Social inequalities in perinatal and infant mortality in the northern region of Belgium (the Flanders)

Hugo Devlieger, Guy Martens, Andries Bekaert

Background: The study was intended to analyse the independent effect of some facets of the socio-economic status of both parents on perinatal, neonatal and post-neonatal mortality in the northern region of Belgium (the Flanders). Method: Perinatal data collected by the Study Centre for Perinatal Epidemiology were linked with socio-economic data collected by the district council. Mothers aged ≥ 25 years are included in the study. Results: 50796 births were analysed. 452 infants died either before birth or during the first year of life. 52% of the foeto-infantile mortality occurred before birth and 57% of the infant mortality in the first week of life. The educational level was strongly related to foetal (p < 0.001) and, to a lesser degree, to early-neonatal mortality (p = 0.001). Employment did not correlate with any mortality item. Except for foetal mortality, the strongest correlation was always observed for maternal rather than paternal social items. In a logistic regression model, foetal mortality, perinatal mortality and infantile mortality remained strongly correlated with the educational level of the mother. Infant mortality beyond the first week of life was not correlated with any aspect of the social status of the parents. Conclusions: The educational level of the mother is the single most important determinant of infantile mortality in the Flanders representing the totality of hospital births by mothers aged ≥ 25 years in 1999 in the Flanders

Key points
• Study Question: Does education, profession and actual employment of both parents, independently operates discrimination in the outcome of pregnancy up to one year?
• Results: Maternal education is the only significant and independent determinant of foetal as well as neonatal and foeto-infantile mortality.
• Results: The status of the mother is by far more important than that of the father in determining the outcome of pregnancy.

Keywords: infant mortality, perinatal mortality, population study, social status

Perinatal outcome has improved substantially during recent decades, neonatal mortality decreasing more rapidly than foetal mortality. In the 1950s perinatal mortality was equally partitioned between foetal and neonatal mortality; perinatal mortality is now about two-thirds foetal mortality. Among the great number of maternal determinants of perinatal mortality identified in the past, socio-economic status has always played an important role in foetal as well as neonatal mortality.

The concept of socio-economic status, however, has rarely been refined and the separate influences of target aspects have only been poorly studied. Important facets of the socio-economic status are the educational level of father and mother, the professional skills of father and mother and the actual profession of both. Each of them may have an independent influence on perinatal and infant mortality. This study was intended to analyse the impact of socio-economic status in its three facets on perinatal, neonatal and post-neonatal mortality.

Methodology

Patients and collection methods
This study is derived from the perinatal data collected by the Study Centre of Perinatal Epidemiology in the Flanders, which, as an independent, state funded institute, registers all births in Flemish maternity hospitals since 1990. In addition to hospital births the study centre collects more than half of the files of home deliveries, which represent only 0.9% of all deliveries. The data entry of 32 obstetrical and 20 neonatal items is done by the local obstetrician or midwife, and by the local paediatrician. The study centre collects the medical data. The district councils collect socio-economic data at the time of the registration of birth by both father and mother. The study centre collects the medical data. The district councils collect socio-economic data at the time of the registration of birth by both father and mother. In the case of foetal death or early neonatal death, the undertaker often does the registration at the district council. Data sets are linked at the study centre by means of a common code number on both files. Data cleaning and requests for checks of outliers occur at the centre. In addition, the data manager (GM) visits at random the 80 maternity hospitals to operate a double check.

In this study, only infants born in 1999 to mothers aged ≥ 25 years who delivered after 22 weeks of gestation in the 80 Flemish maternity hospitals were included. The age range was restricted to not include mothers whose educational training was not yet finished.

Mortality data
Mortality data were subdivided into three groups: foetal mortality, early neonatal mortality (0–7 d) and combined late neonatal (8–28 d) and post-neonatal mortality (29–56 d). Perinatal mortality includes foetal mortality and early-neonatal mortality. Foeto-infantile mortality includes all mortality categories. Late neonatal and post-neonatal mortality data
were registered on a form similar to that used for the birth certificate, collected by the district council and, after registration by the Scientific Institute of Public Health, linked to the perinatal data in the study centre by means of a common identification number.

Socio-economic status
In Belgium, both the birth certificate and the death certificate for infants less than one year include an exhaustive social questionnaire concerning educational level, professional skills and employment. To meet the aims of the study, we simplified this classification into a smaller number of categories.

- Educational level
  1. No education or low-grade education
  2. Lower degree of middle grade
  3. Higher degree of middle grade
  4. University or non-university high grade
- Professional skills
  1. Without profession
  2. Manual profession
  3. Employee
  4. Independent or managerial
- Actual employment
  1. No employment
  2. Unemployed (job-seeker)
  3. Employed

Statistical analysis
First the social profile of both groups (alive or death before 1 year) were analysed with a χ² analysis to identify significant differences in both profiles of social data. Next a stepwise logistic regression analysis was performed with the significant items from the univariate analysis to identify those independent factors within the socio-economic status that may explain the differences in distribution between mortality groups and the alive at 1 year group. The statistical package used was SPSS 9.0.

Results
In 1999 in the northern region of Belgium (the Flanders) 61341 births were registered. The total birth rate in Belgium in 1999 was 113469. The study population, namely mothers aged ≥ 25 years, were divided either before birth or during the first year of life. The distribution outcome categories of pregnancy and during the first year of life is shown in table 1. It is seen that 52% of foetal-infantile mortality occurs before birth and that 57% of infantile mortality occurs in the first week of life.

Table 2 shows the relation between the three social items and the different categories of outcome in a univariate analysis. The educational level is strongly related to foetal ("p < 0.001") and, to a lesser degree, to early-neonatal mortality ("p = 0.001"). Employment did not correlate with any item. The professional skills correlated mainly with the early-neonatal mortality ("p < 0.001") and to a lesser degree with foetal mortality.

When comparing the relationship between the educational level of the mother and that of the father it comes out that 23% of mothers have a higher educational level than fathers while the inverse condition is observed in 11%. The distribution of the educational level of both parents is shown in the figure 1.

Table 3 shows a comparison of the χ² values between mother and father for those correlations that were significant for the mother. Except for foetal mortality, the strongest correlation is always observed for maternal social items.

<table>
<thead>
<tr>
<th>Category of mortality</th>
<th>Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foetal death</td>
<td>235</td>
<td>0.46</td>
</tr>
<tr>
<td>Early neonatal death</td>
<td>124</td>
<td>0.25</td>
</tr>
<tr>
<td>Late neonatal and post-neonatal death</td>
<td>92</td>
<td>0.18</td>
</tr>
<tr>
<td>Alive at 1 year</td>
<td>50344</td>
<td>99.1</td>
</tr>
</tbody>
</table>

Multivariate analysis
After introduction of the socio-economical items in a logistic regression model, the only correlations that remained significant are shown in Table 4. Foetal mortality, perinatal mortality, early-neonatal mortality and foeto-infantile mortality remained correlated with the educational level of the mother with an odds ratio and 95% confidence interval of resp. 1.71 (1.44–2.04), 1.61 (1.40–1.85), 1.48 (1.18–1.81) and 1.49 (1.32–1.69).

Discussion
This study was made possible by the link between the free routine registration of perinatal data by the independent Study Centre of Perinatal Epidemiology in Flanders and the socio-economic data collected by the state district councils. The link between data sets could not be made in 19.7% of the foetal mortality group and in 9% of the group of liveborns due to missing socio-economic data. This difference could introduce a bias into the conclusions. It is presumed, however, that the reasons why the socio-economic data are less well registered in this group of foetal deaths are not related to the educational level of the parents but are related to local circumstances, i.e. the registration of foetal or infant death by the undertaker, who is often unaware of the social status and profession of the parents. Concerning the actual employment of the mother, it should be taken into account that unemployed may include those mothers who stay at home and care for other children as well as those mothers who are unable to undertake an employment. The impact of both on the health status of the (expected) child is quite different, which may further mask the impact of low social status.

The most relevant conclusion from this study is that the educational level of the mother is the only significant and independent determinant of foetal as well as neonatal, perinatal and foeto-infantile mortality. This means that in Flanders, social inequalities in pregnancy outcome are based mainly on the educational level of the mother and less on the professional status. That mothers with low education have a higher risk of foetal death has been repeatedly found in Scandinavian as well as in North American studies. In a comparative study in Denmark (1985–86) and Norway (1979–1982) Balketeig et al. studied the influence of the educational level of the mother.
Table 2 Relation between the three social items and the different categories of outcome in a univariate analysis (χ² and significance)

<table>
<thead>
<tr>
<th></th>
<th>Foetal mortality</th>
<th>Early neonatal mortality</th>
<th>Perinatal mortality</th>
<th>&gt;7–356 d</th>
<th>Foeto-infantile mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Education</strong></td>
<td>37.6</td>
<td>12.0</td>
<td>47.9</td>
<td>1.0</td>
<td>42.6</td>
</tr>
<tr>
<td></td>
<td>p &lt; 0.001</td>
<td>p = 0.001</td>
<td>p &lt; 0.001</td>
<td>NS</td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td><strong>Professional skills</strong></td>
<td>5.6</td>
<td>8.1</td>
<td>13.5</td>
<td>2.0</td>
<td>15.2</td>
</tr>
<tr>
<td></td>
<td>P &lt; 0.05</td>
<td>p &lt; 0.01</td>
<td>p &lt; 0.001</td>
<td>NS</td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td><strong>Employment</strong></td>
<td>0.1</td>
<td>0.2</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>

Table 3 Comparison of the χ² values between mother and father for those correlations that were significant for the mother

<table>
<thead>
<tr>
<th></th>
<th>Mother</th>
<th>p</th>
<th>Father</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foetal mortality</td>
<td>36.1</td>
<td>&lt;0.001</td>
<td>37.1</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Early neonatal</td>
<td>19.5</td>
<td>0.003</td>
<td>10.8</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Perinatal</td>
<td>15.9</td>
<td>&lt;0.001</td>
<td>4.6</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Foeto-infantile</td>
<td>44.9</td>
<td>&lt;0.001</td>
<td>31.2</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Professional skills</td>
<td>13.7</td>
<td>&lt;0.05</td>
<td>7.9</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Early neonatal</td>
<td>22.9</td>
<td>&lt;0.001</td>
<td>8.0</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Perinatal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foeto-infantile</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 1 Distribution of the educational levels of both parents.

and the father on the risk of foetal, neonatal and perinatal mortality (2). In a univariate analysis, they found, in the three countries studied, that the relative risk for the three outcome variables was increased if the mother had an education of less than 8 years. The difference in risk according to the degree of education was lowest for the neonatal mortality. In accordance with our findings, it appears, from the studies of Bakke et al. that the educational level of the father was a better determinant of the perinatal mortality whereas in their study that of the mother was more related to the post-neonatal mortality. The differential effect of the maternal and paternal education resort also from the studies of Arntzen et al., who made a logistic regression model for the population of Norway resulting in three significant variables determining mortality: the educational level of the father and the mother and the age of the mother. In

In a comparative population study in Sweden involving 185156 deliveries in 1985–1986, Haglund et al. concluded that the odd ratio of foetal death in the unskilled mother and those with education less than 12 years ranged between 1.3 and 1.8. In contrast, neonatal mortality and educational level relates according to a U form: unskilled mothers and those with >15 years of education have an increased OR. The OR for post-neonatal mortality was 2.0 in the class with lowest education but the influences of social and educational classes became very weak when corrected for age of the mothers, parity and smoking.

The Norwegian national study compared the Norwegian with the Pakistani infants during the period 1967–1993 concerning the risk factors for foetal and infant mortality. The influence of low education contributes for 17% (95% CI 13–21) to the foeto-infantile death but was negligible in the Pakistani population in which the consanguinity was the major risk factor.

In another Norwegian study Froen et al. concluded from a logistic regression analysis concerning unexplained foetal and infant mortality in Oslo 1986–1995 that low education <10 years of education have an increased OR. The OR for post-neonatal mortality was 2.0 in the class with lowest education but the influences of social and educational classes became very weak when corrected for age of the mothers, parity and smoking.

The same conclusions are drawn from the American National Natality Survey in 1980. A high education had an OR of 0.72 (CI 0.58–0.90) as compared to low education concerning foetal
mortality. Maternal age ≥ 35 years and smoking were also associated with a significant OR. 7

In contrast with foetal mortality, early neonatal mortality appears to be less dependent on the social and educational status of the mother. This is in line with our conclusions. On the other hand, late neonatal and post-neonatal mortality again increases with low social conditions and education. An American study on vital records 1983–1984 shows by logistic regression analysis that in low educated mothers the risk of post-neonatal death doubles whereas the risk of neonatal mortality is only marginally increased, especially in white, less educated mothers. 6 In less developed countries, educational level exerts its influence particularly on post-neonatal mortality and less on neonatal mortality. 6

How can we explain the differences in conclusions between the Scandinavian and American studies and the present one showing that foetal mortality and to a lesser degree early neonatal mortality was related to the educational level of the mother, but not post-neonatal mortality? The influence of high and low maternal age and of smoking was convincingly shown by Haglund et al. 4 The age of the mother of course is an important determinant. By restricting the population to mothers of 25 years and more we did exclude a group of mothers with a relatively higher foetal death rate but with the lowest early neonatal death rate and with a high late neonatal and post-neonatal date rate (Table 5). We did include, however, an age group with both high foetal mortality and high early neonatal mortality but with low late neonatal and postneonatal mortality. When applying the logistic regression model to the age group 25–34.9 years, the independent influence of the maternal educational level on the early neonatal mortality even disappeared. The timeframe in which the former studies were done (1980s and early 1990s) compared with the present study (1999) may explain the greater independence of neonatal mortality from the education of the mother. In the 1980s neonatal intensive care was still on a learning curve. Since then there has been tremendous improvement in perinatal care including the prevention of prematurity, peripartal treatment of infections, use of prenatal steroids, surfactant high frequency ventilation, etc. In 1985 infant mortality in Sweden was still 6.8‰ while in 1999 infant mortality dropped to 3.8‰. 11

Few studies recognized a difference between social status or professional skills and educational level. According to Haglund et al. 4 both have an independent and separate impact on foetal mortality and neonatal mortality. In this study in Flanders in 1999 education has an impact on foetal mortality and on early neonatal mortality. It can be hypothesized that educational level intervenes in the early recognition of actual pregnancy and foetal problems and plays a decisive role on the circumstances in which pregnancy evolves and thus on the quality of the foetus at birth. In line with this hypothesis is the finding that maternal education has an impact on foetal mortality and on early neonatal mortality. In this study in Flanders an indication that targeted campaigns may have a greater impact on post-neonatal mortality than global improvement of the educational level?

Further studies are needed to confirm these findings and to elaborate preventive strategies.

In conclusion, the educational level of the mother appears to be the single most important determinant of foeto-infantile, especially foetal, mortality in Flanders.

A second conclusion concerns the fact that infant mortality beyond the first week of life was not correlated with any aspect of social status of the parents. Interestingly, the status of the mother is by far more important than that of the father and mothers have predominantly a higher educational level than the fathers.

The Study Centre for Perinatal Epidemiology is funded by the Flemish Ministry of Health and Social Affairs.

References


