

Obstetric anal sphincter injury by maternal origin and length of residence: a nationwide cohort study

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Objective To estimate the association between maternal origin and obstetric anal sphincter injury (OASI), and assess if associations differed by length of residence.

Design Population-based cohort study.

Setting The Medical Birth Registry of Norway.

Population Primiparous women with vaginal livebirth of a singleton cephalic fetus between 2008 and 2017 ($n = 188\,658$).

Methods Multivariable logistic regression models estimated adjusted odds ratios (aORs) for OASI with 95% CI by maternal region of origin and birthplace. We stratified models on length of residence and paternal birthplace.

Main outcome measures OASI.

Results Overall, 6373 cases of OASI were identified (3.4% of total cohort). Women from South Asia were most likely to experience OASI (6.2%; aOR 2.24, 95% CI 1.87–2.69), followed by those from Southeast Asia, East Asia & the Pacific (5.7%; 1.59, 1.37–1.83) and Sub-Saharan Africa (5.2%; 1.85, 1.55–2.20), compared with women originating from Norway. Among women born in the same region, those with short length of residence in Norway

(0–4 years), showed the highest odds of OASI. Migrant women across most regions of origin had the lowest risk of OASI if they had a Norwegian partner.

Conclusions Primiparous women from Asian regions and Sub-Saharan Africa had up to two-fold risk of OASI, compared with women originating from Norway. Migrants with short residence and those with a foreign-born partner had higher risk of OASI, implying that some of the risk differential is due to sociocultural factors. Some migrants, especially new arrivals, may benefit from special attention during labour to reduce morbidity and achieve equitable outcomes.

Keywords Delivery, obstetric, length of residence, maternal birthplace, maternal origin, migrant, obstetric anal sphincter injury.

Tweetable abstract Anal sphincter injury during birth is more common among Asian and Sub-Saharan migrants and particularly among recent arrivals.

Linked article This article is commented on by M-L Marschalek, p. 432 in this issue. To view this mini commentary visit <https://doi.org/10.1111/1471-0528.16991>.

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Introduction

Obstetric anal sphincter injury (OASI) can be a serious complication of vaginal birth, causing anal incontinence, perineal pain, dyspareunia and increased rates of caesarean section in subsequent deliveries.^{1,2} Primiparity, fetal macrosomia, operative vaginal delivery, midline versus lateral

episiotomy, prolonged second stage, epidural analgesia and increasing maternal age are well-known risk factors for OASI.^{3–5} However, incidence varies significantly between populations and time periods (0.6–6.6%) and this variance has not been fully explained by known risk factors.^{4–7}

Several studies have reported an association between ethnicity and risk for OASI.^{8–15} Asian women, in particular, have been shown to have an up to four-fold increased risk of OASI.^{16,17} Anatomical differences, such as shorter

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perineal length in Asian women, have been suggested to contribute towards ethnic differences in risk of OASI. However, studies are inconclusive, because they are based on few cases and are retrospective in design.^{18–20} Asian women living in Asia experience a lower risk of OASI compared with Asian migrants living in high-income countries.^{21,22} For this reason, migration-specific factors, rather than ethnic factors, presumably explain at least part of the observed pattern.

We know that subgroups of migrants have an increased risk across a range of adverse maternal outcomes compared with host populations.^{23,24} These disparities are likely to result from a complex interplay of multiple factors, including substandard health care before migration, limited health literacy, language barriers and suboptimal care after migration.²⁵ The risk is expected to be more pronounced among those with a short length of residence in the host country.²⁶ Post-migration influences, such as changes in socio-economic status, lifestyle, diet, maternal body mass index (BMI) and infant size as well as paternal influences have the potential to influence the risk of OASI, both directly and through other known risk factors.^{27,28}

Few studies have explored how migration-related factors affect the risk of OASI. The primary aim in this study was to estimate the total association between maternal region of origin and birthplace with OASI. Second, we explored whether the association changed across different lengths of residence; lastly, we explored whether associations altered with paternal birthplace. We studied these associations in a nationwide population-based linked registry study with complete coverage of births, within a framework of public universal free maternity care in Norway.

Methods

Data sources

We used data from the Medical Birth Registry of Norway (MBRN) linked to the National Population Register between 2008 and 2017. The MBRN includes all pregnancies ending after gestational week 12, and provides information about maternal pre-pregnancy health, pregnancy and delivery complications and offspring health.²⁹ The National Population Register includes information on maternal and paternal country of birth and country of origin, highest completed education, immigration status, reason for immigration and length of residence in Norway. Information from the two registries was linked using the woman's unique person identification number.

We included all primiparous women with a vaginal live birth of a singleton cephalic fetus weighing 500 g or more between 2008 and 2017 ($n = 192\,881$). Women with pregnancies ending before 20 or after 44 completed gestational weeks or with missing information on gestational length were

excluded ($n = 1139$). We also omitted women with missing information on country of birth ($n = 1481$) and foreign-born women with two Norwegian-born parents ($n = 1633$), leaving 188 658 pregnancies for study (97.8% of total deliveries).

The main outcome measure was the occurrence of OASI, as registered in the MBRN. The attending midwife codes OASI by checking a tick box in the standardised form sent to MBRN within 1 week after birth. The variable in MBRN has been validated with a satisfactory result.³⁰ The definition of OASI is based on a modified version of Sultan³¹ as adapted by the Royal College of Obstetricians and Gynaecologists.

Two levels of exposure were evaluated. The first was maternal region of origin, defined as the women's ethnic origin, as determined by the birthplace of her parents. The second was the women's birthplace, defined as the country where she was born. We used the Global Burden of Disease framework,³² based on epidemiological similarity and geographic closeness, to classify maternal origin into the following regions: women originating from Norway (Norway); women originating from other high-income countries (High-income countries) and women originating from low- or middle-income countries into the following regions Europe & Central Asia; Sub-Saharan Africa; North Africa & the Middle East; South Asia; South East Asia, East Asia & the Pacific and Latin America & the Caribbean.

Length of residence in Norway was calculated as the time interval between the year of first immigration to Norway and the year of delivery and categorised as birth before lawful residence/negative length of residence, 0–4 years and ≥ 5 years. Newly arrived migrants that were lawfully registered were defined as having a length of residence from 0 to 4 years. Women giving birth in Norway before lawful immigration are registered as having a negative length of residence. Since 2008, the case processing time for new arrivals in Norway has increased, causing a delay in the registration. Consequently, a higher proportion of women (19.1%, $n = 8785$) are registered with negative values in more recent years. Most women in this group migrated to Norway for family reunion.

We included sociodemographic covariates such as maternal age, marital status (married, not married), maternal completed educational level (none, primary, secondary, university/college, missing) and year of delivery. We also evaluated pre-pregnancy BMI in kg/m^2 (<18.5 , 18.5 – 24.9 , ≥ 25.0 , missing), maternal height, smoking at the end of pregnancy, macrosomia (birthweight ≥ 4500 g) paternal/partner's birthplace (Norwegian-born versus foreign-born) and Norwegian health regions (Southeast, West, Mid and North).

Statistical analysis

We applied univariable and multivariable logistic regression analyses to examine the associations between maternal region of origin and birthplace with OASI and present the results as odds ratio (OR) and adjusted odds ratio (aOR)

with 95% CI. Maternal pre-pregnancy BMI was partially registered in the MBRN from 2006 onwards, resulting in a high proportion of missing values at the beginning of the study period (62.1% in 2008 to 12.1% in 2016). The completeness of pre-pregnancy BMI did not differ by the exposure or outcome variables, so we included a separate category for women with missing values.

First, we estimated the association between maternal birthplace and OASI using Norwegian-born women as the reference group. Second, we estimated the association between maternal region of origin and OASI. Further analyses of the association between maternal region of origin and OASI were restricted to migrant/foreign-born women. In these analyses, the reference group comprised women born in high-income countries. We used stratified analysis to explore if the association between maternal origin and OASI differed by length of residence in Norway or by paternal birthplace. We used post-estimation command to test if the effect estimates differed between strata of length of residence or paternal birthplace. Maternal age, education, marital status, pre-pregnancy BMI, maternal height, smoking, macrosomia and year of delivery were included as covariates in the adjusted models. We included year of delivery as a covariate to adjust for trends in OASI within the study period. Because of large variations in the registration of pre-pregnancy BMI among Norwegian health regions, we also adjusted for health region. To avoid overestimation bias, we did not include episiotomy, instrumental delivery or epidural in the models because they are considered potential intermediaries on the path between exposure and outcome.³³ These variables are also highly intercorrelated.

Additionally, we performed three sensitivity analyses with OASI as the outcome. First, we restricted the analysis to non-operative vaginal deliveries (79.2%) as an attempt to account for the high rate of OASI observed in women with an instrumental delivery (vacuum or forceps) as operative vaginal delivery was considered a potential intermediary between maternal origin and OASI. Second, women giving birth to a newborn whose head circumference was above the 90th centile were excluded (14.8%). Third, we performed a complete case analysis excluding women with missing pre-pregnancy BMI (39.5%).

Data were analysed using Stata IC version 16.0 (Stata Statistical Software, College Station, TX, USA). Patient involvement was not considered relevant because this was a registry study. No core outcome set has been used in the study.

Results

Between 2008 and 2017 there were 188 658 singleton vaginal deliveries in Norway, out of which 24.3% ($n = 45\ 923$) were among foreign-born women. Table 1 displays the distribution of characteristics by OASI and maternal birthplace.

Foreign-born women were less frequently overweight. The proportion of macrosomia was lower among neonates born to foreign-born women compared with Norwegian-born women ($P = 0.000$). Mean head circumference of neonates of foreign-born women with OASI did not differ from that of neonates of Norwegian-born women without OASI ($P = 0.000$). Compared with Norwegian-born women, higher proportions of foreign-born women had an instrumental vaginal delivery (23.4 and 19.9%, respectively), and this was the case for both the OASI and the no OASI groups. Episiotomy was more frequent among foreign-born women overall in both the OASI and the no OASI groups. However, we found large variations in epidural use, instrumental deliveries and episiotomy by maternal region of origin. The highest prevalence of epidural use was observed among women from Latin America & the Caribbean (63.7%), whereas women from Sub-Saharan Africa had the lowest prevalence (42.7%). South Asian women had the highest prevalence of an instrumental delivery (27.0%) and Norwegian women had the lowest (19.9%). Prevalence of episiotomy was highest among Sub-Saharan women (46.7%) and lowest among women from Latin America & the Caribbean (28.6%). During the period of study, the proportion of births to foreign-born women increased from 19.1 to 29.6% (data not shown).

The overall prevalence of OASI was 3.4%. Between 2008 and 2017, OASI rates decreased for both Norwegian-born and foreign-born primiparous women, with the largest decrease in Norwegian-born women (Figure S1). We found large variations in the rates of OASI by year of birth for women originating from South Asia, Southeast Asia, East Asia & the Pacific and Sub-Saharan Africa. We also observed large variations in the proportions of OASI when looking at the three largest country groups within each region (Table S1). For instance, within the South Asian region where Pakistani, Indian and Nepalese women constituted the largest groups, Indian women had the highest OASI rate with 9.9%, followed by Pakistani (4.9%) and Nepalese (4.2%) women. Similarly, within the Southeast Asia, East Asia & the Pacific region where the Philippines, Thailand and Vietnam constituted the largest groups, Vietnamese women had the highest rate of OASI with (7.4%), followed by Philippine (6.5%) and Thai (5.7%) women. However, the absolute numbers of OASI in some of the groups were small.

Comparing all migrant women with non-migrant women, migrants were more likely to have an OASI compared with Norwegian-born women, adjusting for maternal age, education, pre-pregnancy BMI, maternal height, smoking, macrosomia, health region and year of delivery (aOR 1.13, 95% CI 1.04–1.23) (data not shown). Women originating from South Asia (6.21%), Southeast Asia, East Asia & the Pacific (5.73%) and Sub-Saharan Africa (5.20%) had the highest crude incidences of OASI (Figure 1). Compared with women originating from Norway, women originating

Table 1. Characteristics among 188 658 primiparous women by OASI and maternal birthplace, 2008–17

Characteristic	OASI, <i>n</i> = 6373 (3.4%)		No OASI, <i>n</i> = 182 285 (96.6%)	
	Norwegian-born ^a <i>n</i> = 4608 72.30%	Foreign-born ^b <i>n</i> = 1765 27.70%	Norwegian-born <i>n</i> = 138 127 (75.8%)	Foreign-born <i>n</i> = 44 158 (24.2%)
Maternal age, mean (SD)	28.3 (4.5)**	28.3 (4.5)*	27.4 (4.9)	28.1 (4.8)*
Norwegian Health regions, <i>n</i> (%)				
Southeast	2260 (49.1)	957 (54.2)	74 516 (54.0)	27 397 (62.0)
West	1249 (27.1)	460 (26.1)	31 691 (22.9)	9449 (21.4)
Mid	730 (15.8)	225 (12.8)	20 003 (14.5)	4624 (10.5)
North	369 (8.0)	123 (7.0)	11 917 (8.6)	2688 (6.1)
Educational level				
No education	–	21 (1.2)	–	246 (0.6)
Primary (1–10 years)	391 (8.5)	285 (16.2)	18 376 (13.3)	7471 (16.9)
Secondary (11–13 years)	1155 (25.1)	298 (16.9)	35 917 (26.0)	7411 (16.8)
University, college (14–20 years)	3056 (66.3)	749 (42.4)	83 620 (60.5)	18 262 (41.4)
Missing information	6 (0.1)	412 (23.3)	214 (0.2)	10 768 (24.4)
Married	4275 (92.8)	1621 (91.8)	124 411 (90.1)	42 017 (91.5) [§]
Pre-pregnancy BMI (kg/m ²)				
<18.5	99 (2.2)	105 (6.0)	3453 (2.5)	2383 (5.4)
18.5–24.9	1647 (35.7)	766 (43.4)	53 599 (38.8)	19 681 (44.6)
25.0–29.9	570 (12.4)	143 (8.1)	16 845 (12.2)	4169 (9.4)
≥30.0	296 (6.4)	59 (3.3)	8939 (6.5)	1325 (3.0)
Missing information	1996 (43.3)	692 (39.2)	55 291 (40.3)	16 600 (37.6)
Maternal smoking ^c	173 (3.8) [§]	21 (1.2)	8015 (5.8) [§]	1246 (2.8)
Maternal region of origin (GBD)				
Norway	4093 (88.8)	–	120 939 (87.6)	–
High-income countries	358 (7.8)	273 (15.5)	12 667 (9.2)	9346 (21.2)
Europe & Central Asia	23 (0.5)	461 (26.1)	923 (0.7)	16 154 (36.6)
Sub-Saharan Africa	12 (0.3)	247 (14.0)	456 (0.3)	4261 (9.7)
North Africa & Middle East	30 (0.7)	217 (12.3)	886 (0.6)	5573 (12.6)
South Asia	60 (1.3)	141 (8.0)	1025 (0.7)	2011 (4.6)
Southeast Asia, East Asia & the Pacific	23 (0.5)	379 (21.5)	1017 (0.7)	5594 (12.7)
Latin America & Caribbean	9 (0.2)	47 (2.7)	214 (0.2)	1219 (2.8)
Length of residence				
<0 years		321 (18.2)		8463 (19.2)
0–5 years		947 (53.7) [§]		22 503 (51.0)
≥5 years		497 (28.2)		13 192 (29.9)
Paternal birthplace				
Norwegian-born	4175 (90.6)	532 (30.1)	123 324 (89.3)	13 576 (30.7)
Foreign-born	342 (7.4)	1125 (63.7) [§]	12 260 (8.9)	28 143 (63.7) [§]
Missing	91 (2.0)	108 (6.1)	2543 (1.8)	2439 (5.5)
Episiotomy	1582 (34.3)	663 (37.6) [#]	44 752 (32.4)	15 461 (35.0) [§]
Epidural	2082 (45.2)	819 (46.4)	63 814 (46.2)	21 569 (48.9)
Instrumental delivery	1706 (37.0)	752 (42.6) [§]	26 705(19.3)	10 003 (22.7) [§]
Macrosomia, ≥4500 g	187 (4.1) [§]	47 (2.7)	1952 (14) [§]	459 (1.0)
Newborn birthweight (g), mean (SD)	3699.9 (449.2)***	3557.5 (466.5)	3459.8 (486.1)	3373.6 (479.3)
Head circumference (cm), mean (SD)	35.6 (1.5) ^{##}	35.1 (1.6) ^{###}	35.0 (1.8)	34.7 (1.7) ^{##}

GBD, Global Burden of Disease; SD, standard deviation.

^aNorwegian-born women with two Norwegian born parents, Norwegian-born women with two foreign-born parents and Norwegian-born women with one foreign-born parent.

^bForeign-born women with two foreign-born parents and foreign-born women with one Norwegian-born parent.

^cMissing range 10.0–17.1%.

**P* = 0.000 compared with no-OASI, Norwegian-born.

***P* = 0.000 compared with no-OASI groups.

****P* = 0.000 compared with all other groups.

[§]*P* = 0.000.

[#]*P* = 0.016.

^{##}*P* = 0.000 compared with no-OASI, Norwegian-born and foreign-born.

^{###}*P* = 0.000 compared with no-OASI, foreign-born and OASI, Norwegian-born.

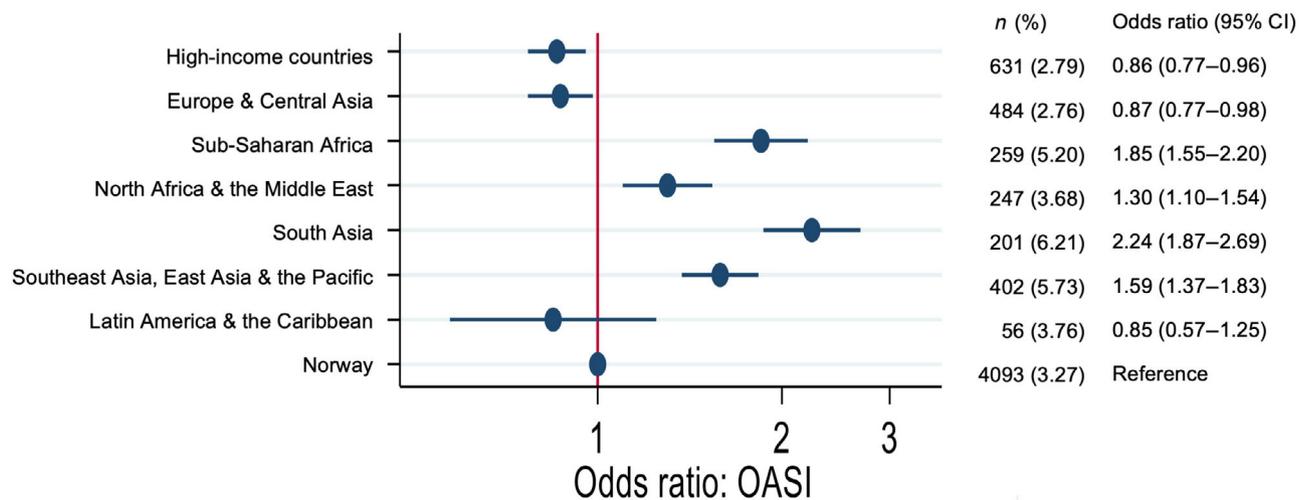


Figure 1. Odds ratio of OASI according to maternal region of origin. The dot and capped line represent point estimates and 95% CI, respectively, of odds ratio of having OASI according to maternal region of origin. Reference group comprised women from Norway. Estimates are adjusted for maternal age, education, year of delivery, pre-pregnancy BMI, maternal height, marital status, smoking, macrosomia and health region ($n = 121\ 85$).

from South Asia (aOR 2.24, 95% CI 1.87–2.69), Sub-Saharan Africa (aOR 1.85, 95% CI 1.55–2.20), Southeast Asia, East Asia & the Pacific (aOR 1.59, 95% CI 1.37–1.83) and North Africa & the Middle East (aOR 1.30, 95% CI 1.10–1.54), were more likely to have an OASI (Figure 1). In separate analyses restricted to migrants/foreign-born women, we observed similar associations between region of origin and OASI, but with higher risk estimates, compared with women from high-income countries (Table 2).

The association between OASI and region of origin among foreign-born women was further stratified by length of residence in Norway (Table 3). Among women born in the same region, we found the highest risk estimates for OASI in newly arrived migrants. The adjusted odds ratio for OASI among newly arrived migrant women born in South Asia was 4.09 (96% CI 2.82–5.92), whereas South Asian migrant women with residence at or above 5 years

had an aOR of 2.00 (95% 1.23–3.26), both compared with women from high-income countries. Our results were similar in newly arrived migrants born in Sub-Saharan Africa and Southeast Asia, East Asia & the Pacific.

We found the highest odds ratios of OASI among women with a foreign-born partner in four out of seven regions (Table S2). Among South Asian women, those with a foreign-born partner had the highest odds of OASI of all groups (aOR 2.82; 95% CI 2.14–3.72) and those with a Norwegian-born partner had an odds ratio of 2.04 (95% CI 1.46–2.85), both compared with Norwegian women. The small number of women in the Latin America & the Caribbean group means that estimates must be interpreted with caution.

In the first sensitivity analysis evaluating the association between maternal region of origin in women with non-operative vaginal deliveries only, women from high-income

Table 2. Association between maternal region of origin with OASI among foreign-born women, 2008–17 ($n = 45\ 923$)

Exposure	n (%)	Cases (%)	Unadjusted		Adjusted OR*	
			OR	95% CI	OR	95% CI
Maternal region of origin (GBD)						
High-income countries	9619 (20.9)	273 (2.8)	Reference		Reference	
Europe & Central Asia	16 615 (36.2)	461 (2.8)	0.98	0.84–1.14	1.06	0.87–1.28
Sub-Saharan Africa	4508 (9.8)	247 (5.5)	1.98	1.66–2.37	2.23	1.74–2.86
North Africa & the Middle East	5790 (12.6)	217 (3.8)	1.33	1.11–1.60	1.53	1.21–1.95
South Asia	2152 (4.7)	141 (6.6)	2.4	1.95–2.96	2.82	2.15–3.70
Southeast Asia, East Asia & the Pacific	5973 (13.0)	379 (6.4)	2.32	1.98–2.72	2.08	1.66–2.60
Latin America & the Caribbean	1266 (27.6)	47 (3.7)	1.32	0.96–1.81	0.99	0.63–1.55

GBD, Global Burden of Disease.

*Adjusted for: maternal age, education, marital status, pre-pregnancy body mass index, maternal height, smoking, macrosomia, health region and year of delivery.

Table 3. Association between maternal region of origin with OASI by length of residence among foreign-born women, 2008–17 (*n* = 45 923)

Length of residence	Birth before lawful residence						0–4 years						≥5 years					
	<i>n</i> = 8784 (19.1%)						<i>n</i> = 23 450 (51.1%)						<i>n</i> = 13 689 (29.8%)					
	Unadjusted	95% CI	OR	Adjusted	95% CI	Reference	Unadjusted	95% CI	OR	Adjusted	95% CI	Reference	Unadjusted	95% CI	OR	Adjusted	95% CI	
Maternal region of origin (GBD)	Reference			Reference			Reference			Reference			Reference			Reference		
High-income countries	0.93	0.64–1.35	0.98	0.59–1.61	1.15	0.92–1.44	1.26	0.94–1.69	0.83	0.64–1.08	0.91	0.66–1.24						
Europe & Central Asia	2.67	1.80–3.95	1.88	0.98–3.61	2.24	1.72–2.91	2.87	1.99–4.13	1.38	0.99–1.90	1.52	1.00–2.33						
Sub-Saharan Africa	1.46	0.95–2.26	1.58	0.87–2.87	1.65	1.26–2.15	1.92	1.35–2.74	0.95	0.69–1.31	1.05	0.70–1.57						
North Africa & the Middle East	2.1	1.19–3.68	0.8	0.27–2.40	3.15	2.37–4.18	4.09	2.82–5.92	1.53	1.01–2.34	2	1.23–3.26						
South Asia	3.13	2.09–4.68	3.01	1.66–5.47	2.58	2.03–3.27	2.61	1.86–3.67	1.84	1.42–2.38	1.49	1.04–2.13						
Southeast Asia, East Asia & the Pacific	0.95	0.40–2.26	0.58	0.13–2.51	1.59	1.03–2.44	1.27	0.69–2.35	1.24	0.71–2.18	1.04	0.47–2.29						
Latin America & the Caribbean																		

GBD, Global Burden of Disease. Adjusted for: maternal education, marital status, pre-pregnancy body mass index, smoking, maternal height, smoking, macrosomia, health regions and year of delivery.

regions and Europe & Central Asia were less likely to sustain an OASI (aOR 0.82, 95% CI 0.74–0.92; and aOR 0.79, 95% CI 0.69–0.90, respectively) compared with Norwegian women. Women from Asian and African regions including the Middle East were more likely to sustain an OASI with similar risk estimates, as shown in Figure 1. In the second sensitivity analysis excluding women giving birth to a newborn whose head circumference was above the 90th centile, the risk estimates were slightly stronger in women from the Asian regions. Among women from African regions including the Middle East the risk estimates were somewhat decreased compared with those shown in Figure 1. In the last sensitivity analysis, after excluding women without information on pre-pregnancy BMI, the results did not change substantially from Figure 1.

Discussion

Main findings

We found a more than twofold significantly increased risk of OASI among primiparous women originating from the regions of South Asia, Southeast Asia, East Asia & the Pacific and Sub-Saharan Africa, compared with women originating from Norway. Among foreign-born women from these regions, we found the highest risk estimates for OASI in those with a short length of residence. Conversely, women originating from high-income countries had a lower risk of OASI compared with women originating from Norway. Women with a foreign-born partner were more likely to sustain an OASI than those with a Norwegian-born partner. There was a downward trend in OASI over the study period; however, the decrease was more pronounced among Norwegian-born women than among foreign-born women.

Strengths and limitations

A major strength of this registry study is its large sample size linked to high-quality registries allowing for detailed analysis of women's country of birth and origin, and other potential risk factors over a 10-year period with a validated main outcome. By linking data from two national registries, we had access to a comprehensive data set, which allowed us to take into account a wide range of possible confounding factors and to perform subgroup analyses.

A possible limitation was the low absolute numbers of OASI in some regions. This may also have diluted the association between maternal birthplace or region of origin and OASI. Latin America & the Caribbean group was the smallest and constituted only 0.8% of total birth cohort (2.8% of the foreign-born women). With only 56 cases of OASI among these women, we cannot rule out the possibility of a type II error. We found a high proportion of missing values for maternal education and pre-pregnancy BMI.

However, neither education nor pre-pregnancy BMI changed the risk estimates substantially and therefore we do not believe the high proportions of missing values influenced the associations. We did not have information about women's language proficiency, an important migration-related factor previously shown to be associated with OASI.^{34,35} However, we performed stratified analyses by length of residence to better understand the impact of acculturative change. Individual information on female genital mutilation (FGM), which has been shown to increase the risk of OASI, was not readily available from the MBRN. The vast majority of Sub-Saharan African women in our study came from Somalia, Eritrea and Ethiopia where FGM is prevalent. These women also had the highest prevalence of episiotomy. Given the observed higher odds of OASI among these women in our study, it is likely that not adjusting for FGM may have overestimated risk estimates for Sub-Saharan women.

Interpretation

Our study confirms previous findings of an approximately doubled risk of OASI in primiparous South Asians and East Asians as well as Sub-Saharan African women.^{4,5,22,36,37} Higher risk estimates for OASI in analysis restricted to foreign-born women only, excluding women with the same ethnicity without being migrants, show that risk profiles change with context and over time. As such, our findings are in line with implications from studies indicating a higher incidence of OASI among migrant Asian women compared with women living in Asia.^{22,38} The lower risk of OASI among women born in high-income countries is probably attributable to the fact that most immigrants in this group originate from within the EU and may represent a 'healthy migrant effect'.³⁹

The low odds of OASI in primiparous women with long residence (≥ 5 years) is a novel finding. Long residence is associated with resource accumulation and acculturation, such as higher maternal education, family income and improved majority language skills.³⁹ The importance of language skills as an independent risk factor for OASI has been demonstrated by recent studies showing a more than two-fold increased risk among women who do not speak the majority language.^{34,35} Language skills are likely to affect collaboration between the woman and the birth attendant, particularly in the active second stage of labour.⁴⁰ The observation that most foreign-born women with a Norwegian-born partner had lower odds ratios for an OASI, as opposed to women with a foreign-born partner, is also a new finding. This corresponds to studies of neonatal outcomes that found poorer neonatal outcomes among migrant women with a foreign-born partner.^{41,42} The partner's facilitating role, potentially through communication and familiarity with the healthcare system,⁴³ regarding

intrapartum care for migrant women, needs to be further explored. This observation suggests that explanatory factors other than biological factors contribute to risk differentials.

It is important to bear in mind that the country representation of migrants from a region reflects the specific migration patterns to Norway. For instance, in our study, the majority of women from the Southeast Asia, East Asia & the Pacific region originated from the Philippines, Thailand and Vietnam. Caution should be applied in generalising findings to regions, because country-level migrant flows may differ per region to other host countries.

Even though instrumental vaginal deliveries were more common in foreign-born women overall, risk estimates of OASI did not change substantially when restricted to women with spontaneous vaginal deliveries. In sensitivity analyses excluding women who gave birth to a newborn with head circumference above the 90th centile, we observed similar results. We therefore believe that these factors may have at most a minor impact on the relationship between maternal region of origin and birth with OASI.

Despite an overall downward incidence across the period, this was not the case for women from regions with the highest incidence of OASI, and some regions even had a higher incidence in 2017 than in 2008. A previous reduction in OASI across Norway has been suggested to be the result of training programmes for improved manual perineal protection techniques.⁴⁴ However, the lack of benefit in high-risk groups suggests that if so, such programmes have yet to benefit all groups of women. With increasing proportions of foreign-born women giving birth across many host countries, this is a critical policy issue.

Conclusion

We found that primiparous women from South and East Asia, as well as Sub-Saharan Africa, had an up to two-fold increased risk of experiencing an OASI during delivery compared with Norwegian women. Migrant women with short length of residence or who had a foreign-born partner faced an elevated risk of OASI. Future studies should examine if sociocultural factors contribute to risk differentials. There was a downward trend in incidence of OASI over the period; however, this decrease was less pronounced for women from high-risk regions, which implies that inequity is increasing. Better identification of subgroups at high risk for OASI is necessary to be able to provide special attention in labour and so reduce morbidity. Ultimately, barriers to optimal system utilisation and patient-provider interactions need to be addressed at a policy level to achieve true migrant-friendly care and equity of outcomes.

Disclosure of interests

The authors declare that they have no competing interests.

Contribution to authorship

As part of the MiPreg research project, this study was planned and designed by IKS, JS, BL and SV. KO performed the statistical analyses. IKS, SB and KO interpreted the data and wrote the manuscript. All authors contributed substantially to revisions of the manuscript and approved the final version.

Details of ethics approval

This study was approved by the Regional Committees for Medical and Health Research Ethics, South-East Region of Norway, approval no. 2018/1086, and by the Data Protection Office of Oslo University Hospital, approval no. 18-15786. Individual patient's consent was waived.

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Data availability statement

The data that support the findings of this study are available from the corresponding author (SB) upon reasonable request.

Supporting Information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Figure S1. Rate of OASI in Norway, 2008–17, by maternal birthplace (solid lines), and for the three maternal regions of origin with the highest overall prevalence.

Table S1. Association between maternal region of origin with OASI by paternal birthplace, 2008–17 ($n = 183\,477$).

Table S2. The proportions of OASI by country for the three largest groups within each region among foreign-born women compared with Norwegian-born women ($n = 188\,658$). ■

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