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Maternal country of birth and epidural during delivery

Effect of maternal country of birth on intrapartum epidural use – A population-based register study of 602 095 deliveries

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Conflict of interest notification

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Abstract

Objective To assess intrapartum epidural use during vaginal delivery among immigrant women giving birth in Norway, compared with Norwegian born women, and to explore associations between epidural use and other maternal characteristics, fetal and obstetrical variables.

Study design Population-based cohort study. Data were obtained from Norwegian Medical Birth Registry and Statistics Norway, including 602 095 deliveries in 1999-2014. Intrapartum epidural analgesia use was described in percentages. Multivariable logistic regression analysis was performed to investigate the association between maternal country of birth and intrapartum epidural use, adjusted with maternal and fetal comorbidity, age, stillbirth, birthweight, fetal presentation, delivery method and time period.

Results There were significant differences in epidural use between women born in different parts of the world. Among nulliparous women, increased odds for intrapartum epidural use was observed among women born in Latin America compared with Norwegian born women, even after adjustment for maternal, fetal and obstetrical factors (aOR 1.93, CI 1.79-2.09).

Reduced odds for intrapartum epidural use was observed among nulliparous women born in Sub-Saharan Africa (aOR 0.83, CI 0.78-0.88), East Asia and Pacific area (aOR 0.83, CI 0.80-0.87), and women with unknown country of birth (aOR 0.79, CI 0.71-0.89) compared with Norwegian born women. Similar pattern was observed among parous women from Latin America (aOR 1.69, CI 1.54-1.87), Sub-Saharan Africa (aOR 0.62, CI 0.57-0.67), East-Asia and Pacific area (aOR 0.68, CI 0.64-0.73), unknown country of birth (aOR 0.97, CI 0.84-1.13). Maternal hypertensive disorders, high infant birthweight, stillbirth, breech presentation and operative vaginal delivery increased the odds for use of intrapartum epidural analgesia.

Conclusions

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We found differences between immigrant women from different parts of the world and use of intrapartum epidural, possibly related to un-measurable issues like cultural differences, maternal expectations and knowledge of safety on pain relief during childbirth. Intrapartum epidural use was more frequent in conditions related to maternal co-morbidity and factors indicating complicated delivery.

Key words:

Epidural analgesia

Instrumental delivery

Maternal country of birth

Pain relief during childbirth

Socioeconomic status

Stillbirth

Introduction

Labor pain is considered the strongest pain experience during a woman's life (1,2).

Intrapartum epidural use has become common in high-income countries and is considered the most effective method for labor pain relief (3-6). Indication for epidural is the subjective experience of unbearable pain. However, access, availability and labor room staff attitudes may also affect the use of epidural (5). Cultural differences, expectations of birth experience and knowledge on safety of epidural as pain relief may also have an impact on the woman's desire of using epidural during labor (7-10). Previous studies show conflicting results according to use of intrapartum epidural and socioeconomic status (4,11,12). Maternal country of birth and ethnicity may also influence the use of epidural during labor (8,13-15). In Norway, care during childbirth is offered by the public healthcare system and governmentally funded leading to equal health care regardless of socioeconomic status, social class, occupation or ethnic background. All antenatal health care and care during childbirth is free of charge in Norway. Therefore, we hypothesized that maternal country of birth and socioeconomic status are not associated with intrapartum epidural use for pain relief.

Aim of this study was to assess the use of intrapartum epidural analgesia during vaginal delivery among immigrant women giving birth in Norway, compared with Norwegian born women, and to explore associations with other maternal, perinatal and obstetrical variables.

Materials and methods

This population based register study is a part of The PURPLE Study that was evaluated and approved by the Regional Committee for Medical Research Ethics in South East Norway (2015/681) and by the Institutional Personal Data Officer in Oslo University Hospital in 2015. Information related to pregnancy, newborn and delivery were obtained from the Medical Birth Registry Norway (MBRN), maternal country of birth and education level from Statistics Norway (SSB).

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All births in Norway (including homebirths) are recorded in MBRN that collects information on pregnancy and delivery. Maternal pre-pregnancy morbidity and pregnancy related health conditions are prospectively recorded on a standard pregnancy health card similarly in the entire country. Midwife in charge records all data on a mandatory standardized form immediately after delivery. SSB is a central agency collecting statistics of all inhabitants in Norway, such as education, country of birth and immigrant status. Data from health and population registries can be linked and used in research purposes.

Of the entire population of 930 881 deliveries registered in MBRN during the study period 1999-2014, 160 418 were excluded based on following criteria: gestational age less than 22 weeks, gestational age beyond 43 weeks (possibility of error in pregnancy length), multiple pregnancy, fetal transverse lie (because we aimed to study vaginal births), caesarean delivery. Women delivered with caesarean were excluded, because we wanted to assess the intrapartum use of epidural, and we did not have information on when the epidural pain relief was introduced. Some women may have been given the epidural analgesia after the decision of caesarean delivery or after birth when operative treatment of other reasons was needed (for example retained placenta or postpartum haemorrhage). Finally, 168 368 women registered with more than 2 deliveries were excluded, because we wanted to assess nulliparous women and women with one subsequent delivery only. The study population consisted of 602 095 vaginal deliveries during the years 1999-2014 (Table 1).

The main exposure was maternal country of birth. We also assessed maternal educational level, comorbidity and age. Fetal and obstetrical factors that by clinical experience would probably be associated with difficult delivery and need for effective pain relief (birthweight, stillbirth, fetal presentation, delivery method) were also assessed. The variables were chosen from previous literature and by the clinical experience from labor ward.

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Maternal country of birth was categorized to 11 groups, according to geographic, economic and cultural differences. Europe was divided to two categories according to membership in the European Economic Association (EEA). Switzerland was analysed together with the EEA countries. Rest of the world was categorised according to the World Bank classification of countries. Women with unknown country of birth were analysed as an individual category. Norwegian born women were used as the reference.

Based on duration of education in years, four levels of education were created: No education or compulsory only, 11-14 years of education (secondary education), bachelor level and master/PhD-level. Secondary education was used as the reference.

Maternal age was categorised to four groups, and the age group 25-29 years was used as the reference. Gestational hypertension was defined as a de novo elevation of blood pressure to $\geq 140/90$ during pregnancy without proteinuria. Preeclampsia was defined as increased blood pressure to $\geq 140/90$ in combination with proteinuria. Chronic hypertension and epilepsy were based on pre-pregnancy existing medical conditions.

Parity was dichotomized to two groups: no previous deliveries or one previous delivery.

Birthweight was categorized to five groups according to infant weight in grams measured immediately after birth: < 3000 grams, 3000-3499, 3500-3999, 4000-4499 or >4499 grams.

Information on fetal presentation at birth was categorized to cephalic, breech or abnormal cephalic (occiput posterior, brow or face presentation).

Delivery method was categorized to spontaneous vaginal, vacuum assisted or forceps delivery.

Three time periods were assessed (1999-2004, 2005-2009 or 2010-2014) to explore secular trends.

Women with missing information on education (3.6 %) and country of birth (0.5%) and were managed as own categories in all analyses.

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Statistical analyses

Continuous data were categorized. Descriptive statistics were used to present the prevalence of intrapartum epidural use among subgroups of women.

Crude logistic regression analyses were performed to examine the association between the outcome (here epidural analgesia) and other possible confounding factors. Adjusted logistic regression analyses were performed to examine the association between the exposure (here maternal country of birth) and the outcome adjusted for maternal education, age, hypertensive disorders (preeclampsia, gestational hypertension, chronic hypertension), epilepsy, stillbirth, birthweight, fetal presentation, delivery method and time period, stratified for parity (other independent variables having an effect on use of epidural analgesia as the dependent variable).

No multicollinearity or interaction were found between the variables.

Statistical analyses were performed by using IBM® SPSS®, version 23.

Results

The prevalence of intrapartum epidural use was 41.6% among nulliparous (131 989 of 317 441) and 19.6% (55 669 of 284 654) among women with one previous delivery (Table 2).

Maternal country of birth

The multivariable logistic regression analyses showed that for nulliparous women, odds for intrapartum epidural use was 93% increased (aOR 1.93, 95% CI 1.79-2.09) among women born in Latin America/Caribbean and 39% increased (aOR 1.39, 95% CI (1.25-1.56) among North American born women, compared with women born in Norway (the reference group) after adjustment for maternal education, age, parity, hypertensive disorders, epilepsy, stillbirth, birthweight, fetal presentation, delivery method and time period. Odds for epidural use was 17% decreased among women born in Sub-Saharan Africa (aOR 0.83, 95% CI 0.78-

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0.88) and East Asia Pacific area (aOR 0.83, 95% CI 0.80-0.87) compared with the reference group. Nulliparous women with an unknown country of birth had 21% (aOR 0.79, 95% CI 0.71-0.89) reduced odds for epidural use compared with Norwegian born women.

Similar pattern was observed among parous women after adjustment for maternal and fetal characteristics and obstetric factors. Women born in Latin America/Caribbean had 69% (aOR 1.69, 95% CI 1.54-1.87) and women from North America 30% (aOR 1.30, 95% CI 1.14-1.49) increased odds for intrapartum epidural use compared with parous women born in Norway. Reduced odds for intrapartum epidural use was observed among parous women born in Sub-Saharan Africa (aOR 0.62, 95% CI 0.57-0.67) and East Asia Pacific (aOR 0.68, 95% CI 0.64-0.73) compared with Norwegian born women (Table 3).

Education and age

Maternal education had only a minor effect on intrapartum epidural use. Nulliparous and parous women with the lowest educational level had 18 % increased odds for intrapartum epidural use compared with women with secondary or higher educational level.

In the adjusted analysis, younger (<25 years) and older (>30 years) women had 6-15% increased odds for epidural use than nulliparous women in the age of 25-29 years (the reference group). In parous women, the odds for epidural use was 19% increased among the women over 30 years of age compared with the reference group.

Comorbidity

Among nulliparous women, preeclampsia was associated with a two-fold odds for intrapartum epidural use (aOR 2.38, CI 2.29-2.48) compared with women with no preeclampsia.

Gestational hypertension (aOR 1.49 CI 1.42-1.57) and chronic hypertension (aOR 1.28, CI 1.13-1.44) were associated with 49% and 28% increased odds, respectively for the use of epidural. Similar pattern was observed among parous women (preeclampsia: aOR 2.08, 95%

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CI 1.96-2.21). Epilepsy increased the odds for epidural use by 50-64% among nulliparous and parous women.

Infant

The odds for epidural use was three-fold in nulliparous women with stillbirth (aOR 2.98, CI 2.67-3.34) compared with women with live birth. Among parous women with stillbirth, the odds for the intrapartum epidural was five-fold (aOR 5.19, CI 4.51-5.98) compared with multiparous women with live birth. Increased odds for epidural use was observed in all gestational ages of stillbirth (data not shown).

Use of epidural was positively correlated with birthweight. Nulliparous and parous women with an infant birth weight of 4499 grams or more had up to 73% and up to 54% increased odds, respectively, for epidural use compared with women with an infant 3000-3499 grams in birth weight.

Odds for epidural use was three-fold among nulliparous women when the fetus was in breech presentation (aOR 3.08, CI 2.89-3.27), and almost four-fold among parous women (aOR 3.72, CI 3.45-4.00).

Abnormal head presentation was not associated with increased odds for intrapartum epidural use in the adjusted analysis among nulliparous women and was slightly reduced among parous women.

Labor and delivery

In comparison with spontaneous vaginal delivery, vacuum extraction and forceps delivery were associated with 2-3 -fold and 4-5 -fold increased odds for epidural use among nulliparous and parous women, respectively.

Time period

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Epidural use increased across the three time periods in nulliparous and parous women. During the last time period (2010-2014) use of epidural was increased by 50% compared with the first study period (Table 3).

Comment

Our main finding was that women born in different parts of the world used intrapartum pain relief to varying extent. Women from Latin America used intrapartum epidural as pain relief more often than women born in Norway, as women from countries in Sub-Saharan Africa, East Asia and Pacific areas and women with unknown country of birth used intrapartum epidural as pain relief less than Norwegian born women. These differences remained significant after adjustment for maternal, fetal and obstetric factors associated with epidural use.

Different use of epidural may be explained by lacking knowledge of safety related to epidural analgesia among women from different cultural backgrounds, as previous studies have confirmed (7,10,16). Women from different backgrounds may also have different expectations for pain relief during labor and delivery (7,8,16) and have a desire of natural childbirth without medical pain relief (7). Another reason for the difference in effective pain relief during delivery may be that immigrant women may have language barriers hampering the communication with the staff, or the staff may interpret the woman's pain differently than with women without communicational barriers. This may indicate inequality in labor and delivery care services, as previously described when patients from different cultures and ethnicities were compared (9,17). However, in contrast for the reduced use of epidural among women from Sub-Saharan Africa, East Asia and Pacific areas, immigrant women from Latin America were more likely to receive intrapartum epidural pain relief, reducing the likelihood that inferior health care service for pain relief could explain the differences in our study. In the present study, less educated women used more intrapartum epidural than more educated

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women suggesting that there is no social gradient in epidural use. This is in line with a previous study from Finland (4), but in conflict with some other previous studies showing increasing intrapartum epidural use with increasing income and social class (12,18).

Perceived pain is the main indication for intrapartum epidural use. However, significant differences in use of intrapartum epidural were observed between subgroups of women according to maternal comorbidity, delivery method, infant birthweight and presentation.

Both pre-pregnancy comorbidity and pregnancy related morbidity increased the use of intrapartum epidural (preeclampsia, gestational hypertension, epilepsy). Among women with hypertensive disorders, epidural may be used for the reduction of the elevated blood pressure, in line with recommendations in Norwegian national obstetric guidelines.

Increasing likelihood of epidural use was related to factors indicating difficult labor and delivery. Postnatal information, such as infant birthweight, indicate problems related to labor progress, and we observed that increasing birthweight increased the use of epidural, indicating more painful labor, prolonged labor duration or need for augmentation. This is in line with previous observations (19). Women giving birth to an infant in breech presentation also more often had intrapartum epidural, probably due to the Norwegian national guidelines, where epidural has been recommended during vaginal breech delivery since 1995 (paper back, in Norwegian only).

Stillbirth doubled the use of epidural among nulliparous women whereas among parous women odds was five-fold in comparison with live births. This may be due to the deep grief of losing a child, causing increased expectancy for perceiving less painful childbirth.

The present study has several strengths. The population-based design with the large study population, as well as the access for both maternal, fetal and obstetric factors were the main strengths. The data from MBRN is considered being of high quality, reliable and suitable for research purposes (20). We believe that our study results might be generalisable in other

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European settings based on the large number of participants and the unselected study population, including women from different regions in the world.

Weaknesses in the present study were lacking information on labor progress and duration, fetal distress, oxytocin augmentation or duration of epidural use or the timepoint of the application of epidural before birth. Neither did we have information on the women's desire of pain relief or their language skills. These weaknesses are related to the limitations of a register study. The available data is limited to what is collected in the registry, and with no access to patient records, lacking information cannot be collected afterwards. However, assessing the variables related to epidural use, we can speculate that intrapartum epidural was not only used by subjective need for pain relief, but also by medical indications in certain conditions, such as maternal morbidity, stillbirth and factors indicating difficult delivery (large infant and instrumental delivery).

For the best of our knowledge, this is the largest study describing epidural use associated with maternal country of birth, adjusted with factors related to maternal health and obstetric factors. The differences between immigrant women from different parts of the world according to intrapartum epidural as pain relief remained significant after adjusting for the multiple maternal, fetal and obstetrical factors. We can only speculate that the reasons for these differences may be un-measurable issues related to cultural differences, maternal expectations or knowledge of safety on pain relief during childbirth.

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Table 1 The study population. Maternal, fetal and obstetrical characteristics in singleton vaginal deliveries, stratified by parity (N=602 095).

	Nulliparous women % (N= 317 441)	Women with one previous delivery % (N=284 654)
Country of birth by region		
Norway	80.4 (255 250)	81.7 (232 509)
Europe, EEA ¹	7.1 (22 413)	6.0 (17 131)
Europe, non-EEA ²	2.4 (7 550)	2.3 (6 427)
North America ³	0.4 (1 320)	0.4 (1 244)
Latin America/Caribbean ⁴	0.9 (2 770)	0.7 (2 118)
Middle East/North Africa ⁵	1.9 (5 942)	1.8 (5 232)
Sub-Saharan Africa ⁶	1.7 (5 453)	1.8 (5 217)
Transcaucasia/Central Asia ⁷	0.1 (295)	0.1 (257)
South Asia ⁸	1.8 (5 595)	1.9 (5 328)
East Asia Pacific ⁹	2.8 (9 010)	2.7 (7 591)
Oceania ¹⁰	0.1 (208)	0.1 (175)
Unknown country of birth	0.5 (1 635)	0.5 (1 425)
Educational level		
None or compulsory education (gr. 0-10)	15.3 (48 682)	14.2 (40 407)
Secondary education (gr. 11-13)	38.9 (123 581)	30.7 (87 264)
Higher education (Bachelor)	13.3 (42 171)	39.4 (112 160)
Higher education (Master/PhD)	4.1 (12 872)	12.4 (35 211)
Unknown educational level	28.4 (90 135)	3.4 (9612)
Maternal age, years		
<20	5.3 (16 726)	0.4 (1 034)
20-24	25.5 (80 903)	11.3 (32 203)
25-29	38.7 (123 001)	34.6 (98 391)
30-34	23.2 (73 676)	38.3 (108 38.3)
35-39	6.4 (20 245)	13.7 (38 901)
40 or more	0.9 (2 866)	1.8 (5 179)
Preeclampsia	3.7 (11 603)	1.8 (5 099)
Gestational hypertension	2.1 (6 609)	1.3 (3 721)
Chronic hypertension	0.4 (1 183)	0.5 (1 332)
Epilepsy	0.7 (2 249)	0.7 (1 896)
Stillbirth	0.5 (1 467)	0.3 (882)
Birthweight		
<3000	15.8 (50 032)	9.3 (26 544)
3000-3499	36.3 (115 321)	29.0 (82 643)
3500-3999	34.6 (109 776)	38.7(110 096)
4000-4499	11.5 (36 419)	18.6 (53 073)
>4499	1.8 (5 685)	4.3 (12 169)
Fetal presentation		
Cephalic	94.5 (300 086)	95.5 (271 857)
Abnormal head presentation	3.8 (12 213)	3.4 (9 600)
Breech	1.6 (5 142)	1.1 (3 197)
Delivery method		
Spontaneous	83.5 (255 377)	95.1 (270 843)
Vacuum extraction/ventouse	16.4 (52 001)	4.1 (11 740)
Forceps	3.2 (10 063)	0.8 (2 170)
Time period		
1999-2004	35.7 (113 455)	36.7 (104 381)
2005-2009	31.7 (100 638)	31.0 (88 137)
2010-2014	32.6 (103 348)	32.4 (92 136)

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¹**Europe, EEA:** Sweden, Finland, Denmark, Iceland, Cyprus, Bulgaria, Estonia, Croatia, Latvia, Poland, Romania, Lithuania, Slovenia, Hungary, Slovakia, Czech Republic, Belgium, France, Greece, Ireland, Italy, Malta, Netherlands, Liechtenstein, Luxembourg, Portugal, Spain, United Kingdom, Switzerland (not actually in the EEA), Germany, Austria

²**Europe, non-EEA:** , Greenland, Faroe Islands, Albania, Belarus, Moldova, Russia, Turkey, Ukraine, Bosnia-Herzegovina, Macedonia, Serbia, Montenegro, Kosovo, Andorra, Gibraltar, Monaco, San Marino, Vatican City State, Guernsey, Jersey, Isle of Man

³**North America:** Canada, Saint Pierre and Miquelon, United States

⁴**Latin American/Caribbean:** United States Virgin Islands, Barbados, Antigua and Barbuda, Belize, Bahamas, Bermuda, British Virgin Islands, Cayman Islands, Costa Rica, Cuba, Dominica, Dominican Republic, Grenada, Guadeloupe, Guatemala, Haiti, Honduras, Jamaica, Martinique, Mexico, Montserrat, Aruba, Sint Maarten, Bonaire, Sint Eustatius and Saba, Anguilla, Curaçao, Nicaragua, Panama, El Salvador, Saint Kitts og Nevis, Saint Lucia, Saint Vincent and the Grenadines, Trinidad and Tobago, Turks and Caicos Islands, Puerto Rico, Saint Martin, Saint Barthélemy, Argentina, Bolivia, Brazil, Guyana, Chile, Colombia, Ecuador, Falkland Islands, French Guiana, Paraguay, Peru, Suriname, Uruguay, Venezuela

⁵**Middle East/North Africa:** Algeria, Egypt, Djibouti, Libya, Morocco, Tunisia, Bahrain, United Arab Emirates, Iraq, Iran, Israel, Jordan, Kuwait, Lebanon, Oman, Palestine, Qatar, Saudi Arabia, Syria, Yemen

⁶**Sub-Saharan Africa:** Angola, Botswana, Saint Helena, Burundi, Comoros, Benin, Equatorial Guinea, Côte d'Ivoire, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Cameroon, Cape Verde, Kenya, Congo-Brazzaville, Congo, Lesotho, Liberia, Madagascar, Malawi, Mali, Western Sahara, Mauritania, Mauritius, Namibia, Niger, Nigeria, Mozambique, Mayotte, Réunion, Zimbabwe, Rwanda, Sao Tome and Principe, Senegal, Central African Republic, Seychelles, Sierra Leone, Somalia, South Sudan, Sudan, Swaziland, South Africa, Tanzania, Chad, Togo, Uganda, Zambia, Burkina Faso

⁷**Transcaucasia/Central Asia:** Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan

⁸**South Asia:** British Indian Ocean Territory, Afghanistan, Bangladesh, Bhutan, Sri Lanka, India, Maldives, Nepal, Pakistan

⁹**East Asia Pacific:** Brunei, Myanmar, Philippines, Taiwan, Hong Kong, Indonesia, Japan, Cambodia, China, North Korea, South Korea, Laos, Macao, Malaysia, Mongolia, Timor-Leste, Singapore, Thailand, Vietnam, Solomon Islands, Fiji, Vanuatu, Tonga, Kiribati, Tuvalu, Nauru, Federated States of Micronesia, Papua New Guinea, Samoa, Marshall Islands, Palau

¹⁰**Oceania:** American Samoa, Australia, Christmas Island, Cocos (Keeling) Islands, Cook Islands, French Polynesia, Guam, United States Minor Outlying Islands, New Zealand, Niue, Norfolk Island, Pitcairn, Tokelau, Wallis and Futuna Islands, New Caledonia, Northern Mariana Islands

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Table 2 Prevalence of epidural use in subgroups according to maternal, fetal and obstetrical characteristics in singleton vaginal deliveries (N=602 095).

	Nulliparous % (N= 317 441)		Women with one previous delivery % (N=284 654)	
Epidural in the entire study population	41.6 (131 989)	P	19.6 (55 669)	P
Country of birth by region				
Norway	41.2 (105 193)	0.000	16.6 (45 637)	0.000
Europe, EEA ¹	44.6 (9 996)		20.9 (3 582)	
Europe, non-EEA ²	42.6 (3 214)		18.1 (1 162)	
North America ³	48.9 (646)		23.5 (292)	
Latin America/Caribbean ⁴	57.2 (1 584)		30.5 (646)	
Middle East/North Africa ⁵	44.5 (2 647)		19.5 (1 081)	
Sub-Saharan Africa ⁶	39.0 (2 126)		15.3 (799)	
Transcaucasia/Central Asia ⁷	47.5 (140)		18.7 (48)	
South Asia ⁸	42.2 (2 363)		17.8 (950)	
East Asia Pacific ⁹	37.8 (3 402)		15.8 (1 196)	
Oceania ¹⁰	41.8 (87)		24.6 (43)	
Unknown country of birth	36.1 (591)		20.8 (296)	
Educational level				
None or compulsory education (gr. 0-10)	45.1 (21 964)	0.000	21.2 (8 570)	0.000
Secondary education (gr. 11-13)	41.4 (37 285)		19.5 (16 980)	
Higher education (Bachelor)	40.2 (4 983)		19.0 (21 256)	
Higher education (Master/PhD)	41.9 (17 650)		19.9 (7 022)	
Unknown educational level	42.0 (5 407)		19.2 (1841)	
Maternal age, years				
<20	43.0 (7 184)	0.000	18.7 (187)	0.000
20-24	41.0 (33 161)		18.3 (5 901)	
25-29	39.9 (49 112)		18.3 (17 961)	
30-34	43.4 (31 884)		19.9 (21 671)	
35-39	45.9 (9 299)		22.3 (8 671)	
40 or more	46.6 (1 336)		24.5 (1 270)	
Preeclampsia	60.6 (7 027)	0.000	33.3 (1 696)	0.000
No preeclampsia	40.9 (124 962)		19.3 (53 973)	
Gestational hypertension	50.4 (3 334)	0.000	28.9 (1 076)	0.000
No gestational hypertension	41.4 (128 655)		19.4 (54 593)	
Chronic hypertension	50.5 (597)	0.000	28.9 (385)	0.000
No chronic hypertension	41.5 (131 392)		19.5 (55 284)	
Epilepsy	51.6 (1 160)	0.000	28.5 (541)	0.000
No epilepsy	41.5 (130 829)		19.5 (55 128)	
Stillbirth	64.6 (948)	0.000	57.1 (504)	0.000
Livebirth	41.5 (131 041)		19.4 (55 165)	
Birthweight				
<3000	36.1 (18 064)	0.000	19.5 (5 184)	0.000
3000-3499	39.5 (45 609)		19.2 (21 162)	
3500-3999	43.5 (47 725)		17.9 (14 810)	
4000-4499	47.9 (17 442)		21.6 (11 463)	
>4499	54.0 (3 069)		24.9 (3 035)	
Fetal presentation				
Cephalic	40.9 (122 756)	0.000	19.1 (52 006)	0.000
Abnormal head presentation	47.7 (5 829)		21.9 (2 106)	
Breech	66.2 (3 404)		48.7 (1 557)	
Delivery method				
Spontaneous	36.9 (94 313)	0.000	17.9 (48 529)	0.000
Vacuum extraction/ventouse	59.8 (31 105)		50.3 (5 904)	
Forceps	65.3 (6 571)		59.8 (1 298)	
Time period				

Maternal country of birth and epidural during delivery

1999-2004	36.7 (41 634)	0.000	16.6 (17 299)	0.000
2005-2009	41.7 (41 972)		19.7 (17 329)	
2010-2014	46.8 (48 383)		22.8 (21 041)	

¹**Europe, EEA:** Sweden, Finland, Denmark, Iceland, Cyprus, Bulgaria, Estonia, Croatia, Latvia, Poland, Romania, Lithuania, Slovenia, Hungary, Slovakia, Czech Republic, Belgium, France, Greece, Ireland, Italy, Malta, Netherlands, Liechtenstein, Luxembourg, Portugal, Spain, United Kingdom, Switzerland (not actually in the EEA), Germany, Austria

²**Europe, non-EEA:** , Greenland, Faroe Islands, Albania, Belarus, Moldova, Russia, Turkey, Ukraine, Bosnia-Herzegovina, Macedonia, Serbia, Montenegro, Kosovo, Andorra, Gibraltar, Monaco, San Marino, Vatican City State, Guernsey, Jersey, Isle of Man

³**North America:** Canada, Saint Pierre and Miquelon, United States

⁴**Latin American/Caribbean:** United States Virgin Islands, Barbados, Antigua and Barbuda, Belize, Bahamas, Bermuda, British Virgin Islands, Cayman Islands, Costa Rica, Cuba, Dominica, Dominican Republic, Grenada, Guadeloupe, Guatemala, Haiti, Honduras, Jamaica, Martinique, Mexico, Montserrat, Aruba, Sint Maarten, Bonaire, Sint Eustatius and Saba, Anguilla, Curaçao, Nicaragua, Panama, El Salvador, Saint Kitts og Nevis, Saint Lucia, Saint Vincent and the Grenadines, Trinidad and Tobago, Turks and Caicos Islands, Puerto Rico, Saint Martin, Saint Barthélemy, Argentina, Bolivia, Brazil, Guyana, Chile, Colombia, Ecuador, Falkland Islands, French Guiana, Paraguay, Peru, Suriname, Uruguay, Venezuela

⁵**Middle East/North Africa:** Algeria, Egypt, Djibouti, Libya, Morocco, Tunisia, Bahrain, United Arab Emirates, Iraq, Iran, Israel, Jordan, Kuwait, Lebanon, Oman, Palestine, Qatar, Saudi Arabia, Syria, Yemen

⁶**Sub-Saharan Africa:** Angola, Botswana, Saint Helena, Burundi, Comoros, Benin, Equatorial Guinea, Côte d'Ivoire, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Cameroon, Cape Verde, Kenya, Congo-Brazzaville, Congo, Lesotho, Liberia, Madagascar, Malawi, Mali, Western Sahara, Mauritania, Mauritius, Namibia, Niger, Nigeria, Mozambique, Mayotte, Réunion, Zimbabwe, Rwanda, Sao Tome and Principe, Senegal, Central African Republic, Seychelles, Sierra Leone, Somalia, South Sudan, Sudan, Swaziland, South Africa, Tanzania, Chad, Togo, Uganda, Zambia, Burkina Faso

⁷**Transcaucasia/Central Asia:** Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan

⁸**South Asia:** British Indian Ocean Territory, Afghanistan, Bangladesh, Bhutan, Sri Lanka, India, Maldives, Nepal, Pakistan

⁹**East Asia Pacific:** Brunei, Myanmar, Philippines, Taiwan, Hong Kong, Indonesia, Japan, Cambodia, China, North Korea, South Korea, Laos, Macao, Malaysia, Mongolia, Timor-Leste, Singapore, Thailand, Vietnam, Solomon Islands, Fiji, Vanuatu, Tonga, Kiribati, Tuvalu, Nauru, Federated States of Micronesia, Papua New Guinea, Samoa, Marshall Islands, Palau

¹⁰**Oceania:** American Samoa, Australia, Christmas Island, Cocos (Keeling) Islands, Cook Islands, French Polynesia, Guam, United States Minor Outlying Islands, New Zealand, Niue, Norfolk Island, Pitcairn, Tokelau, Wallis and Futuna Islands, New Caledonia, Northern Mariana Islands

Maternal country of birth and epidural during delivery

Table 3 Maternal, fetal and obstetrical factors associated with use of epidural pain relief during vaginal delivery, crude and adjusted OR and 95% confidence intervals (N=602 095).

Maternal, fetal and obstetrical factors	Nulliparous (N=317 441)		Women with one previous delivery (N=284 654)	
	OR (CI)	aOR (CI)	OR (CI)	aOR (CI)
Country of birth by region				
Norway	Ref	Ref	Ref	Ref
Europe, EEA ¹	1.15 (1.12-1.18)	1.09 (1.05-1.12)	1.08 (1.04-1.13)	1.00 (0.96-1.05)
Europe, non-EEA ²	1.06 (1.01-1.11)	1.04 (0.99-1.09)	0.90 (0.84-0.96)	0.85 (0.80-0.91)
North America ³	1.37 (1.23-1.52)	1.39 (1.25-1.56)	1.26 (1.01-1.43)	1.30 (1.14-1.49)
Latin America/Caribbean ⁴	1.91 (1.77-2.06)	1.93 (1.79-2.09)	1.79 (1.64-1.97)	1.69 (1.54-1.87)
Middle East/North Africa ⁵	1.15 (1.09-1.21)	1.14 (1.08-1.21)	0.99 (0.92-1.06)	0.93 (0.86-1.00)
Sub-Saharan Africa ⁶	0.91 (0.86-0.96)	0.83 (0.78-0.88)	0.74 (0.69-0.80)	0.62 (0.57-0.67)
Transcaucasia/Central Asia ⁷	1.29 (1.03-1.62)	1.27 (1.00-1.60)	0.94 (0.69-1.29)	0.91 (0.66-1.26)
South Asia ⁸	1.04 (0.99-1.10)	1.06 (1.00-1.26)	0.89 (0.83-0.95)	0.84 (0.77-0.90)
East Asia Pacific ⁹	0.87 (0.83-0.90)	0.83 (0.80-0.87)	0.77 (0.72-0.82)	0.68 (0.64-0.73)
Oceania ¹⁰	1.03 (0.78-1.35)	0.97 (0.73-1.29)	1.33 (0.95-1.88)	1.25 (0.88-1.78)
Unknown country of birth	0.81 (0.73-0.89)	0.79 (0.71-0.89)	1.07 (0.94-1.22)	0.97 (0.84-1.13)
Educational level				
None/compulsory (gr. 0-10)	1.17 (1.14-1.19)	1.18 (1.15-1.21)	1.11 (1.08-1.15)	1.18 (1.14-1.21)
Secondary (gr. 11-14)	Ref	Ref	Ref	Ref
Higher education (Bachelor)	0.95 (0.94-0.97)	0.92 (0.91-0.94)	0.97 (0.95-0.99)	0.92 (0.90-0.94)
High education (Master/PhD)	1.02 (1.00-1.04)	0.92 (0.91-0.96)	1.03 (1.00-1.06)	0.93 (0.90-0.96)
Unknown educational level	1.03 (0.99-1.07)	0.97 (0.93-1.01)	0.98 (0.93-1.03)	0.97 (0.91-1.04)
Maternal age, years				
<25	1.06 (1.04-1.08)	1.06 (1.04-1.08)	1.00 (0.97-1.04)	0.99 (0.96-1.03)
25-29	Ref	Ref	Ref	Ref
30-34	1.15 (1.13-1.17)	1.10 (1.08-1.12)	1.11 (1.09-1.14)	1.09 (1.06-1.11)
35 or more	1.28 (1.25-1.32)	1.15 (1.12-1.19)	1.30 (1.27-1.34)	1.19 (1.15-1.22)
Preeclampsia	2.22 (2.14-2.31)	2.38 (2.29-2.48)	2.08 (1.96-2.21)	2.08 (1.96-2.21)
Gestational hypertension	1.44 (1.37-1.51)	1.49 (1.42-1.57)	1.69 (1.57-1.81)	1.67 (1.55-1.79)
Chronic hypertension	1.43 (1.28-1.61)	1.28 (1.13-1.44)	1.68 (1.49-1.89)	1.47 (1.30-1.66)
Epilepsy	1.50 (1.38-1.63)	1.50 (1.37-1.63)	1.65 (1.49-1.82)	1.64 (1.48-1.82)
Stillbirth	2.58 (2.32-2.87)	2.98 (2.67-3.34)	5.53 (4.83-6.32)	5.19 (4.51 -5.98)
Birthweight				
<3000	0.86 (0.85-0.88)	0.81 (0.79-0.82)	1.11 (1.07-1.15)	0.99 (0.96-1.03)
3000-3499	Ref	Ref	Ref	Ref
3500-3999	1.18 (1.16-1.20)	1.18 (1.16-1.20)	1.09 (1.06-1.12)	1.10 (1.07-1.13)
4000-4499	1.41 (1.37-1.44)	1.39 (1.35-1.42)	1.26 (1.23-1.29)	1.28 (1.24-1.31)
>4499	1.79 (1.70-1.89)	1.73 (1.63-1.82)	1.52 (1.46-1.59)	1.54 (1.47-1.61)
Fetal presentation				
Cephalic	Ref	Ref	Ref	Ref
Abnormal head presentation	1.32 (1.27-1.37)	1.00 (0.96-1.04)	1.19 (1.13-1.25)	0.90 (0.85-0.95)
Breech	2.83 (1.32-1.37)	3.08 (2.89-3.27)	4.01 (3.74-4.31)	3.72 (3.45-4.00)

Maternal country of birth and epidural during delivery

Delivery method				
Vacuum extraction/ventouse	2.43 (2.38-2.48)	2.46 (2.41-2.51)	4.54 (4.37-4.71)	4.54 (4.37-4.71)
Forceps	2.70 (2.62-2.85)	2.87 (2.75-2.99)	6.25 (5.73-6.81)	5.24 (4.85-5.67)
Time period				
1999-2004	Ref	Ref	Ref	Ref
2005-2009	1.23 (1.21-1.26)	1.25 (1.22-1.27)	1.23 (1.20-1.26)	1.26 (1.23-1.29)
2010-2014	1.52 (1.49-1.55)	1.53 (1.50-1.56)	1.49 (1.46-1.52)	1.53 (1.49-1.56)

¹**Europe, EEA:** Sweden, Finland, Denmark, Iceland, Cyprus, Bulgaria, Estonia, Croatia, Latvia, Poland, Romania, Lithuania, Slovenia, Hungary, Slovakia, Czech Republic, Belgium, France, Greece, Ireland, Italy, Malta, Netherlands, Liechtenstein, Luxembourg, Portugal, Spain, United Kingdom, Switzerland (not actually in the EEA), Germany, Austria

²**Europe, non-EEA:** Greenland, Faroe Islands, Albania, Belarus, Moldova, Russia, Turkey, Ukraine, Bosnia-Herzegovina, Macedonia, Serbia, Montenegro, Kosovo, Andorra, Gibraltar, Monaco, San Marino, Vatican City State, Guernsey, Jersey, Isle of Man

³**North America:** Canada, Saint Pierre and Miquelon, United States

⁴**Latin American/Caribbean:** United States Virgin Islands, Barbados, Antigua and Barbuda, Belize, Bahamas, Bermuda, British Virgin Islands, Cayman Islands, Costa Rica, Cuba, Dominica, Dominican Republic, Grenada, Guadeloupe, Guatemala, Haiti, Honduras, Jamaica, Martinique, Mexico, Montserrat, Aruba, Sint Maarten, Bonaire, Sint Eustatius and Saba, Anguilla, Curaçao, Nicaragua, Panama, El Salvador, Saint Kitts og Nevis, Saint Lucia, Saint Vincent and the Grenadines, Trinidad and Tobago, Turks and Caicos Islands, Puerto Rico, Saint Martin, Saint Barthélemy, Argentina, Bolivia, Brazil, Guyana, Chile, Colombia, Ecuador, Falkland Islands, French Guiana, Paraguay, Peru, Suriname, Uruguay, Venezuela

⁵**Middle East/North Africa:** Algeria, Egypt, Djibouti, Libya, Morocco, Tunisia, Bahrain, United Arab Emirates, Iraq, Iran, Israel, Jordan, Kuwait, Lebanon, Oman, Palestine, Qatar, Saudi Arabia, Syria, Yemen

⁶**Sub-Saharan Africa:** Angola, Botswana, Saint Helena, Burundi, Comoros, Benin, Equatorial Guinea, Côte d'Ivoire, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Cameroon, Cape Verde, Kenya, Congo-Brazzaville, Congo, Lesotho, Liberia, Madagascar, Malawi, Mali, Western Sahara, Mauritania, Mauritius, Namibia, Niger, Nigeria, Mozambique, Mayotte, Réunion, Zimbabwe, Rwanda, Sao Tome and Principe, Senegal, Central African Republic, Seychelles, Sierra Leone, Somalia, South Sudan, Sudan, Swaziland, South Africa, Tanzania, Chad, Togo, Uganda, Zambia, Burkina Faso

⁷**Transcaucasia/Central Asia:** Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan

⁸**South Asia:** British Indian Ocean Territory, Afghanistan, Bangladesh, Bhutan, Sri Lanka, India, Maldives, Nepal, Pakistan

⁹**East Asia Pacific:** Brunei, Myanmar, Philippines, Taiwan, Hong Kong, Indonesia, Japan, Cambodia, China, North Korea, South Korea, Laos, Macao, Malaysia, Mongolia, Timor-Leste, Singapore, Thailand, Vietnam, Solomon Islands, Fiji, Vanuatu, Tonga, Kiribati, Tuvalu, Nauru, Federated States of Micronesia, Papua New Guinea, Samoa, Marshall Islands, Palau

¹⁰**Oceania:** American Samoa, Australia, Christmas Island, Cocos (Keeling) Islands, Cook Islands, French Polynesia, Guam, United States Minor Outlying Islands, New Zealand, Niue, Norfolk Island, Pitcairn, Tokelau, Wallis and Futuna Islands, New Caledonia, Northern Mariana Islands