214)	0.01	5.7 (12,700)
Twins	47.5 (318)	NS	55.9 (492)	NS	49.3 (426)	NS	53.9 (443)
All[f]	5.7 (13,133)	< 0.001	7.2 (14,458)	0.003	6.3 (14,643)	<0.001	7.5 (13,158)
Small for gestational age (< 10th percentile)							
Reference curves: AUDIPOG, 2008[g]							
Singletons	9.0 (12,684)	< 0.001	10.4 (13,843)	<0.001	8.5 (14,175)	NS	9.1 (12,284)
Twins	28.7 (314)	NS	29.5 (489)	0.009	21.8 (426)	NS	22.7 (418)
All[f]	9.5 (13,010)	< 0.001	11.0 (14,335)	<0.001	8.9 (14,604)	NS	9.5 (12,717)
Reference curves: EPOPé, 2016[g]							
Singletons	10.4 (12,684)	< 0.001	12.0 (13,843)	<0.001	10.1 (14,175)	<0.001	10.8 (12,284)
Twins	39.5 (314)	NS	42.3 (489)	NS	35.5 (426)	NS	34.7 (418)
All[f]	11.1 (13,010)	< 0.001	13.0 (14,335)	<0.001	10.8 (14,604)	<0.001	11.6 (12,717)

NS: not significant if *P* > 0.01.
[a] Comparison 1995–2003.
[b] Comparison 2003–2010.
[c] Comparison 2010–2016.
[d] Core indicator collected for all births.
[e] *P* for trend: < 0.0001.
[f] Including triplets.
[g] Adjusted for gestational age and sex.

protocol with pretested definitions. However, because of the large number of topics addressed in this survey, only a few questions can be included on each one and therefore specific databases, such as the registries, the Audipog network, or ad-hoc surveys, are a necessary complement for more detailed analyses.

Conclusion

We have shown major trends in risk factors, medical practices and the health status of children at birth since 1995. More detailed analyses will allow us to rank France in relation to other European countries in the Euro-Peristat Project, study some risk factors in greater detail and assess the application of some regulatory measures and guidelines, as was done with the previous survey (see Appendix 1).

National perinatal surveys are one of the tools in the French national perinatal information system and, as shown in this overview, yield essential high-quality information, unavailable elsewhere, about perinatal practices and outcomes. They constitute an important information base for physicians, public health policy makers, and women and families, in addition to routine national statistics and specific databases or surveys.

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Disclosure of interest

The authors declare that they have no competing interest.

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Appendix 1. Main publications based on the National Perinatal Survey 2010

International comparisons

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