Safe motherhood : severe maternal morbidity in the Netherlands. The LEMMoN study

Zwart, J.J.

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CHAPTER 4

Ethnic disparity in severe acute maternal morbidity: a nationwide cohort study in the Netherlands

Zwart JJ, Jonkers MDJ, Richters JM, Öry F,
Bloemenkamp KWM, Duvekot JJ, van Roosmalen J.

Abstract

Background: There are concerns about ethnic disparity in outcome of obstetric health care in high income countries. Our aim was to assess these differences in a large cohort of women having experienced severe acute maternal morbidity (SAMM) during pregnancy, delivery and puerperium.

Methods: All women experiencing SAMM were prospectively collected in a nationwide population-based design during a two-year period. Women delivering in the same period served as reference cohort. Population-based risks were calculated by ethnicity and by type of morbidity. Additionally, non-Western and Western women having experienced SAMM were compared in multivariable analysis.

Results: All 98 Dutch maternity units participated. A total of 2506 women with SAMM were included, 21.1% of whom were non-Western immigrants. Non-Western immigrants showed a 1.3-fold (95% CI 1.2-1.5) increased risk to develop SAMM. Great differences were observed among different ethnic minority groups, ranging from a non-increased risk for Moroccan and Turkish women to a 3.5-fold (95% CI 2.8-4.3) increased risk for sub-Saharan African women. Low socio-economic status, unemployment, single household, high parity and prior caesarean were independent explanatory factors for SAMM, although they did not fully explain the differences. Immigration-related characteristics differed by ethnic background.

Conclusions: Non-Western immigrants have an increased risk of developing SAMM as compared to Western women. Risks varied greatly by ethnic origin. Immigration-related characteristics might partly explain the increased risk. The results suggest that there are opportunities for quality improvement by targeting specific disadvantaged groups.

Introduction

Although high income countries have become multi-ethnic societies, still little attention is paid to explanations of ethnic disparities in outcome of obstetric health care. A three times elevated risk of maternal mortality has been reported for immigrants as compared to native women in the Netherlands.[1;2] This corresponds with findings from the United Kingdom, with black women even having a six-fold increased risk of maternal mortality compared to native women.[3] Maternal mortality, however, has become rare in high income countries and numbers are small, especially for the smaller ethnic minority groups. Little is known about the risk of severe acute maternal morbidity (SAMM) in immigrants as compared to native women. Therefore, we assessed data related to ethnicity in a large group of women with SAMM and related them to the cohort of all women giving birth in the Netherlands during the study period. Our aim was twofold: firstly, we wanted to assess the population-based incidence of SAMM in different ethnic groups in the Netherlands. Secondly, we wanted to assess adjusted risk factors for the differences between non-Western immigrants and Western women.

Methods

This study is part of a large nationwide cohort study of pregnant women to assess SAMM in the Netherlands, the LEMMoN study. Detailed methods of data collection were described previously.[4] The study enrolled cases of SAMM from 1st August 2004 until 1st August 2006 divided in five categories as shown in Figure 1. The study was centrally approved by the medical ethics committee of Leiden University Medical Centre.

Figure 1. Inclusion criteria for the LEMMoN study

Group 1: ICU admission
- Admission to intensive care unit or coronary care unit, other than for standard postoperative recovery

Group 2: Uterine rupture
- Clinical symptoms (pain, fetal distress, acute loss of contractions, haemorrhage) that led to an emergency caesarean section, at which the presumed diagnosis of uterine rupture was confirmed
- Peripartum hysterectomy or laparotomy for uterine rupture

Group 3: Eclampsia / HELLP syndrome
- Eclampsia
- HELLP-syndrome only when accompanied by liver haematoma or rupture

Group 4: Major Obstetric Haemorrhage
- Transfusion need of ≥ 4 units of packed cells
- Embolisation or hysterectomy for major obstetric haemorrhage

Group 5: Miscellaneous
- Other cases of severe maternal morbidity to the opinion of the treating obstetrician, not to be included in group 1-4

Study Population

All 98 hospitals with a maternity unit in the Netherlands participated in the survey: Eight tertiary care centres, 35 non-university teaching hospitals and 55 other general hospitals. In the Netherlands women with high risk pregnancies and women with low risk pregnancies who develop complications deliver in hospital under supervision of obstetricians (secondary or tertiary care, 59% of all births in the Netherlands). Women with uncomplicated low risk pregnancies deliver under supervision of midwives or family physicians (primary care), either at home (30% of all births) or in hospital (11% of all births).[5] In 2005, 10.3% of the total population and 16.8% of all delivering women were non-Western immigrants.[6] The four largest immigrant groups in the Netherlands originate from Turkey, Morocco and the former Dutch colonies of Surinam and the Dutch Caribbean. Turkish and Moroccan immigrants settled at first in the Netherlands as guest workers in the 1960s and 1970s, and ever since due to family reunion or marriage.

Definition of ethnicity

Ethnicity was defined by geographical ethnic origin. We used the definitions of Statistics Netherlands, based on country of birth of the woman.[6] Accordingly, women born in the Netherlands with at least one parent born abroad were considered to be from the same origin as their non-Dutch parent(s). Immigrants from other European countries, North America, Japan and Indonesia were considered Western immigrants because of their similar cultural and socio-economic background as compared to native Dutch women. Western immigrants and native Dutch women constitute the group of Western women. All other immigrants were considered non-Western and constitute the group of non-Western women.

Data collection

Included in the study were all women who experienced SAMM or death during pregnancy, childbirth or puerperium. Maternal socio-demographic characteristics (age, body mass index, geographical ethnic origin, socio-economic status, smoking, single household, unemployment, language skills, length of residence, immigration status), and obstetric characteristics were recorded for each case. We also recorded general history, categorised as hypertension, diabetes, cardicac disease, clotting disorders, thyroid disorders, epilepsy, pulmonary disorders, psychiatric disorders and miscellaneous. A woman was considered unemployed if her reported job was 'none', or if she had reported to be a mother, student or housewife. Overweight was defined as BMI $\geq$ 25.0, obesity as BMI $\geq$ 30.0. We used the six-digit postal code as a proxy for socio-economic status. For each postal code area, comprising of on average 25 persons, Statistics Netherlands has estimated a validated socio-economic status (SES) indicator by combining mean family income and house price.[7]

Statistical analysis

Denominator data were obtained from Statistics Netherlands.[6] They were based on birth registrations during the exact study period, corrected for multiple births and stillbirths after 24 weeks of gestation. To calculate population-based incidence by ethnicity, denominator data for the number of women from the different ethnic groups were also obtained from Statistics Netherlands. For the four largest immigrant groups and the aggregate group of other non-Western immigrants (consisting of women from sub-Sahara Africa, Middle East, Far East, Latin America and miscellaneous), numbers of mothers giving birth were used. For more specific sub-analysis of the smaller ethnic minority groups, we had to use numbers of women of fertile age (15-40 years) to calculate the denominator thereby neglecting differences in fertility rate. Population based relative risks (RR) with 95% confidence intervals (CI) were calculated for each immigrant group and type of SAMM, as compared to all Western women in the Netherlands.

To identify risk estimators for the differences in incidence of SAMM, odds ratios (OR) with 95%-CI were calculated for the whole group of non-Western immigrants having experienced SAMM as compared to Western women having experienced SAMM, with ethnicity defined dichotomous. Differences were assessed using the Chi square or Student T test whenever appropriate, considering p-values < 0.05 significant. Significant risk estimators in univariable analysis were entered into a multivariable regression model to calculate adjusted odds ratios for SAMM. Statistical analysis was performed using Statistical Package for the Social Sciences 14.0 (SPSS Inc., Chicago, IL, USA).

Results

Population-based incidences and relative risks

During the study period, there were 371,021 deliveries in the Netherlands. From all 2352 (98 hospitals, 24 months) monthly notification cards, 97% were returned. Therefore, the study represents 358,874 deliveries in the Netherlands. A total of 2552 cases of SAMM were reported. We received detailed data on 2513 cases (98.5%). Seven cases were excluded because of unknown ethnicity, leaving 2506 cases available for analysis; 529 non-Western immigrants (21.1%) and 1977 Western women. Geographical ethnic origin is shown in table 1. The overall incidence of SAMM was 7.1 per 1000 deliveries, 8.4 per 1000 among non-Western women and 6.3 per 1000 among Western women. The overall RR for non-Western immigrants to experience SAMM was 1.3 (95% CI 1.2-1.5). Large differences were observed among the different ethnic groups and the different categories of SAMM (Table 2). Especially sub-Saharan African women showed an increased RR irrespective of the morbidity category.

Table 1. Geographical ethnic origin (n=2513)

	n	(%)
Western Overall	1977	(78.7%)
The Netherlands	1864	(74.2%)
Western Europe	48	(1.9%)
Eastern Europe	27	(1.1%)
Miscellaneous Western	44	(1.8%)
non-Western Overall	529	(21.1%)
Morocco	116	(4.6%)
Turkey	87	(3.5%)
Surinam	82	(3.3%)
Dutch Caribbean	29	(1.2%)
Sub-Saharan Africa*	92	(3.7%)
Middle East*	34	(1.4%)
Far East*	53	(2.1%)
Latin America*	15	(0.6%)
Miscellaneous non-Western*	22	(0.9%)
Unknown	7	

* referred to as 'other non-Western' in Figure 2

The overall RR of SAMM in this subgroup was 3.5 (95% CI 2.8 to 4.3), ranging from 3.0 (95% CI 2.2-3.9) for major obstetric haemorrhage to 6.2 (95% CI 3.6-10.6) for eclampsia. Turkish and Moroccan women did not have elevated RRs for any of the morbidity categories. Surinamese women had elevated RRs for all categories of SAMM except for uterine rupture. Dutch Caribbean women only had an elevated RR for eclampsia.

Table 2. Relative risks and 95% confidence intervals for severe acute maternal morbidity by ethnicity and by type of morbidity as compared to the Western women in the Netherlands

RR (95% CI)	n	ICU admission (n=837)	Uterine rupture (n=218)	Eclampsia (n=230)	MOH (n=1590)	Total[†] (n=2506)
Western	1977	1	1	1	1	1
Non-Western Overall	529	1.5 (1.2-1.7)*	1.4 (1.0-1.9)*	1.7 (1.3-2.3)*	1.3 (1.1-1.4)*	1.3 (1.2-1.5)*
Morocco	116	1.3 (0.9-1.7)	1.0 (0.5-2.0)	1.2 (0.7-2.3)	1.1 (0.8-1.4)	1.1 (0.9-1.4)
Turkey	87	1.0 (0.7-1.5)	1.4 (0.8-2.7)	1.1 (0.6-2.3)	1.0 (0.7-1.3)	1.1 (0.9-1.3)
Surinam	82	1.6 (1.1-2.2)*	1.2 (0.5-2.7)	2.4 (1.3-4.3)*	1.4 (1.0-1.8)*	1.4 (1.1-1.8)*
Dutch Caribbean	29	1.7 (1.0-2.9)	0.9 (0.2-3.7)	2.7 (1.2-6.2)*	0.9 (0.5-1.5)	1.1 (0.8-1.6)
sub-Saharan Africa	90	3.7 (2.6-5.3)*	3.9 (2.0-7.7)*	6.2 (3.6-10.6)*	3.0 (2.2-3.9)*	3.5 (2.8-4.3)*
Middle East	33	1.6 (0.9-2.9)	1.0 (0.3-4.2)	2.1 (0.8-5.6)	1.7 (1.1-2.5)*	1.5 (1.1-2.1)*
Far East	49	2.4 (1.5-3.8)*	1.9 (0.7-5.1)	1.4 (0.5-4.5)	2.4 (1.7-3.3)*	2.2 (1.7-2.8)*

ICU=Intensive Care Unit. MOH=Major Obstetric Haemorrhage. †=numbers do not add up to total as women could have more than one severe morbid condition; also includes cases included as 'Miscellaneous', *=significant.

Women from the Middle and Far East had an elevated RR overall but this reached only significance for major obstetric haemorrhage. RR for non-Western immigrant women overall was increased for all morbidity categories. Further analysis of the group of sub-Saharan African women revealed that risks were particularly elevated for women from Congo (RR 7.0, 95% CI 4.2-11.9), Ghana (RR 6.3, 95% CI 4.1-9.7) and Sudan (RR 5.9, 95% CI 2.8-12.3). Among Western immigrants, relative risks were comparable to or even lower than for native Dutch women. Population based incidence of SAMM by ethnicity is shown in figure 2. Since more specific data on ethnicity of mothers giving birth were not available for the smaller ethnic minority groups, we undertook a sub analysis using the number of women of fertile age as the denominator. This sub analysis revealed that incidence of SAMM was especially increased in women from sub-Sahara Africa with 150 cases per 100,000 women of fertile age as compared with 43 per 100,000 in Western women. For women from the Far East and Middle East, incidences were 93 and 65 per 100,000 women of fertile age, respectively.

Figure 2. Population-based incidence of severe maternal morbidity by ethnicity (per 1000 deliveries)
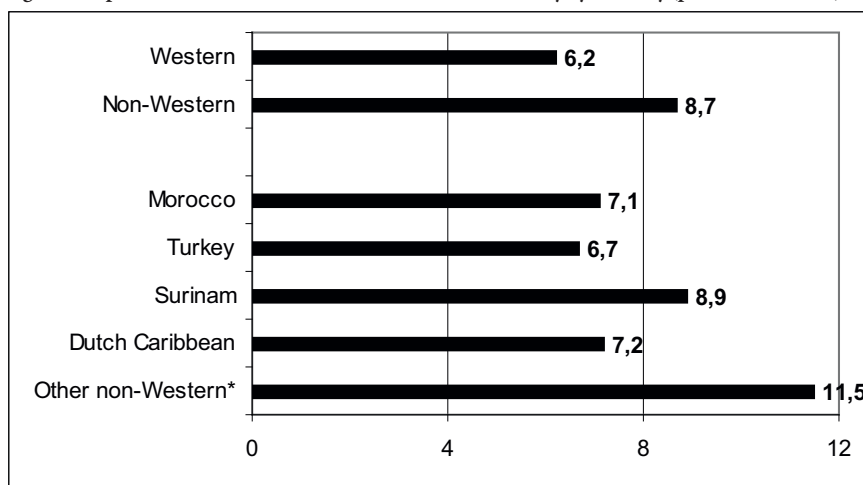
* includes sub-Sahara Africa, Middle East, Far East, miscellaneous

Risk estimators in non-Western immigrants vs. Western women with SAMM

We also compared non-Western and Western women who had experienced SAMM. Differences in characteristics between both groups are shown in table 3. Univariable analysis revealed that low SES, unemployment, single household, age under 20, age over 40, overweight, and diabetes were associated with SAMM in non-Western immigrants. Table 4 shows unadjusted and adjusted odds ratios for SAMM after adjustment for age, parity, SES, unemployment, single household, BMI, diabetes, prior caesarean delivery, antenatal care at booking by the obstetrician and late booking for antenatal care in a multi-

logistic regression model. Significant risk factors after adjustment were low SES (OR 5.0; 95% CI 2.9-8.4), unemployment (OR 4.0; 95% CI 2.6-6.2), single household (OR 2.7; 95% CI 1.2-6.4), overweight (OR 1.5; 95% CI 1.0-2.3), prior caesarean delivery (OR 1.9; 95% CI 1.2-3.2), antenatal care at booking by the obstetrician (OR 1.6; 95% CI 1.1-2.3), and parity ≥ 3 (OR 2.3; 95% CI 1.1-5.1). Entering age and body mass index as continuous variables did not change the estimates of interest essentially. Although ventouse delivery appeared to be a risk estimator in univariable analysis, it was not entered into the multivariable model because it was uncertain whether the ventouse constituted the risk factor or the consequence of severe morbidity itself.

Table 3. Characteristics of non-Western and Western women with severe acute maternal morbidity

	non-Western (n=529)		Western (n=1977)		p-value
Age in years (mean)	(31.4)		(32.2)		<0.001
< 20	16	3.0%	15	0.8%	<0.001
20-40	473	89.4%	1880	95.1%	<0.001
>40	40	7.6%	82	4.1%	0.001
Socio-economic status indicator					
Low	299	62.6%	401	23.1%	<0.001
Modal	130	27.2%	861	49.7%	<0.001
High	49	10.3%	471	27.2%	<0.001
Unknown	*51*		*244*		
Single household	43	8.1%	32	1.6%	<0.001
Unemployed	157	44.5%	148	11.4%	<0.001
Smoking during pregnancy	31	10.9%	145	12.3%	0.52
Body mass index in kg/m² (mean)	(25.8)		(24.4)		<0.001
<18.5	12	3.6%	36	2.7%	0.36
18.5 – 24.9	165	49.8%	851	63.4%	<0.001
25.0-29.9 (overweight)	93	28.1%	295	22.0%	<0.05
30.0-34.9 (obese)	34	10.3%	92	6.9%	<0.05
≥ 35.0 (morbidly obese)	27	8.2%	68	5.1%	<0.05
Unknown	*198*		*635*		
Chronic diseases					
any*	136	25.7%	485	24.5%	0.58
hypertension	24	4.5%	82	4.1%	0.69
Diabetes	13	2.5%	21	1.1%	<0.05
cardiac disease	17	3.2%	45	2.3%	0.22
clotting disorder	9	1.7%	53	2.7%	0.20

*groups mentioned beneath, thyroid disorders, epilepsy, pulmonary disorders, psychiatric disorders, miscellaneous

Characteristics related to the immigration of the 529 non-Western women overall are shown in table 5. Thirty asylum seekers (6.5 %) or illegal women (2.4 %) were reported, mainly from sub-Sahara Africa. Of 91 of the women (43%), duration of stay in the Netherlands was five years or less. Language barriers were reported in 38% of all immigrants. Of 16 cases in which proper communication was deemed impossible, only in one case a professional interpreter was arranged. The most important possibly associated risk estimators for the differences in SAMM among the different ethnic groups are summarized in table 6. The rate of recent immigration was highest among women from sub-Sahara Africa, Middle East and Far East. Immigrants from Sub-Sahara Africa, Middle East, Far East and Turkey showed the highest rates of women with language barriers (65, 56, 49 and 49%, respectively). Nine of the 16 women in which proper communication was deemed impossible were Turkish or Moroccan immigrants.

Table 4. Unadjusted and adjusted odds ratios for severe acute maternal morbidity

Factor	non-Western (n=529)		Western (n=1977)		univariable OR (95% CI)	multivariable OR (95% CI)**
Patient						
age < 20	16	3.0%	15	0.8%	4.1 (2.0-8.3)*	0.5 (0.2-2.0)
age ≥ 40	40	7.6%	82	4.1%	1.9 (1.3-2.8)*	1.0 (0.4-2.3)
low socio-economic status	299	62.6%	401	23.1%	5.5 (4.5-6.9)*	4.2 (2.9-6.0)*
single household	43	8.1%	32	1.6%	5.4 (3.4-8.6)*	2.9 (1.2-6.8)*
Unemployed	153	44.5%	156	11.4%	6.2 (4.8-8.2)*	4.1 (2.7-6.2)*
BMI ≥ 25 (overweight)	154	46.5%	455	33.9%	1.7 (1.3-2.2)*	1.5 (1.0-2.3)*
BMI ≥ 30 (obese)	61	18.4%	160	11.9%	1.7 (1.2-2.3)*	0.9 (0.5-1.5)
diabetes	13	2.5%	21	1.1%	2.3 (1.2-4.7)*	0.1 (0.0-2.5)
Pregnancy						
initial antenatal care by obstetrician	244	46.1%	697	35,3%	1.6 (1.3-1.9)*	1.6 (1.1-2.4)*
late booking (gestational age ≥20w)	39	9.3%	55	3.5%	2.8 (1.8-4.3)*	1.9 (0.8-4.3)
prior caesarean delivery	122	23.1%	357	18.1%	1.4 (1.1-1.7)*	1.9 (1.1-3.1)*
parity 0	217	41.0%	1031	52.3%	0.6 (0.5-0.8)*	1.3 (0.8-2.1)
parity ≥3	64	12.1%	63	3.2%	4.2 (2.9-6.0)*	2.3 (1.0-4.9)*
multiple pregnancy	34	6.4%	168	8.5%	0.7 (0.5-1.1)	
artificial reproduction techniques: IVF/ICSI	23	4.3%	97	4.9%	0.9 (0.5-1.4)	
Delivery						
home delivery	16	3.0%	149	7.5%	0.4 (0.2-0.6)*	
induction of labour	127	24.0%	532	26.9%	0.9 (0.7-1.1)	
Epidural						
caesarean delivery without labour	130	24.6%	411	20.8%	1.2 (1.0-1.6)	
caesarean delivery overall	243	45.9%	827	41.8%	1.2 (1.0-1.4)	
preterm birth (<37w)	159	32.1%	530	28.3%	1.2 (1.0-1.5)	
post term birth (≥42w)	34	6.9%	94	5.0%	1.4 (0.9-2.1)	

* statistically significant; **Adjusted for age, parity, SES, single household, unemployment, BMI, diabetes antenatal care at booking by obstetrician, prior CS and late booking for antenatal care

Table 5. Immigration characteristics of non-Western women (n=529)

		cases n (%)
Immigration status		
Permanent	293	86.4%
Temporary	16	4.7%
asylum seeker	22	6.5%
Illegal	8	2.4%
unknown (n=190, 35.9%)		
Years since immigration		
≤1 year	30	14.2%
1-5 year	61	28.9%
5-10 year	46	21.8%
>10 year	*74*	35.1%
unknown (n=318, 60.1%)		
Language skills		
small language barrier	65	15.9%
considerable language barrier	73	17.9%
communication impossible	16	3.9%
no language barrier	254	62.3%
unknown (n=121, 22.9%)		
Interpreter used		
family member	68	17.1%
professional	9	2.3%
None	320	80.6%
unknown (n=132, 25.0%)		

Table 6. Demographic and immigration-related characteristics of women with SAMM by ethnic minority group*

	low SES	unemploy-ment	single household	≤5 years in NL	asylum seeker/ illegal	considerable language barrier
Morocco (n=116)	76	54	2	38	0	20
Turkey (n=87)	68	54	7	30	4	37
Surinam (n=82)	53	20	9	21	2	0
Dutch Caribbean (n=29)	68	37	31	38	0	4
Sub-Sahara Africa (n=92)	63	58	17	55	32	26
Middle East (n=34)	62	48	6	47	29	35
Far East (n=53)	37	43	0	59	6	31
Eastern Europe (n=27)	48	22	11	63	18	5

*numbers are percentages within each ethnic minority group

Discussion

This study presents an overall picture of ethnic differences in SAMM in a nationwide design. Increased risk for non-Western women to experience SAMM was present among all categories of SAMM (intensive care unit admission, uterine rupture, eclampsia, major obstetric haemorrhage), although the relative risks were lower than previously reported for maternal mortality.[2;3;8] Ethnic differences were earlier reported for obstetric complications including pre-eclampsia,

low birth weight, perinatal death and SAMM.[9-14] In all these studies non-Western ethnic origin was found to be a risk factor. Very recently, a comparable national study was published on ethnic variation in SAMM in the United Kingdom.[14] Although this study only concerned some specific subgroups of SAMM and numbers in ethnic minority groups were small, the results are largely comparable. Like in the present study, black African (~sub-Saharan African) and black Caribbean (~Surinamese and Dutch Caribbean) women had the highest risks.

The increased incidence of SAMM among non-Western immigrants found in this study may be explained by genetic, socio-demographic and lifestyle related differences, but there are also several factors related to immigration that possibly influence the risk of SAMM. The role of these factors is difficult to quantify in comparative studies as indigenous women are not exposed to these risk factors. However, from the qualitative study that was conducted to complement the quantitative one presented in this article, it is clear that also patient-related and health care related factors play a role.[15] Immigration-related risk estimators mentioned in table 6 were confirmed in this study. Other related factors included: lack of health knowledge, asylum seeker or illegal status, weak social and economic position and as a consequence daily stress factors, factors related to (recent) immigration such as language barriers, small social (ethnic) network and inexperience with the system and policies of obstetric health care in the Netherlands.

Our study did not clearly confirm the recent finding that late booking for antenatal care is an important contributor to maternal morbidity among immigrants, although a trend was observed.[3;10]

It is striking that great differences in risks of SAMM existed between the distinct ethnic groups in the Netherlands. Turkish and Moroccan women showed relative and absolute risks comparable to Western women, while sub-Saharan African women showed a three to six-fold increased risk. Among the four largest immigrant populations with a relatively long history in the Netherlands, only Surinamese women were overall more susceptible to developing SAMM, mainly due to an elevated incidence of eclampsia. Dutch Caribbean women also had an elevated RR of eclampsia. This pattern could be caused by the relatively large proportion of women of black African descent among Surinamese and Dutch Caribbean women, since black African women were found to have an increased risk of experiencing pre-eclampsia by us and others.[11] Also, single household, which appeared to be an independent risk factor in this study, is more common among Dutch Caribbean women, leading to weak social networks and lack of social support.[12;16]

The currently most supported hypothesis is that ethnic disparity can be largely explained by the low SES of non-Western immigrants.[17] However, part of the disparity can not be explained using multivariable logistic regression models, as some important possible risk factors cannot be included in the model since they only apply to non-Western women. Like others, we also found

low SES to be an independent risk factor for SAMM in multivariable analysis. However, we found that this was not compatible with the most important observational finding that women from the large Turkish and Moroccan immigrant populations -residing in the Netherlands for more than 40 years- do not show elevated RR to experience SAMM despite their generally low SES. Therefore, the explanation for the differences in risk of experiencing SAMM should rather be sought in factors related to immigration. The strong social-ethnic networks and collectively shared experiences with the Dutch health care system of Turkish and Moroccan immigrant populations seem to prevent them from developing SAMM. Even though many Turkish and Moroccan women have recently come to the Netherlands because of family reunion or marriage, their risk was not increased despite frequently observed language barriers and acculturation problems.

Relative risks appeared to be especially increased in women from the smaller ethnic minority groups who recently arrived in the Netherlands. Short residence in the Netherlands possibly results in a weak social network and inadequate knowledge of the health care system, contributing to this increased risk. Other disadvantages related to recent arrival in the Netherlands are an illegal status, health insurance problems, communication barriers and inadequate health skills to participate in the interaction with health care providers.

The increased risk for non-Western immigrants was most definite in the category of eclampsia. This may not be surprising, as in hypertensive disorders, recognition and interpretation of often subtle signs and symptoms by obstetric health care providers plays an important role in the prevention of severe complications, and this can be hampered by communication barriers between patient and health care provider as was found in the qualitative analysis. We therefore recommend providing a leaflet to all pregnant women containing warning signs of pregnancy complications. This leaflet should be available in all appropriate languages.

This study has the following limitations. First, every definition of ethnicity is arbitrary. In our opinion the definition by geographical ethnic origin is the most objective, although it does not completely account for racial, cultural and socio-economic subgroup differences. Also, arbitrary choices have to be made with respect to geographical regions. Another limitation is that immigration characteristics were lacking in numerous cases. Cultural background is obviously not an item usually discussed by health care providers during antenatal or intrapartum care. Despite all our efforts data collection could be incomplete due to the large nationwide character of the study. However, especially for the severest complications, we are quite sure not to have missed a substantial amount of cases and inclusion bias towards Western or non-Western women is unlikely. For sub-analysis of the different small ethnic minority populations, we had to rely on numbers of women of fertile age as the denominator instead of mothers giving birth.

Although this may introduce some bias due to differences in fertility rates, the main analysis showed that the incidence of SAMM in the aggregate group of other non-Western immigrants was indeed almost twice as high compared with Western women.

Key-points

- Risk of severe maternal morbidity varies greatly by ethnicity, ranging from a non-increased risk for Moroccan and Turkish women to a 3.5-fold increased risk for sub-Saharan African women.
- More attention should be drawn to this subject in medical education and patient care.
- Although low SES is an important contributor in explaining health inequalities, it does not solely explain the increased risk of non-Western immigrants to experience SAMM.
- Immigration–related characteristics deserve more attention as explanation for inequality in health care outcome.
- The results suggest that there are opportunities for quality improvement by targeting health care reforms on specific disadvantaged groups.

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