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APPENDIX

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ORIGINAL ARTICLE

Increased perinatal mortality among sub-Saharan immigrants in a city-population in Sweden

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Background. The aim of the study was to investigate whether the maternal country of origin affected the risk for perinatal mortality and to determine its relationship to risk factors.
Methods. A study of 15,639 deliveries in Malmö, Sweden. Data regarding demographic factors, life-style and perinatal risk factors, together with data pertaining to outcome was obtained from the Malmö database and the Swedish Medical Birth Register.
Results. Perinatal mortality was increased among infants to women of Foreign origin as compared to those delivered by women of Swedish origin (OR 1.5, CI 1.0–2.2). Even after adjustments for maternal background and risk factors (diabetes, anemia, pre-eclampsia, placental abruption and small-for-gestational age), the increased risk of perinatal mortality among women of Foreign origin remained statistically significant. Women from sub-Saharan Africa, comprising 7.3% of all immigrants, differed from all other subgroups of women of foreign origin by having a higher risk of adverse outcome (small-for-gestational age OR 1.9, CI 1.0–3.6, neonatal distress OR 2.7, CI 5.1–4.8 and perinatal mortality OR 4.3, CI 2.1–8.6).
Conclusions. Women of foreign origin, especially from sub-Saharan Africa, have a higher risk of perinatal mortality than native Swedish women. The differences in mortality could not be explained by risk factors. The results suggest that women and newborns from sub-Saharan Africa should be given more intense surveillance on all levels of perinatal care in order to reduce perinatal mortality.

Key words: immigrants; perinatal mortality; sub-Saharan Africa

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Socio-economic and biological factors are known to have an impact on perinatal outcome (1,2). Sweden enjoys one of the lowest perinatal mortality rates in the world (3). The decrease in perinatal mortality during the last decades has been attributed to socio-economic improvements and to better antenatal and neonatal care (4). National studies during the last twenty years have shown an even lower perinatal mortality among immigrant women (5,6). However, in recent years, the immigration profile in Sweden has changed. Previously immigration was mainly labor market driven and composed of immigrants originating from other Nordic countries or the Balkan area, while recent immigrants are mostly refugees coming from a wider range of geographical areas. A moderately increased perinatal mortality in the last decade has recently been reported among sub-Saharan African immigrants in Sweden (7). The population of the city of Malmö (247,000, 1998) in southern Sweden has a high percent (27%, in 1998) of individuals of Foreign origin. Earlier studies from the Department of Obstetrics and Gynecology in Malmö have reported a higher incidence of perinatal complications among low income populations and in neighborhoods with large immigrant communities (8).

Maternal health care has always been free of

charge in Sweden and compliance with the routine antenatal program is extremely high (9). Perinatal care is of an internationally high standard. However, cutbacks in the government funding of social welfare programs may have led to widening financial gaps between different socio-economic groups and between immigrants and the native Swedish population over the last years in Sweden.

The aim of the present study was to investigate how the maternal country of origin affected the risk for perinatal mortality and to determine which are the perinatal risk factors that seem to be of importance in this context.

Material and methods

This is a community based cohort study of a total population of 16,088 pregnancies giving birth at University Hospital MAS, Malmö, during the six years from 1990 to 1995. Information about pregnancy, delivery and the neonatal period was available in the perinatal database at the Department of Obstetrics and Gynecology, Malmö, which is the only delivery unit in the city. The information was linked to the Swedish Population Register, by means of the patient's personal identification number, in order to determine the maternal country of birth. Factors such as smoking habits, cohabiting status and maternal height were obtained from the Swedish Medical Birth Registry. When combining these registers, part of the population was lost, due to identification numbers being missing or incorrect or due to an absence of information about the country of birth (n=41). Furthermore, all multiple pregnancies were excluded (n=408). Thus, 15,639 singleton deliveries remained, which constitutes the population of this study.

In all 4,855 (31.0%) women had a country of origin other than Sweden. A total of 133 countries of maternal origin were identified, but due to the small numbers, nations were classified into eight groups based upon geographical location: Sweden (n=10,784) (69.0%), other Nordic countries (n=421) (2.7%), Western Europe and North America (n=177) (1.1%), Eastern Europe (n=1,546) (9.9%), Middle East and North Africa (n=1,529) (9.8%), Latin America (n=296) (1.9%), Asia (n=530) (3.4%) and Africa (defined as sub-Saharan countries) (n=356) (2.3%). For some parts of the analysis these groups were disregarded and the entire population was denoted as Foreign origin. A similar classification of geographic background has been used in a previous Swedish study (7, 10).

All groups were analyzed for background factors and perinatal outcome. In order to perform a multiple logistic regression analysis, background factors were classified into different categories; maternal age (<19/19–40/>40 years) and height (>1.55/<1.55 m), parity (0/1–4/>4 deliveries), gestational age (<37/37–42/>42 weeks), smoking versus non-smoking (including irregular smoking) during early pregnancy and cohabiting versus non-cohabiting (with the father of the child) during early pregnancy. Age, parity and gestational age are known as non-linear U-shaped risk factors in relation to perinatal mortality and were therefore categorized. Adverse perinatal outcome, apart from mortality, was defined as: pre-eclampsia (blood pressure>140/90 mmHg and proteinuria >0.3 g/l), diabetes (gestational and diabetes mellitus), anemia (Hb <100 g/l), small-for-gestational age (CD9 No. 764A, SGA, defined as birthweight <mean –2 s.d.) (11), placental abruption, preterm delivery (<37 weeks of gestation), neonatal acidosis (umbilical artery pH <7.10 or umbilical venous pH <7.20) (umbilical cord pH was not always taken), neonatal distress (Apgar score <7 at 5 minutes), transferral to Neonatal Intensive Care Unit (NICU) and severe congenital anomalies (ICD9 No. 740–759, including anencefali, lung hypoplasia, diaphragmatic hernia, cardiac malformations, trisomi 13 and 18). Perinatal mortality was defined as stillbirth (fetus >28 weeks of gestation) and death within the first week of life.

Information about participation in antenatal care, duration of residence in Sweden, the legal status of the immigrants, refugee status or paternal country of birth were not available.

Statistical analysis was performed by means of the SPSS program (12). A difference was considered statistically significant if $p<0.05$. The relative risk for perinatal mortality and other adverse perinatal outcome was estimated by means of odds ratios (OR) and 95% confidence intervals (CI). The multivariate analysis was done by means of multiple logistic regression. This analysis was carried out in two steps, first maternal age and height, parity, smoking and cohabiting status were included in the model (model 1), followed by diabetes, anemia, pre-eclampsia, SGA and placental abruption (model 2). The study was approved by the Ethics Committee of Lund University and by the Swedish Data Inspection Board.

Results

Women of Foreign origin differed from women of Swedish origin in being more often multiparous, of short stature, non-smokers and not cohabiting in early pregnancy (Table I). The mean birthweight in the Foreign origin group was 3431 (+583) g and in the Swedish group it was 3512 (+543)g (no missing cases).

Perinatal mortality was 0.60% among Swedish

women and 0.91% among the women of Foreign origin (Table II). The percentage of early neonatal death of all perinatal death was 37.0% among women of Foreign origin and 52.0% among Swedish women (not in Table). Among all women of Foreign origin, the African group had the highest

Table I. Prevalence of background factors regarding women of Swedish origin, of all Foreign origins and of African origin, giving birth in Malmö during 1990–95

Background-factors	Swedish origin (*n*=10,784)		All Foreign origins (*n*=4,855)		African origin (*n*=356)	
	n	%	*n*	%	*n*	%
Maternal age (y)						
<19	97	0.7%	43	1.3%	2	0.3%
19–40	10,344	97.1%	4,630	95.9%	338	98.6%
>40	254	2.2%	113	2.8%	8	1.1%
(Missing)	(89)		(69)		(8)	
Parity (n)						
0	4,458	45.0%	2,006	33.1%	159	30.9%
1–4	6,190	54.5%	2,785	63.8%	195	62.9%
>4	134	0.5%	60	3.1%	2	6.2%
(Missing)	(2)		(4)			
Maternal height (m)						
>1.55	9,517	98.0%	3,736	86.3%	293	92.1%
≤1.55	194	2.0%	593	13.7%	25	7.9%
(Missing)	(1,073)		(529)		(38)	
Gestational age (wk)						
<37	621	5.7%	248	5.1%	22	6.2%
37–42	10,096	93.6%	4,569	94.1%	328	92.1%
>42	67	0.7%	38	0.8%	6	1.7%
Smoking[a]						
No	7,890	72.5%	3,525	82.5%	327	96.1%
Yes	2,549	27.5%	1,138	17.5%	14	3.9%
(Missing)	(345)		(192)		(15)	
Cohabiting[a]						
Yes	9,413	91.6%	4,208	90.2%	306	84.2%
No	914	8.4%	408	9.8%	29	15.8%
(Missing)	(457)		(239)		(21)	

[a]in early pregnancy.

Table II. Perinatal risk factors and outcomes regarding women of Swedish origin, of all Foreign origins and of African origin, giving birth in Malmö during 1990–95

Risk factors and outcomes	Swedish origin (*n*=10,784)		All Foreign origins (*n*=4,855)		African origin (*n*=356)	
	n	%	*n*	%	*n*	%
Diabetes	67	0.7%	45	1.0%	6	1.7%
Anemia	350	3.2%	268	5.5%	45	12.6%
Pre-eclampsia	504	4.6%	121	2.5%	15	4.2%
SGA[a]	163	1.5%	74	1.5%	10	2.8%
Placental abruption	23	0.2%	6	0.1%	0	–
Severe anomalies	22	0.2%	12	0.2%	0	–
Preterm (<37 wk)	621	5.8%	248	5.1%	22	6.2%
Neonatal distress[b]	148	1.4%	74	1.5%	13	3.6%
NICU[c]	766	7.1%	283	5.8%	21	5.9%
Neonatal acidosis[d]	3,134	29.6%	1,317	27.1%	86	24.1%
Perinatal mortality	65	0.60%	44	0.91%	9	2.53%

[a]Small for Gestational Age.
[b]Apgar Score 5'<7.
[c]Transferred to Neonatal Intensive Care Unit.
[d]umbilical cord pH, artery <7,1 or venous <7,2 (*n*=8,379/3,782).

risk of perinatal mortality (OR 4.3, CI 2.1–8.6). When African women were excluded from the group of Foreign origin, there was still a tendency towards a higher perinatal mortality risk, although this was not statistically significant (OR 1.3, CI 0.8–1.8) (not in Table). In Table VI the distribution of stillborn and early neonatal death divided in subgroups of maternal origin are shown. The percentage of lethal anomalies among the Swedish and the African group were 11%. East Europe and Middle East and North Africa showed 15% respectively 13%.

Table II also shows that diabetes and anemia were more prevalent among women of Foreign origin, but no differences were seen between the two groups regarding severe anomalies, preterm delivery, neonatal distress or SGA. Pre-eclampsia was less frequent as compared to Swedish women. The African group differed from all other immigrants, showing a higher prevalence of neonatal distress, preterm delivery and SGA but a smaller proportion of newborns to women of the African group were transferred to the Neonatal Intensive Care Unit (NICU) (Table II).

Table III shows the results of the association between perinatal mortality, backgrounds factors and risk factors among all women. Non-cohabiting displayed a significant association with perinatal mortality, and diabetes, SGA and placental abruption were found to be highly associated.

Table IV shows the results of the multiple logistic regression analysis, made in order to adjust for potentially confounding effects and to identify independent risk factors that could explain why women of Foreign origin had higher perinatal mortality. When background factors were entered as covariates, this did not change the increased perinatal mortality risk for women of Foreign origin (model 1). In model 2, when risk factors for perinatal mortality were added, the increased perinatal mortality risk for women of Foreign origin was still statistically significant. The same pattern was shown among African women (Table V).

Table III. Crude relative risks regarding perinatal mortality when exposed to certain background factors and perinatal risk factors, in women giving birth in Malmö 1990–95 (n=15,639)

Factors	Relative Risk (OR)	(95% CI)
Maternal age (y)		
19–40	1.0	(reference)
<19	3.0	0.9–9.4
>40	0.6	0.1–4.2
Parity (n)		
1–4	1	(reference)
0	0.8	0.6–1.2
>4	0.6	0.1–4.6
Maternal height (m)		
>1.55	1	(reference)
≤1.55	1.0	0.4–2.2
Smoking[a]		
No	1	(reference)
Yes	0.8	0.5–1.2
Cohabiting[a]		
Yes	1	(reference)
No	1.8	1.0–3.1
Diabetes		
No	1	(reference)
Yes	5.4	2.0–15.0
Anemia		
No	1	(reference)
Yes	1.4	0.6–3.2
Pre-eclampsia		
No	1	(reference)
Yes	1.6	0.8–3.6
SGA[b]		
No	1	(reference)
Yes	22.7	14.3–36.1
Placental abruption		
No	1	(reference)
Yes	23.6	8.1–69.1

[a]in early pregnancy.
[b]Small for Gestational Age.

Table IV. Crude and adjusted relative risk regarding perinatal mortality among women of Swedish and Foreign origin, giving birth in Malmö 1990–95 (n= 15,639)

Factors	Crude OR (95% CI) Perinatal Mortality	Adjusted OR (95% CI) Model 1	Model 2
Foreign origin[a]	1.5 (1.0–2.2)	1.5 (1.1–2.3)	1.5 (1.0–2.2)
Maternal age (y)			
19–40		1.0 (reference)	
<19		2.7 (0.8–9.0)	
>40		0.6 (0.1–4.4)	
Parity			
1–4		1.0 (reference)	
0		0.8 (0.5–1.2)	
>4		0.6 (0.1–4.3)	
Maternal height[b]		0.8 (0.3–1.8)	
Smoking[c]		0.7 (0.4–1.2)	
Cohabiting[d]		1.9 (1.1–3.3)	
Diabetes[c]			6.4 (2.2–18.5)
Anemia[c]			1.5 (0.6–3.5)
Pre-eclampsia[c]			0.8 (0.3–1.8)
SGA[c,e]			25.4 (15.7–412)
Placental abruption[c]			34.0 (11.5–100.4)

[a]Foreign versus Swedish origin.
[b]≤1.55 m versus >1.55 m.
[c]yes versus no.
[d]no versus yes.
[e]Small for Gestational Age.

Table V. Crude and adjusted relative risks regarding perinatal mortality among women of Swedish and African origin, giving birth in Malmö 1990–95 (n= 11,140)

Factors	Crude RR (95% CI) Perinatal Mortality	Adjusted OR (95% CI) Model 1	Model 2
African origin[a]	4.3 (2.1–8.6)	4.1 (1.9–8.7)	4.0 (1.9–8.2)
Maternal age (y)			
19–40		1.0 (reference)	
<19		6.3 (1.8–22.2)	
>40		1.2 (0.1–8.6)	
Parity			
1–4		1.0 (reference)	
0		0.8 (0.5–1.3)	
>4		1.1 (0.3–18.9)	
Maternal height[b]		1.1 (0.2–4.5)	
Smoking[c]		0.8 (0.4–1.4)	
Cohabiting[d]		1.7 (0.8–3.3)	
Diabetes[c]			5.3 (1.2–22.4)
Anemia[c]			1.4 (0.5–4.0)
Pre-eclampsia[c]			0.6 (0.2–1.6)
SGA[c,e]			9.0 (10.0–35.7)

[a]African versus Swedish origin.
[b]≤1.55 m versus >1.55 m.
[c]yes versus no.
[d]no versus yes.
[e]Small for Gestational Age.

Table VI. Groups of country of origin regarding perinatal mortality in women giving birth in Malmö 1990–95 (n=15,639)

Groups	Stillborn (n=57)	Early neonatal death (n=52)	Total perinatal death (n=109)
Sweden	31	34	65
Eastern Europe	8	5	13
Middle East	9	6	15
Africa	6	3	9
Other groups[a]	3	4	7

[a]Latin America, Asia, other Nordic countries, Western Europe.

Discussion

This study shows an increased risk of perinatal mortality, as well as a higher prevalence of anemia and diabetes, among women of Foreign origin living in the city of Malmö. However, in the group of women of Foreign origin there was a lower incidence of pre-eclampsia, neonatal acidosis and transfers to Neonatal Intensive Care Unit (NICU) as compared to the Swedish group.

Among the subgroups of Foreign origin there were only minor differences regarding outcomes except for the African subgroup, which showed a higher risk of perinatal mortality, neonatal distress, preterm delivery and SGA. Despite this, new-newborns to women of African origin were transferred to the NICU at a lower frequency than newborns to the Swedish group. Health workers might be less able to observe problems among the newborns of immigrants, which could reflect differences in the efficiency of perinatal care at hospital level, as well as interpersonal communication problems (15). The higher perinatal mortality among children born to women of Foreign origin does not appear to be explained by the most commonly discussed risk factors during pregnancy and delivery (Tables IV, V).

The results of this study might be biassed by selection or by misclassification. Inclusion in the study-population of women of Foreign origin with higher obstetric risk factors could in theory result in an overestimation of the risk for adverse perinatal outcome. However, we do not consider this to be very plausible, since there is a delivery clinic at another university hospital in a city only 20 km from our clinic, and women are not encouraged to give birth outside the home city as this entails extra charges for the hospital in their home city. Selection bias by sampling fewer deliveries of Swedish women seems unlikely as only 5% of the total population of Malmö gives birth outside of the city of Malmö. Women of Foreign origin in Malmö have a higher prevalence of induced abortion (13) than Swedish women and assuming that induced abortion is positively associated with risk for adverse outcome, rather than the opposite, a selection bias that would increase the risk estimates is therefore unlikely. In the excluded group there were two cases of perinatal mortality, one being excluded because of twin pregnancy and the other excluded because the personal identification number could not be linked to any maternal place of birth.

Misclassification of perinatal mortality is unlikely and the registration of the country of birth is based upon data from the National Registry and has the same precision and validity as other Swedish register-based studies (6, 10, 14). Adopted women, born abroad, are classified as women of Foreign origin, but they comprised less than 1% to the total immigrant population.

Of the total number of perinatal deaths in Sweden, 62% are stillborn and 38% occur within the first seven days of life (Swedish Medical Birth Register 1995). In the present study, the group of women of Foreign origin showed the same pattern as the national data (63%).

The majority of women in the African group were born in Somalia. Nearly 100% of the Somali women undergo some sort of genital mutilation. In studies comparing the perinatal outcome of mutilated and non-mutilated women, no significant differences were found in perinatal mortality (16). Earlier studies from Somalia have reported on a

tradition amongst pregnant women whereby, in order to avoid large fetuses and subsequent complications during delivery, women voluntarily eat less than when they are not pregnant (17). If this tradition is maintained when Somali women emigrate to Sweden, it could be a part explanation for the higher prevalence of small-for-gestational-age infants. The prevalence of SGA in this group might be inflated as the intrauterine growth curve is based on a Swedish population. However, the prevalence of SGA might be deflated, as the diagnosis is only based on ICD9 code in the Malmö database where all multiple pregnancies were excluded. In a population with a relatively high percentage of non-Caucasian origin, further study as to how the growth curve is dependent on maternal background factors would be worthwhile (ethnicity, height and weight).

It is well-known that pregnant women with diabetes have a higher risk of perinatal mortality, which is partly related to fetal malformation (18). However, these risk factors could not explain the higher mortality rate among new-newborns to women of Foreign origin (Table IV). Even if some religions do not accept abortion in circumstances where severe fetal anomalies exist and with regard to the traditions of consanguinity, severe fetal anomalies were equally prevalent among the two groups (Table II) and among the perinatal death group.

Anemia was more common among women of Foreign origin and was associated with adverse outcome, including perinatal mortality (Tables lll, IV). However, when adjustments were made for anemia, the higher risk of perinatal mortality still remained. The anemia variable in the register does not distinguish iron deficiency from other causes of anemia such as malaria, chronic infection, inflammation or hemoglobinopathies. The number of registered cases of infection during pregnancy was too low during the studied period to permit a meaningful analysis.

Smoking is a well known risk factor for SGA and has been shown to be related with perinatal death (19). The prevalence of smoking among women of Foreign origin was lower as compared to Swedes. As smoking explains approximately 10% of all perinatal deaths in the Swedish population (20), the differences in mortality and intrauterine growth retardation between the two groups might be even more pronounced. Unexpectedly, smoking was not associated with perinatal mortality in this study. We have therefore considered validity problems in the smoking variable in the study. However, smokers had a higher relative risk (OR 1.8, CI 1.4–2.4) and prevalence of SGA (2.3% *vs* 1.3%) and the mean birth weight of new-newborns to smokers was lower (3359 g *vs* 3532 g) as compared to non-smokers which indicates that we had a valid measure of smoking status. The prevalence of smoking in the total study population did not differ from the total Swedish population (21) and the excluded cases were less than 4%. Patients excluded showed similar smoking and cohabiting status as those included.

In the present study, not cohabiting was a statistically significant risk factor for perinatal mortality, and the prevalence was higher especially among women of African origin. Earlier studies have shown a tendency towards increasing perinatal mortality among groups with a lower socio-economic status (22, 23). It has recently been shown that single mothers with low psycho-social resources also have an increased risk for SGA-newborns (24). In national and local registers there is a lack of information about socio-economic variables such as educational level, living conditions, employment, income and occupation amongst immigrants. For this reason, we have not been able to determine the relative importance of these factors for the higher perinatal mortality observed among the Sub-Saharan women in this study.

Prerequisites for screening procedures in maternal health care are proper assessment of conditions with possible adverse outcome, knowledge of the relative risks and prevalence in the population (25). Thus, the initial antenatal visit for screening in immigrant groups may not be sufficient or appropriate to determine those at risk. This may lead to fewer referrals to specialist care than would otherwise be needed. Even if antenatal care is free and well distributed among the population, some immigrant groups might also utilize the facilities in a less appropriate way, and with less compliance, due to cultural and language barriers.

In conclusion, the main finding of this study is the higher risk of perinatal mortality among women from sub-Saharan Africa and the tendency in the group of Foreign origin, in comparison to native Swedes in Malmö, which could not be explained by well-known risk factors. Women, and newborns from sub-Saharan Africa especially, should be better focused on all levels of maternal and neonatal care. In order to obtain further socio-economic information such as life-style and psycho-social factors and to illuminate the effect of poor knowledge of the language, anthropological studies are needed. Perinatal mortality is said to indicate the efficiency of health services, while infant mortality is claimed to be an indicator of the parents' socio-economic status (26). It is beyond the scope of the present study to analyze each individual case of perinatal mortality with regard

to the standard of perinatal care. This could be done in a perinatal audit procedure, by searching for further explanations to the inter-cultural differences of perinatal mortality.

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