Trends in maternal mortality ratio among women of German and non-German nationality in West Germany, 1980–1996

Oliver Razum, Albrecht Jahn, Maria Blettner and Pitt Reitmaier

Background
Maternal mortality is a sensitive indicator for inequity in health. We describe recent trends in overall and cause-specific maternal mortality ratio among women of German and non-German nationality residing in West Germany.

Methods
Using birth and death register data for 1980–1996 we related 1067 cases of maternal death (ICD 9: 630–676) to 11.2 million live births. We assessed the effects of nationality and of marital status, a proxy for socioeconomic status, controlling for year of death and age of the mother in a Poisson regression model.

Results
Maternal mortality ratio in West Germany decreased from 13 per 100 000 live births in 1980–1988 to 6.1 in 1989–1996. The crude relative risk for non-German nationality decreased from 1.9 (95% CI: 1.6–2.3) to 1.3 (1.0–1.7); after adjusting for age, year of death and marital status it was 1.7 (95% CI: 1.4–2.1) and 1.6 (95% CI: 1.2–2.1). Unmarried women incurred an adjusted relative risk of 1.8 (95% CI: 1.5–2.3). Non-German women experienced an excess mortality from abortions which largely disappeared in 1989–1996; concurrently, being unmarried no longer conveyed an additional risk to them. The risk status of German mothers developed unfavourably: increasing proportions are unmarried, which continues to be a marker of elevated relative risk in this group.

Conclusions
Our findings suggest continuously improving accessibility and quality of obstetric services, in particular for women of non-German nationality. Still, inequity in maternal risk continues to exist. Maternal risk, however, is not determined by the simple distinction ‘German’ versus ‘non-German’; its association with socioeconomic status extends beyond nationality.

Keywords
Maternal mortality, Germany, transients and migrants, equity, obstetrics

Accepted
19 February 1999
the reproductive age group 15–44 years. They delivered 123,661 live infants (16% of all live births in Germany). The largest groups by nationality were Turks (36% of all live births among non-German residents) and nationals of other Mediterranean countries (18%), with little change since 1980. Women from Austria, France, the Netherlands, England and Wales and the US together accounted for 5% of live births among non-German nationals.

Nationality and marital status are the only proxies for socioeconomic status in German national statistics. In 1995, 26.1% of households with a non-German head of household were below the poverty line (defined as below 50% of the mean income), as opposed to 10% of households with a German head. According to official data, 22% of unmarried mothers but only 2% of married mothers with children under 18 years of age were social welfare recipients in 1996. In 1995, 42.6% of one-parent households lived in poverty, compared to 16.8% of two-parent-households.

Our hypotheses were that the MMR is higher among women of non-German as compared to German nationality; and among non-married as compared to married women. Our study was explorative in regard to causes of maternal death and their change over time, with special attention to deaths from abortion which are reportedly higher among minorities.

Methods

The Federal Statistical Office provided annual birth and death register data for women resident in West Germany, 1980–1996. For each live birth and maternal death (ICD 9: 630–676), the following information was available: age (grouped in 5-year bands), nationality (German versus non-German passport), and marital status of the woman (married versus single, divorced or widowed). Table 1 details numbers of births and maternal characteristics by nationality in 1980 and 1996. For 215 live births (61 non-German and 154 German), information on the age of the mother was missing; for 2 deaths, both in 1993, information on the nationality of the mother was missing. These births and deaths were excluded from the analysis.

A numerator-denominator bias arises due to a peculiarity in birth registration in Germany: The newborn of a woman of non-German nationality married to a German father will be assigned German nationality; however, the woman would contribute to non-German maternal deaths. To avoid this bias, we used the number of mothers of non-German nationality giving live births as denominator (rather than the number of live infants of non-German nationality, which is up to 20% lower). A second bias arises as a consequence of the different modes of age notification in German vital statistics: for deaths, age at the last birthday is reported; for live births, the mother’s age is calculated as the difference between reporting year and the mother’s year of birth. Thus, assigned age of the mother is one year too high in about half of all live births, relatively to the way age at death is assigned. This results in erroneously low denominator figures in the age group <20 years and in an overestimate of their MMR. We corrected by shifting 50% of live births in each one-year age interval to the next lower interval.

Stata 5.0 was used for the statistical analysis. We first performed a stratified analysis by age group in two time periods of about equal length to describe age and period effects. We investigated whether interaction between nationality and time period was present and examined whether being unmarried further increases the risk among women of non-German nationality. Comparisons of rate ratios were performed with a $\chi^2$ test for unequal rate ratios. Poisson regression models were used to simultaneously investigate the effects of nationality and marital status on the risk of overall and cause-specific maternal mortality, adjusting for year of death and age of the mother.

Different models were tested by comparing their dispersion, defined as deviance divided by degrees of freedom, with the appropriate $\chi^2$ value. The dispersion for the final model was <0.9; a value <1.5 indicates absence of over-dispersion, confirming that the choice of a Poisson model was appropriate.

Results

Stratified analysis

Between 1980 and 1996 a total of 1067 maternal deaths and 11.22 million live births were reported. Figure 1 shows MMR by age group in two sub-periods of roughly equal length. The strong association of maternal mortality with age is visible. In 1989–1996 risk has decreased significantly in all age groups as compared to 1980–1988, with non-overlapping 95% CI. This decrease is most pronounced in the age groups <20 years and >39 years when pregnancies are considered ‘high risk’.

Of the maternal deaths, 226 (21.2%) and 1.62 million (14.5%) of the live births were among women of non-German nationality, yielding a crude relative risk (RR) of 1.59 (95% CI: 1.37–1.84) over the whole study period. Figure 2 shows time trends of maternal mortality among women of German and non-German nationality. Both groups experience considerable absolute decreases in risk. In addition, the risk of non-German women appears to approach that of German women. An analysis stratified by time periods supports this: the risk for non-German women decreases by almost two-thirds, in absolute terms as well as relative to the risk of German women (Table 2). A $\chi^2$ test for unequal rate ratios indicates that the decrease in RR is significant ($P = 0.02$). This is suggestive of effect modification between time period and nationality, warranting stratification for time period when modelling. Over the whole period 1980–1996, age-specific RR among non-German women are significantly different from 1 only in the age groups 25–39 years, ranging between 1.7 and 2.5. The unadjusted RR of unmarried women compared to married women is 1.43 (95% CI: 1.19–1.68).

### Table 1 Live births and maternal characteristics by nationality, West Germany, 1980 and 1996

<table>
<thead>
<tr>
<th></th>
<th>German</th>
<th>Non-German</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1980</td>
<td>1996</td>
</tr>
<tr>
<td>Number of live births</td>
<td>527,549</td>
<td>573,176</td>
</tr>
<tr>
<td>Proportion of total live births (%)</td>
<td>85.0</td>
<td>81.6</td>
</tr>
<tr>
<td>Total fertility ratea</td>
<td>1.64</td>
<td>1.53b</td>
</tr>
<tr>
<td>Maternal age &lt;25 years (%)</td>
<td>36.0</td>
<td>12.8</td>
</tr>
<tr>
<td>Maternal age 30–39 years (%)</td>
<td>25.3</td>
<td>50.9</td>
</tr>
<tr>
<td>Mother unmarried (%)</td>
<td>8.2</td>
<td>14.7</td>
</tr>
</tbody>
</table>

a Restricted to age group 15–44 years.
b Denominator of total fertility rate in 1996 includes East Berlin population.
Poisson modelling

Table 3 shows the stepwise forward development of a Poisson regression model and the respective goodness-of-fit statistics. The variables age and year of death are considered to be *a priori* confounders. Their inclusion, together with that of a quadratic term for age, results in the largest decrease in deviance and gives the most improvement compared to the model containing age only. Nationality and marital status decrease deviance further. Interaction between nationality and year of death no longer shows a significant effect and does not improve the fit of

**Figure 1** Maternal mortality ratio by age groups in the periods 1980–1988 and 1989–1996

Note: bars indicate 95% CI of maternal mortality ratio. The age groups 40–44 and 45+ years were combined.

**Figure 2** Maternal mortality ratio by nationality, 1980–1996
In the second time period, as compared to the first, being unmarried (all nationalities) is 1.79 (95% CI: 1.50–2.13). Table 4 shows adjusted rate ratios relating the risk of non-German women to that of German women of the same marital status, stratified by time period.

Table 4: Results of Poisson modelling based on model 6: adjusted relative risk by time periods (subgroup analysis), West Germany

<table>
<thead>
<tr>
<th>Period</th>
<th>Non-German versus German</th>
<th>Unmarried versus married (all nationalities)</th>
<th>Non-German versus German unmarried</th>
<th>Non-German versus German married</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980–1988</td>
<td>1.73 (1.44–2.06)</td>
<td>1.75 (1.40–2.20)</td>
<td>1.89 (1.07–3.36)</td>
<td>1.72 (1.43–2.08)</td>
</tr>
<tr>
<td>1989–1996</td>
<td>1.58 (1.20–2.06)</td>
<td>1.85 (1.39–2.45)</td>
<td>0.92 (0.39–2.14)</td>
<td>1.73 (1.30–2.30)</td>
</tr>
</tbody>
</table>

Discussion

Limitations and bias

The RR of maternal death among women of non-German nationality compared to West German women, adjusted for age, year of death and marital status, was 1.67. This is lower than the RR among most groups of foreign-born women in England and Wales in 1970–1985 (1.6–10.3) and of black minorities in the US in 1990 (3.3).3 Could our findings be due to bias? In Germany, maternal mortality registration is based on death certificates on which a box has to be ticked if death is from causes associated with childbirth. In most countries, reporting is not complete.12,13 This would affect the validity of our main findings only if completeness differed by nationality, which would be conceivable only in very early or late maternal deaths outside the hospital in the presence of language problems. Not all maternal deaths undergo necropsy, and resulting findings are not routinely included in the death statistics.14 Thus, the precision of cause-of-death assignment is low; we took this into account by only analysing broad groups of ICD diagnoses. We did not analyse the risk of medical interventions as the available data are not based on a confidential inquiry; their accuracy may thus be low.
Parity was found to contribute to differences in maternal risk in the US,15 but not in England and Wales.3 In this study, data on parity at death were not available, so we could not adjust for it. In re-unified Germany, the proportion of women of non-German nationality among mothers with ≥6 live births is 35%, as opposed to a 14% share in total deliveries (1995, only married couples of non-German nationality).7 The age-specific RR of non-German women (Table 3) are highest in the age groups >30 years when many West German women have their first baby (Table 1) whereas non-German women may already be multiparous. Our adjusted risk estimates thus fail to account for a possible contribution of higher parity to the risk of non-German women. Unlike in the paper by Ibison et al.,5 a detailed breakdown by nationality groups was not possible due to data protection regulations. It might be argued that northern and western European women have a lower risk; but due to their small number, they will not markedly dilute the risk of the group of non-German women as a whole.

Interpretation of the trends in risk
Between 1980 and 1996, MMR in West Germany decreased markedly despite an increase in the proportion of births among women with an unfavourable risk in terms of age, marital status and nationality (Table 1). It can therefore be assumed that improvements in antenatal and obstetric services have contributed. The decrease appears most pronounced among women <20 and >39 years, and among women of non-German nationality. This indicates that high-risk groups have improving access to services.

The significant secular decrease in crude RR experienced by women of non-German nationality largely disappears after adjusting for age and marital status (Tables 2 and 4). This can be explained by an increasing proportion of German women giving birth at higher ages (Table 1), thus incurring a higher absolute risk. Also, a change in the effect of marital status contributes: after 1988, non-German nationality is no longer an additional risk factor among unmarried women. A likely explanation for this observation is that being unmarried and being of non-German nationality increasingly measure similar aspects of socioeconomic disadvantage and its effect on maternal risk.

The all-cause RR estimates of non-German versus German women are stable over time after adjusting for differences in age and marital status; maternal mortality among non-German women is thus decreasing parallel to that of German women. In other words, non-German women equally benefit from the improving quality and accessibility of obstetric services in West Germany. Additional evidence for improved access for non-German women is provided by the over-proportional decrease in their risk of dying from abortion. In the US, the black-white differential is greatest for pregnancies that do not end in a life birth, such as spontaneous and induced abortions.3 This is explained by delayed antenatal booking among minorities. In Germany, late booking has been observed among women of non-German nationality as well.16 However, among Turkish women, the largest single nationality group, the problem is of decreasing importance.17 An individual case analysis of maternal deaths in the federal state of Bavaria 1983–1996 confirms a decrease in the unadjusted RR among women of non-German nationality, both for all causes and for abortion.14

Ibison et al.5 found no clear evidence for an effect of lower socioeconomic status on the risk of maternal death; they assumed that an increased incidence of obstetric conditions among immigrants partly accounts for their higher RR. Our findings point in a different direction: socioeconomic disadvantages were, as defined by the risk marker ‘unmarried’, do incur a significantly increased risk of maternal death in West Germany. This increase persists over time, at least among women of German nationality, in spite of a general liberalization of societal norms and an increase in the proportion of single mothers (Table 1).

The compulsory health insurance system in Germany aims to avoid maternal deaths through universal antenatal and obstetric coverage to all resident women. Our findings suggest that the existing obstetric services in West Germany are moving towards that goal, reaching women of German as well as of non-German nationality. It remains to be studied whether the persisting difference in adjusted RR can be explained by higher parity and by differences in socioeconomic status alone. The epidemiological analysis of maternal mortality data show that the risk of a maternal death is not determined by the simple distinction ‘German’ versus ‘non-German’. The association with socioeconomic status extends beyond nationality. In order to better support high-risk groups, emphasis should be put on intervention strategies that decrease, or compensate for, social inequity.

Table 5 Adjusted relative risk (RR) of cause-specific maternal deaths by nationality and marital status, West Germany, 1980–1996

<table>
<thead>
<tr>
<th>Cause</th>
<th>Non-German</th>
<th></th>
<th></th>
<th>Unmarried</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cases (n)</td>
<td>RR 95% CI</td>
<td>RR 95% CI</td>
<td>RR 95% CI</td>
<td></td>
</tr>
<tr>
<td>Abortion</td>
<td>84</td>
<td>3.55</td>
<td>2.27–5.57</td>
<td>3.56</td>
<td>2.11–6.01</td>
</tr>
<tr>
<td>Ectopic</td>
<td>42</td>
<td>1.31</td>
<td>0.58–2.97</td>
<td>3.39</td>
<td>1.59–7.19</td>
</tr>
<tr>
<td>APH + PPH</td>
<td>118</td>
<td>1.72</td>
<td>1.10–2.68</td>
<td>2.21</td>
<td>1.35–3.66</td>
</tr>
<tr>
<td>HDP</td>
<td>168</td>
<td>2.25</td>
<td>1.59–3.19</td>
<td>1.36</td>
<td>0.82–2.23</td>
</tr>
<tr>
<td>Medical</td>
<td>113</td>
<td>1.43</td>
<td>0.89–2.30</td>
<td>2.03</td>
<td>1.23–3.35</td>
</tr>
<tr>
<td>Puerperal</td>
<td>118</td>
<td>1.27</td>
<td>0.78–2.06</td>
<td>1.42</td>
<td>0.80–2.52</td>
</tr>
<tr>
<td>Embolism</td>
<td>191</td>
<td>1.05</td>
<td>0.70–1.58</td>
<td>1.27</td>
<td>0.80–2.02</td>
</tr>
</tbody>
</table>

Based on n = 834 deaths, adjusted for age, year of death, nationality and marital status. The RR for non-German nationality among the 239 cases with ICD groups not included in the Table is similar to that of the total cases.

Diagnoses were grouped before data analysis following Ibison et al.5 Abortion (excluding ectopic): ICD 630–632, 634–639; Ectopic: ICD 633; APH + PPH (ante- and post-partum haemorrhage, retained placenta): ICD 640, 641, 666, 667; HDP (hypertensive disease of pregnancy): ICD 642; Medical (medical preconditions, i.e. indirect maternal deaths): ICD 643, 646–648; Puerperal (puerperal causes excluding pulmonary embolism and venous disease): ICD 670, 672, 674–676; Embolism (embolism and venous disease): ICD 671, 673.
Acknowledgements

Rachel Snow and Annette Kopp-Schneider gave helpful comments on earlier versions of this paper. We thank the staff of the Federal Statistical Office, in particular Mr Hammer, for the provision of mortality and live birth data.

References