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## **Ethnic differences in stillbirth and early neonatal mortality in the Netherlands**

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A.R., M.T., M.E., BM and J.R. contributed to the conception and design of the study. J.D. and J.P. were involved in acquisition of the data. A.R. conducted the analyses and A.R. and M.E, drafted the manuscript. All authors had full access to of the reports and tables. All authors provided advice on the analysis and interpretation of the data. All authors critically revised the draft versions and approved the final version of the manuscript.

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## **ABSTRACT**

### **Background:**

Ethnic disparities in perinatal mortality are well known. This study aims to explore the contribution of demographic, socioeconomic, health behavioural and pre-existent medical risk factors among different ethnic groups on foetal and early neonatal mortality.

### **Methods:**

We assessed perinatal mortality from 24.0 weeks gestation onwards in 554,234 singleton pregnancies of nulliparous women in the linked Netherlands Perinatal Registry over the period 2000-2006. Logistic regression modelling was used.

### **Results:**

Considerable ethnic differences in perinatal mortality exists especially in foetal mortality. Maternal age, socioeconomic status and pre-existent diseases could not explain these ethnic differences. Late booking visit could explain some differences. Compared to the Dutch, African women had an increased foetal mortality risk of odds ratio 1.7 (95% CI 1.4 to 2.1), South Asian women of 1.8 (1.4 to 2.3), other non-Western women of 1.3 (1.1 to 1.6) and Turkish/Moroccan women of 1.3 (1.1 to 1.4). The risk on early neonatal mortality was only increased in other non-Western women, odds ratio 1.3 (1.0 to 1.8). Ethnic differences were even present in the women without risk factors including preterm births. Mortality risk for East-Asian and other Western women was lower or comparable to the Dutch.

### **Conclusion:**

Important ethnic differences in foetal mortality exist, especially among women of African and South Asian origin. Ethnic minorities should be more acquainted with the significance of early start of prenatal care. **Tailored prenatal care for women with African and South Asian origin seems necessary.** More research on underlying cause of deaths is needed by ethnic group.

### **Keywords:**

Perinatal mortality, ethnicity, stillbirth, late in care, socioeconomic status.  
Article type: original research paper, epidemiology

**What is already known on this topic**

- Ethnic minority women have higher perinatal mortality in Western countries.
- Teenage pregnancy, low socioeconomic status and pre-existent diseases are important risk factors for perinatal mortality.
- Women from non-Western ethnic origin have more preterm births and low birth weight newborns.

**What this study adds:**

- Ethnic differences in foetal and early neonatal mortality exist in the Netherlands and foetal mortality is especially elevated among women of African, South Asian and other non-Western origin.
- Women from other Western or East Asian origin have lower foetal and neonatal mortality risk compared to the Dutch women.
- Living in urbanised areas diminishes the risk on mortality for ethnic minorities and first booking visit after 18 weeks aggravates the risk on mortality. Maternal age, socioeconomic status and pre-existent disease had no effect
- In women without risk factors the ethnic risk differences in mortality were even more pronounced.

## Introduction

Ethnic disparities in perinatal mortality exist in western countries.<sup>1 2 3</sup> It has been argued that these differences are predominantly determined by socioeconomic disparities, while others state that biological and medical conditions underlay the elevated risks.<sup>4 5</sup> These findings signify that differences in perinatal mortality between ethnic groups are poorly understood.<sup>2 6 7, 8</sup>

In the Netherlands, 16% of the pregnant women are from non-Western origin. The main ethnic minorities originate from the former Dutch colony Indonesia (independency in 1945), Surinam (independency in 1975) and from Turkey and Morocco as migrant labourers mainly in the sixties. A recent study in the Netherlands showed that the non-Western women had a 40% higher risk on perinatal mortality.<sup>9</sup> Previous studies showed that ethnic specific differences exist in perinatal and infant mortality in the Netherlands.<sup>10 11 12</sup> Ethnic women also experience an increased risk on severe maternal morbidity.<sup>13</sup> It is unknown if ethnic differences exists in stillbirth on a national level.

The aim of this paper is to describe the differences in foetal and early neonatal mortality between women of different ethnic origin in the Netherlands. Furthermore the aim is to explore the contribution of demographic, socioeconomic, health behavioural and pre-existent medical risk factors on foetal and early neonatal mortality among different ethnic groups.

## Materials and Methods

### Data sources

The Netherlands Perinatal Registry (PRN) contains population based information on pregnancies, deliveries and (re)admissions of newborns.<sup>14</sup> The PRN is based on a validated probabilistic linkage of the national midwifery registry (LVR1), the obstetrics registry (LVR2) and the neonatology/ paediatrics registry (LNR).<sup>15 16</sup> The recent linkage of 7-years of

obstetric and neonatal registry data allows detailed analysis of a large cohort of 1,3 million births.<sup>17</sup> The midwifery and obstetrics registries start at the first (booking) prenatal visit. If the child is admitted to a neonatal ward after birth the information is collected in the neonatology registry. Around 96% of all births are included in the perinatal registration.

#### Study population

The study population comprised nulliparous women who gave birth to singletons during the period 2000-2006. We excluded births before the legal term of 24 weeks gestation and below 500 gram, because there are terminations of pregnancy before 24 weeks which could be distributed unequally among the ethnic groups.<sup>9</sup> Women who conceived after assisted reproductive technology (n=14,766, 2.6%) were also excluded for reason of unequal distribution. The study population existed of 554,234 births including 3135 stillbirths and 1266 early neonatal deaths.

#### Outcome variables

Perinatal mortality, foetal and early neonatal mortality were the main outcome variables. Foetal mortality (stillbirths) was defined as death of the unborn child either antenatal or during labour (per 1000 births). Early neonatal mortality was defined as death up to 7 days of life (per 1000 live births). Perinatal mortality is the sum of foetal and early neonatal mortality divided per 1000 births (including stillbirths) from 24 weeks gestation onwards. Other adverse outcomes were preterm birth (< 37.0 weeks gestational age) low birth weight (<2500 gram) and congenital anomalies.

#### Definition of ethnicity

The classification of ethnicity was performed by the health care professional on the basis of race and country of birth. Since mid eighties this definition is used in the midwifery and obstetrics registry and is in fact a mixture of ethnicity and race. The Western ethnic groups included ethnic "Dutch" and "other Western" women with Caucasoid ancestry (Belgium, UK,

Germany, etc). The non-Western ethnic group was classified in five subgroups. Two different ethnic groups originate from Surinam (a former Dutch colony): the “African” or Creole and the “South Asian” or Hindustani originating from Africa and India respectively. The other subgroups include the “Turkish/Moroccan” women, “East-Asian” women originating mainly from Indonesia (a former Dutch colony) and “other non-Western” women.

#### Risk factors

Demographic and socioeconomic risk factors were maternal age, urbanisation degree and socioeconomic status (SES). The urbanisation degree and SES indicators were created on the basis of the four digit postcode of the pregnant woman. Urbanisation was based on the number of addresses per square kilometre and categorized in very urban ( $\geq 2500$  adresses/km<sup>2</sup>), intermediate urban/rural (between 500 and 2500 adresses/km<sup>2</sup>) and very rural ( $< 500$  adresses/km<sup>2</sup>). The SES indicators included the data from the Netherlands Institute for Social Research/SCP in three categories (10<sup>th</sup>, 10-90,  $\geq 90^{\text{th}}$  percentile) and the mean average household equivalent income for neighbourhoods as low and high ( $<40\%$ ,  $\geq 40\%$ ).

Pre-existent medical risk factors were essential hypertension, diabetes mellitus, other endocrine diseases, cardiac disease, systemic diseases, thrombo-embolic disorders and psychiatric disorders as recorded by the midwife or gynaecologist.

Behavioural risk factors considered were the booking visit and smoking during gestation. The timing of the first antenatal or booking visit was measured in weeks of gestational age and categorized in four groups as ( $<12$  weeks (in time), 12-17 weeks, after 18 weeks gestational age (late) and unknown. Heavy smoking registered as “abuse of nicotine” was recorded by the health care professional based on self report of the woman ( $\geq 20$  cigarettes a day).

#### Statistical analyses



The prevalence of risk factors among the different ethnic groups was determined and differences were tested with a Chi-Square test. The incidence of perinatal, foetal and early neonatal mortality as well as preterm birth, low birth weight and congenital anomalies was described for the different ethnic groups and the differences were tested with a Chi-Square test.

The crude odds ratios (OR) and their 95% confidence interval (95% CI) of the different ethnic groups on foetal and neonatal mortality were calculated using logistic regression modelling. The reference categories are based on that level of the predictor with the lowest risk of the outcome.

The adjustment (enter method) included all relevant risk factors for mortality: maternal age, urbanization, SES, low income, booking visit, heavy smoking and pre-existing diseases. The effect of each adjustment factor separately on ethnicity was also determined.

A second multivariate model was created including the effect of preterm birth as preterm birth is more prevalent among African and South Asian women and is a strong indicator for mortality. Thirdly, the analyses were repeated in group of women with known ethnicity and without risk factors. For this group, women with age below 20 or above 40 years, low SES, low income level, booking visit  $\geq$  18 weeks gestation, heavy smoking, pre-existent diseases, gestational age below 32 weeks, congenital anomalies and a birth weight below 2000 gram were excluded. The SAS software, version 9.1, was used (SAS institute Inc, Cary NC).

## **Results**

Table 1 shows the prevalence of risk factors for perinatal mortality among the different ethnic groups. The prevalence of teenage pregnancy, was ten times higher among the African women compared to the Dutch women (2.3%). In addition, African, South Asian, Turkish/Moroccan and other non-Western women lived more often in very urban areas and had a lower social economic status compared to Dutch women. African and other non-Western women were more often late in care. On the contrary heavy smoking was more prevalent in Dutch women. South Asian women more often suffered from diabetes mellitus.

Table 1		Characteristics (%) of the 554,234 pregnant nulliparous women by ethnic group									
Ethnic group		Dutch	Other Western	Turkish/Moroccan	African	South Asian	East Asian	Other Non-Western	Unknown	Total	Chi Square p-value
<b>Pregnant women (number)</b>		<b>460,543</b>	<b>15,007</b>	<b>34,973</b>	<b>11,605</b>	<b>5,853</b>	<b>10,675</b>	<b>12,541</b>	<b>3,037</b>	<b>554,234</b>	
<b>Pregnant women (%)</b>		<b>83.1</b>	<b>2.7</b>	<b>6.3</b>	<b>2.1</b>	<b>1.1</b>	<b>1.9</b>	<b>2.3</b>	<b>0.5</b>	<b>100.0</b>	
<b>Maternal age at birth (years)</b>											<0.0001
	< 20	2.3	4.3	7.7	19.9	6.7	7.4	10.9	6.0	3.5	
	20-24	12.6	20.1	43.8	33.6	29.3	22.0	26.0	21.7	15.9	
	25-34	74.2	62.4	43.6	40.9	56.7	59.4	52.9	63.7	70.2	
	35-39	9.8	11.7	4.2	4.7	6.4	9.7	8.7	7.7	9.3	
	>= 40	1.1	1.5	0.9	1.0	1.0	1.6	1.4	0.9	1.1	
	mean (year)	29.1	28.5	25.2	24.6	26.7	27.8	26.9	27.6	28.6	
<b>Urbanisation</b>											<0.0001
	Very urban	17.0	35.9	48.7	55.3	55.1	33.6	41.6	32.4	21.7	
	urban/rural	64.1	55.6	49.1	40.9	42.0	59.7	51.7	57.1	61.8	
	Very rural	18.9	8.5	2.2	3.9	3.0	6.7	6.7	10.5	16.5	
<b>SES</b>											<0.0001
	high	10.4	9.7	2.9	3.8	6.8	9.5	7.2	7.7	9.6	
	middle	83.3	74.8	61.4	57.2	59.3	72.7	69.7	76.7	80.3	
	low	6.3	15.5	35.7	39.1	33.9	17.9	23.1	15.5	10.1	
<b>Low income</b>		35.3	36.8	61.1	64.1	58.2	42.2	46.8	42.3	38.2	<0.0001
<b>Booking visit ≥ 18 weeks</b>		13.2	23.0	20.4	32.7	22.8	24.0	28.4	17.4	15.0	<0.0001
<b>Heavy smoking</b>		0.6	0.4	0.3	0.2	0.1	0.2	0.1	0.4	0.4	<0.0001
<b>Pre-existent disease</b>											
	essential hypertension	0.6	0.3	0.2	0.5	0.5	0.2	0.3	0.2	0.5	<0.0001
	diabetes mellitus	0.2	0.1	0.2	0.3	0.6	0.1	0.1	0.0	0.2	<0.0001
	other endocrinological diseases	0.4	0.5	0.3	0.2	0.7	0.3	0.4	0.2	0.4	<0.0001
	systemic disease	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.03
	cardiac disease	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.0	0.1	0.46
	trombo-embolitical disorders	0.3	0.1	0.1	0.2	0.2	0.1	0.1	0.1	0.2	<0.0001
	psychiatric disorders	0.3	0.2	0.4	0.4	0.3	0.2	0.3	0.1	0.3	0.002

Table 2

## Mortality and other adverse outcome by ethnic group

Ethnic group	Dutch	Other Western	Turkish/Moroccan	African	South Asian	East Asian	Other Non-Western	Unknown	Total	Total	Chi Square
<b>Number of births</b>	460,543	15,007	34,973	11,605	5,853	10,675	12,541	3,037		554,234	<b>p-value</b>
<b>Percentage</b>	83%	3%	6%	2%	1%	2%	2%	1%			
<b>Perinatal mortality per 1000 total births</b>	7.6	5.7	9.8	13.9	12.5	6.6	11.4	8.2	7.9	4,401	<0.0001
<b>Foetal mortality per 1000 total births</b>	5.4	4.5	7.1	10.6	9.9	5.1	8.0	5.9	5.7	3,135	<0.0001
during gestation	4.3	3.7	5.4	8.4	8.2	4.1	6.9	5.9	4.5	2,508	<0.0001
during labour	1.1	0.7	1.7	2.2	1.7	0.9	1.0	\$	1.1	627	0.0001
<b>Early neonatal mortality per 1000 live births</b>	2.3	1.3	2.7	3.3	2.6	1.5	3.5	2.3	2.3	1,266	0.0008
within 24hours after birth	1.3	0.7	1.8	2.4	1.6	0.9	2.5	1.3	1.3	742	<0.0001
early, day 1-6	1.0	0.5	0.9	1.0	1.0	0.6	1.0	1.0	1.0	524	0.694
<b>Preterm births %</b>	7.8	6.3	5.6	8.9	9.5	6.1	7.2	4.8	7.6	42,299	<0.0001
<b>Low birth weight %</b>	6.6	5.0	6.1	10.0	14.3	6.2	7.6	5.0	6.7	36,970	<0.0001
<b>Congenital anomalies %</b>	2.5	2.4	2.6	2.6	2.6	2.3	2.5	1.8	2.5	13,839	0.115
<b>\$ due to low numbers no value</b>											

Perinatal mortality occurred in 7.9 per 1000 births, with significant ethnic differences (table 2). Foetal mortality was clearly higher in African, South Asian, other non-Western women and Turkish/Moroccan compared to the Dutch women. Early neonatal mortality was increased among African and other non-Western women mainly caused by deaths within 24 hours after birth (table 2).

African and South Asian women also had the highest risks on preterm births and low birth weight. East-Asian, other Western women and women of unknown ethnicity had a mortality risk that was comparable or even lower than in Dutch women (table 2).

A separate introduction of each risk factor to the model showed that adjustment for urbanisation increased the ethnic differences and adjustment for booking visit after 18 weeks reduced the ethnic differences on both mortality outcomes (table 3). Separate adjustment for age, SES, or pre-existent disease did not alter the ethnic differences on foetal and early neonatal mortality (data not shown).

Table 4 presents the crude and total adjusted odds ratios for different risk factors on foetal and early neonatal mortality. Compared to the Dutch women the foetal mortality risks of both African and South Asian women were 1.7 (95% CI 1.4 to 2.1) and 1.8 (1.4 to 2.3) respectively. The risk for early neonatal mortality was only increased for other non-Western women 1.3 (95% CI 1.0 to 1.8)

The addition of preterm birth did not alter the increased foetal risk for African and South Asian women while the effects for Turkish-Moroccan and other non-Western women increased with OR 1.4 (1.2 to 1.6) and OR 1.5 (1.2 to 1.8) respectively (data not shown). The early neonatal mortality risk for African (OR 1.4 (1.0 to 2.0) women became significant and the odds of other non-Western women (OR 1.5 (1.1 to 2.1) increased (data not shown).

**Table 3**

Effects of ethnicity on foetal mortality and early neonatal mortality after adjustment for urbanisation or for booking visit

<b>Foetal mortality</b>	<b>Crude</b>			<b>adjusted for urbanisation</b>			<b>adjusted for booking visit</b>		
				<b>OR 95%CI</b>			<b>OR 95%CI</b>		
<b>Ethnicity</b>									
Dutch	1.0			1.0			1.0		
Other Western	0.8	0.7	1.1	0.9	0.7	1.1	0.8	0.6	1.0
Turkish/Moroccan	1.3	1.2	1.5	1.4	1.2	1.6	1.3	1.1	1.4
African	2.0	1.7	2.4	2.1	1.8	2.5	1.7	1.4	2.1
South Asian	1.9	1.4	2.4	2.0	1.5	2.6	1.7	1.3	2.2
East Asian	0.9	0.7	1.2	1.0	0.7	1.3	0.9	0.7	1.1
Other non									
Western	1.5	1.2	1.8	1.6	1.3	1.9	1.3	1.1	1.6
Unknown	1.1	0.7	1.8	1.1	0.7	1.8	1.1	0.7	1.7
<b>Early neonatal mortality</b>									
	<b>Crude</b>			<b>adjusted for urbanisation</b>			<b>adjusted for booking visit</b>		
				<b>OR 95%CI</b>			<b>OR 95%CI</b>		
<b>Ethnicity</b>									
Dutch	1.0	reference		1.0			1.0		
Other Western	0.6	0.4	0.9	0.6	0.4	0.9	0.5	0.3	0.8
Turkish/Moroccan	1.2	1.0	1.5	1.3	1.0	1.6	1.1	0.9	1.4
African	1.5	1.1	2.0	1.6	1.1	2.2	1.3	0.9	1.7
South Asian	1.1	0.7	1.9	1.2	0.7	2.0	1.1	0.6	1.8
East Asian	0.7	0.4	1.1	0.7	0.4	1.1	0.6	0.4	1.0
Other non									
Western	1.5	1.1	2.1	1.6	1.2	2.2	1.3	1.0	1.8
Unknown	1.0	0.5	2.2	1.1	0.5	2.2	1.0	0.5	2.1

**Table 4**Crude and **total** adjusted odds ratio's (95% CI) of risk factors for foetal and early neonatal mortality

Risk factors	Foetal mortality crude			Foetal mortality total adjusted <sup>†</sup>			Early neonatal mortality crude			Early neonatal mortality total adjusted <sup>†</sup>		
	n=3.135/554.234						n=1.266/551.099					
	Odds	95%CI		Odds	95%CI		Odds	95%CI		Odds	95%CI	
<b>Ethnicity</b>												
Dutch	1.0	reference		1.0	reference		1.0	reference		1.0	reference	
Other Western	0.8	0.7	1.1	0.8	0.6	1.0	0.6	0.4	0.9	0.5	0.3	0.8
Turkish/Moroccan	1.3	1.2	1.5	1.3	1.1	1.4	1.2	1.0	1.5	1.1	0.9	1.4
African	2.0	1.7	2.4	1.7	1.4	2.1	1.5	1.1	2.0	1.2	0.9	1.7
South Asian	1.9	1.4	2.4	1.8	1.4	2.3	1.1	0.7	1.9	1.1	0.7	1.8
East Asian	0.9	0.7	1.2	0.9	0.7	1.1	0.7	0.4	1.1	0.6	0.4	1.0
Other non Western	1.5	1.2	1.8	1.3	1.1	1.6	1.5	1.1	2.1	1.3	1.0	1.8
Unknown	1.1	0.7	1.8	1.1	0.7	1.7	1.0	0.5	2.2	1.0	0.5	2.1
<b>Age (years)</b>												
<20	1.5	1.2	1.7	1.1	0.9	1.3	1.6	1.3	2.1	1.3	1.0	1.7
20-24	1.3	1.2	1.4	1.1	1.0	1.2	1.2	1.0	1.4	1.1	0.9	1.3
25-34	1.0	reference		1.0	reference		1.0	reference		1.0	reference	
35-39	1.3	1.2	1.5	1.3	1.2	1.5	1.2	1.0	1.5	1.2	1.0	1.5
>= 40	1.9	1.5	2.5	1.9	1.4	2.4	1.5	1.0	2.4	1.5	0.9	2.3
<b>Urbanisation</b>												
Very urban	1.0	0.9	1.1	0.8	0.7	0.9	0.9	0.8	1.1	0.9	0.7	1.0
urban/rural	1.0	reference		1.0	reference		1.0	reference		1.0	reference	
Very rural	1.1	0.9	1.1	1.0	0.9	1.1	1.1	0.9	1.3	1.1	0.9	1.2
<b>SES</b>												
high	1.0	reference		1.0	reference		1.0	reference		1.0	reference	
middle	1.3	1.2	1.5	1.3	1.1	1.5	1.2	1.0	1.4	1.2	0.9	1.4
low	1.6	1.4	1.9	1.4	1.2	1.7	1.2	1.0	1.6	1.2	0.9	1.7
<b>Low income</b>	1.2	1.1	1.3	1.1	1.0	1.2	1.0	0.9	1.2	1.0	0.8	1.1

<b>Booking visit</b>												
<12 weeks	1.0	reference		1.0	reference		1.0	reference		1.0	reference	
12-17 weeks	0.9	0.8	0.9	0.8	0.8	0.9	0.9	0.8	1.0	0.9	0.8	1.0
≥ 18 weeks	2.0	1.8	2.1	1.9	1.2	2.0	2.0	1.7	2.2	1.9	1.7	2.2
Unknown	0.6	0.5	0.8	0.6	0.5	0.8	0.4	0.2	0.6	0.4	0.2	0.6
<b>Heavy smoking</b>	1.8	1.2	2.6	1.8	1.2	2.6	1.2	0.6	2.4	1.2	0.6	2.4
<b>Pre-existent disease</b>												
essential hypertension	1.9	1.3	2.7	1.8	1.3	2.6	2.0	1.1	3.4	1.9	1.1	3.3
diabetes mellitus	2.9	1.7	4.9	2.7	1.6	4.5	2.6	1.1	6.2	2.4	1.0	5.9
cardiac disease	1.6	0.7	3.5	1.5	0.7	3.4	3.2	1.3	7.8	3.2	1.3	7.8
trombo-embolitical disorders	2.3	1.4	3.7	2.2	1.4	3.4	1.4	0.5	3.7	1.3	0.5	3.6
psychiatric disorders	1.7	1.1	2.8	1.5	0.9	2.5	0.8	0.2	2.3	0.7	0.2	2.1
<b>* Total adjusted for age, urbanisation, SES, low income, booking visit, smoking and pre-existent diseases</b>												

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**Table 5**

Crude odds ratio's (95% CI) for ethnicity on foetal and early neonatal mortality for 264502 women without risk factors

Ethnicity	Foetal mortality crude			Early neonatal mortality crude		
	OR	95% CI	95% CI	OR	95% CI	95% CI
Dutch	1.0	Reference		1.0	Reference	
Other Western	0.8	0.5	1.5	1.2	0.5	3.0
Turkish/Moroccan	1.4	0.8	1.7	1.2	0.6	2.6
African	2.2	1.1	4.0	3.1	1.1	8.3
South Asian	2.3	1.1	4.6	\$		
East Asian	0.9	0.4	1.7	\$		
Other non Western	0.8	0.4	1.6	\$		

\$ due to low numbers no value

Women with age below 20 or above 40 years, low SES, low income level, booking visit  $\geq$  18 weeks gestation, heavy smoking, pre-existent diseases, gestational age below 32 weeks, congenital anomalies and a birth weight below 2000 gram were excluded.



When the analysis was limited to the 264.502 (48% of the study group) women without the risk factors, the ethnic differences became even higher. The risk on foetal mortality for African and South Asian women were respectively OR 2.2 (1.1 to 4.0) and OR 2.3 (1.2 to 4.6) (**Table 5**). In early neonatal mortality the odds ratio for African women was increased to OR 3.1 (1.1 to 8.3). Additional adjustment for age did not change these effects.

## Comments

### <Principal findings>

Important ethnic differences exist in stillbirth and early neonatal mortality among nulliparous women in the Netherlands especially among African, South Asian and other non-Western women. Teenage pregnancy, living in very urban areas, lower social economic status and late in care were more prevalent among all non-Western ethnic groups. Moreover, South Asian women had diabetes mellitus more often. These ethnic differences were more pronounced in foetal mortality risk. Living in urban areas was slightly protective, maternal age, SES and pre-existent medical conditions showed no effect on ethnic differences in mortality. Booking visit after 18 weeks gestation explained partly the ethnic differences in mortality. The ethnic differences in mortality became even more visible in women without these risk factors. Women from other Western or East Asian origin have lower foetal and neonatal mortality risk compared to the Dutch women.

### <Strengths and weaknesses of the study>

The nearly complete coverage of all births makes the large linked national perinatal database suitable for analyzing the effect of different ethnic groups on both foetal and neonatal mortality. A study limitation is the definition of ethnicity which is based on the information from the healthcare providers. Turkish and Moroccan women are from different ethnic origin but are registered in one group. The information of the ethnic origin of the father is not

recorded and possibly some African women are defined as other non-Western. Another limitation of this study is the possible insufficient adjustment for SES since it was measured on postcode area, an effect of SES could be present if measured on the individual level. Underreporting by the health care providers of maternal pre-existing risks factors and especially of heavy smoking during pregnancy could also have affected the results, however we have no reason to assume that underreporting is related to ethnicity of the women. Women with unknown ethnicity had comparable mortality risks as the Dutch women. The percentage of missing values of outcomes and risk factors did not differ between the ethnic groups and were overall below 2%. The 4% missing birth data in the registry are due to non reporting midwives and general practitioners (low risk pregnancies), while 99% of the obstetricians participate in the registry. The perinatal registry does not contain information on maternal education, body mass index, marital/relationship status and more detailed information about utilization of health care, that might explain the ethnic differences found. Since 2009, this information as well as the country of both parents is included in the revised national perinatal registry. In this study only nulliparous women were included but the ethnic differences are also visible in the total population from 22 weeks onwards including multiple births and pregnancies conceived after assisted reproductive technology.<sup>9</sup>

#### <Relation to other studies >

The finding of elevated perinatal mortality among ethnic minorities is in accordance with earlier international studies.<sup>3 8</sup> In the UK, effects on perinatal mortality for African and South Asian women compared to white women were also found, where black women had the largest risks.<sup>18</sup> The increased risk of African women on neonatal mortality in the first month of life and total infant mortality was also seen in the USA.<sup>2</sup> No elevated risk of the East-Asian women compared to the Caucasian women was reported in Norway.<sup>19</sup>

The finding on ethnic differences in foetal mortality is new. In previous studies in Europe the differentiation of perinatal mortality in foetal and early neonatal mortality lacks on

a national level. Increased perinatal mortality differences among ethnic minorities as was found in other studies.<sup>10 11,20, 21</sup> The healthy migrant effect is a well known phenomenon and this might explain the low foetal and early neonatal mortality in other Western and East Asian women compared to the Dutch women. The higher prevalence of teenage pregnancy among non-Western women is reported as explanation for the elevated perinatal mortality risk.<sup>22</sup> Our study does not confirm this. The crude mortality risk for teenage African women was even lower than the mortality risk for older African women (data not shown) which was also shown in black newborns in the USA.<sup>2</sup> This possibly suggests earlier maturation for procreation of women of African descent. Living in a very urban or rural area has been reported as a risk factor for perinatal mortality. However, we found that living in very urban areas was favourable for non-Western women. Perhaps the easier access (travel distance) and a more adapted health care services to non-Western groups in urban areas plays a role.<sup>23</sup> The high prevalence of low SES in non-Western women is another frequently used explanation of the elevated risks among these groups.<sup>24 25</sup> Although low SES is related to more mortality we did not find that low SES explained the elevated mortality risks among the non-Western women as was also found in Denmark.<sup>3</sup>

In the Netherlands there is guaranteed access to maternity care at all levels as part of the national health care system, but this opportunity is possibly not fully taken by women from non-Western origin through possible language, cultural or knowledge barriers. In Norway an audit of stillbirths revealed a strong association of sub-optimal obstetric care in non-Western women compared to Western women.<sup>26</sup> This can be reason of late start of antenatal care and not alarming a caregiver in time, less compliance to treatment or advise and possibly reticent policy of caregivers.<sup>27,28</sup> We found on average that 15% of the pregnant women started prenatal care after 18 weeks while among African and other non-Western women these percentages were doubled. However, in our study the ethnic differences in mortality were also visible in the earlier starters as was also shown in the USA.<sup>29</sup> Language problems are less obvious in the African and South Asian women who both came from Surinam, a former Dutch colony. Women with pre-existing diseases are at elevated risk for

perinatal mortality, however adjusting for or even excluding women with pre-existing diseases did not change the ethnic differences on foetal and neonatal mortality.

<meaning of the study, questions and proposals>

The ethnic differences apparent in especially in foetal mortality are remarkable. Our study revealed that excess in perinatal mortality among African, South Asian and other non-Western women could not be explained by the generally supposed explaining risk factors (teenage pregnancy, living in very urban areas and low SES). A possible explanation is that cultural or knowledge barriers affect the access of women to regular care, or affect its effectiveness once women got access to care. Another possibility is a biological working mechanism. It could be relevant for example to evaluate if the optimum duration of pregnancy in the African, South Asian and other non-Western women is different from the Dutch women.<sup>18</sup> The need for tailored perinatal care for women from African and South Asian ethnic background in case of preconception care, screening and risk factor management should be focus of research. Because there are ethnic differences in foetal and neonatal mortality in the Netherlands, it should be stressed to record race/ethnicity of the patient because of its potential implications for decisional based care paths.<sup>30</sup>

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