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1 **Use of labour neuraxial analgesia according to woman immigration status: a**
2 **national cross-sectional retrospective population-based study in France**

3

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21

22 **Keywords:** disparity; epidemiology; health equity; immigrant; labour ; neuraxial
23 analgesia; obstetric anaesthesia

24

25

26 **Editor's key points**

27

28 Disparities in neuraxial analgesia use for childbirth by maternal origin have been
29 reported in high-resource countries.

30 **The authors hypothesized that immigrant women from low-resource countries have**
31 **more limited access to neuraxial analgesia than native French women.**

32

33 Timely neuraxial analgesia to relieve labour pain did not differ between native-born
34 and immigrant women by geographic region of birth or for immigrant women from
35 countries with low Health Disparities Index.

36 However, there was differential care in favour of immigrant women from countries
37 with a very high Health Disparities Index, compared with both native-born and
38 immigrant women from other countries.

39

40

41 **Abstract**

42 **Background:** Disparities in neuraxial analgesia use for childbirth by maternal origin
43 have been reported in high-resource countries. We explored the association between
44 maternal immigrant status (characterized separately by geographic continental origin
45 and human development index (HDI) of maternal country of birth) and neuraxial
46 analgesia use. We hypothesized that immigrant women from low-resource countries
47 may have more limited access to neuraxial analgesia than native French women.

48 **Methods:** The study population, extracted from the 2016 National Perinatal Survey,
49 a cross-sectional study of a representative sample of births in France, included only
50 women who initially wished to deliver with neuraxial analgesia. We used multivariable
51 multilevel logistic regression to explore the association between immigrant status and
52 both use of NA neuraxial analgesia and its timely administration.

53 **Results:** Among the 6070 women included, 88.1% gave birth with neuraxial
54 analgesia and 15.8% were immigrants. There was no difference in neuraxial
55 analgesia use between native French women and either immigrant women by
56 geographic continental region of origin, or immigrants from countries with low HDI.
57 But immigrants from countries with very high HDI were more likely to give birth with
58 neuraxial analgesia (adjusted odds ratio 2.6, 95% confidence interval: 1.2–5.8,
59 $P=0.018$) and its timeliness <60 min after admission (adjusted odds ratio 1.8, 95%
60 confidence interval: 1.2–2.7, $P=0.005$) compared with native French women.

61 **Conclusions:** In France, immigrant women from low-resource countries have similar
62 access to labour neuraxial analgesia to native French women. Our results suggest
63 differential neuraxial analgesia use in favour of immigrant women from very high HDI
64 countries compared with native women.

65 Disparities in the management of acute and chronic pain by patient ethnic origin have
66 been widely demonstrated in high-resource countries.^{1,2} Pain management during
67 labour and delivery is no exception.^{3,4} Neuraxial analgesia is currently the standard of
68 care for relieving labour pain.⁵ Ethnic disparities in its use have been reported, mostly
69 in studies from the US, where Hispanic and Black women are less likely to receive it
70 than white non-Hispanic women.^{3,4} In European countries, variations in neuraxial
71 analgesia access have not been studied by ethnicity, but rather by parturient
72 immigrant status based on geographic region of birth.⁶⁻¹¹ These studies, performed in
73 Germany, Ireland, Spain, and Norway, show that immigrant women are less likely to
74 receive neuraxial analgesia than women born in the host country. Nonetheless, the
75 great variety of situations covered by the term "immigrant" makes these results
76 difficult to interpret. Sub-classification by maternal geographic area of birth may
77 address a part of this heterogeneity and enable us to go further in understanding the
78 mechanisms of the association with neuraxial analgesia administration. However, it
79 does not consider the heterogeneity of the characteristics of the women in each
80 geographic continental region. Because it is not feasible to consider each country of
81 birth as a category, classifying immigrant women according not only to their
82 geographical continental region of origin, but also to the level of development of their
83 country of birth could be a useful complementary strategy. The United Nations
84 calculates every country's Human Development Index (HDI) annually, aggregating
85 dimensions of health, education and standard of living,¹² which could be a valuable
86 indicator of the level of development for a given maternal country of birth in the study
87 of neuraxial analgesia access according to maternal migrant status.

88 In 2016, 22% of births involved immigrant women in France.¹³ Differential care,
89 defined as medically unjustified inequalities in health care access ¹⁴, has already

90 been demonstrated in France in some areas of perinatal care, including the
91 management of hypertensive disorders during pregnancy¹⁵ and performance of
92 caesarean deliveries.¹⁶ These especially affect immigrants from sub-Saharan Africa.
93 In France, neuraxial analgesia is a standard procedure, fully covered by the national
94 health insurance system. Therefore, its administration should be based mainly on the
95 woman's desire to receive it. Nonetheless, no study has yet examined whether
96 differential care by migration status restricts immigrants' access to neuraxial
97 analgesia for labour pain, or whether variations in the timing of neuraxial analgesia
98 administration by this status exist.

99 This study aims to assess the association between immigrant status (by geographic
100 continental region and Human Development Index of the mother's country of birth)
101 and access to neuraxial analgesia among women initially preferring it for delivery, by
102 examining both its use and its timeliness during labour in a French national
103 population-based study. We hypothesized that immigrant women from low-resource
104 countries may have more limited access to labour neuraxial analgesia as compared
105 with native French women.

106 **Methods**

107 *Ethics approval*

108 We used data from the 2016 French National Perinatal Survey (NPS), approved by
109 the National Council on Statistical Information (CCTIRS n°15.169), the Institutional
110 Review Board of the French Institute of Medical Research and Health (IRB00003888)
111 and the French Commission on Information Technology and Liberties (registration
112 number 915197). All women provided oral informed consent to be interviewed.

113

114 *Study population*

115 The study population was extracted from the 2016 NPS, a representative sample of
116 all deliveries in France, including all women with live births or stillbirths at or after 22
117 gestational weeks or weighing at least 500 g during a one-week period in all French
118 maternity units (n=13,893 women, 517 maternity units).¹⁷ Data came from three
119 sources: medical records for characteristics of delivery; midwives' interviews of the
120 women, before discharge, with a standardised questionnaire asking about social and
121 demographic variables and characteristics of prenatal care and pain management
122 during labour; and a questionnaire completed by the head of each unit concerning
123 characteristics of the maternity unit.

124 The study population included all women from the 2016 NPS who answered during
125 midwives' interview an antepartum preference to deliver with neuraxial analgesia,
126 except the following: women who gave birth outside the hospital or within 15 min of
127 admission (a period considered as too short to administer neuraxial analgesia),
128 women for whom neuraxial analgesia was medically indicated (prior caesarean,
129 caesarean in the hour after arrival at the maternity unit, fetus in breech presentation,
130 and multiple pregnancy) or contraindicated (coagulation or spinal disorders), and

131 women with missing data for neuraxial analgesia use or country of birth. Women who
132 had labour induction were also excluded, as neuraxial analgesia is usually performed
133 in this specific context in France.¹⁷

134

135 *Study outcomes and variables*

136 Two outcomes were assessed: 1) neuraxial analgesia use for labour pain relief
137 (including epidural and combined spinal-epidural analgesia), 2) its timeliness, relative
138 to admission to the delivery room, that is, <60 min of admission (reference category,
139 75th percentile of timing of neuraxial analgesia performance), compared with
140 neuraxial analgesia administration \geq 60 min after maternal admission or no neuraxial
141 analgesia.

142 The exposure variable was maternal immigrant status, defined two ways. First, we
143 used her geographic continental region of origin, **based on country of birth**.

144 Categories were defined according to the profile of contemporary immigration in
145 France: Europe, North Africa, other African countries, and other regions.¹³ Details
146 about countries included in each category of geographical continental region is
147 provided in Supplementary Materials Table 1. Second, as these categories of
148 geographical region are very heterogenous, particularly the category “other regions”,
149 we used the Human Development Index (HDI) score of maternal country of birth,
150 which aggregates three dimensions: health (approached by life expectancy at birth),
151 education (measured by mean years of schooling for adults aged 25 yr or more and
152 expected years of education for children of school-entering age), and standard of
153 living (measured by gross national income per capita).¹² The United Nations
154 calculates HDI annually, classing it in 4 categories (very high: \geq 0.80; high: 0.70-0.79;
155 middle: 0.55-0.69; and low: <0.55). We used HDI of the year 2009, which

156 corresponded to the median year of arrival in France of immigrant women in the
157 study population.

158 We studied the following maternal characteristics: age, parity, and chronic medical
159 conditions (hypertension, diabetes mellitus or other severe chronic disorders),
160 educational level (middle school or less, high school, university), deprivation index
161 (from 1 to 4, based on the following four criteria: social isolation, poor housing
162 conditions, no work-related household income, and recipient of state-funded health
163 insurance).¹⁸ Among migrant women, we identified women with recent immigration,
164 arrived in France <1 yr before delivery (dichotomous variable). We considered some
165 characteristics of pregnancy and delivery: **inadequate antenatal care (corresponding
166 to a late initiation of antenatal care (after the first trimester of pregnancy) and/or
167 insufficient number of antenatal visits (< 1 visit per month after the first trimester)
168 and/or insufficient number of ultrasonographic examinations according to the length
169 of gestation (examinations at 12, 22 and 32 weeks of gestation))**, delivery in the
170 same maternity unit as prenatal follow-up (at least one prenatal care appointment in
171 the maternity unit of delivery), and mode (spontaneous vaginal, operative vaginal or
172 caesarean delivery). We also studied two maternity unit characteristics: hospital
173 status (university public, non-university public and private), and on-site presence of
174 an anaesthesiologist 24/7 **in the maternity unit** (dichotomous variable).

175

176 *Statistical analysis*

177 We described and compared the native French women and the immigrants (overall
178 and then classified in separate analyses by region of birth and HDI category) **for
179 individual characteristics, characteristics of delivery, and characteristics of maternity
180 unit**. We used the Chi² test for categorical variables and the Kruskal-Wallis test for

181 continuous variables (normal distribution not demonstrated by Shapiro-Wilk test).
182 Statistical significance was established at $\alpha < 0.05$.

183 To explore the associations between immigrant status (exposure), neuraxial
184 analgesia use, and timely neuraxial analgesia (outcomes), we used univariable and
185 multivariable multilevel logistic regression models with random intercept for maternity
186 units to consider the hierarchical structure of the data (women in the first level and
187 maternity units in the second), and the correlation between women giving birth in the
188 same maternity unit, likely to receive similar medical care. Causal assumptions
189 relating immigrant status, neuraxial analgesia use/timely neuraxial analgesia, and
190 covariates, were identified according to the literature and represented using a
191 directed acyclic graph (DAG) to depict exposure-outcomes relationship with
192 confounders and intermediate factors (see Supplementary Figure 1 in Supplemental
193 Materials). The DAG helped us to select confounders (variables associated with both
194 the exposure - immigrant status - and the outcomes - neuraxial analgesia use and
195 timely neuraxial analgesia), and intermediate factors (placed on the causal pathway
196 between immigrant status and neuraxial analgesia). Crude odds ratios (ORs) and
197 adjusted ORs (aOR) were estimated by the maximum likelihood method with their
198 95% confidence intervals (CIs).

199 In the first model of the multivariable analysis, planned *a priori*, the association
200 between immigrant status and neuraxial analgesia outcomes was adjusted for
201 independent variables related to individual characteristics: maternal age as a
202 continuous variable, parity as a dichotomic variable (nulliparous or parous), and
203 maternal education level as a three categorical variable (middle school or less, high
204 school, university). We included maternal age and parity in the multivariable model
205 because they are well-known determinants of neuraxial analgesia use during

206 labour.^{19,20} Maternal educational level was also included as it could be considered as
207 a cofounder in the association between immigrant status and neuraxial analgesia
208 provision. To consider organisational characteristics, we performed a second model
209 of multivariable analysis, planned *a posteriori*, with additional adjustment for
210 **maternity unit status** as a categorical variable (university public, non-university public
211 and private). **The same multivariable models were separately applied to explore the**
212 **association between immigrant status according to maternal geographic origin and**
213 **neuraxial analgesia, and the association between immigrant status according to the**
214 **HDI level of maternal country of birth and neuraxial analgesia.**

215 Data about neuraxial analgesia use were missing for < 1% of the study population.
216 We thus performed a multivariable analysis of complete cases to assess the
217 association between immigrant status and neuraxial analgesia use. Data about
218 neuraxial analgesia timing, however, were missing for 9.5% of the women included.
219 The similarity of the characteristics of women with and without missing data
220 (Supplementary Materials Table 2) showed that the hypothesis of missing at random
221 was plausible. To assess the association between immigrant status and timely
222 neuraxial analgesia, we performed a multivariable analysis with multiple imputations
223 by chained equations with 100 iterations and 10 imputation bases. Finally, we
224 performed a sensitivity analysis excluding women who had a caesarean delivery
225 during labour (**intrapartum caesarean delivery**), to consider the indication bias
226 associated with neuraxial analgesia in this context. Data were analysed with Stata
227 15.1 software (StataCorp LP, College Station, TX, USA), and figures were generated
228 with R Studio software version 1.1.414.

229 **Results**

230

231 The study population included 6070 women; 959 (15.8%) were immigrants and 5348
232 (88.1%) used neuraxial analgesia to relieve labour pain (Figure 1).

233

234 *Characteristics by immigrant status*

235 Classified either by geographic continental region of origin (Table 1) or by HDI of
236 country of birth (Table 2), immigrant women overall were significantly more frequently
237 > 35 yr old, parous, with lower education levels, higher deprivation index scores, and
238 received inadequate antenatal care more frequently than French-born women.
239 Immigrants gave birth by operative vaginal or caesarean delivery significantly more
240 often than native French women, in a university public hospital, with an
241 anaesthesiologist in the delivery unit 24/7.

242 Immigrant women born in sub-Saharan Africa (Table 1) and those born in low HDI
243 countries (Table 2) more often had a chronic medical condition, a higher deprivation
244 index, a lower education level, and a caesarean delivery, compared with other
245 immigrant women. In contrast, immigrant women from very high HDI countries were
246 more often nulliparous and had operative vaginal deliveries and delivered in a private
247 hospital more frequently than either French-born or other immigrant women (Table
248 2).

249

250 *Use and timing of neuraxial analgesia*

251 In the univariate analysis, neuraxial analgesia use did not differ between native and
252 immigrant women ($P=0.274$), and between native and immigrant women when
253 immigrant status was defined by geographic region of origin ($P=0.086$, Table 1). But

254 it differed significantly when this status was classified by HDI ($P=0.002$, Table 2). The
255 timing of neuraxial analgesia did not differ by immigrant status, whether classified by
256 geographic origin or by HDI of country of birth ($P=0.722$ in Table 1, and $P=0.340$ in
257 Table 2, respectively).

258 In the multivariable multilevel analysis, neither neuraxial analgesia use nor its timely
259 administration differed significantly for immigrants defined by geographic region of
260 origin, compared with native-born women (Figure 2), particularly for women from
261 North Africa, the largest group of immigrants defined by geographic region of origin
262 (aOR 1.39, 95% CI: 0.93-2.09, $P=0.105$ and aOR 0.90, 95% CI: 0.69-1.17, $P=0.073$,
263 respectively). These results were unchanged after adjustment for maternity unit
264 status (Supplementary Figures 2). When immigrant status was classified by HDI of
265 maternal country of birth, women from very high HDI countries were significantly
266 more likely than women born in France to use neuraxial analgesia (aOR 2.6, 95% CI:
267 1.2-5.8, $P=0.02$), and to receive it < 60 min after admission (aOR 1.8, 95% CI: 1.2-
268 2.7, $P=0.005$). Native French women, however, did not differ from women from
269 countries in other HDI categories, particularly low HDI countries (aOR 0.67, 95%CI:
270 0.44-1.02, $P=0.066$) (Figure 3). These results were unchanged after adjustment for
271 maternity unit status (Supplementary Figures 3). The sensitivity analysis after the
272 exclusion of women with caesarean delivery during labour shows similar results
273 (Supplementary Figures 4, 5, 6 and 7).

274 Discussion

275

276 This French population-based study shows that, while neuraxial analgesia access is
277 similar for immigrants from lower HDI countries and women born in France,
278 differential care, specifically differential use and timeliness of neuraxial analgesia
279 administration, is observed in favour of immigrants coming from very high HDI
280 countries **as compared to French-native women.**

281 We did not observe any association between neuraxial analgesia use or timeliness
282 and immigration status defined by the mother's continental region of origin. Our
283 results differ from those of other European studies, which are over 10 yr old:
284 retrospective studies from Spain and from Ireland, and a German cross-sectional
285 study reported significantly lower neuraxial analgesia use by immigrants compared
286 with native-born women.⁶⁻⁸ Three more recent studies from Norway also reported
287 disparities between natives and migrant women in the use of neuraxial analgesia, **but**
288 **with contrasting results according to the maternal country of birth.**^{9,10,11} **In contrast to**
289 **our study, all these studies included mothers who expressed a preference not to use**
290 **neuraxial analgesia as well as mothers who chose** neuraxial analgesia. Immigrant
291 women in France, however, are more likely than native-born women to prefer
292 childbirth without neuraxial analgesia²¹, which may explain the differences with our
293 results. In addition, the rate of neuraxial analgesia for labour in France is among the
294 highest in the world: 82% of women in 2016, compared with **38% in nulliparous and**
295 **15% in multiparous** in Germany and 20% in the UK.^{17,22,23} Moreover, neuraxial
296 analgesia use is fully covered by the French health insurance system, regardless of
297 the woman's insurance coverage. This easy and universal access to neuraxial
298 analgesia in France may also explain why we did not observe any difference in

299 neuraxial analgesia use and timely performance according to the maternal
300 geographic origin. Differences in migration profiles make international comparisons
301 difficult. Finally, these European studies from Spain, Ireland and Germany are single
302 or multicentre cross-sectional studies, with poorer external validity than population-
303 based studies. The 95% CI of the ORs for use of neuraxial analgesia by immigrant
304 women defined by the mother's continental region of origin as compared to native
305 French women are wide. Consequently, the absence of association we found might
306 also be explained by the small sample size of the groups of immigrant women.
307 However, we did not find any significant association between neuraxial analgesia use
308 and immigrant women coming from low or very low HDI countries, strengthening
309 these results.

310 In our study, when immigrant status was characterised by HDI, neuraxial analgesia
311 access during labour for immigrant women not from very high HDI countries was like
312 that of those born in France. This result suggests that the principle of universal
313 access to labour pain management is effective in France. This rule of universal
314 access is not, however, systematically applied to all aspects of perinatal care.
315 Differential care has been identified in France in the management of hypertensive
316 disorders during pregnancy ¹⁵ and in the performance of caesarean deliveries ¹⁶,
317 particularly for women born in sub-Saharan Africa.

318 Nonetheless, we observed differential care in favour of immigrants from very high
319 HDI countries in neuraxial analgesia use and timeliness. This higher and earlier use
320 of neuraxial analgesia among immigrant women from very high HDI countries does
321 not appear to be related to individual characteristics, as their profiles were similar to
322 those of women born in France. However, this category of immigrant women had
323 operative vaginal deliveries more frequently and gave birth more often in private

324 hospitals than native-born or other immigrant women. Several previous French
325 studies did not report any difference in neuraxial analgesia access between private
326 and public maternity units overall.^{21,24} Kpéa and colleagues²¹ reported an association
327 between maternity unit status (public or private) and the antenatal maternal
328 preference to deliver with neuraxial analgesia, but they did not find an association
329 between maternity unit status and use of neuraxial analgesia. Merrer and
330 colleagues²⁴ reported a significant association between use of non-pharmacological
331 analgesia (alone or combined with neuraxial analgesia) and maternity unit status, but
332 not between use of neuraxial analgesia alone and maternity unit status. Neuraxial
333 analgesia use favouring women from very high HDI countries may be partly
334 explained by the existence of potential implicit bias in caregivers towards this group.
335 The concept of implicit bias, developed by social psychologists, refers to an
336 unconscious and automatic phenomenon that leaves unexpressed stereotypes
337 between membership in a social group and a negative or positive attribute.^{25,26} A
338 psycho-sociological approach would be an appropriate method to explore a link
339 between implicit bias in healthcare professionals and the provision of neuraxial
340 analgesia.

341 *Strengths and limitations of the study*

342 Our study has several strengths. First, we were able to select women with an initial
343 preference for delivery with neuraxial analgesia. This information, although essential
344 for examining neuraxial analgesia use in labour, is rarely available in population-
345 based studies.³ The exclusion of women without medical indications or
346 contraindications for neuraxial analgesia use enabled us to rule out an indication
347 bias. We explored care related to neuraxial analgesia among immigrant women
348 according to the human development index for the mother's country of birth. This

349 original classification, characterizing immigrant background by socio-economic and
350 public health criteria ²⁷, offers a supplemental approach to immigrant status by
351 geographic region of birth, which provides some cultural homogeneity. The study of
352 migrant women according to these two different classifications offers a
353 multidimensional approach to characterization of immigrant status. However,
354 because HDI is a country-level indicator of economic status, it may obscure local
355 differences. Therefore, it is an imperfect indicator of individual pre-migration status.
356 Yet, in our study, women from high HDI countries had a significant higher educational
357 level and a lower deprivation index than other immigrant women, suggesting that on
358 average, immigrant women from very high HDI countries have better socio-economic
359 conditions than women from other countries. No categorization is perfect. Thus, we
360 used several approaches to characterize the immigrant status of pregnant women.
361 The timeliness of neuraxial analgesia is rarely explored. A long interval before
362 neuraxial analgesia administration may be interpreted as delayed management, and
363 thus as differential care. We used data extracted from a cross-sectional population-
364 based study that is a representative sample of all deliveries in France. Moreover, we
365 performed a sensitivity analysis excluding women with caesarean delivery during
366 labour, given that these women are more likely to receive neuraxial analgesia.
367 Finally, the proportion of missing data among the variables explored was very low in
368 our source population (0.5% to 2.5%).¹⁷

369 Our study also had several limitations. A selection bias related to the non-inclusion of
370 women with a significant language barrier could not be ruled out. A significant
371 language barrier was the most common reason for not participating in the 2016 NPS.
372 This group of women might have been more likely to receive differential care
373 involving neuraxial analgesia for labour pain. This limitation is almost unavoidable in

374 population-based studies. Patients with linguistic barriers are usually included only in
375 prospective studies, specifically designed to explore differential care in immigrant
376 populations and using interpreters.²⁸ But only 86 women could not be included in our
377 study because of a significant language barrier, accounting for < 1% of the total
378 population. In addition, women with a partial linguistic barrier, **defined as requiring the**
379 **assistance of third person to answer questions**, were included, thus limiting the
380 selection bias related to the language barrier. **An additional limitation is that we could**
381 **not distinguish** asylum seekers or refugees among immigrant women, as this
382 information was not collected in the 2016 NPS. Indeed, differential care might
383 specifically apply to refugees/asylum seekers, rather than immigrants as a whole.
384 Asylum seekers face well-documented unique financial, legal, language, healthcare
385 access, and administrative barriers as compared to other immigrants. The
386 association between administrative immigrant status and neuraxial analgesia would
387 deserve a specific study. **Because of its retrospective design, our study can only**
388 **support correlation and not causation in exploring the association between maternal**
389 **immigrant status and neuraxial analgesia performance and timeliness.** Completion of
390 the preanesthetic evaluation was not available in the 2016 National Perinatal Survey.
391 We cannot exclude that woman without preanesthetic evaluation may have had
392 limited access to neuraxial anaesthesia. However, preanesthetic evaluation is
393 mandatory in France, consequently the proportion of women who did not had this
394 evaluation is probably very low. Finally, the very high rate of neuraxial analgesia use
395 in France compared with other high-resource countries may limit the external validity
396 and generalisation of our results to countries with similar resource levels, but different
397 management of labour pain.

398

399 *Conclusions*

400 This study highlights that, in France, neuraxial analgesia use and its timely
401 administration to relieve labour pain did not differ between native-born and immigrant
402 women assessed by the mother's geographic region of birth or for immigrant women
403 from countries with low HDI. This finding is reassuring regarding the universal access
404 to neuraxial analgesia in France, especially for immigrant women from low-resource
405 countries, **although we did not study whether this finding differed among immigrants**
406 **based on specific administrative status.** Yet, we observed differential care in favour of
407 immigrant women from countries with a very high HDI, compared with both native-
408 born and immigrant women from other countries. The mechanisms underlying this
409 differential care remain to be explored.

410 **Authors' contributions**

411 Study conception and design: MB, MPB, EA, MJS-C, PS

412 Data analysis and interpretation: MB, MPB, EA, MJS-C, PS, BB, CD-T

413 Drafting of manuscript: MB, MPB, EA

414 Critical revision of manuscript: BB, CD-T, PS, MJS-C

415 All the co-authors contributed to this paper, and are responsible for all aspects of the
416 work and approved the final manuscript.

417

418 **Declaration of interests**

419 The authors declare that they have no conflict of interest.

420

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	Native parturients	Immigrant parturients					P value ^Δ	P value [†]
	N (%)	N (%)						
	5111 (84.2)	959 (15.8)						
	Total N (%)	European countries N (%)	North Africa N (%)	Other African countries N (%)	Other countries N (%)			
		n (%)						
		959 (15.8)	217 (22.6)	353 (36.8)	229 (23.9)	160 (16.7)		
Use of neuraxial analgesia	4493 (87.9)	855 (89.2)	198 (91.2)	320 (90.6)	193 (84.3)	144 (90.0)	0.274	0.086
Timing of neuraxial analgesia performance (min) (median (IQR))	37 (24-61)	39 (24-70)	39 (26-61)	43 (24-69)	39 (19-63)	39 (28-65)	0.217	0.722
Timing of neuraxial analgesia performance < 60 min	2915 (62.6)	547 (62.4)	127 (66.1)	195 (61.3)	127 (60.2)	98 (63.2)	0.920	0.757
Maternal age, yr (median (IQR)) (years)	30 (26-33)	31 (27-34)	31 (27-34)	31 (26-35)	30 (26-34)	31 (27-34)	< 0.001	<0.001
Chronic medical conditions*	677 (13.4)	113 (11.9)	21 (9.8)	38 (10.9)	35 (15.4)	19 (12.1)	0.221	0.276
BMI > 30 kg m ⁻²	434 (8.6)	79 (8.6)	17 (8.0)	33 (9.5)	22 (10.5)	7 (4.5)	0.998	0.314
Nulliparity	2467 (48.3)	383 (39.9)	92 (42.4)	132 (37.4)	86 (37.6)	73 (45.6)	< 0.001	<0.001
Educational level							< 0.001	<0.001
Middle school or less	1012 (20.0)	269 (28.4)	55 (25.5)	94 (27.1)	89 (39.2)	31 (19.6)		
High school	1077 (21.2)	218 (23.0)	50 (23.1)	85 (24.5)	54 (23.8)	29 (18.3)		
University	2981 (58.8)	461 (48.6)	111 (51.4)	168 (48.4)	84 (37.0)	98 (62.0)		
Deprivation index [§]							< 0.001	<0.001
0 factor	4232 (83.5)	572 (61.2)	157 (73.7)	215 (61.6)	96 (43.8)	104 (68.0)		
1 factor	389 (7.7)	166 (17.8)	27 (12.7)	69 (19.8)	46 (21.0)	24 (15.7)		
2 factors	266 (5.2)	123 (13.2)	23 (10.8)	48 (13.7)	37 (16.9)	15 (9.8)		
≥ 3 factors	180 (3.5)	73 (7.8)	6 (2.8)	17 (4.9)	40 (18.3)	10 (6.5)		
Recent immigration [¶]		100 (10.4)	7 (3.7)	48 (15.2)	30 (14.3)	15 (10.3)		
Inadequate antenatal care [#]	179 (3.5)	103 (11.7)	13 (6.3)	46 (14.0)	35 (17.7)	9 (6.2)	< 0.001	< 0.001
Follow-up in maternity unit of delivery	4778 (93.5)	878 (92.7)	197 (90.8)	330 (93.5)	205 (89.5)	146 (91.2)	0.179	0.289
Mode of delivery							0.013	0.001
Spontaneous vaginal	4084 (79.9)	733 (76.4)	167 (77.0)	272 (77.0)	178 (77.7)	116 (72.5)		
Operative vaginal	733 (14.3)	150 (15.6)	39 (18.0)	56 (15.9)	23 (10.0)	32 (20.0)		
Caesarean	292 (5.7)	76 (7.9)	11 (5.1)	25 (7.1)	28 (12.2)	12 (7.5)		
Status of the maternity unit							< 0.001	<0.001
University public	793 (15.5)	238 (24.8)	35 (16.1)	101 (28.6)	67 (29.3)	35 (21.9)		
Non-university public	2618 (51.2)	443 (46.2)	103 (47.5)	156 (44.2)	116 (50.7)	68 (42.5)		
Private	1700 (33.3)	278 (29.0)	79 (36.4)	96 (27.2)	46 (20.1)	57 (35.6)		
In-house availability of anaesthesiologist 24h/day	3228 (63.2)	728 (76.4)	140 (64.8)	284 (80.4)	183 (81.3)	121 (76.1)	< 0.001	<0.001

BMI: Body Mass Index
IQR: interquartile range
* corresponding to hypertension, diabetes mellitus or others severe chronic disorders
§ corresponding to 1 of 4 criteria: social isolation, poor housing condition, no work-related household income and beneficiary of state-funded health care insurance
¶ Interval between arrival in France and delivery less than 1 yr
corresponding to a late initiation of prenatal care and/or insufficient number of antenatal visits and/or insufficient number of ultrasounds according to the length of gestation
Data are presented as n (%), excepting for timing of neuraxial analgesia performance and maternal age
Δ P value for comparisons between native and immigrant women in two categories
† P value for comparison among five categories (native parturients, European, North Africa, other African, other)
Because of missing data, the number of cases may vary slightly from one characteristic to another.

Table 2. Characteristics of women, deliveries, and maternity units according to the level of development of maternal country of birth, defined by the Human Development Index (n=6070 women)

	Native parturients	Immigrant parturients					P value Δ	P value \ddagger
		N (%)						
	5111 (84.2)	Total N (%)	Very high HDI (≥ 0.80) N (%)	High HDI (0.70-0.79) N (%)	Middle HDI (0.55-0.69) N (%)	Low HDI (< 0.55) N (%)		
		n (%)						
		959 (15.8)	144 (15.0)	364 (38.0)	242 (25.2)	209 (21.8)		
Use of neuraxial analgesia	4493 (87.9)	855 (89.2)	137 (95.1)	324 (89.0)	222 (91.7)	172 (82.3)	0.274	0.002
Timing of neuraxial analgesia performance (min) (median (IQR))	37 (24-61)	39 (24-70)	35 (20-59)	39 (24-70)	46 (28-76)	39 (20-61)	0.217	0.340
Timing of neuraxial analgesia performance < 60 min	2915 (62.6)	547 (62.4)	94 (74.0)	198 (60.4)	141 (62.1)	115 (59.3)	0.920	0.069
Maternal age, yr (median (IQR)) (years)	30 (26-33)	31 (27-34)	32 (28-35)	31 (27-35)	30 (26-34)	30 (26-34)	<0.001	<0.001
Chronic medical conditions*	677 (13.4)	113 (11.9)	15 (10.5)	37 (10.3)	28 (11.8)	33 (15.9)	0.221	0.237
BMI > 30 kg m ²	434 (8.6)	79 (8.6)	13 (9.3)	29 (8.0)	20 (8.5)	17 (9.0)	0.998	0.991
Nulliparity	2467 (48.3)	383 (39.9)	76 (52.8)	130 (35.7)	100 (41.3)	77 (36.8)	<0.001	<0.001
Educational level								<0.001
Middle school or less	1012 (20.0)	269 (28.4)	27 (18.7)	86 (23.9)	71 (30.0)	85 (41.1)		
High school	1077 (21.2)	218 (23.0)	34 (23.6)	76 (21.1)	61 (25.7)	47 (22.7)		
University	2981 (58.8)	461 (48.6)	83 (57.6)	198 (55.0)	105 (44.3)	75 (36.2)		
Deprivation index [§]							<0.001	<0.001
0 factor	4232 (83.5)	572 (61.2)	117 (81.8)	219 (61.5)	145 (62.0)	91 (45.3)		
1 factor	389 (7.7)	166 (17.8)	14 (9.8)	64 (18.0)	50 (21.4)	38 (18.9)		
2 factors	266 (5.2)	123 (13.2)	10 (7.0)	54 (15.2)	23 (9.8)	36 (17.9)		
≥ 3 factors	180 (3.5)	73 (7.8)	2 (1.4)	19 (5.3)	16 (6.8)	36 (17.9)		
Recent immigration [¶]		100 (10.4)	7 (5.6)	41 (12.7)	26 (11.6)	26 (13.8)		
Inadequate antenatal care [#]	179 (3.5)	103 (11.7)	7 (5.1)	33 (9.9)	31 (13.8)	32 (18.0)	<0.001	<0.001
Follow-up in maternity unit of delivery	4778 (93.5)	878 (92.7)	125 (86.8)	346 (95.0)	220 (90.9)	187 (89.5)	0.179	0.020
Mode of delivery							0.013	0.011
Spontaneous vaginal	4084 (79.9)	733 (76.4)	100 (69.4)	281 (77.2)	187 (77.3)	165 (78.9)		
Operative vaginal	733 (14.3)	150 (15.6)	34 (23.6)	55 (15.1)	37 (15.3)	24 (11.5)		
Caesarean	292 (5.7)	76 (7.9)	10 (6.9)	28 (7.7)	18 (7.4)	20 (9.6)		
Status of the maternity unit							<0.001	<0.001
University public	793 (15.5)	238 (24.8)	19 (13.2)	101 (27.7)	58 (24.0)	60 (28.7)		
Non-university public	2618 (51.2)	443 (46.2)	63 (43.7)	165 (45.3)	108 (44.6)	107 (51.2)		
Private	1700 (33.3)	278 (29.0)	62 (43.1)	98 (27.0)	76 (31.4)	42 (20.1)		
In-house availability of anaesthesiologist 24 h per day	3228 (63.2)	728 (76.4)	93 (65.0)	288 (79.3)	185 (76.4)	162 (79.0)	<0.001	<0.001

BMI: Body Mass Index

HDI: Human Development Index

IQR: interquartile range

* corresponding to hypertension, diabetes mellitus or others severe chronic disorders

§ corresponding to 1 of 4 criteria: social isolation, poor housing condition, no work-related household income and beneficiary of state-funded health care insurance

¶ Interval between arrival in France and delivery less than 1 yr

corresponding to a late initiation of prenatal care and/or insufficient number of antenatal visits and/or insufficient number of ultrasounds according to the length of gestation

Data are presented as n (%), excepting for timing of NA performance and maternal age

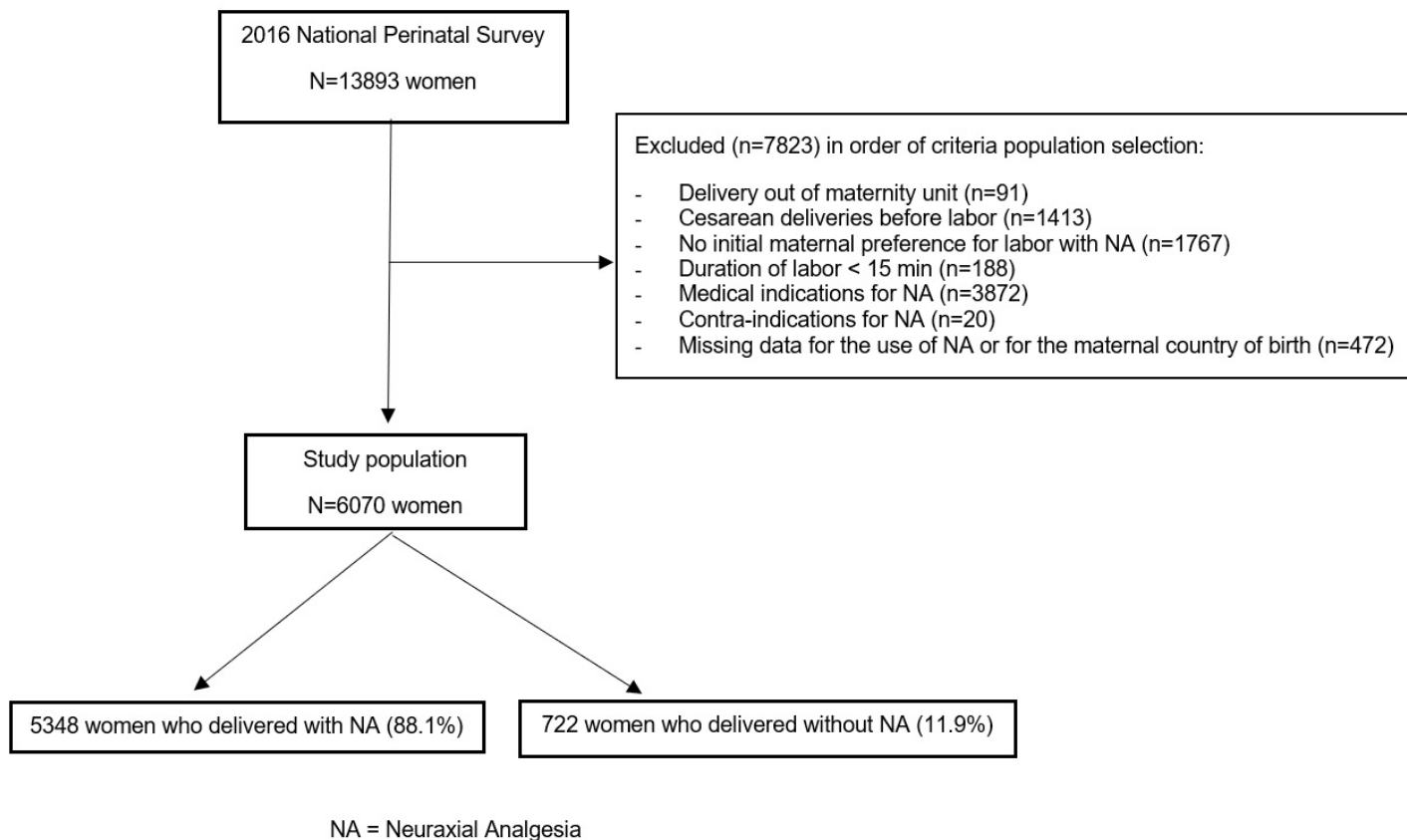
 Δ P value for comparisons between native and immigrant women in two categories \ddagger P value for comparison among five categories (natives, immigrants from very high HDI, from high HDI, from middle HDI, and from low HDI)

Because of missing data, the number of cases may vary slightly from one characteristic to another.

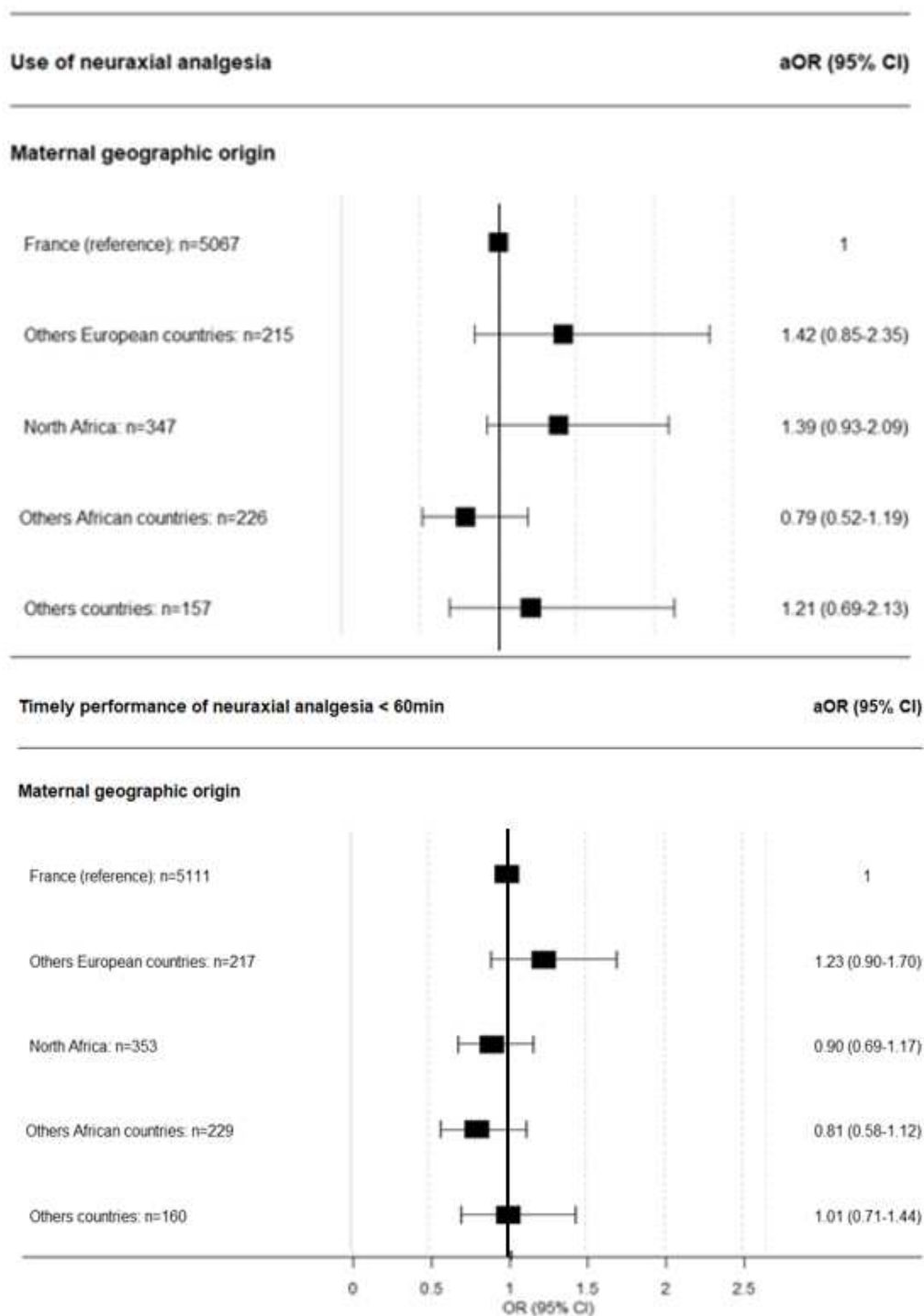
506 **LEGENDS TO FIGURES**

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508 Figure 1. Flow chart



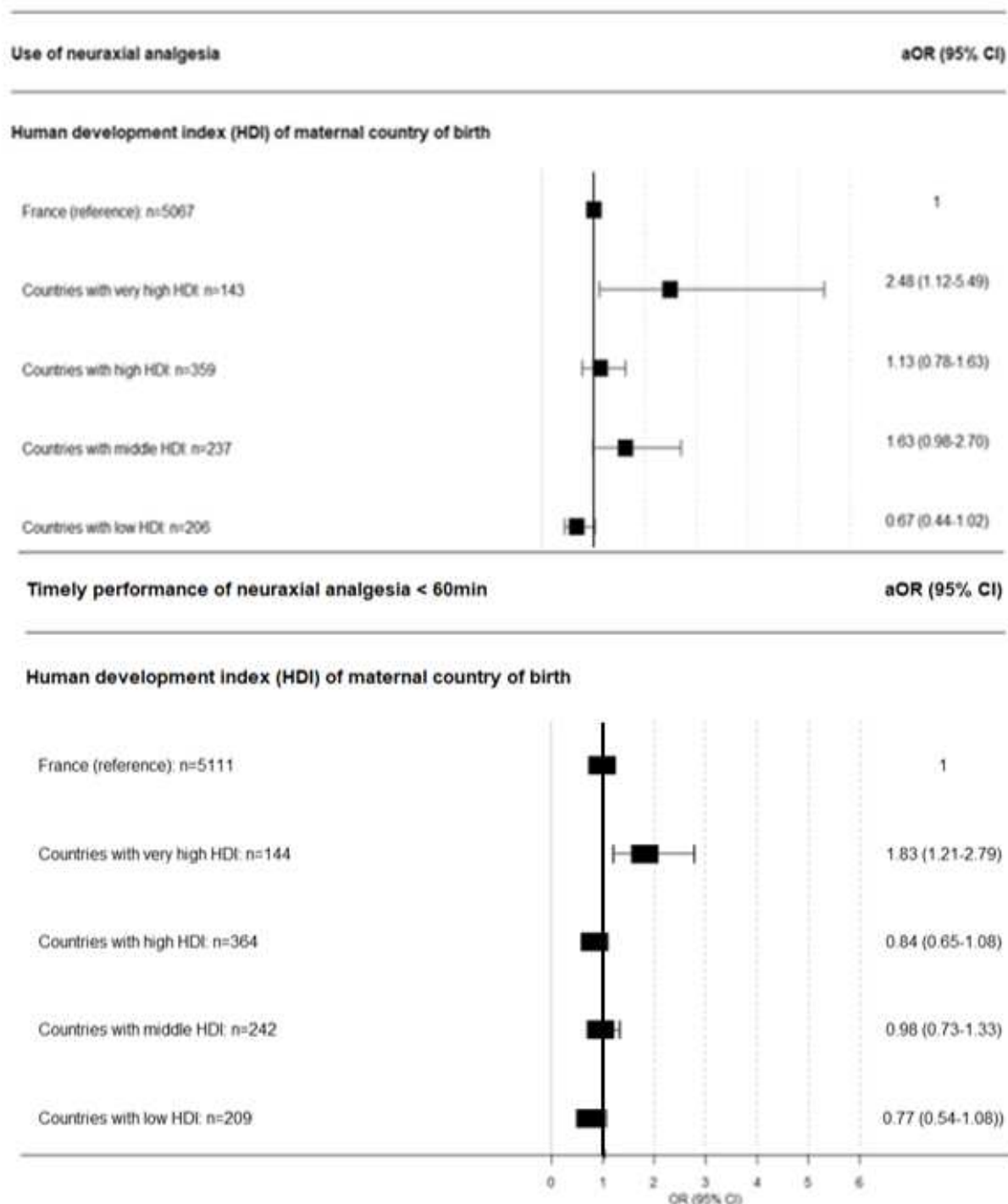
509 **Figure 2.** Association between maternal continental geographic origin and use or timely performance of neuraxial
 510 analgesia in parturients who preferred to deliver with a neuraxial analgesia (multivariable multilevel logistic
 511 regression).



565
 566 The association between maternal geographic origin and the use of neuraxial analgesia was explored using
 567 multivariable multilevel logistic regression in complete cases (N=6012).
 568 The association between maternal geographic origin and the timely performance of neuraxial analgesia was
 569 explored using multivariable multilevel logistic regression with multiple imputation (N=6070).
 570 Odds ratio were adjusted for maternal age (continuous variable), parity (binary variable), and educational level
 571 (middle school or less, high school or university) with random intercept for maternity unit.
 572 Boxes and whiskers represent adjusted OR and its IC 95%, respectively.
 573

574

575 **Figure 3.** Association between Human Development Index of maternal country of birth and use or timely
 576 performance of neuraxial analgesia in parturients who preferred to deliver with a neuraxial analgesia
 577 (multivariable multilevel logistic regression).



578 The association between Human Development Index of maternal country of birth and the use of neuraxial
 579 analgesia was explored using multivariable multilevel logistic regression in complete cases (N=6012)

580 The association between Human Development Index of maternal country of birth and the timely performance of
 581 neuraxial analgesia was explored using multivariable multilevel logistic regression with multiple imputation
 582 (N=6070).

583 Odds ratio were adjusted for maternal age (continuous variable), parity (binary variable), and educational level
 584 (middle school or less, high school or university), with random intercept for maternity unit.

585 Boxes and whiskers represent adjusted OR and its IC 95%, respectively.