



Endocrine disruptors and pregnancy: Knowledge, attitudes and practice of perinatal health professionals. A French multicentre survey

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1 **Abstract**

2 **Introduction**

3 Endocrine disruptors (ED) such as phthalates or bisphenol A are ubiquitous and pregnant women
4 and children are particularly vulnerable. Perinatal health professionals are well-placed to inform
5 pregnant women about the risks. We set out to evaluate perinatal health professionals' knowledge
6 of ED and the information they give during pregnancy.

7 **Material and Methods**

8 We invited midwives, obstetrician-gynecologists (OB/GYN), general practitioners (GP), and
9 general medicine and OB/GYN residents to respond to a short Google survey between August and
10 November 2018 by email using perinatal network.

11 **Results**

12 Out of 4100 questionnaires sent, 1650 completed questionnaires were returned and analyzed. The
13 participation rate was 41% with the following distribution: midwives (n=1215, 74%), OB/GYN
14 residents (n=102, 6%), OB/GYNs (n=129, 8%), GPs and residents in general medicine (n=204,
15 12%), in private and public hospitals in France. Only 181 of the respondents thought they were
16 well-informed about ED including 160 midwives (11%). Most of the responding professionals
17 reported not to give any information during pregnancy (n=946, 57.3%). Midwives (n=452, 37.2 %),
18 people >50 years (n=104, 41.6%) and people working in private structures (n=451, 34.9%) were the
19 most likely to give information, mainly orally. Overall, 346 (74.2%) of the respondents considered
20 that information about health risks of endocrine disruptors was important and most of them wished
21 they were better informed (n=1532, 92.9%).

22 **Conclusion**

23 Our study suggests that perinatal health professionals do not have enough medical information,
24 training or tools to communicate about the risks associated with ED to pregnant women and
25 consequently cannot educate them. Research is needed to further explore the risks and support
26 prevention of environmental exposure for pregnant women.

27

28 **Keywords:** Endocrine disruptors; Environmental toxicants; Reproductive health; Environmental
29 health; Perinatal health professionals; Attitudes; Risk perception.

30

Introduction

Since the discovery of the estrogen-like effect of chlordecone in rats[1] in the 80's, endocrine disruptors have been at the center of a lively and permanent debate attracting considerable scrutiny by the media. There is no question that they pose a major threat to public health. At an international level, different definitions of an endocrine disruptor co-exist and are constantly being re-evaluated. The most common definition used is that by the WHO in 2002: "an endocrine disruptor is an exogenous substance or mixture that alters functions of the endocrine system and consequently causes adverse health effects in an intact organism, or its progeny"[2]. The effects observed involve signaling pathways, regulation or physiological mechanisms as opposed to classic direct toxicity mechanisms.

Phtalates, bisphenol A and parabens are the most famous of them. They are associated with a potential deterioration of the male reproductive health [3][4][5][6][7][8]. Others substances like pesticides may also affect thyroid function[9][10] or like PBDEs that affects neurological functions [11][12] [13][14].

Of course, the diethylstilbestrol tragedy (DES) serves as a stark reminder that chemical substances acting like a hormone do not only have the potential to seriously affect the health of people exposed but also to produce irreversible disorders in their offspring[15]. Moreover, it is becoming more and more obvious that the pre- and post-natal periods are critical windows of exposure, especially the first 1000 days[16].

It would appear that both health professionals and patients lack adequate knowledge about endocrine disruptors[17]. Several health professionals are concerned: midwives, gynecologist-obstetricians (OB/GYN) and residents in gynecology-obstetrics (OB/GYN residents), and general practitioners (GP) and residents in general medicine. These professionals are in the front line to inform patients and prevent the risks associated with environmental exposure to endocrine disruptors. Nevertheless, the topic is not specifically covered during medical school.

The objective of this study was to assess perinatal health professionals' knowledge about

57 endocrine disruptors and the information given to pregnant women about the associated risks during
58 pregnancy.

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60

61 **Material and Methods**

62

63 *Design*

64 We created a 7-item questionnaire using Google form which was sent by e-mail to
65 midwives, OB/GYNs, GPs, OB/GYN residents and general medicine residents throughout France
66 (Metropolitan and Overseas Territories). The survey was sent between August and November 2018
67 and followed up once with a reminder. Our study was exempted from IRB approval, as it wasn't
68 dealing with patients.

69

70 *Health professionals contacted*

71 Health professionals were identified using mailing lists from the prenatal diagnostic network
72 (mainly in Brittany, about 200 people contacted), mailing lists from perinatal networks (in Brittany
73 and in Auvergne-Rhône-Alpes, about 400 people contacted), OB/GYNs working in various
74 University Hospitals (32 French University Hospitals, about 500 professionals contacted), the
75 residents' office of the same University Hospitals (about 600 OB/GYN residents and residents in
76 general medicine contacted), via the professional board of midwives (about 2300 midwives
77 contacted) or via social networks (Facebook, mainly for residents, GPs and OB/GYNs, about 100
78 people contacted).

79

80 *Data Collection*

81 The first part of the questionnaire collected the demographic characteristics of the
82 respondents (age, profession, area of activity, working structure). The second part focused on
83 attitudes, beliefs and practices about the risks associated with endocrine disruptors: level of
84 knowledge about the endocrine disruptors, how often they informed their patients, type of
85 information given (orally or with written support), the importance they accorded the subject, and

86 their interest in obtaining additional information.

87

88 *Statistical analysis*

89 Qualitative variables were described by size (N) and percentage (%) for each category,
90 quantitative variables were presented using mean +/- standard deviation (SD). Quantitative data
91 were compared using the chi2 test and Fisher's exact test when appropriate. If there were more than
92 two groups with an overall difference, 2 by 2 comparisons were made with a Bonferroni correction.
93 A *p-value* <0.05 was selected to denote significance. The analyzes were performed with the SAS
94 software, version 9.4.

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98 **Results**

99 Of a total of 4100 questionnaires sent, 1650 completed questionnaires were returned and
100 analyzed. The participation rate was 41% (**Figure 1**) with most of the respondents being hospital or
101 freelance midwives (n=1215, 73.6%). There were also responses from GPs/residents in general
102 medicine (n=204, 12.4%), OB/GYNs (n=129, 7.8%), and OB/GYN residents (n=102, 6.2%).

103 The sociodemographic and geographical characteristics of the respondents are detailed in
104 **Table 1**. More than half of them were under 40 years (n=1113, 67.5%). All OB/GYN residents and
105 general medicine residents were part of this category as were 763 (63%) of the midwives and 72
106 (56%) of the OB/GYNS.

107 Most of the respondents worked as freelancers or for the private sector 1348 (82%) vs 302
108 (18%) for a public hospital (university or non-university public hospitals). A total of 1131 midwives
109 (93.1%) worked for the private sector as well as 166 GPs (81.4%). All the residents were working in
110 a public hospital as were most of the OB/GYNs (n=80, 62%).

111 Most of the respondents felt that they were not sufficiently informed about the risks of
112 endocrine disruptors during pregnancy (n=1407, 85%); 181 (11%) of them thought they were pretty
113 well informed, mostly midwives (n=160, 13.2%); and 62 (4%) did not express an opinion. (**Table**
114 **2**). Midwives expressed more concern about endocrine disruptors than the other professionals: 356
115 (29.3%) thought the question was “very important” versus five (4.9%) OB/GYN residents, 18
116 (14%) OB/GYNs and 32 (15.7%) GPs. Nine-hundred and forty-six (57.3%) provided no
117 information about the risk of endocrine disruptors to their patients (**Table 2**).

118 In a comparison based on age, those over 50 years declared they were more informed (n=43,
119 17.2%) than those under 30 years (yes: n=44, 8.4%) ($p<0.001$). Respondents over 50 years old are
120 also more likely to give information to patients (answers yes: n=104, 41.6%), than those under 30
121 years-old (n=112, 21.3%; $p<0.05$), those between 30 and 40 years old (n=189, 32.2% $p <0.05$), and
122 those between 40 and 50 years-old (n= 84, 29.3%, $p <0.05$) (**Table 3**).

123 Comparing the workplace, health professionals working as freelancers or in the private
124 sector declared to be better informed (yes: n=168, 10.2%) than those working in a public structure
125 (n=13, 0.8 %) (p <0.001). Office-based professionals (n=451, 34.9%) also declared they gave more
126 information than those working in a university hospital (n=19, 10.2%, p <0.05), in a private hospital
127 (n=8, 14.8%, p <0.05) or non-university public hospital (n=11, 9.6%, p <0.05) (**Table 4**).

128 The information (when provided) was mainly given orally (n=356/466, 76.4%) than in
129 written supports (n=110/466, 23.6%). There was no significant difference between the different
130 health professionals, nor between the different age groups or work structures in the type of
131 information given (**Tables 2 to 4**). Twenty-three people did not answer this question (n=22 for
132 midwives, and n=1 for OB/GYNs).

133 Finally, most of the responding health professionals said they would like to have more
134 information about the subject (n=1532, 92.9%). Only 38 (2.3%) of them did not want more
135 information and 80 (4.8%) of them were undecided.

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140 Discussion

141 This study is one of the first in France to focus on the knowledge and practices of health
142 professionals about the risks of endocrine disruptors for pregnant women. Our results suggest that,
143 although little information is given to patients, in practice, most perinatal health professionals feel
144 that it is “quite” to “very” important to provide information about the risk of endocrine disruptors to
145 pregnant women. Thus, while most health professionals recognized the importance of the subject
146 and the impact of endocrine disruptors on human health, there appears to be a lack of training and
147 tools at their disposal which prevents them from being able to provide sufficient information and
148 advice to the women during their pregnancy.

149 The most frequent endocrine disruptor are the phthalates that are contained in plastic
150 packagings, cosmetics, paints, clothes, toys. They are toxic for the human reproduction, and can
151 cause early puberty in both genders[5]. We can also cite the bisphenol A, estrogeno-mimetic,
152 contained in cans, bottles, or receipts, which is associated with all types of cryptorchidism [4].

153 Midwives, people over 50 years, and those working in a private structure were more likely
154 to inform women, although mainly orally. We had very few answers from the OB/GYNs (7.8%).
155 They may have less time to answer the survey and feel less concerned by the subject. They also
156 may have less time per patient to discuss this problem as they deal with patients with high-
157 pregnancy-risks conditions. Another explanation may be the fact that the profile of patients
158 attending public hospital is different, with high-risk pregnancies and time-consuming management.
159 The younger populations of health professionals, especially those under 30 years old, felt less
160 concerned about the issue and seem to attach less importance to it. However, a majority of people
161 were interested in obtaining additional information on the subject.

162 The strength of this study is in the power as we were able to collect a large number of
163 completed questionnaires from perinatal health professionals throughout France (metropolitan and
164 Overseas Territories). The large and unselected sample of professionals provided a complete vision

165 of endocrine disruptor risk prevention during pregnancy follow-up.

166 The study suffers from a selection bias, which is typical to such transversal studies. It was
167 easier to contact midwives than OB/GYNs or GPs, which is why midwives are over-represented.
168 Nevertheless, the high number of midwives who participated might be because they felt more
169 concerned by the subject and that, consequently, they responded to the questionnaire more readily.

170 The geographical distribution of the responding health professionals was also
171 heterogeneous. This was because some areas were more accessible than others (such as the west or
172 south-east areas of France). In addition, some areas have a small number of health professionals
173 compared to others, which may explain a low answer rate.

174 A similar French study (the PERI-HELPE study, Perception of Risk–HEaLth Professionals
175 & Environment Study) the aim of which was to assess the perception of environmental risks for
176 pregnant women among health professionals, was conducted in 2014 in the region of Auvergne by a
177 team from Clermont-Ferrand [17]. The study included interviews of 188 people (OB/GYNs,
178 midwives and GPs). Few health professionals in this study claimed to question pregnant women
179 about their exposure to chemicals or to advise them to reduce exposure. The most common toxins
180 named were carbon monoxide, pesticides and lead. Lack of information, training and scientific
181 evidence were the most frequently cited reasons to justify the little information given to pregnant
182 women. These results are concordant with our findings.

183 Another larger self-reported questionnaire study was conducted in 2017 in the south of
184 France (PACA area) with 962 participants (41.1% of midwives, 25.6% of OB/GYNs, pediatricians
185 and GPs) and 11% of nurses) [18]. The results obtained were similar to ours. Fear of the patient's
186 reaction and lack of a reliable solution to manage environmental risks were mentioned as major
187 barriers.

188 In 2014, a team in the United States conducted a study among OB/GYN members of the
189 American Congress of Obstetricians and Gynecologists (ACOG)[19]. Most (78%) of the 2514
190 health professionals who responded believed that they could reduce the risk of exposure to

191 endocrine disruptors of pregnant women by advising patients However, 50% of them said that they
192 rarely asked pregnant women about their environment and practices, and fewer than 20% did it
193 frequently. Only around 7% believed they had been sufficiently trained about the subject. The
194 barriers found were similar to those commonly named in French studies: lack of knowledge or clear
195 evidence on the subject, doubt about the ability of patients to effectively reduce their exposure to
196 risk, and fear of causing anxiety to the patient.

197 To complete our study, it would be interesting to interview midwives, pediatricians and GPs
198 about whether they give information about the risks of endocrine disruptors during the postpartum
199 period and early childhood. Young children are equally as vulnerable as pregnant women and the
200 compulsory follow-up period of newborns and children could be an ideal opportunity to
201 communicate about such risks.

202 Another question to consider is whether parents feel they are sufficiently informed and to
203 what extent. Rouillon et al. studied this point using a qualitative psycho-social survey conducted in
204 300 women (pregnant or postpartum) in the Vienne Department (France) between August 2015 and
205 March 2016[20]. The objective was to assess the patients' knowledge, attitudes (risk perception),
206 behaviors and anxiety towards endocrine disruptors. They reported an average endocrine disruptor
207 knowledge score of 42.9 ± 9.8 out of 100 revealing a poor knowledge of the risks. However, most
208 of the women (92%) felt ready to change their habits to avoid environmental risks. Anxiety
209 increased significantly after answering the survey and to a greater extent when knowledge of
210 endocrine disruptors was high (OR=2.30, 95% CI [1.12-4.71]).

211

212 **Conclusion**

213 Most of the health professionals who took part in our study recognized the importance of the
214 risk of endocrine disruptors in pregnant women and the role they have to play in preventing these
215 risks. However, they feel that they lack sufficient training about these risks and few of them inform
216 patients properly.

217 This is a real public health issue. Medical education with clear guidelines and adapted tools

218 to communicate to patients are necessary to support the preventive role of all healthcare
219 professionals managing vulnerable patients exposed to environmental risks. National
220 recommendations are in progress.

221 To overcome the lack of action from the public authorities, many initiatives are taking place
222 at a regional or departmental level: proposals for training for health professionals and patients
223 "Environment and Health" congresses, and specialized consultations such as those organized by the
224 ARTEMIS (Aquitaine Reproduction Enfance Maternité et Impact en Santé environnement) center
225 in Bordeaux. *Santé Publique France* also build a website on the subject : ([https://agir-pour-
226 bebe.fr/](https://agir-pour-bebe.fr/)).

227 At an individual level, it is possible for any health professional to put informative posters in
228 their waiting rooms, distribute information flyers, or smartphone applications (either already made
229 and easy to print out from the internet or made by the professional him/herself) or at least give
230 pregnant women some oral information about the risks of endocrine disruptors.

231

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Figure 1. Flow Chart

GP : General practitioners
OB/GYN : Obstetrics and Gynecology

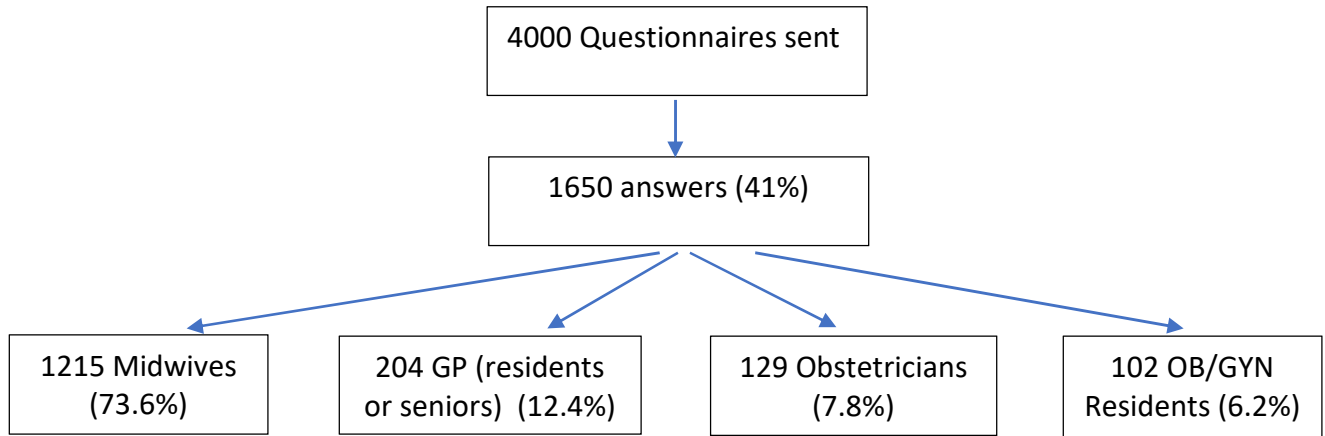


Table 1. Sociodemographic and geographical characteristics of respondents

Respondants					
	Midwives (n=1215, 73.6 %)	Residents in Gynecology- obstetrics (n=102, 6.2%)	Gynecologists- obstetricians (n=129, 7.8 %)	General practitioners or p residents in General Medicine (n=204, 12.4%)	
Age					
≤30 years, n(%)	304 (25.0%)	97 (95.1%)	12 (9.3%)	113 (55.4%)	<0.0001
]30-40] years	459 (37.8%)	5 (4.9%)	60 (46.5%)	63 (30.9%)	
]40-50] years	251 (20.7%)	0 (0.0%)	20 (15.5%)	16 (7.8%)	
>50 years	201 (16.5%)	0 (0.0%)	37 (28.7%)	12 (5.9%)	
Geographic Region	1212 (3)	102 (0)	129 (0)	203 (1)	NS
South-East, n (%)	337 (27.8%)	20 (19.6%)	17 (13.2%)	2 (1%)	
North-West	226 (18.6%)	38 (37.2%)	62 (48%)	191 (94%)	
East	129 (10.6%)	10 (9.8%)	14 (10.9%)	1 (0.5%)	
Overseas Territories	47 (3.9%)	2 (2%)	3 (2.3%)	2 (1%)	
North	47 (3.9%)	22 (21.6%)	6 (4.7%)	0 (0%)	
Center	208 (17.2%)	8 (7.8 %)	15 (11.6%)	5 (2.5%)	
South-West	218 (18%)	2 (2%)	12 (9.3%)	2 (1%)	
Structure of activity					
University Hospital n(%)	34 (2.8%)	78 (76.5%)	57 (44.2%)	18 (8.8%)	<0.0001
Office-based	1093 (90.0%)	1 (1.0%)	36 (27.9%)	164 (80.4%)	
Private Hospital	38 (3.1%)	1 (1.0%)	13 (10.1%)	2 (1.0%)	
Non-University Public Hospital	50 (4.1%)	22 (21.6%)	23 (17.8%)	20 (9.8%)	

Table 2. Responses about endocrine disruptors according to type of perinatal health professional.

	Midwives (n=1215, 73.6 %)	Residents in Gynecology- obstetrics (n=102, 6.2%)	Gynecologists- obstetricians (n=129, 7.8 %)	General practitioners or residents in General Medicine (n=204, 12.4%)	P
Q1.Do you think you are sufficiently informed about the risks of endocrine disruptors in pregnant women?					< 0.001
No n(%)	1003 (82.6%)	99 (97.1%)	116 (89.9%)	189 (92.6%)	
Yes	160 (13.2%)	2 (2.0%)	11 (8.5%)	8 (3.9%)	
Don't know	52 (4.3%)	1 (1.0%)	2 (1.6%)	7 (3.4%)	
Q2. Do you (or another person working in the same structure) give any information on the risk of endocrine disruptors during pregnancy? »					< 0.001
No n(%)	604 (49.7%)	88 (86.3%)	89 (69.0%)	165 (80.9%)	
Yes	452 (37.2%)	2 (2.0%)	21 (16.3%)	14 (6.9%)	
Maybe	159 (13.1%)	12 (11.8%)	19 (14.7%)	25 (12.3%)	
Q3.If yes, what kind of information do you give?	430	2	20	14	NS
Oral information n(%)	330 (76.7%)	2 (100.0%)	13 (65.0%)	11 (78.6%)	
Written information	100 (23.3%)	0 (0.0%)	7 (35.0%)	3 (21.4%)	
Q4. How important is the information provided to the pregnant woman during her follow-up on the risk of endocrine disruptors? »					< 0.001
1 : not important n(%)	41 (3.4%)	18 (17.6%)	7 (5.4%)	18 (8.8%)	
2	113 (9.3%)	25 (24.5%)	26 (20.2%)	27 (13.2%)	
3	312 (25.7%)	37 (36.3%)	43 (33.3%)	76 (37.3%)	
4	393 (32.3%)	17 (16.7%)	35 (27.1%)	51 (25.0%)	
5 : very important	356 (29.3%)	5 (4.9%)	18 (14.0%)	32 (15.7%)	
Q5. Would you like more information about the risk of endocrine disruptors in pregnant women?					0,01
No n(%)	29 (2.4%)	1 (1.0%)	4 (3.1%)	4 (2.0%)	
Yes	1139 (93.7%)	89 (87.3%)	114 (88.4%)	190 (93.1%)	
Maybe	47 (3.9%)	12 (11.8%)	11 (8.5%)	10 (4.9%)	

NS : Not Significant

Table 3. Responses about endocrine disruptors according to the age of the health professionals.

	Age				P
	≤ 30 yo (n=526, 31.9%)]30-40] yo (n=587, 35.6%)]40-50] yo (n=287, 17.4%)	> 50 yo (n=250, 15.1%)	
Q1 : « Do you think you are sufficiently informed about the risks of endocrine disruptors in pregnant women? »					0.001
No n(%)	468 (89.0%)	498 (84.8%)	250 (87.1%)	191 (76.4%)	
Yes	44 (8.4%)	67 (11.4%)	27 (9.4%)	43 (17.2%)	
Don't know	14 (2.7%)	22 (3.7%)	10 (3.5%)	16 (6.4%)	
Q2 : « Do you give (or is it given by another person working in the same structure) any information on the risk of endocrine disruptors during pregnancy? »					< 0.001
No n(%)	353 (67.1%)	325 (55.4%)	166 (57.8%)	102 (40.8%)	
Yes	112 (21.3%)	189 (32.2%)	84 (29.3%)	104 (41.6%)	
Maybe	61 (11.6%)	73 (12.4%)	37 (12.9%)	44 (17.6%)	
Q3 : « If yes, what kind of information ? »	107 (5)	180 (9)	78 (6)	101 (3)	NS
Oral information n(%)	86 (80.4%)	142 (78.9%)	56 (71.8%)	72 (71.3%)	
Written information	21 (19.6%)	38 (21.1%)	22 (28.2%)	29 (28.7%)	
Q4 : « How important is the information provided to the pregnant woman during her follow-up on the risk of endocrine disruptors? »					< 0.001
1 : not important n(%)	48 (9.1%)	24 (4.1%)	9 (3.1%)	3 (1.2%)	
2	73 (13.9%)	62 (10.6%)	37 (12.9%)	19 (7.6%)	
3	171 (32.5%)	161 (27.4%)	79 (27.5%)	57 (22.8%)	
4	145 (27.6%)	202 (34.4%)	77 (26.8%)	72 (28.8%)	
5 : very important	89 (16.9%)	138 (23.5%)	85 (29.6%)	99 (39.6%)	
Q5 : « Would you like more information on the risk of endocrine disruptors in pregnant women? »					NS
No n(%)	8 (1.5%)	14 (2.4%)	8 (2.8%)	8 (3.2%)	
Yes	489 (93.0%)	549 (93.5%)	261 (90.9%)	233 (93.2%)	
Maybe	29 (5.5%)	24 (4.1%)	18 (6.3%)	9 (3.6%)	

NS : Not Significant. Yo : years old.

Table 4. Responses about endocrine disruptors according to the place of activity.

	Activity structures				P
	1-Office-based (n=1294, 78.4%)	2- University hospital (n=187, 11.3%)	3- Private hospital (n=54, 3.3%)	4-Non-University public hospital (n=115, 7%)	
Q1 : « Do you think you are sufficiently informed about the risks of endocrine disruptors in pregnant women? ? »					<0.001
No n(%)	1075 (83.1%)	177 (94.7%)	48 (88.9%)	107 (93.0%)	
Yes	163 (12.6%)	9 (4.8%)	5 (9.3%)	4 (3.5%)	
Don't know	56 (4.3%)	1 (0.5%)	1 (1.9%)	4 (3.5%)	
Q2 : « Do you give (or is it given by another person working in the same structure)any information on the risk of endocrine disruptors during pregnancy? »					< 0.001
No n(%)	688 (53.2%)	142 (75.9%)	31 (57.4%)	85 (73.9%)	
Yes	451 (34.9%)	19 (10.2%)	8 (14.8%)	11 (9.6%)	
Maybe	155 (12.0%)	26 (13.9%)	15 (27.8%)	19 (16.5%)	
Q3 : « If yes, what kind of information ? »					NS
Oral information n(%)	328 (76.5%)	14 (77.8%)	6 (75.0%)	8 (72.7%)	
Written information	101 (23.5%)	4 (22.2%)	2 (25.0%)	3 (27.3%)	
Q4 : « How important is the information provided to the pregnant woman during her follow-up on the risk of endocrine disruptors? »					< 0.001
1 : not important n(%)	48 (3.7%)	23 (12.3%)	3 (5.6%)	10 (8.7%)	
2	126 (9.7%)	40 (21.4%)	6 (11.1%)	19 (16.5%)	
3	355 (27.4%)	55 (29.4%)	21 (38.9%)	37 (32.2%)	
4	408 (31.5%)	42 (22.5%)	17 (31.5%)	29 (25.2%)	
5 : very important	357 (27.6%)	27 (14.4%)	7 (13.0%)	20 (17.4%)	
Q5 : « Would you like more information on the risk of endocrine disruptors in pregnant women? »					NS
No n(%)	32 (2.5%)	4 (2.1%)	1 (1.9%)	1 (0.9%)	
Yes	1208 (93.4%)	168 (89.8%)	48 (88.9%)	108 (93.9%)	
Maybe	54 (4.2%)	15 (8.0%)	5 (9.3%)	6 (5.2%)	

NS : Not Significant