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Title Page

Severe maternal morbidity among undocumented migrant women in the PreCARE prospective cohort study

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Short title: Migrants' legal status and severe maternal morbidity

Abstract

Objective: In Europe, migrant women, especially from sub-Saharan Africa, have higher risks of adverse maternal outcomes than non-migrants. Legal status, a component of migrant condition, may be an important, and potentially actionable, risk factor. We aimed to assess the risk of severe maternal outcomes among migrant women, considering both their legal status and birthplace.

Design: Prospective cohort study.

Setting: Four maternity units around Paris in 2010–2012.

Sample: 9599 women with singleton pregnancies.

Methods: Legal status was categorized in four groups: reference group of non-migrant native Frenchwomen, legal migrants with French or European citizenship, other legal migrants with non-European citizenship, and undocumented migrants. The risk of severe maternal morbidity was assessed with multivariable logistic regression models according to women's legal status and birthplace.

Main Outcome Measure: Binary composite criterion of severe maternal morbidity.

Results: Undocumented migrants had resided less time in France, experienced social isolation, linguistic barriers and poor housing conditions more frequently, and had a prepregnancy medical history at lower risk than other migrants. The multivariable analysis showed they had a higher risk of severe maternal morbidity than non-migrants (33/715 (4.6%) versus 129/4523 (2.9%), adjusted odds ratio [aOR] 1.68; 95% confidence interval [CI] 1.12–2.53). This increased risk was significant for undocumented women from sub-Saharan Africa (18/308 (5.8%) versus 129/4523 (2.9%), aOR 2.26; 95%CI 1.30–3.91), and not for those born elsewhere (15/407 (3.7%) versus 129/4523 (2.9%), aOR 1.44; 95%CI 0.82–2.53).

Conclusion: Undocumented migrants are the migrant subgroup at highest risk of severe maternal morbidity, while the prevalence of risk factors does not appear to be higher in this subgroup. This finding suggests that their interaction with maternity care services may be non-optimal.

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Keywords: Legal status, undocumented migrant, severe maternal morbidity, health inequalities

Introduction

Europe has been experiencing a migration and humanitarian crisis for several years. The proportion of migrants among childbearing women in these countries is increasing.[1] In 2019, 24.6% of women who gave birth in France were born elsewhere.[2] Migrant women have a higher risk of adverse pregnancy outcomes than women born in their host country,[3–7] including higher risks of maternal mortality and severe morbidity.[8–11] Nonetheless, disparities exist between migrant subgroups, particularly according to maternal birthplace. In several high-income countries, migrant women from sub-Saharan Africa appear to be the most vulnerable group; their risk of adverse maternal outcomes ranges from two to four times higher than that of native-born women.[6,10,12–16] In addition to the question of social justice, this situation presents organisational and cost challenges for the host health system.

The mechanisms explaining these social inequalities in health remain unclear. Adding to geographical origin, legal status may be an important, and potentially actionable, risk factor. The main focus of the available literature, although very limited, has been so far asylum seekers and refugees, because these subgroups of migrants, with their traumatic migration histories, were expected to have the worst outcomes and have been shown to be at higher risk of severe maternal morbidity than native-born women.[17,18] Nonetheless, asylum seekers and refugees benefit from a status that is supposed to provide them with some social protection, while undocumented migrants, i.e., those without any permit for legal residence, are likely to be at even greater risk because of the many barriers they face in their interactions with the health system, including individual and institutional discrimination, and the lack of social protection.[5,19,20] The size of this subgroup of migrants is growing in Europe.[21] In France, undocumented migrants can claim free care under the state medical assistance (AME) system. They can apply for it 3 months after their arrival, and it is valid two months after the application. Recent data showing a high frequency of inadequate antenatal care among undocumented migrants further supports the hypothesis that legal status plays a role.[22] Exploring if and how legal status is associated with differential maternal outcomes might provide insights into the

28 causal mechanisms of health disparities among migrant women, in particular those related to
29 geographical origin, and into the possibilities for preventive interventions.
30 The French multicentre prospective PreCARE cohort, as one of the few databases including
31 the legal status of migrant pregnant women, offers the opportunity to explore this question.
32 Thus, our aim was to assess the association between women's migrant profile, considering
33 both their legal status and birthplace, and severe maternal outcomes.

Methods

Population

The French PreCARE multicentre prospective cohort study took place in four university hospital maternity units in the northern Paris area from October 2010 to May 2012.[22,23] This geographical area is characterised by its high prevalence of social deprivation and its multicultural population.

The study included all pregnant women ≥ 18 years old, registered and giving birth in these hospitals. This analysis covered the study population of women who gave birth after 21 completed weeks of gestation. It excluded women who finally gave birth in a nonparticipating hospital, were lost to follow-up, or had completely empty questionnaires.

The regional ethics review board, CPP-Ile-de-France III (No. 09.341bis, 19 November, 2009), and the CNIL (Commission Nationale Informatique et Liberté) approved this study. Each woman provided oral informed consent, in accordance with French law. Women were not involved in the development of the research.

Data collection

Data on maternal birthplace, legal status, social and demographic characteristics (age, deprivation index, education level, social welfare coverage at inclusion, length of residency, and linguistic barrier) were collected by self-administered questionnaires at inclusion and repeated during the postpartum period before discharge. To enable the inclusion of women not speaking French fluently or who could not read or write, these questionnaires were available in the four principal languages of the main region of origin of the residents, and a research assistant or interpreter helped in their completion when needed. Data on women's medical history and information about their pregnancy, labour, delivery and postpartum period were collected by research assistants and practitioners (midwives and obstetricians) with specific questionnaires completed from the medical files in the postpartum period before discharge.

Definition of women's legal status

The exposure of interest, the women's legal status, was first categorised in four groups: 1) non-migrants, i.e., women born in France, as the reference group, 2) legal migrants with French or other European Union-27 citizenship, 3) other legal migrants, with non-European citizenship, and 4) undocumented migrants. Migrant women with French or European citizenship were born outside France and reported a French or other European citizenship, and were thus automatically legal. Other legal migrants were born outside France and held a residence permit, or a temporary residence permit, or a short- or long-term tourist visa, issued by French or European authorities. Asylum seekers and women with refugee status were categorised as other legal migrants. Undocumented migrants were born outside France, had a non-European citizenship, and were awaiting a decision about their legal status (regularisation and residence permit), or on expiry of their visa or residence permit, or with a negative response to their application for regularisation. Details on the various categories of legal status are provided in Table S1. Information about legal status was self-reported during the inclusion questionnaire, administered either by the woman herself or by a research assistant or interpreter when needed. If this information was missing, it was extracted from the postpartum questionnaire. To further consider the women's birthplace together with their legal status, the exposure of interest was also analysed as a seven category variable combining the two dimensions of migrant status: 1) non-migrants, 2) legal migrants with French or European citizenship, born outside sub-Saharan Africa, 3) legal migrants with French or European citizenship born in sub-Saharan Africa, 4) other legal migrants born outside sub-Saharan Africa, 5) other legal migrants born in sub-Saharan Africa, 6) undocumented migrants born outside sub-Saharan Africa, and 7) undocumented migrants born in sub-Saharan Africa.

Definition of severe maternal morbidity

The outcome was severe maternal morbidity, as a binary composite variable. It was defined by at least one of the following complications at or after 21 completed weeks of gestation and up to 42 days postpartum: severe hypertensive disorder of pregnancy (presence of severe preeclampsia [systolic blood pressure > 160 mm Hg, diastolic blood pressure > 110 mm Hg, or hypertension with general signs, and one or more of the following: proteinuria >3.5 g/24

hours, serum creatinine >100 µmol/l, diuresis <20 ml/hour, haemolysis, aspartate transaminase > 3N, thrombocytopaenia <100 000/mm3, or before 32 weeks], eclampsia or placental abruption in the context of a pregnancy-related hypertensive disorder), severe postpartum haemorrhage (second-line uterotonic treatment associated with transfusion of at least two units of packed red blood cells, and/or uterine artery ligation, and/or uterine compressive sutures, and/or embolisation and/or hysterectomy), grade 3 or 4 perineal trauma, surgical reintervention, maternal admission to intensive care unit, deep venous thrombosis or pulmonary embolism, convulsions (excluding eclampsia), placental abruption except for severe hypertensive disorder of pregnancy, uterine rupture, diabetic ketoacidosis, severe sepsis (sepsis with organ failure), haemorrhagic shock, or maternal death.[23]

Definition of covariables

Maternal social deprivation was defined at the beginning of pregnancy by a previously described[22] quantitative deprivation index that was the sum of four dimensions of deprivation: social isolation, poor or insecure housing conditions, no standard healthcare insurance, and no work-related household income.

High-risk pregnancy was defined in accordance with French guidelines by the presence of at least one of the following condition at the beginning of pregnancy: history of cardiac disease, hypertension, diabetes, venous thrombosis, pulmonary embolism, Graves' disease, asthma, homozygous sickle cell disease, anaemia, thrombocytopaenia, coagulation disorder, systemic disease, nephropathy, HIV infection, previous late miscarriage, previous preeclampsia, previous fetal growth restriction, previous preterm delivery, previous fetal death or neonatal death.[24]

Statistical analysis

We described the women's baseline characteristics and their rates of severe maternal morbidity according to their legal status, expressing qualitative variables as percentages and quantitative variables as their medians and interquartile ranges. The statistical tests used were the Kruskal–Wallis test for medians, and the chi-square test (or Fisher's exact test, as appropriate) for qualitative variables.

We used logistic regression models to assess the association between legal status and severe maternal morbidity. We represented causal assumptions between legal status, severe maternal morbidity, and covariates with a directed acyclic graph to depict the exposure-outcome relations with confounding and intermediate factors (Figure S1). This graph helped to select variables that are confounders (i.e., variables associated with both the exposure, which is legal status, and the outcome of severe maternal morbidity, and not on the causal pathway between legal status and severe maternal morbidity) and those that do not qualify as confounders (especially intermediate factors on the causal pathway).[25] The main regression model included only confounders: maternal age, education level, number of previous pregnancies, and maternity unit of delivery. Antenatal care utilisation was considered as intermediate factor and thus not included in the model. The linearity of the association of the continuous variables (age and number of previous pregnancies) with severe maternal morbidity was tested. A secondary analysis with the seven-category exposure variable considering both the women's legal status and place of birth was conducted with the same strategy.

A sensitivity analysis was performed after the exclusion of women who had arrived in France less than 12 months before delivery and who started their antenatal follow-up in France after 14 weeks of gestation, to avoid a potential bias related to norms of care outside France.

The proportion of women with missing data in the multivariable model was 4.0%. Multiple imputation using chained equations (25 datasets) was performed to handle the missing data, assumed to be missing at random.[26] The results are presented with imputed data as adjusted odds ratios (aOR) with their 95% confidence intervals (95% CIs). All statistical tests were two-tailed, and the threshold for statistical significance was set at a probability value of <0.05. Analyses were performed with STATA software, version 13.1 (Stata Corporation, College Station, TX, USA).

Results

Among the 10 576 women asked to participate in the Pre-CARE study, 10 419 agreed (98.5%). After the exclusion of women mistakenly included (n = 60), or withdrew their consent (n = 6), gave birth before 21 completed weeks of gestation (n = 135) or in a nonparticipating maternity unit (n = 209), were lost to follow-up (n = 378), or had missing questionnaires (n = 32), the analysis included 9599 women (Figure S2).

In the analysis population, 4523 women were born in France (47.1%), 1555 were legal migrants with French or other European citizenship (16.2%), 2806 were other legal migrants (29.2%) and 715 women were undocumented migrants (7.4%), accounting for 14.1% of all migrant women. Table 1 summarizes the women's baseline characteristics by legal status. Undocumented migrants had lived less time in France and experienced linguistic barriers, social isolation and poor housing conditions more frequently than other categories of migrants. Ninety-nine percent (637/715) of undocumented migrants have at least 1 criterion of maternal social deprivation compared to 19% (858/4523) of non-migrants. On the other hand, they were younger (398/715 (55.7%) were under 30 years old versus 2110/4523 (46.7%)) and less frequently at high risk at the beginning of pregnancy than either the native-born Frenchwomen (124/715 (17.3%) versus 925/4523 (20.5%) or the other categories of migrants. One quarter of the undocumented migrants were not covered by state medical assistance at inclusion, this proportion was 17.6% among those who arrived in France at least 5 months before inclusion (and were thus legally eligible for this assistance). The proportion of women born in sub-Saharan Africa was higher among undocumented migrants (43.1%) than in the other migrant groups (31.3% for other legal migrants and 24.5% for legal migrants with French or European citizenship). Undocumented migrants had the highest prevalence of caesarean deliveries of the four groups (Table 1).

Severe maternal morbidity occurred in 304 women (3.2%) overall. The main maternal complication was severe pregnancy-related hypertensive disorders (1.0%) (Table 2). This

predominance was particularly marked in undocumented migrants born in sub-Saharan Africa (2.9%) (Table S2).

In the multivariable analysis, undocumented migrants had the highest risk of severe maternal morbidity (33/715 (4.6%) versus 129/4523 (2.9%), absolute difference 1.7% (95%CI 0.4%–3.6%), aOR 1.68; 95% CI 1.12–2.53), compared with the reference group of non-migrant women (Table 3). When considering the women's place of birth with their legal status, this higher risk was significant only for undocumented migrants born in sub-Saharan Africa (18/308 (5.8%) versus 129/4523 (2.9%), absolute difference 2.9% (95%CI 0.8%–6.2%), aOR 2.26; 95% CI 1.30–3.91), not for those born elsewhere (15/407 (3.7%) versus 129/4523 (2.9%), aOR 1.44; 95% CI 0.82–2.53). A similar pattern of associations, although less marked, was found for other legal migrants (101/2806 (3.6%) versus 129/4523 (2.9%), aOR 1.35; 95% CI 1.03–1.79) overall compared with natives, with a frankly higher risk for those born in sub-Saharan Africa (34/877 (3.9%) versus 129/4523 (2.9%), aOR 1.62; 95% CI 1.07–2.47) than those born elsewhere (67/1929 (3.5%) versus 129/4523 (2.9%), aOR 1.33; 95% CI 0.97–1.82) (Table 3). No significant difference was found for legal migrants with French or European citizenship (aOR 0.94; 95% CI 0.7–1.4) compared with non-migrants, regardless of maternal birthplace (Tables 2 and 3). Results were similar in the complete case analysis (Table S3).

The sensitivity analysis excluding women who arrived in France less than a year before delivery and who started their antenatal follow-up in France after 14 weeks of gestation, found similar associations, in particular, an increased risk of severe maternal morbidity in undocumented migrants from sub-Saharan Africa (aOR 2.80; 95% CI 1.42–5.53) compared with women born in France (Table S4).

Discussion

Main Findings

Undocumented migrants constitute a significant subgroup of migrant women in this cohort. They had resided in France for less time, had experienced linguistic barriers, social isolation, and poor housing conditions more frequently than other categories of migrants, and had an at-risk medical history before pregnancy less often. They had a higher risk of severe maternal morbidity than French-born women. When place of birth was considered with their legal status, the risk was higher only for undocumented migrants born in sub-Saharan Africa. Similar but less strong associations were found for other legal migrants but not for those with French or European citizenship.

Strengths and Limitations

To our knowledge, this study is one of the very few based on prospective multicentre data able to clarify the association between legal status and maternal health outcomes, as information about legal status is generally unavailable in most databases. We chose to examine this status in four groups to understand more clearly the specific impact of lacking legal status. Similarly, we chose to isolate women born in sub-Saharan Africa from those born elsewhere because previous reports have shown the highest risks of inadequate antenatal care utilisation and morbidity in this subgroup.[6,10,12,14–16,22] The large sample of migrant women and in particular of undocumented migrant women, with very few missing data, provides adequate statistical power. The rate of missing data in the study population was low and, as demonstrated by the comparisons of results obtained by the analyses with imputed data and with complete cases, had a very limited impact on the results (Table S3). The data collection method, especially the availability of the questionnaires in four different languages and the availability of a research assistant or interpreter to help complete it enabled us to include women who did not speak French and reduced both the risk of selection bias and the missing data rate. The high prevalence of social deprivation and the multicultural cohort recruited in this area is a strength, even though it produces a population not representative of that of France. The choice to build

this cohort in this setting was deliberate and consistent with our scientific objectives, in particular to be able to constitute a large group of migrant and undocumented women to allow subgroup analyses. Nevertheless, the substantial number of women excluded for missing data for pregnancy outcomes or with missing questionnaires, or because they gave birth elsewhere or were lost to follow-up, remains a limitation. Because these women were more often underprivileged and born abroad than the final sample (Table S5), we hypothesize that if there is a selection bias, these exclusions may have resulted in underestimating the strength of the association we studied. The relatively limited number of severe maternal morbidity events did not allow us to study this outcome by cause. Information on the legal or illegal status of migrant women was self-reported; the distinction, among legal migrants, between asylum seekers, refugees and other legal status was not collected. Although the prevalence of undocumented women is relatively high, we cannot rule out the possibility that it was underestimated. Finally, despite the fact that information on pre-existing morbidity was collected from medical files in the same way for all groups, it is possible that this information was under-reported in medical files of undocumented migrants, because they are less likely to have adequate medical follow-up and interaction with the health system. Thus the possibility of a differential measurement bias cannot be excluded.

Interpretation

Our analysis shows that undocumented migrants have a higher risk of severe maternal morbidity than non-migrant women, a risk not explained by a higher rate of baseline at-risk medical conditions and history. One hypothesis that might explain this result is that antenatal care utilisation was inadequate in both quantity and quality. A previous analysis of this study has reported this inadequacy to be more prevalent among undocumented women.[27] This higher risk of inadequate antenatal care utilisation might be explained by the shorter residence and the greater frequency of linguistic barriers, social isolation and poor housing conditions among these women, compared with other categories of migrants. Moreover, 17.6% of undocumented migrants who arrived in France at least 5 months before inclusion were not covered by state medical assistance, although they were legally eligible for this type of aid.

The lack of legal status may specifically impair women's ability to interact with the health system and obtain care because of their difficulty in accessing their legal rights. The quality of antenatal care is especially important in screening and monitoring of hypertensive disorders. We found that this pregnancy complication is twice or more as prevalent among undocumented migrants as among non-migrants or legal migrants. These points provide further support to the supposition that antenatal care inadequacy plays a causal role in these disparities. Another explanatory hypothesis is the possibility of an implicit bias related to illegal status that would lead health professionals to provide a lower quality of care to undocumented migrants.[28] Implicit bias related to maternal origin may also explain another finding of our analysis that migrant women born in sub-Saharan Africa, whatever their legal status, are at the highest risk for severe maternal morbidity compared with non-migrants. Indeed, although women from sub-Saharan Africa are more often undocumented, our results show that this only partially explains their higher risk of severe maternal morbidity and suggests that other causal mechanisms exist. Healthcare provision for undocumented migrants could be improved to reduce this higher risk of severe morbidity. Quicker and easier implementation of rights, especially state medical assistance could facilitate access to prenatal care. In addition, implementation of targeted interventions, such as "outreach" approaches[29] to reach out undocumented migrants, or educational programs to strengthen health literacy and empowerment, is essential. This could help migrant women to navigate in a complex healthcare system. Finally, prenatal care utilisation could also be improved in both quantity and quality to make healthcare system more migrant-friendly with the systematic presence of professional translators and the reduction of individual and institutional discriminations[28].

Conclusion

Undocumented migrants, especially those born in sub-Saharan Africa, have the highest risk of severe maternal morbidity, while the prevalence of risk factors does not appear to be higher in this subgroup. Future investigations should assess the extent to which inadequate antenatal care utilisation and healthcare professionals' implicit biases mediate the association between

undocumented status and severe maternal morbidity, particularly severe hypertensive complications. Our results support the need to increase healthcare providers' awareness about this group of women at high risk and to improve access to their legal rights.

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Disclosure of Interests

None declared. Completed disclosure of interests form available to view online as supporting Information.

Contribution to Authorship

EA, CE, LM, DL and TS conceptualised and developed the methodology for the PreCARE cohort. EA, TS, LM, DL and CE contributed to data acquisition. ME and EA designed the study question and analytic plan. ME, CDT and EA conducted data analysis and generated the tables and figures. ME, CDT, and EA drafted the manuscript. CDT, EA, PS, LM, TS and DL provided analytic oversight and edited the manuscript. All authors have read and agreed to the published version of the manuscript.

Details of ethics approval

The regional ethical review board (CPP-Ile-de-France III, No.09.341bis, date of approval 19 November 2009) and the CNIL (Commission Nationale Informatique et Liberté) approved the study. Each woman provided oral informed consent, in compliance with French law.

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References

1. Les immigrés récemment arrivés en France [Recent immigrants to France] - Insee Première - 1524. Available from: https://www.insee.fr/fr/statistiques/1281393

2. Institut National de la Statistique et des Etudes Economiques. Les naissances en 2019 [Births in 2019]. 2020. Available from: https://www.insee.fr/fr/statistiques/4647557

3. Zeitlin J, Combier E, Levaillant M, Lasbeur L, Pilkington H, Charreire H, et al. Neighbourhood socio-economic characteristics and the risk of preterm birth for migrant and non-migrant women: a study in a French district. Paediatr Perinat Epidemiol. 2011;25:347–56.

4. Zeitlin J, Bucourt M, Rivera L, Topuz B, Papiernik E. Preterm birth and maternal country of birth in a French district with a multiethnic population. BJOG. 2004;111:849–55.

5. De Jong L, Pavlova M, Winters M, Rechel B. A systematic literature review on the use and outcomes of maternal and child healthcare services by undocumented migrants in Europe. Eur J Public Health. 2017;27:990–7.

6. Saurel-Cubizolles M-J, Saucedo M, Drewniak N, Blondel B, Bouvier-Colle M-H. Santé périnatale des femmes étrangères en France [Perinatal health of foreign women in France]. Bull Épidémiologique Hebd. 2012;2:3–4.

7. Gagnon AJ, Zimbeck M, Zeitlin J. Migration to western industrialised countries and perinatal health: A systematic review. Soc Sci Med. 2009;69:934–46.

8. Pedersen GS, Grøntved A, Mortensen LH, Andersen A-MN, Rich-Edwards J. Maternal Mortality Among Migrants in Western Europe: A Meta-Analysis. Matern Child Health J. 2014;18:1628–38.

9. Van den Akker T, van Roosmalen J. Maternal mortality and severe morbidity in a migration perspective. Best Pract Res Clin Obstet Gynaecol. 2016;32:26–38.

10. Sauvegrain P, Stewart Z, Gonthier C, Saurel-Cubizolles MJ, Saucedo M, Azria E. Accès aux soins prénatals et santé maternelle des femmes immigrés [Women migrants' access to antenatal care and maternal health]. Bulletin Epidémiologique Hebdomadaire; 2017.

11. Almeida LM, Santos CC, Caldas JP, Ayres-de-Campos D, Dias S. Obstetric care in a migrant population with free access to health care. Int J Gynaecol Obstet. 2014;126:244–7.

12. Kandasamy T, Cherniak R, Shah R, Yudin MH, Spitzer R. Obstetric risks and outcomes of refugee women at a single centre in Toronto. J Obstet Gynaecol Can. 2014;36:296–302.

13. Philibert M, Deneux-Tharaux C, Bouvier-Colle M-H. Can excess maternal mortality among women of foreign nationality be explained by suboptimal obstetric care? BJOG Int J Obstet Gynaecol. 2008;115:1411–8.

14. Deneux-Tharaux C, Saucedo M. Epidemiology of maternal mortality in France, 2010-2012. Gynecol Obstet Fertil Senol. 2017;45:S8–21.

15. Boulkedid R, Sibony O, Bossu-Salvador C, Oury J, Alberti C. Monitoring healthcare quality in an obstetrics and gynaecology department using a CUSUM chart: CUSUM to monitor quality indicators in obstetrics. BJOG. 2010;117:1225–35.

16. Azria E, Stewart Z, Gonthier C, Estellat C, Deneux-Tharaux C. Inégalités sociales de santé maternelle [Social inequalities of maternal health]. Gynécologie Obstétrique Fertil. 2015;43:676–682.

17. Heslehurst N, Brown H, Pemu A, Coleman H, Rankin J. Perinatal health outcomes and care among asylum seekers and refugees: a systematic review of systematic reviews. BMC Med. 2018;16. Available on: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5996508/

18. Gieles NC, Tankink JB, van Midde M, Düker J, van der Lans P, Wessels CM, et al. Maternal and perinatal outcomes of asylum seekers and undocumented migrants in Europe: a systematic review. Eur J Public Health. 2019;29:714-23.

19. Almeida LM, Caldas J, Ayres-de-Campos D, Salcedo-Barrientos D, Dias S. Maternal healthcare in migrants: a systematic review. Matern Child Health J. 2013;17:1346–54.

20. Van Hanegem N, Miltenburg AS, Zwart JJ, Bloemenkamp KWM, Van Roosmalen J. Severe acute maternal morbidity in asylum seekers: a two-year nationwide cohort study in the Netherlands: Severe maternal morbidity in asylum seekers. Acta Obstet Gynecol Scand. 2011;90:1010–6.

21. European border and coast guard agency. Annual Risk Analysis 2014. Available from: https://frontex.europa.eu/assets/Publications/Risk_Analysis/Annual_Risk_Analysis_2014.pdf

22. Gonthier C, Estellat C, Deneux-Tharaux C, Blondel B, Alfaiate T, Schmitz T, et al. Association between maternal social deprivation and prenatal care utilization: the PreCARE cohort study. BMC Pregnancy Childbirth. 2017;17. Available from: http://bmcpregnancychildbirth.biomedcentral.com/articles/10.1186/s12884-017-1310-z

23. Linard M, Blondel B, Estellat C, Deneux-Tharaux C, Luton D, Oury J, et al. Association between inadequate antenatal care utilisation and severe perinatal and maternal morbidity: an analysis in the PreCARE cohort. BJOG. 2018;125:587–95.

24. Haute Autorité de Santé. [Follow-up and orientation of pregnant women regarding identified risk situations. Professional guidelines: a synthesis]. Gynecol Obstet Fertil. janv 2008;36:111-4.

25. Ananth CV, Schisterman EF. Confounding, causality, and confusion: the role of intermediate variables in interpreting observational studies in obstetrics. Am J Obstet Gynecol. 2017;217:167–75.

26. RJ Little, Rubin DB. Statistical Analysis with Missing Data, 3rd Edition. Hoboken, New Jersey: John Wiley & Sons; 2019.

27. Eslier M, Deneux-Tharaux C, Sauvegrain P, Schmitz T, Luton D, Mandelbrot L, et al. Association between Migrant Women's Legal Status and Prenatal Care Utilization in the PreCARE Cohort. Int J Environ Res Public Health. 2020;17.

28. Sauvegrain P, Azria E, Chiesa-Dubruille C, Deneux-Tharaux C. Exploring the hypothesis of differential care for African immigrant and native women in France with hypertensive disorders during pregnancy: a qualitative study. BJOG. 2017;124:1858-65.

29. Bonevski B, Randell M, Paul C, Chapman K, Twyman L, Bryant J, et al. Reaching the hard-to-reach: a systematic review of strategies for improving health and medical research with socially disadvantaged groups. BMC Med Res Methodol. 2014;14:42.

This article has a Video Abstract presented by Maxime ESLIER.

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Table S1. Categories of women's legal status and corresponding definitions

Categories of legal status	Definitions
Non-migrants	- Women born in France
Legal migrants with French or European citizenship	- Women born outside France, AND reporting a French or other European citizenship.
Other legal migrants	- Women born outside France, with a non-European citizenship AND holding a regularisation issued by French or European authorities : o a residence permit, which is an authorization allowing a migrant who has been in the country for more than 3 months to stay in France. It can be issued to migrants for family ties, for services rendered to France or for protection granted, including refugees. It is valid for 10 years and is renewable. Asylum seekers have a legal status while their case is being processed. o OR a temporary residence permit, which is available under conditions to migrants with family in France, to migrants coming to work in France, to seasonal workers, to workers on assignment in France in a company of the group that employs them abroad, and to students after a one-year long-stay visa. It is valid from 1 to 4 years maximum, o OR a long-term tourist visa, which is valid from 4 to 12 months with the same conditions as a temporary residence permit, o OR a short-term tourist visa which is valid maximum 3 months.
Undocumented migrants	- Women born outside France, with a non-European citizenship AND o awaiting a decision about their legal status (regularisation and residence permit), o OR on expiry of their visa or residence permit, o OR with a negative response to their application for regularisation.

Figure S1. Directed acyclic graph.

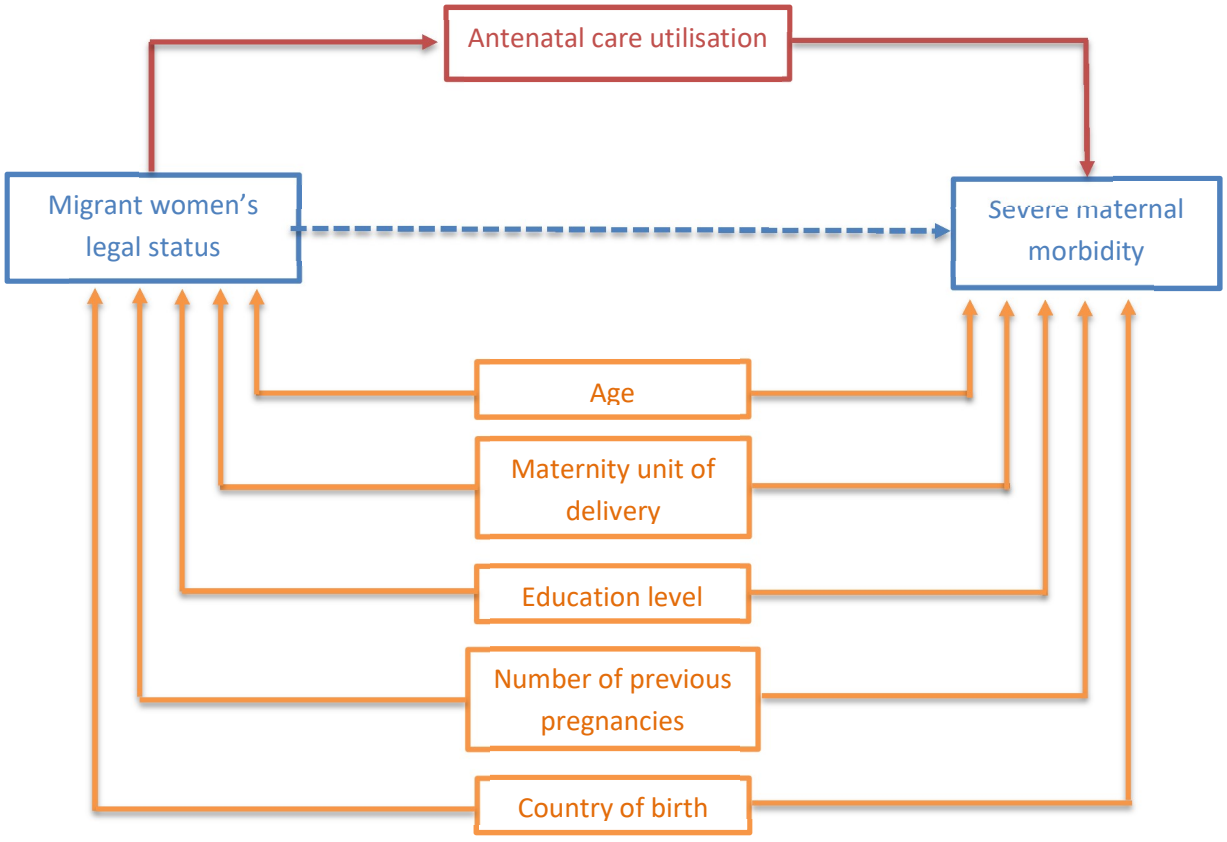

Figure S2. Study population selection.

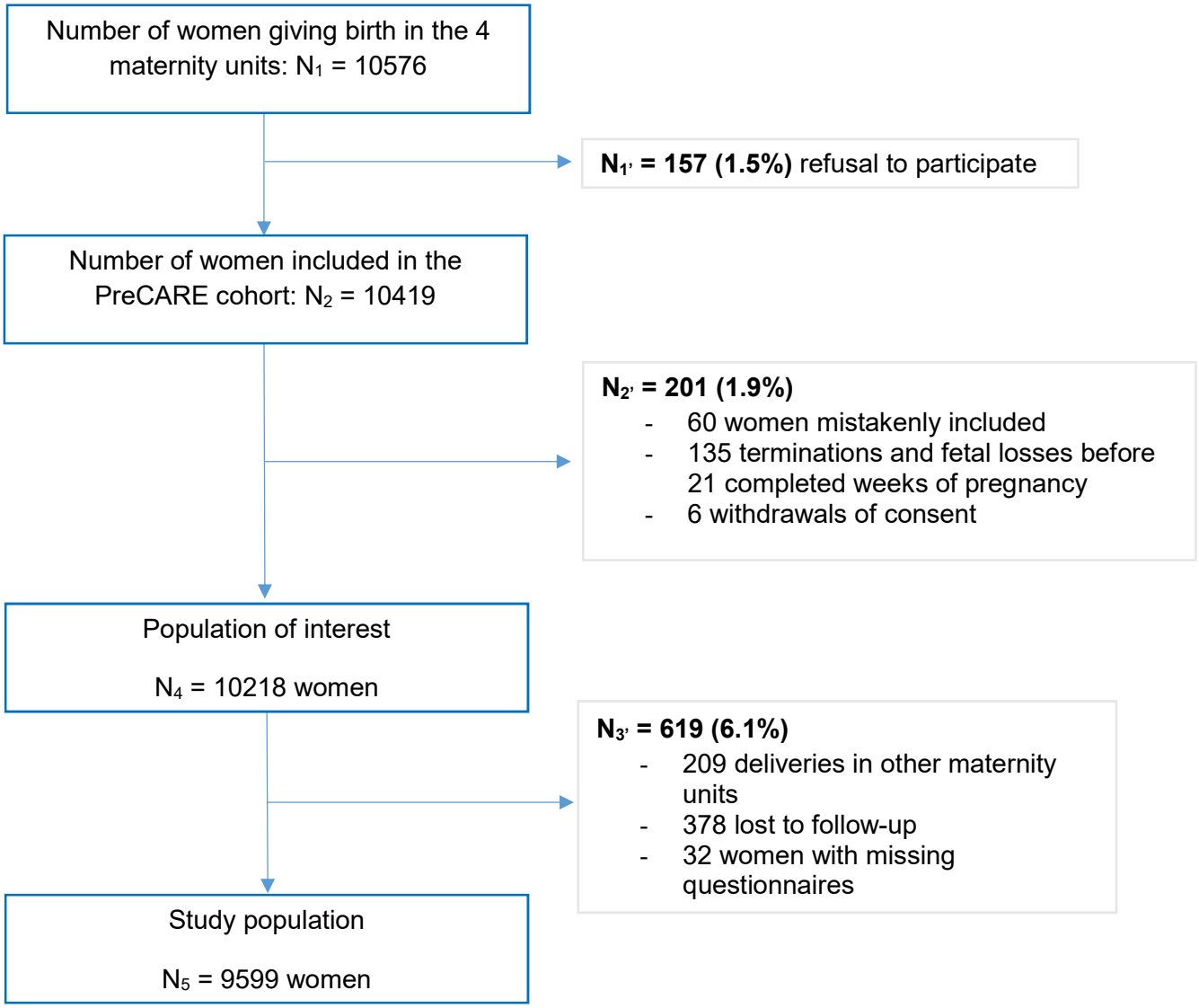

Table S2. Severe maternal morbidity rates according to the woman's legal status and birthplace

	All women		**Non-migrants**		**Legal migrants with French or European citizenship born in a non-sub-Saharan African country**		**Legal migrants with French or European citizenship born in sub-Saharan Africa**		**Other legal migrants born in a non-sub-Saharan African country**		**Other legal migrants born in sub-Saharan Africa**		**Undocumented migrants born in a non-sub-Saharan African country**		**Undocumented migrants born in sub-Saharan Africa**	
	(n = 9 599)		**(n = 4 523)**		**(n = 1 174)**		**(n = 381)**		**(n = 1 929)**		**(n = 877)**		**(n = 407)**		**(n = 308)**	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Severe hypertensive disorder of pregnancy *	95	1.0	44	1.0	5	0.4	4	1.1	16	0.8	12	1.4	5	1.2	9	2.9
Severe postpartum haemorrhage	56	0.6	22	0.5	9	0.8	0	0.0	11	0.6	9	1.0	2	0.5	3	1.0
Perineal trauma grade 3 or 4	58	0.6	27	0.6	2	0.2	1	0.3	19	1.0	5	0.6	3	0.7	1	0.3
Surgical re-intervention	53	0.6	25	0.6	5	0.4	4	1.1	11	0.6	4	0.5	0	0.0	4	1.3
Maternal admission to intensive care unit	57	0.6	24	0.5	8	0.7	3	0.8	8	0.4	9	1.0	3	0.7	2	0.7
Deep venous thrombosis or pulmonary embolism	25	0.3	9	0.2	3	0.3	1	0.3	7	0.4	1	0.1	1	0.3	3	1.0
Convulsions (excluding eclampsia)	13	0.1	5	0.1	2	0.2	1	0.3	4	0.2	0	0.0	1	0.3	0	0.0
Placental abruption except for severe hypertensive disorder of pregnancy	12	0.1	3	0.1	2	0.2	0	0.0	2	0.1	2	0.2	1	0.3	2	0.7
Uterine rupture	10	0.1	2	0.0	1	0.1	0	0.0	3	0.2	1	0.1	2	0.5	1	0.3
Diabetic ketoacidosis	7	0.1	2	0.0	1	0.1	0	0.0	3	0.2	0	0.0	1	0.3	0	0.0
Severe sepsis	6	0.1	1	0.0	0	0.0	1	0.3	3	0.2	0	0.0	1	0.3	0	0.0
Haemorrhagic shock	6	0.1	1	0.0	2	0.2	1	0.3	0	0.0	2	0.2	0	0.0	0	0.0
Maternal death	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
**Severe maternal morbidity ** **	**304**	**3.2**	**129**	**2.9**	**29**	**2.5**	**12**	**3.2**	**67**	**3.5**	**34**	**3.9**	**15**	**3.7**	**18**	**5.8**

* Severe hypertensive disorder of pregnancy is defined as the presence of severe preeclampsia, eclampsia or placental abruption in the context of a pregnancy-related hypertensive disorder.

** Severe maternal morbidity was defined by at least one of the above complications up to 42 days postpartum, non-exclusive categories.

Table S3. Risk of severe maternal morbidity according to the woman's legal status – Multivariable analysis with complete cases versus multiple imputation.

	Severe maternal morbidity*	
	Complete cases (n = 9213)	Multiple imputation (n = 9599)
	aOR [95% CI][1]	aOR [95% CI][1]
Non-migrants (n = 4523)	1	1
Legal migrants with French or European citizenship (n = 1555)	1.01 [0.80 - 1.45]	0.94 [0.66 - 1.35]
Other legal migrants (n = 2806)	1.40 [1.05 - 1.85]	1.35 [1.03 - 1.79]
Undocumented migrants (n = 715)	1.76 [1.15 - 2.68]	1.68 [1.12 - 2.53]

OR, odds ratio; aOR, adjusted odds ratio; CI, Confidence interval.

* Severe maternal morbidity (SMM) was defined by at least one of the following items: Severe hypertensive disorder of pregnancy (presence of severe preeclampsia [systolic blood pressure > 160 mm Hg, diastolic blood pressure > 110 mm Hg, or hypertension with general signs, and one or more of the following: proteinuria >3.5 g/24 hours, serum creatinine >100 µmol/l, diuresis <20 ml/hour, haemolysis, aspartate transaminase > 3N, thrombocytopaenia <100 000/mm3, or before 32 weeks], eclampsia or placental abruption in the context of a pregnancy-related hypertensive disorder), severe postpartum haemorrhage (second-line uterotonic treatment associated with transfusion of at least two units of packed red blood cells, and/or uterine artery ligation, and/or uterine compressive sutures, and/or embolisation and/or hysterectomy), grade 3 or 4 perineal trauma, surgical reintervention, maternal admission to intensive care unit, deep venous thrombosis or pulmonary embolism, convulsions (excluding eclampsia), placental abruption except for severe hypertensive disorder of pregnancy, uterine rupture, diabetic ketoacidosis, severe sepsis (sepsis with organ failure), haemorrhagic shock, or maternal death.

[1] Logistic regression model adjusted for maternal age, education level, number of previous pregnancies and maternity unit of delivery.

Table S4. Risk of severe maternal morbidity according to the woman's legal status and birthplace, sensitivity analysis after exclusion of women who arrived in France less than 12 months before delivery and who started their antenatal care in France after 14 weeks of gestation.

	Severe maternal morbidity*	
	OR [95% CI]	aOR [95% CI][1]
Non-migrants (n = 3874)	1	1
Legal migrants with French or European citizenship (n = 1288)	0.85 [0.57 - 1.27]	0.96 [0.64 - 1.44]
Other legal migrants (n = 2075)	1.17 [0.87 - 1.59]	1.34 [0.97 - 1.86]
Undocumented migrants (n = 413)	1.81 [1.12 - 2.92]	1.96 [1.18 - 3.27]
Non-migrants (n = 3874)	1	1
Legal migrants with French or European citizenship born outside sub-Saharan Africa (n = 972)	0.92 [0.60 - 1.42]	1.00 [0.64 - 1.55]
Legal migrants with French or European citizenship born in sub-Saharan Africa (n = 316)	0.64 [0.28 - 1.47]	0.81 [0.35 - 1.89]
Other legal migrants born outside sub-Saharan Africa (n = 1440)	1.21 [0.86 - 1.70]	1.35 [0.95 - 1.92]
Other legal migrants born in sub-Saharan Africa (n = 635)	1.09 [0.67 - 1.77]	1.33 [0.79 - 2.25]
Undocumented migrants born outside sub-Saharan Africa (n = 254)	1.37 [0.71 - 2.65]	1.49 [0.75 - 2.94]
Undocumented migrants born in sub-Saharan Africa (n = 159)	2.57 [1.35 - 4.88]	2.80 [1.42 - 5.53]

OR, odds ratio; aOR, adjusted odds ratio; CI, Confidence interval.

* Severe maternal morbidity (SMM) was defined by at least one of the following items: Severe hypertensive disorder of pregnancy (presence of severe preeclampsia [systolic blood pressure > 160 mm Hg, diastolic blood pressure > 110 mm Hg, or hypertension with general signs, and one or more of the following: proteinuria >3.5 g/24 hours, serum creatinine >100 µmol/l, diuresis <20 ml/hour, haemolysis, aspartate transaminase > 3N, thrombocytopaenia <100 000/mm3, or before 32 weeks], eclampsia or placental abruption in the context of a pregnancy-related hypertensive disorder), severe postpartum haemorrhage (second-line uterotonic treatment associated with transfusion of at least two units of packed red blood cells, and/or uterine artery ligation, and/or uterine compressive sutures, and/or embolisation and/or hysterectomy), grade 3 or 4 perineal trauma, surgical reintervention, maternal admission to intensive care unit, deep venous thrombosis or pulmonary embolism, convulsions (excluding eclampsia), placental abruption except for severe hypertensive disorder of pregnancy, uterine rupture, diabetic ketoacidosis, severe sepsis (sepsis with organ failure), haemorrhagic shock, or maternal death.

[1] Logistic regression model adjusted for maternal age, education level, number of previous pregnancies and maternity unit of delivery.

Table S5. Comparison of the characteristics of women included and excluded from the study population.

	Study population (n = 9599)		**Women excluded (n = 619)**	
	n	%	n	%
Women's legal status				
Non-migrants	4523	47.1	277	44.7
Legal migrants with French or European citizenship	1555	16.2	93	15.0
Other legal migrants	2806	29.2	154	24.9
Undocumented migrants	715	7.4	54	8.7
Missing data	*0*	*0.0*	*41*	*6.6*
Maternal birthplace				
Metropolitan France	4363	45.5	262	42.4
French overseas	166	1.7	15	2.4
Europe (others)	467	4.9	38	6.1
North Africa	2116	22.0	103	16.6
Sub-Saharan Africa	1566	16.3	115	18.6
Asia - Middle East	626	6.5	27	4.4
Others	295	3.1	59	9.5
Missing data	*0*	*0.0*	*0*	*0.0*
Maternal age (years)				
< 20	128	1.3	19	3.1
[20 - 25[	1303	13.6	99	16.0
[25 - 30[	2912	30.3	184	29.7
[30 - 40[	4793	49.9	271	43.8
≥ 40	463	4.8	46	7.4
Missing data	*0*	*0.0*	*0*	*0.0*
Living alone	1409	14.7	130	21.0
Missing data	*27*	*0.3*	*41*	*6.6*
Deprivation index * :				
0 criterion	6322	65.9	340	54.9
1 criterion	1681	17.5	97	15.7
2 criteria	839	8.7	66	10.7
3 or 4 criteria	660	6.9	67	10.8
Missing data	*97*	*1.0*	*49*	*7.9*
Education level				
≤ Primary school	667	6.9	37	6.0
Middle school	1746	18.2	98	15.8
High school	2299	24.0	124	20.0
University	4792	49.9	318	51.4
Missing data	*95*	*1.0*	*42*	*6.8*
Social welfare coverage				
Standard health insurance	1368	14.3	86	13.9
Complementary health insurance	6001	62.5	338	54.6
Universal health coverage	1191	12.4	69	11.1
State medical assistance	586	6.1	38	6.1
No healthcare insurance	367	3.8	38	6.1
Missing data	*86*	*0.9*	*50*	*8.1*

* Deprivation index: simple sum of 4 deprivation dimensions: Social isolation, Poor or insecure housing condition, No work-related household income, and No permanent heath care insurance

Table 1. Women's baseline characteristics according to their legal status (N=9599).

Legal Status (N = 9 599)	Non-migrants (n = 4523)		Legal migrants with French or European citizenship (n = 1555)		Other legal migrants (n = 2806)		Undocumented migrants (n = 715)		p ****
	n	%	n	%	n	%	n	%	
Age (years)									**< 0.001**
< 20	76	1.7	13	0.8	26	0.9	13	1.8	
[20 – 25[	606	13.4	188	12.1	375	13.4	134	18.7	
[25 – 30[	1428	31.6	362	23.3	871	31.0	251	35.1	
[30 – 35[	1553	34.3	503	32.4	861	30.7	191	26.7	
[35 – 40[	702	15.5	361	23.2	518	18.5	104	14.6	
≥ 40	158	3.5	128	8.2	155	5.5	22	3.1	
Social isolation	77	1.7	55	3.5	172	6.1	123	17.2	**< 0.001**
Poor or insecure housing condition	412	9.1	175	11.3	510	18.2	406	56.8	**< 0.001**
No standard health care insurance	396	8.8	276	17.7	833	29.7	639	89.4	**< 0.001**
No work-related household income	435	9.6	194	12.5	520	18.5	335	46.9	**< 0.001**
Deprivation index *									**< 0.001**
0 criterion	3661	80.9	1087	69.9	1574	56.1	0	0.0	
1 criterion	515	11.4	293	18.8	667	23.8	206	28.8	
2 criteria	240	5.3	117	7.5	337	12.0	145	20.3	
3 or 4 criteria	103	2.3	55	3.5	216	7.7	286	40.0	
Education level									**< 0.001**
≤ Primary school	32	0.7	88	5.7	391	13.9	156	21.8	
Middle school	643	14.2	297	19.1	633	22.6	173	24.2	
High school	892	19.7	419	26.9	793	28.3	195	27.3	
University	2943	65.1	736	47.3	943	33.6	170	23.8	
Social welfare coverage at inclusion									**< 0.001**
Standard health insurance (SHI)	429	9.5	264	17.0	675	24.1	0	0.0	
SHI + Complementary health insurance	3695	81.7	1013	65.1	1293	46.1	0	0.0	
Universal health coverage (CMU)	366	8.1	218	14.0	607	21.6	0	0.0	
State medical assistance (AME)	1	0.0	22	1.4	90	3.2	473	66.2	
No healthcare insurance	29	0.6	36	2.3	136	4.8	166	23.2	
Maternal birthplace									**< 0.001**
Metropolitan France	4357	96.3	0	0.0	0	0.0	6	0.8	
French overseas	166	3.7	0	0.0	0	0.0	0	0.0	
Europe (others)	0	0.0	339	21.8	77	2.7	51	7.1	
North Africa	0	0.0	611	39.3	1314	46.8	191	26.7	
Sub-Saharan Africa	0	0.0	381	24.5	877	31.3	308	43.1	
Asia - Middle East	0	0.0	138	8.8	379	13.6	109	15.2	
Others	0	0.0	86	5.5	159	5.7	50	7.0	
Length of residency (median in months)**	NA	NA	141.4		71.9		31.6		**< 0.001**
IQR 25/75			82.7	250.6	26.0	118.8	9.4	73.4	
Linguistic barrier	41	0.9	150	9.6	575	20.5	241	33.7	**< 0.001**
Smoker before pregnancy	1237	27.3	206	13.2	138	4.9	45	6.3	**< 0.001**
Smoker during pregnancy	644	14.2	113	7.3	66	2.4	21	2.9	**< 0.001**
Alcohol during pregnancy	372	8.2	96	6.2	134	4.8	61	8.5	**< 0.001**
Drugs during pregnancy	39	0.9	5	0.3	6	0.2	1	0.1	**< 0.001**

Body mass index (kg/m²)									**< 0.001**
< 18.5	303	6.7	76	4.9	122	4.3	46	6.4	
18.5 – 24.9	2844	62.9	864	55.6	1361	48.5	318	44.5	
25 – 29.9	767	17.0	366	23.5	733	26.1	167	23.4	
≥ 30	505	11.2	187	12.0	376	13.4	80	11.2	
Obstetric history									
Nulliparous	2302	50.9	520	33.4	963	34.3	332	46.4	**< 0.001**
Previous caesarean section	178	3.9	127	8.2	253	9.0	33	4.6	**< 0.001**
Voluntary abortion	974	21.5	308	19.8	505	18.0	137	19.2	**< 0.001**
Ectopic pregnancy	90	2.0	33	2.1	54	1.9	10	1.4	0.6
Late miscarriage	49	1.1	29	1.9	48	1.7	13	1.8	**0.04**
Gestational diabetes	136	3.0	72	4.6	148	5.3	12	1.7	**< 0.001**
Pregnancy-related hypertensive disorder	99	2.2	54	3.5	80	2.9	7	1.0	**0.02**
Fetal growth restriction	62	1.4	23	1.5	49	1.7	8	1.1	0.5
Preterm delivery	218	4.8	97	6.2	169	6.0	37	5.2	0.06
Postpartum haemorrhage	59	1.3	36	2.3	62	2.2	12	1.7	0.1
Fetal or neonatal death	100	2.2	41	2.6	79	2.8	29	4.1	**0.03**
High risk at the beginning of pregnancy***	925	20.5	297	19.1	521	18.6	124	17.3	0.1
Gestational age at delivery									0.4
< 32 weeks of gestation	95	2.1	32	2.1	52	1.9	11	1.5	
[32-37[weeks of gestation	327	7.2	108	6.9	166	5.9	45	6.3	
≥ 37 weeks of gestation	4101	90.7	1415	91.0	2588	92.2	659	92.2	
Mode of delivery									**< 0.001**
Vaginal delivery	3684	81.5	1226	78.8	2209	78.7	516	72.2	
Caesarean section	821	18.2	319	20.5	585	20.8	194	27.1	

IQR, interquartile range; NA, not applicable; the sum is not equal to 100% due to missing data

* Deprivation index: simple sum of 4 deprivation dimensions: Social isolation, Poor or insecure housing condition, No work-related household income, and No permanent heath care insurance

** If born abroad

*** High-risk at the beginning of pregnancy is defined by at least one of the following items in accordance with French guidelines: history of cardiac disease, hypertension, diabetes, venous thrombosis, pulmonary embolism, Graves' disease, asthma, homozygous sickle cell, anaemia, thrombocytopaenia, coagulation disorder, a rare or systemic disease, nephropathy, HIV infection, late miscarriage, preeclampsia, fetal growth restriction, preterm delivery, fetal death or neonatal death

**** Chi² test (or Fisher's exact test if necessary) for qualitative variables and Kruskal–Wallis test for medians of quantitative variables

Table 2. Severe maternal morbidity rates according to the woman's legal status.

	All women (n = 9599)		**Non-migrants (n = 4523)**		**Legal migrants with French or European citizenship (n = 1555)**		**Other Legal migrants (n = 2806)**		**Undocumented migrants (n = 715)**	
	n	%	n	%	n	%	n	%	n	%
Severe hypertensive disorder of pregnancy *	95	1.0	44	1.0	9	0.6	28	1.0	14	2.0
Severe postpartum haemorrhage	56	0.6	22	0.5	9	0.6	20	0.7	5	0.7
Perineal trauma grade 3 or 4	58	0.6	27	0.6	3	0.2	24	0.9	4	0.6
Surgical re-intervention	53	0.6	25	0.6	9	0.6	15	0.5	4	0.6
Maternal admission to intensive care unit	57	0.6	24	0.5	11	0.7	17	0.6	5	0.7
Deep venous thrombosis or pulmonary embolism	25	0.3	9	0.2	4	0.3	8	0.3	4	0.6
Convulsions (excluding eclampsia)	13	0.1	5	0.1	3	0.2	4	0.1	1	0.1
Placental abruption except for severe hypertensive disorder of pregnancy	12	0.1	3	0.1	2	0.1	4	0.1	3	0.4
Uterine rupture	10	0.1	2	0.0	1	0.1	4	0.1	3	0.4
Diabetic ketoacidosis	7	0.1	2	0.0	1	0.1	3	0.1	1	0.1
Severe sepsis	6	0.1	1	0.0	1	0.1	3	0.1	1	0.1
Haemorrhagic shock	6	0.1	1	0.0	3	0.2	2	0.1	0	0.0
Maternal death	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
**Severe maternal morbidity ** **	**304**	**3.2**	**129**	**2.9**	**41**	**2.6**	**101**	**3.6**	**33**	**4.6**

* Severe hypertensive disorder of pregnancy is defined as the presence of severe preeclampsia, eclampsia or placental abruption in the context of a pregnancy-related hypertensive disorder.

** Severe maternal morbidity was defined by at least one of the above complications up to 42 days postpartum, non-exclusive categories.

Table 3. Risk of severe maternal morbidity according to the woman's legal status and birthplace.

	Severe maternal morbidity*	
	OR [95% CI]	aOR [95% CI][1]
Non-migrants (n = 4 523)	1	1
Legal migrants with French or European citizenship (n = 1 555)	0.93 [0.65 – 1.33]	0.94 [0.66 - 1.35]
Other legal migrants (n = 2 806)	1.28 [0.98 – 1.67]	1.35 [1.03 - 1.79]
Undocumented migrants (n = 715)	1.67 [1.13 – 2.47]	1.68 [1.12 - 2.53]
Non-migrants (n = 4 523)	1	1
Legal migrants with French or European citizenship born outside sub-Saharan Africa (n = 1 174)	0.87 [0.58 - 1.31]	0.93 [0.61 - 1.40]
Legal migrants with French or European citizenship born in sub-Saharan Africa (n = 381)	1.10 [0.60 - 2.01]	1.31 [0.71 - 2.42]
Other legal migrants born outside sub-Saharan Africa (n = 1 929)	1.23 [0.91 - 1.66]	1.33 [0.97 - 1.82]
Other legal migrants born in sub-Saharan Africa (n = 877)	1.39 [0.94 - 2.04]	1.62 [1.07 - 2.47]
Undocumented migrants born outside sub-Saharan Africa (n = 407)	1.32 [0.77 - 2.28]	1.44 [0.82 - 2.53]
Undocumented migrants born in sub-Saharan Africa (n = 308)	2.15 [1.29 - 3.57]	2.26 [1.30 - 3.91]

OR, odds ratio; aOR, adjusted odds ratio; CI, Confidence interval.

* Severe maternal morbidity (SMM) was defined by at least one of the following items: Severe hypertensive disorder of pregnancy (presence of severe preeclampsia [systolic blood pressure > 160 mm Hg, diastolic blood pressure > 110 mm Hg, or hypertension with general signs, and one or more of the following: proteinuria >3.5 g/24 hours, serum creatinine >100 µmol/l, diuresis <20 ml/hour, haemolysis, aspartate transaminase > 3N, thrombocytopaenia <100 000/mm3, or before 32 weeks], eclampsia or placental abruption in the context of a pregnancy-related hypertensive disorder), severe postpartum haemorrhage (second-line uterotonic treatment associated with transfusion of at least two units of packed red blood cells, and/or uterine artery ligation, and/or uterine compressive sutures, and/or embolisation and/or hysterectomy), grade 3 or 4 perineal trauma, surgical reintervention, maternal admission to intensive care unit, deep venous thrombosis or pulmonary embolism, convulsions (excluding eclampsia), placental abruption except for severe hypertensive disorder of pregnancy, uterine rupture, diabetic ketoacidosis, severe sepsis (sepsis with organ failure), haemorrhagic shock, or maternal death.

[1] Logistic regression model adjusted for maternal age, education level, number of previous pregnancies and maternity unit of delivery.