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Classification of cesarean sections among immigrants in Belgium

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Key words
Immigration, cesarean section, quality of health care, classification, labor and delivery, Robson classification

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Conflict of interest
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Abstract

Objective. To provide insight into the differential effect of immigration on cesarean section (CS) rates, using the Robson classification. *Design*. A population-based study using birth certificates from the birth registry of 2009. *Setting*. All births in two of the three Belgian regions excluding Flanders. *Population*. 37 628 deliveries from Belgian and immigrant mothers from sub-Saharan Africa, Maghreb and Eastern Europe. *Methods*. Multivariate analyses using CS as the dependent variable and immigration status as the primary independent variable. Several multivariate logistic regression models were built including medical, anthropometric, socio-economic characteristics, and medical interventions. The impact of analyzing all delivery sites together was tested using mixed-effect analyses. *Main outcome measures*. CSs of immigrant subgroups compared with Belgian women. *Results*. CS rates varied according to immigrant subgroups. Mothers from sub-Saharan Africa had an adjusted odds ratio of 2.06 (1.62–2.63) for CS compared with Belgian natives. Increased risk for mothers from sub-Saharan Africa compared with Belgian natives was found among nulliparous and multiparous women without previous CS, and a term, singleton fetus in cephalic position. In comparison, nulliparous East European mothers with a term singleton fetus in cephalic position in spontaneous labor had an adjusted odds ratio of 0.29 (0.08–0.99) for CS. *Conclusions*. CS rates currently vary between Robson categories in immigrant subgroups. Immigrant mothers from sub-Saharan Africa with a term, singleton infant in cephalic position, without previous CS, appear to carry the highest burden.

Abbreviations: BMI, body mass index; CS, cesarean section; OR, odds ratio.

Introduction

The proportion of births delivered by cesarean section (CS) in Belgium increased from 13.5% in 1995 to 19.1% in 2009 (1–4). The CS rate continues to rise in many countries (5). The introduction of cardiotocography and ultrasonography and the increased range of indications might be part of the explanation, but the rising CS rates in some areas might also reflect population changes (5). In the United States, it has been found that delivery mode varies by the ethnicity of the mother (6). A recent review has shown that the CS rates appeared to be higher in immigrant populations taken as a whole compared with host-country women in 40% of the published studies (7). Recent European studies have shown that cesarean delivery is more frequent in women of African origin than in native West European mothers, whereas women from East European countries and Maghreb had lower CS

Key Message

Cesarean section rates currently vary between Robson categories in immigrant subgroups. Mothers from sub-Saharan Africa with a term singleton infant in cephalic position, without previous cesarean section, appear to carry the highest burden.

rates than West European mothers (8–11). There are many possible causes of ethnic disparities in obstetrics, including economics, biology, and discrimination, and there is likely overlap in these categories (12).

A recent review has suggested that women-based classifications for CSs in general, and Robson classification in particular, would be in the best position to fulfill current international and local needs for evaluation and comparison (13). Robson has formed a 10-group classification using the previous obstetric record, course of labor and delivery and the gestational age of the pregnancy. These parameters are all prospective, mutually exclusive, totally inclusive and easy to organize (14).

Immigrant women now contribute approximately one third of all deliveries in Belgium, and it would be useful to assess CS statistics in each immigrant subgroup (3,4,15). This study aims to provide insight into the differential effect of immigration status on CS rate, covering all obstetrical parameters of the Robson classification. The objective is to examine differences in the occurrence of CS according to the maternal immigrant subgroup.

Material and methods

This is a population-based study using birth certificates from the birth registry of 2009. Data pertain to all births in two of the three Belgian regions excluding Flanders. The birth registry legally includes birth certificates of all live births, and stillbirths from 500 g or 22 weeks' gestation.

In all, 48 843 consecutive deliveries were considered for the present analysis. Mothers' origin was defined based on their nationality at birth. Nationality at birth was missing in 33 births (<0.1%) and delivery mode in 67 births (0.1%). Three immigrant subgroups were compared with Belgian natives, accounting for 37 628 deliveries in total: Belgian former colonies or protectorates in sub-Saharan Africa: Burundi, Congo-DRC and Rwanda; Maghreb: Algeria, Morocco and Tunisia; and Eastern Europe: Albania, Bulgaria, Czech Republic, Hungary, Poland, Romania, Slovakia, the former Soviet republics, and the former Yugoslavia. Immigrant subgroups were referred to as 'mothers from sub-Saharan Africa,' 'Maghreb' or 'Eastern Europe' for simplicity. Data regarding other factors were missing in ≤1% of births, except for medically assisted conception: 6.9%; body mass index (BMI): 16.3%; STAN® monitor (Neoventa Medical, Mölndal, Sweden): 9.4%; education: 15.9%.

Potential confounding variables were categorical: age ≥35 years; nulliparous; induction of labor and elective CS; medically assisted reproduction (including in vitro fertilization, intra-cytoplasmic sperm injection and hormonal stimulation), STAN® monitor; birthweight (<2500 g, 2500–3999 g and ≥4000 g); hypertension; diabetes (either gestational or permanent); weight gain ≥500 g per week; BMI (underweight (<18.5 kg/m^2), normal (18.5–24.9 kg/m^2), overweight (25.0–29.9 kg/m^2), obese (30.0–39.9 kg/m^2) and morbidly obese (≥40.0 kg/m^2)); maternal height <155 cm; education (9th grade or less, high school, college); employment status; single mother; naturalization status; poverty in zip code; and delivery unit <1000 deliveries/year. Belgian naturalization status was defined according to the present nationality. A marker of community poverty was used and included living in a zip code with a mean income in individual tax declaration <15 000 euros/year. Pre-pregnancy weight was registered at the first prenatal consultation ≤12 weeks, or based on self-reported weight if the first consultation was held >12 weeks. Elective CS was defined as a section which was planned before the onset of labor.

The Robson classification was used to stratify CS rates according to maternal origin (14). Robson has formed a 10-group classification using the previous obstetric record, course of labor and delivery, and the gestational age of the pregnancy: (1) nulliparous, single cephalic, ≥37 weeks, in spontaneous labor; (2) nulliparous, single cephalic, ≥37 weeks, induced or CS before labor; (3) multiparous (excluding previous CS), single cephalic, ≥37 weeks, in spontaneous labor; (4) multiparous (excluding previous CS), single cephalic, ≥37 weeks, induced or CS before labor; (5) previous CS, single cephalic, ≥37 weeks; (6) all nulliparous breeches; (7) all multiparous breeches; (8) all multiple pregnancies; (9) all abnormal presentations; and (10) all single cephalic, ≤36 weeks.

The CS rate and perinatal characteristics of immigrant and national women were calculated. Differences in percentages between the three groups were compared by chi-squared analyses. Next, the distribution of Robson criteria in each subgroup was calculated. We then conducted bivariate and multivariate analyses using CS as the dependent variable and nationality as the primary independent variable. Several multivariate logistic regression models were built: first, by including medical characteristics: birthweight, maternal age, parity, hypertension, diabetes; second, in an explicative view by adding maternal BMI, weight gain and height <155 cm to the first model; third, by adding parents' socio-economic characteristics to the second model: union status, employment status, educational level, poverty risk in zip code, naturalization status; and fourth, by including the third model and medical interventions at the health provider-level: STAN® monitor, medically assisted reproduction, induction or elective CS, and size of the delivery unit. We also repeated the last analysis with pregnancies ≥36 weeks as it is indicated for the use of the STAN® monitor.

We also tested the impact of analyzing all delivery sites (50 maternity units in total) together by repeating the multivariate regression analyses with mixed-effects logistic regression models. The use of such regression modelling accounts for unmeasured factors at the hospital level. We treated the

Table 1. Perinatal characteristics by maternal region of origin ($n = 37\,628$).

Perinatal characteristics	Belgium ($n = 26209$) %	Sub-Saharan Africa ($n = 1687$) %	Maghreb ($n = 6792$) %	Eastern Europe ($n = 2940$) %
Cesarean section	18.0	27.6	16.5	15.7
Elective CS/total CS	49.4	41.2	45.1	45.9
Induction of labor	32.9	27.4	28.0	26.2
Primiparous	47.7	34.9	39.5	49.7
Weight gain ≥500 g/week	9.8	12.4	8.6	14.7
Height <155 cm	3.2	3.8	6.2	4.9
BMI				
underweight	7.4	2.4	3.2	6.7
overweight	18.8	29.0	29.5	18.0
obese	8.1	16.1	12.8	5.1
morbidly obese	3.6	1.3	1.4	0.6
Hypertension	5.3	10.6	3.1	3.9
Diabetes	4.0	4.7	8.3	4.1
Birthweight <2500 g	7.4	8.9	5.2	5.0
Birthweight ≥4000 g	6.1	8.3	10.5	9.2
STAN monitor	5.2	9.3	8.4	7.7
Medically assisted conception	5.0	3.3	2.6	3.1
Age >35 years	16.7	24.2	21.7	14.9
Obtained Belgian citizenship	–	56.6	45.5	16.6
Education				
9th grade or less	13.2	28.4	38.3	34.4
High school	36.1	41.5	45.1	37.2
College	50.8	30.2	16.6	28.4
Low income in zip code	1.1	2.3	2.8	3.0
Unemployed	30.5	67.3	73.0	62.8
Single mother	6.3	15.5	2.6	10.1

BMI, body mass index; CS, cesarean section.
Differences between groups were all statistically significant with a p-value <0.001.

hospital effect as the random effect and the remaining factors as fixed effects.

Adjusted odds ratio (OR) and 95% confidence interval were derived from the model, and likelihood-ratio test p-values are presented in the result tables. Goodness of fit for the final model was evaluated with the Hosmer–Lemeshow test. Models were tested for the presence of interactions and the graphic of residues against predicted values of losses was used for checking the hypothesis of non-correlation among errors. A two-sided significance level of 0.05 was used in all statistical tests. Statistical calculations were undertaken using STATA software (version 10.0, College Station, TX, USA).

Results

CS rates and perinatal characteristics varied according to maternal origin (Table 1). Robson 10-group classification according to nationality is presented in Table 2. Group 1 (non-induced nulliparous) and 3 (multiparous) are the two largest groups, although Group 3 is more frequent for women of African and Maghreb origin than for Belgian and Eastern European women. The contribution of repeat CS (Group 5) to the overall CS rate is high in every group and is the highest for African mothers. Group 2 (induced nulliparous) is the next largest contributing group to the overall CS rate.

Crude ORs show a decreased global risk for CS for women from Maghreb and Eastern Europe and an increased global risk for women of sub-Saharan origin (Table 3). Adjusted OR for CS were no longer statistically significant after introducing height and weight characteristics in the multivariate model for mothers from Eastern Europe and after controlling for medical procedures for mothers from Maghreb.

The likelihood ratio test of the mixed-effects model taking into account the hospital effect showed that there was a significant overall effect due to the hospital on the relation between all nationality groups and CS in this series (p-value <0.001). The largest difference between the ordinary logistic results and the random-effect model was noted in women from sub-Saharan Africa, where the adjustment for hospital effects reduced the estimated OR from 2.17 to 2.06. A model without variables with missing rate superior to 1% was also used to validate our results and gave similar results (data not shown).

Table 2. Robson classification by maternal region of origin ($n = 37\,628$).

	Belgium ($n = 26\,209$)		Sub-Saharan Africa ($n = 1687$)		Maghreb ($n = 6792$)		Eastern Europe ($n = 2940$)	
Robson categories	Deliveries in group	% CS/ group	Deliveries in group	% CS/ group	Deliveries in group	% CS/ group	Deliveries in group	% CS/ group
1	6505	7.5	322	19.6	1545	8.5	845	5.9
2	4066	22.6	196	45.4	875	24.9	418	20.1
3	5944	1.6	494	5.3	2186	1.7	826	1.9
4	4093	4.0	209	9.1	908	5.1	307	5.5
5	2071	55.2	255	61.6	632	52.1	206	58.8
6	748	91.4	15	73.3	92	87.0	77	96.1
7	585	80.3	27	70.4	122	74.6	38	65.8
8	484	54.6	42	61.9	138	58.0	45	68.9
9	97	97.9	15	100.0	25	96.0	15	93.3
10	1616	24.2	112	36.6	269	30.1	163	17.2
Total	26 209	18.0	1687	27.6	6792	16.5	2940	15.6

CS, cesarean section.

Table 3. Multivariate analysis of cesarean section by maternal region of origin ($n = 37\,628$).

		Adjusted OR 95%CI				
Immigrant subgroups	Crude OR 95%CI	Model 1[a]	Model 2[b]	Model 3[c]	Model 4[d]	Model 4[d] + hospital effect
sub-Saharan Africa vs. Belgium ($n = 29\,002$)	**1.75**	**1.70**	**1.80**	**1.82**	**2.17**	**2.06**
	1.58–1.94	**1.53–1.88**	**1.58–2.05**	**1.49–2.23**	**1.71–2.74**	**1.62–2.63**
Maghreb vs. Belgium ($n = 34\,264$)	**0.90**	**0.90**	**0.86**	**0.87**	0.99	1.01
	0.84–0.96	**0.84–0.96**	**0.79–0.93**	**0.77–0.98**	0.86–1.13	0.87–1.17
Eastern Europe vs. Belgium ($n = 30\,269$)	**0.82**	**0.84**	0.91	1.04	1.00	0.94
	0.74–0.90	**0.77–0.93**	0.81–1.03	0.78–1.38	0.72–1.40	0.68–1.32

In bold: $p < 0.05$; OR: odds ratio; CI, confidence interval.
[a] Adjusted for medical characteristics; $n = 28\,944$, 34 200 and 30 210, respectively.
[b] Adjusted for model 1 and anthropometric characteristics; $n = 23\,106$, 27 302 and 23 981, respectively.
[c] Adjusted for model 2 and socio-economic characteristics; $n = 18\,481$, 22 144 and 19 191, respectively.
[d] Adjusted for model 3 and medical procedures; $n = 16\,149$, 19 190 and 16 738, respectively.

When the analysis is repeated for births greater or equal to 36 weeks, OR for CS in women from sub-Saharan Africa reaches 2.45 (1.92–3.12) (Model 4) and 2.36 (1.84–3.03) (Model 4 with hospital effect). When analyses were restricted to the Robson categories, the adjusted OR was increased for nulliparous and multiparous sub-Saharan African women, without previous CS, and a term single fetus in cephalic position, and it was decreased for nulliparous East European mothers with a term single fetus in cephalic position in spontaneous labor (Table 4). Breeches, multiple and preterm pregnancies showed a more various pattern, as mothers from sub-Saharan Africa and Maghreb had fewer CS in case of breech, and more CS in case of multiple pregnancy, but these results were not statistically significant after adjustment (data not shown).

When grouping nulliparae (groups 1/2), adjusted ORs for CS with hospital effect were 2.83 (1.84–4.34) for mothers from sub-Saharan Africa; 0.97 (0.73–1.28) for mothers from Maghreb; and 0.59 (0.30–1.16) for mothers from Eastern Europe. When grouping multiparae (groups 3/4), adjusted ORs for CS were 3.70 (1.93–7.11) for mothers from sub-Saharan Africa; 1.06 (0.67–1.68) for mothers from Maghreb; and 0.98 (0.30–3.19) for mothers from Eastern Europe. The hospital effect on the relation between immigrant subgroup and CS was statistically significant in nulliparous mothers (groups 1 and 2) and mothers with previous CS (group 5) with term singleton in cephalic position, but not in multiparous mothers (groups 3 and 4), for all immigrant subgroups.

Discussion

These results illustrate that global CS rates currently vary between women from different areas of origin. Compared to Belgian mothers, adjusted ORs for CS were greater for

Table 4. Multivariate analysis of cesarean section by maternal region of origin and Robson classification ($n = 37\,628$).

	Crude		Adjusted[a]	
Robson categories	OR	95%CI	OR	95%CI
Nulliparous, single cephalic, ≥37 weeks, unscarred uterus (Group 1)				
sub-Saharan Africa vs. Belgium	**2.79**	**2.14–3.64**	**3.19**	**1.71–5.96**
Maghreb vs. Belgium	1.07	0.89–1.28	0.73	0.44–1.20
Eastern Europe vs. Belgium	**0.67**	**0.50–0.89**	**0.29**	**0.08–0.99**
Nulliparous, single cephalic, ≥37 weeks, unscarred uterus (Group 2)				
sub-Saharan Africa vs. Belgium	**2.95**	**2.23–3.91**	**2.55**	**1.36–4.80**
Maghreb vs. Belgium	1.20	1.03–1.41	0.98	0.69–1.39
Eastern Europe vs. Belgium	0.87	0.69–1.11	0.79	0.33–1.89
Multiparous, single cephalic, ≥37 weeks, unscarred uterus (Group 3)				
sub-Saharan Africa vs. Belgium	**3.43**	**2.20–5.34**	**5.38**	**2.16–13.37**
Maghreb vs. Belgium	1.06	0.72–1.56	0.93	0.42–2.09
Eastern Europe vs. Belgium	1.22	0.71–2.08	0.88	0.12–6.72
Multiparous, single cephalic, ≥37 weeks, unscarred uterus (Group 4)				
sub-Saharan Africa vs. Belgium	**2.37**	**1.44–3.90**	**2.99**	**1.12–8.00**
Maghreb vs. Belgium	1.27	0.91–1.77	1.41	0.82–2.44
Eastern Europe vs. Belgium	1.39	0.83–2.32	1.32	0.30–5.82
Previous CS, single cephalic, ≥37 weeks (Group 5)				
sub-Saharan Africa vs. Belgium	1.30	0.99–1.69	1.79	0.97–3.30
Maghreb vs. Belgium	0.88	0.74–1.05	1.02	0.71–1.45
Eastern Europe vs. Belgium	1.15	0.86–1.54	1.37	0.55–3.41

In bold: $p < 0.05$; OR: odds ratio; CI, confidence interval; CS, caesarean section.

[a]Adjusted for age, hypertension, diabetes, birthweight, body mass index, weight gain, height, naturalization status, employment, single mother, poverty in zip code, education, STAN®, assisted conception, delivery site, hospital effect.

nulliparous and multiparous mothers from sub-Saharan Africa with a term, singleton fetus in cephalic position without previous CS. ORs were reduced in nulliparous mothers from Maghreb and Eastern Europe for a term, cephalic, singleton fetus, although not reaching statistical significance, except for nulliparous East European mothers with a term singleton fetus in cephalic position in spontaneous labor.

Recent studies have reported a higher global CS rate in immigrant women of African origin (8,10) and lower CS rates in women from East European countries (10,11) and Maghreb (8,11) compared with native Western European mothers. These studies made adjustment on a small set of factors, mostly age and parity. A recent Irish study has concluded that migrants from Eastern European countries exhibited a 'healthy migrant effect' in terms of CS rates explained by lower maternal age and BMI noted in immigrant mothers (16).

It has been suggested that previous studies may be biased if the potential effects of hospital site of delivery were not addressed (17). Our results are similar to a Californian study that has noted a significant effect of ethnicity on the risk of CS delivery. The addition of a hospital effect resulted in a slight diminution of the OR, which was still statistically significant (17).

This study suggests that differences in the risk of CS according to maternal origin persist in sub-Saharan African mothers even after adjusting for maternal, socio-economic, medical, and hospital factors in nulliparous as well as multiparous mothers with term fetus in cephalic position and that the hospital effect on the relation between immigrant subgroup and CS was statistically significant in nulliparous mothers (groups 1/2) for all immigrant subgroups. These results are of particular importance as recent studies have observed that the rate of CS in particular are rising in term nulliparous mothers with a singleton in cephalic position, with large variations according to hospitals and that efforts should concentrate on limiting the rise in this group (18,19). In the present study, such remaining difference according to maternal origin may be due to unobserved mother or health provider factors that the methods of data collection were not able to be captured. According to Robson, the aim is not to worry whether the CS rate is too high, but rather why and whether it can be considered appropriate taking into consideration all the relevant causal and outcome factors (14). It is not possible to know if immigrant women are delivering by CS at a lower or higher rate than required or if their needs are different. It would be of interest in future studies to compare perinatal morbidity and mortality and circumstances of delivery in each immigrant subgroup. Women from sub-Saharan Africa have high perinatal mortality rates despite their high CS rate (7,20,21). Several factors may play an important role in this difference, such as language fluency and broader aspects of communication, intercurrent diseases and prenatal care (7). An English study has found an increased risk of CS in women from sub-Saharan Africa compared with native mothers despite adjusting for the number of prenatal visits and language fluency (9), and in Belgium, sub-Saharan African women come mostly from French-speaking countries. Finally, even if it is not possible to know if infibulation interferes with our results, it is extremely unlikely as infibulation is very rare and not widely practiced in Congo DRC, Rwanda, and Burundi or in the Maghreb area (8). Another limitation of this study is the high rate of missing data in education level and BMI that reaches 16%.

The strength of this study is that it is large and population-based, with a large set of covariates. Another strength includes the implementation of a hospital effect in the regression model. Very few published studies have examined trends in CS rates by maternal origin and, to our knowledge, the present study is the most comprehensive study to date. As

immigrant women contribute approximately one-third of all deliveries in Belgium and up to 65% in the Brussels Region (3,4,15), and as the proportion of births delivered by CS is increasing, investigation of the CS determinants between immigrant subgroups and natives is justified.

Conclusion

A high CS rate is not a general phenomenon among immigrants, and CS rates vary between Robson categories in immigrant subgroups. Mothers from sub-Saharan Africa with a term fetus in cephalic position, without previous CS, appear to carry the highest burden. Future studies, both quantitative and qualitative, should explore the underlying specific determinants that may contribute to these differences.

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