

MORTALITY

## Social inequalities in perinatal mortality in a Southern European city

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**Abstract.** The objective of this study was to describe and explain inequalities in perinatal mortality by educational level and occupational social class in Barcelona for the years 1993–1997. This was a case-control study. Cases were singleton perinatal deaths, controls were singleton live births obtained from a 2% random sample of births. The association among educational level, social class, other confounding and explanatory variables and perinatal mortality was studied through crude and adjusted odds ratios (OR) obtained by logistic regression. The study comprised

423 cases and 1032 controls. The model with mother's age and educational level showed that women with primary education had an OR of 1.75 (95% CI: 1.26–2.42), this association disappearing when explanatory variables were included. We also found inequalities by educational level in fetal mortality. These results point out the need to improve the living conditions, behavioural factors and also the management of pregnancy, labour and the health care of the newborn of these mothers with greater risk.

**Key words:** Epidemiological methods, Inequalities, Perinatal mortality

### Introduction

Perinatal mortality is an indicator of the quality of health care in the perinatal period. Associations between social conditions and outcome of pregnancy have been described; perinatal mortality is associated with socio-demographic characteristics such as mother's age, parent's social class, parity, etc. In developed countries it has been reported that mothers of less privileged classes and with lower educational level have more perinatal mortality risk than those of privileged classes [1, 2].

In Spain, antenatal, labour and child health care is free. The majority of pregnant women visit antenatal clinics regularly and give birth at hospitals. It should be noted that the achievement of information on perinatal mortality is not easy because we do not have a perinatal death certificate, and because a death during the first 24 hours of life is considered a stillbirth (and it is declared in the birth and abortion certificate). Moreover, several studies have found an underregistration of perinatal mortality by death certificates, the degree of underreporting being between 25 and 34% [3–5]. Socio-economic inequalities in infant and perinatal mortality have been described at an ecological level in the whole country [6–8], but not at individual level because socio-economic data is usually not completed in either the death certificates or the birth and abortion certificate [9].

Barcelona is a city of 1,600,000 inhabitants situated in the north-east of Spain where the natality rate has been going down since 1975; the number of births per

year has been around 12,000 since the 1990s. The perinatal mortality rate has been decreasing and has been below 10 per 1,000 births since 1987 [10]. To overcome the limitations of underregistration of perinatal deaths by death certificates, since 1985 there is an active perinatal registry which collects information on perinatal deaths from obstetric and paediatric centres and from death certificates. This registry does not include data on social variables, so we conducted a follow-back survey in order to obtain this type of information and to study social inequalities in perinatal mortality.

The objective of this study was to describe and explain inequalities in perinatal mortality by educational level and occupational social class in Barcelona for the years 1993–1997.

### Material and methods

#### *Selection of cases and controls and source of information*

This was a case-control study. Controls were singleton live births and cases singleton perinatal deaths, defined as stillbirths or deaths during the first week of life with a birthweight of at least 500 g or 22 completed weeks of gestation if birthweight was missing [11]. All were born of women resident in Barcelona during the period 1993–1997.

Information on live births was obtained from a 2% random sample of all singleton births without birth

defects among Barcelona residents during the study years (recruited by the Barcelona Birth Defects Registry [12]). A trained nurse, usually at the delivery centre and using a questionnaire including socio-demographic and obstetric data, interviewed mothers of the newborns included in the sample.

Perinatal deaths were obtained from the Barcelona Perinatal Mortality Registry [3]. A trained nurse actively detects the cases and collects data from the birth and abortion and death certificates and, due to the poor registration of these certificates [3], also from the obstetric and paediatric health services.

In order to obtain socio-economic information on the perinatal deaths we undertook a follow-back telephone survey and also we used the local census. A trained nurse telephoned the parents of the deceased asking for the employment status, occupation and parents' educational level at the moment of the death and also asking about the number of pregnancies, deliveries, outcome of the previous deliveries and live births. The questionnaire used to obtain this information contains the same questions used for controls.

### *Variables*

#### *Dependent variables*

The outcome variables were: perinatal death (stillbirths and deaths occurring during the first week of life with a birthweight greater than 500 g or 22 completed weeks of gestation if birthweight was missing) and its main components: stillbirth or neonatal death (deaths during the first week of life).

#### *Independent variables*

The independent variables studied and their categories are presented in Table 1. For the controls all the variables were obtained through the questionnaire administered after the birth. For perinatal deaths, sex, hospital of delivery, gestational age, birthweight and age of the mother were obtained from the perinatal registry. Parity and gravidity were obtained through the follow-back survey. Educational level was obtained for 87.7% of cases, 75.0% through the follow-back survey (349 cases) and an additional 12.7% through the local census (59 cases who did not answer the questionnaire). Employment status and occupation of the mother and the father, variables needed in order to determine social class, were obtained through the follow-back survey.

Independent variables were classified into three groups:

**Socioeconomic variables:** These variables were educational level and social class. Educational level was categorised as follows: primary education or less (0 to 11 years of schooling), secondary (12–14 years of education) and university (15 or more years). Social class was obtained for the father and for the mother through the occupation from a Spanish adaptation of

the 1980 British Registrar General classification [13]. The social classes of this adaptation are: class I includes managerial and senior technical staff and free professionals; class II includes intermediate occupations and managers in commerce; class III, skilled non-manual workers; class IV, skilled and partly skilled manual workers; and class V, unskilled manual workers. Social class was derived from current or last occupation. Social classes were grouped into non-manual (I, II, III) and manual (IV and V).

**Other variables:** These were other confounding variables and are listed in Table 1. Age of the mother was grouped trying to ensure sufficient cases in each group. Primipara was defined as the first delivery resulting in either live or stillbirth, primigravida as the first pregnancy.

**Explanatory variables:** These variables were birthweight, intrauterine growth retardation (IUGR) and gestational age. IUGR was obtained from the birthweight and the gestational age data (weights below the 10th percentile in the birthweight's distribution of each gestational week in Barcelona).

### *Data analysis*

Responses and non-responses of the follow-back survey were compared using the  $\chi^2$ -test. The comparison of percentages of explanatory variables by educational level of the mother were done with the Mantel-Haenszel test for linear association. The bivariate association between those independent variables for which reliable information was available, and dependent variables was studied obtaining the crude odds ratios (OR) and their 95% confidence intervals (CI).

In a multivariate analysis, logistic regression models were constructed, with the dependent variables being those described above. First we obtained models for each dependent variable, the independent variables being educational level of the mother (because it had fewer missing values than social class) and other variables that had statistical significance or conceptual meaning (model A). Thereafter we constructed models adding explanatory variables (model B). Certain variables were never included together in the models (e.g.: educational level and social class, birthweight and gestational age, primipara and primigravida) because of the presence of collinearity. In the construction of the models, variables were eliminated from the model one at a time based on likelihood ratio tests. When all statistically non-significant ( $p > 0.05$ ) variables had been eliminated we explored the possible two way interactions between the variables that had conceptual meaning. Calibration was assessed using the Hosmer-Lemeshow goodness-of-fit test [14] and discrimination was assessed using the area under the receiver operating characteristic (ROC) curve [15].

**Table 1.** Distribution of independent variables among cases and controls (percentages)

| Variables                       | Controls<br>N = 1032 (%) | Perinatal cases<br>N = 423 (%) | Fetal cases<br>N = 287 (%) | Neonatal cases<br>N = 136 (%) |
|---------------------------------|--------------------------|--------------------------------|----------------------------|-------------------------------|
| <i>Socio-economic variables</i> |                          |                                |                            |                               |
| Educational level mother        |                          |                                |                            |                               |
| University                      | 31.1                     | 27.0                           | 25.8                       | 29.4                          |
| Secondary                       | 42.8                     | 31.2                           | 32.8                       | 27.9                          |
| Primary                         | 20.3                     | 29.6                           | 29.6                       | 29.4                          |
| Social class mother             |                          |                                |                            |                               |
| I, II, III                      | 61.2                     | 46.6                           | 47.4                       | 44.9                          |
| IV, V                           | 30.7                     | 27.2                           | 26.1                       | 29.4                          |
| Social class father             |                          |                                |                            |                               |
| I, II, III                      | 60.7                     | 47.3                           | 48.1                       | 45.6                          |
| IV, V                           | 29.6                     | 25.5                           | 24.0                       | 28.7                          |
| <i>Other variables</i>          |                          |                                |                            |                               |
| Sex                             |                          |                                |                            |                               |
| Female                          | 48.7                     | 47.3                           | 48.4                       | 44.9                          |
| Male                            | 50.7                     | 50.8                           | 49.8                       | 52.9                          |
| Hospital of delivery            |                          |                                |                            |                               |
| Private                         | 54.4                     | 46.6                           | 50.5                       | 38.2                          |
| Public                          | 45.6                     | 53.4                           | 49.5                       | 61.8                          |
| Mother age (years)              |                          |                                |                            |                               |
| <25                             | 8.0                      | 9.7                            | 9.4                        | 10.3                          |
| 25-29                           | 29.7                     | 22.9                           | 22.0                       | 25.0                          |
| 30-34                           | 42.2                     | 37.4                           | 38.7                       | 34.6                          |
| >34                             | 18.7                     | 23.9                           | 24.0                       | 23.5                          |
| Primipara                       |                          |                                |                            |                               |
| No                              | 42.7                     | 34.0                           | 30.3                       | 41.9                          |
| Yes                             | 56.3                     | 41.1                           | 44.3                       | 34.6                          |
| Primigravida                    |                          |                                |                            |                               |
| No                              | 54.7                     | 42.8                           | 38.0                       | 52.9                          |
| Yes                             | 44.4                     | 32.4                           | 36.6                       | 23.5                          |
| Mother working                  |                          |                                |                            |                               |
| Yes                             | 78.2                     | 51.1                           | 51.9                       | 49.3                          |
| No                              | 21.8                     | 24.1                           | 22.6                       | 27.2                          |
| <i>Explanatory variables</i>    |                          |                                |                            |                               |
| Gestational age (weeks)         |                          |                                |                            |                               |
| ≥37                             | 93.6                     | 30.5                           | 28.2                       | 35.3                          |
| <37                             | 4.4                      | 62.4                           | 64.5                       | 58.1                          |
| Birthweight                     |                          |                                |                            |                               |
| ≥2.500 g                        | 95.0                     | 33.6                           | 32.1                       | 36.8                          |
| <2.500 g                        | 4.2                      | 65.0                           | 66.9                       | 61.0                          |
| IUGR                            |                          |                                |                            |                               |
| No                              | 88.5                     | 63.8                           | 62.7                       | 66.2                          |
| Yes                             | 8.9                      | 23.4                           | 23.3                       | 23.5                          |

If percentages do not add 100 it is due to missing data.

IUGR – intrauterine growth retardation.

## Results

The study was done with 423 cases and 1080 controls. There were 319 positive responses to the follow-back survey (75.4%). Mothers who answered the questionnaire were older than the non-responders ( $p < 0.001$ ), and tended to have higher educational level, although this difference was not statistically significant when age was taken into account. Among the controls we had 1032 positive responses (95.5%).

Table 1 presents the distribution of all independent variables among perinatal cases and controls and also for neonatal and fetal deaths. It may be seen how the variables obtained from the follow-back survey have more missing values.

The percentages of explanatory variables among the different educational levels of the mother are presented in Table 2. Perinatal deaths have higher percentages of low birthweight, low gestational age and IUGR than control cases. Lower birthweight was

**Table 2.** Percentages of explanatory variables by educational level of the mother: controls and perinatal cases

| Educational level of the mother | Low birthweight (<2500 g) | Low gestational age (<37 weeks) | IUGR |
|---------------------------------|---------------------------|---------------------------------|------|
|                                 | <i>Controls</i>           |                                 |      |
| Primary education               | 6.2                       | 4.3                             | 14.1 |
| Secondary education             | 3.6                       | 3.9                             | 7.8  |
| University                      | 3.4                       | 5.0                             | 7.8* |
| <i>Perinatal deaths</i>         |                           |                                 |      |
| Primary education               | 71.5                      | 77.6                            | 23.8 |
| Secondary education             | 65.6                      | 63.6                            | 27.3 |
| University                      | 57.5*                     | 57.4*                           | 26.9 |

\**p* < 0.05.

higher in mothers with primary education, the differences being statistically significant for perinatal cases. Lower gestational age was higher in mothers with primary education among cases of perinatal death and IUGR was higher in mothers with primary education among controls.

Tables 3 through 5 present, for each dependent variable, the distribution of variables for which reliable information was available, for cases and controls, the crude OR and the adjusted OR. Unadjusted OR showed that perinatal mortality was associated with delivery in a public hospital, lower gestational age, birthweight less than 2500 g, IUGR, mother not working and lower educational level (OR: 1.68, 95% CI: 1.23–2.28). Social class of the mother and the father were not statistically significant. The multivariate model with mother's age, educational level and sex of the newborn showed that women with primary education had an OR of 1.75 (95% CI 1.26–2.42). When explanatory variables were introduced, educational level lost its importance leaving gestational age (OR: 36.1) and IUGR (OR: 2.63) as the only variables with statistical significance (Table 3).

Fetal deaths constituted the majority of cases of perinatal mortality (287 cases, 67.8% of all perinatal cases). The independent variables associated with fetal mortality without adjustment were the same ones as were related with total perinatal mortality except the hospital of delivery. Women with primary education had an unadjusted OR of 1.76 (95% CI: 1.23–2.51) in comparison to women with higher education. In the multivariate model obtained with mother's age and sex of the newborn, primary education remained statistically significant (OR: 1.84, 95% CI: 1.26–2.69). OR of primary education in the second multivariate model, where explanatory variables were included, was 1.53 (95% CI: 0.90–2.60) the statistically significant variables being gestational age and IUGR (Table 4).

Of the 423 cases of perinatal deaths 32.2% (136 cases) died during the neonatal period. Neither edu-

cational level nor social class were associated with neonatal mortality. Variables associated at multivariate level were: public hospital of delivery, lower gestational age, increasing mother's age and IUGR (Table 5).

## Discussion

This study has shown the existence of inequalities by educational level in perinatal mortality and one of its main components (fetal mortality). We have not found social class inequalities in neonatal mortality. Another variable related with perinatal mortality was delivery in public hospitals. When explanatory variables (low birthweight, low gestational age and IUGR) were introduced in the models, they were the only ones that remained statistically significant.

A possible limitation of this study could be the low response in the follow-back survey by mothers of social classes IV and V and this fact could explain why we did not find inequalities by social class. We were only able to explore differences in educational level by respondent status, and we found that responders had higher educational level, although it was not statistically significant when we adjusted for the age of the mother. We cannot rule out a small selection bias. But this possible limitation does not affect educational level because it was available for both responders (from the follow-back survey) and for the half of non-responders (from the local census).

The fact that inequalities by educational level lose statistical significance when gestational age or birthweight are included in the models has been described by other authors, suggesting that the excess mortality associated with low socio-economic status could be explained by the newborn low birthweight [16–18], being an intermediate variable in the causal process [19]. Forssas et al. [16] reported that in Finland, the association between perinatal mortality and social class was decreased when birthweight was included in the models: odds ratios (OR) for blue-collar workers in relation to upper white collars decreased from 1.69 to 1.37 [16]. In our study, the relationship found among low birthweight and low gestational age with educational level of the mother supports the hypothesis that the association between socio-economic factors and perinatal mortality is explained by low birthweight and low gestational age.

Other studies of European countries have concluded that there are social inequalities in perinatal and infant mortality. In the Northern European countries it is possible to link the birth registry with census data (linkage done by personal ID numbers) and this possibility offers a great advantage in the study of social inequalities in birth outcomes. Several studies found that mothers and fathers with higher level of education had lower stillbirth, neonatal and postneonatal mortality [18, 20–22]. Haglund et al.

**Table 3.** Perinatal mortality, cases and controls (percentages). Bivariate and multivariate associations (OR and 95% CI) between independent variables and perinatal mortality

| Variables                       | Cases<br>N = 423<br>(%) | Control<br>N = 1132<br>(%) | Bivariate OR |                | Multivariate<br>OR <sup>a</sup> (model A) |              | Multivariate<br>OR <sup>b</sup> (model B) |                |
|---------------------------------|-------------------------|----------------------------|--------------|----------------|---|--------------|---|----------------|
|                                 |                         |                            | OR           | 95% CI         | OR  | 95% CI       | OR  | 95% CI         |
| <i>Socio-economic variables</i> |                         |                            |              |                |   |              |   |                |
| Educational level mother        |                         |                            |              |                |   |              |   |                |
| University                      | 30.7                    | 33.0                       | 1            |                | 1   |              | 1   |                |
| Secondary                       | 35.6                    | 45.4                       | 0.84         | (0.63, 1.12)   | 0.93                                      | (0.69, 1.25) | 0.86                                      | (0.58, 1.29)   |
| Primary                         | 33.7                    | 21.6                       | 1.68         | (1.23, 2.28)   | 1.75                                      | (1.26, 2.42) | 1.21                                      | (0.77, 1.89)   |
| Social class mother             |                         |                            |              |                |   |              |   |                |
| I, II, III                      | 63.1                    | 66.6                       | 1            |                |   |              |   |                |
| IV, V                           | 36.9                    | 33.4                       | 1.16         | (0.89, 1.52)   |   |              |   |                |
| Social class father             |                         |                            |              |                |   |              |   |                |
| I, II, III                      | 64.9                    | 67.2                       | 1            |                |   |              |   |                |
| IV, V                           | 35.1                    | 32.8                       | 1.11         | (0.85, 1.45)   |   |              |   |                |
| <i>Other variables</i>          |                         |                            |              |                |   |              |   |                |
| Sex                             |                         |                            |              |                |   |              |   |                |
| Female                          | 48.2                    | 49.0                       | 1            |                | 1   |              | 1   |                |
| Male                            | 51.8                    | 51.0                       | 1.03         | (0.82, 1.30)   | 1.10                                      | (0.86, 1.40) | 1.00                                      | (0.71, 1.40)   |
| Hospital of delivery            |                         |                            |              |                |   |              |   |                |
| Private                         | 46.6                    | 54.4                       | 1            |                |   |              |   |                |
| Public                          | 53.4                    | 45.6                       | 1.37         | (1.09, 1.71)   |   |              |   |                |
| Mother age (years)              |                         |                            |              |                |   |              |   |                |
| <25                             | 10.3                    | 8.2                        | 1            |                | 1   |              | 1   |                |
| 25-29                           | 24.4                    | 30.2                       | 1.56         | (0.98, 2.48)   | 0.96                                      | (0.58, 1.60) | 1.75                                      | (0.85, 3.60)   |
| 30-34                           | 39.8                    | 42.7                       | 1.36         | (0.88, 2.10)   | 1.16                                      | (0.71, 1.90) | 1.64                                      | (0.81, 3.32)   |
| >34                             | 25.4                    | 19.0                       | 0.94         | (0.59, 1.51)   | 1.46                                      | (0.86, 2.40) | 1.87                                      | (0.89, 3.91)   |
| Primipara                       |                         |                            |              |                |   |              |   |                |
| No                              | 45.3                    | 43.2                       | 1            |                |   |              |   |                |
| Yes                             | 54.7                    | 56.8                       | 0.92         | (0.71, 1.18)   |   |              |   |                |
| Primigravida                    |                         |                            |              |                |   |              |   |                |
| No                              | 56.9                    | 55.2                       | 1            |                |   |              |   |                |
| Yes                             | 43.1                    | 44.8                       | 0.93         | (0.72, 1.20)   |   |              |   |                |
| Mother working                  |                         |                            |              |                |   |              |   |                |
| Yes                             | 67.9                    | 78.2                       | 1            |                |   |              |   |                |
| No                              | 32.1                    | 21.8                       | 1.69         | (1.28, 2.24)   |   |              |   |                |
| <i>Explanatory variables</i>    |                         |                            |              |                |   |              |   |                |
| Gestational age (weeks)         |                         |                            |              |                |   |              |   |                |
| ≥37                             | 32.8                    | 95.6                       | 1            |                |   |              | 1   |                |
| <37                             | 67.2                    | 4.5                        | 43.9         | (30.48, 63.32) |   |              | 36.11                                     | (24.39, 53.46) |
| Birthweight                     |                         |                            |              |                |   |              |   |                |
| ≥2.500 g                        | 34.0                    | 95.8                       | 1            |                |   |              |   |                |
| <2.500 g                        | 66.0                    | 4.2                        | 44.1         | (30.60, 63.67) |   |              |   |                |
| IUGR                            |                         |                            |              |                |   |              |   |                |
| No                              | 73.2                    | 90.9                       | 1            |                |   |              | 1   |                |
| Yes                             | 26.8                    | 9.1                        | 3.64         | (2.66, 4.98)   |   |              | 2.63                                      | (1.69, 4.09)   |

OR – odds ratio; IUGR – intrauterine growth retardation.

<sup>a</sup>Number of cases included in the model: 1326.<sup>b</sup>Number of cases included in the model: 1286.

[23] described higher late fetal death for blue collar workers and less education and a U-shaped relationship with neonatal mortality, more mortality being observed among unskilled blue-collar workers and high level white-collar workers. In England and Wales social class inequalities in perinatal mortality have been reported since 1975 [24]. Studies carried

out in other European countries (The Netherlands, Greece and France) found a weaker relationship between social conditions and perinatal mortality, that almost disappeared in multivariate models [25-27]. Studies done in other settings have found different results: some of them also have described an inverse relationship [28-30].

**Table 4.** Fetal mortality, cases and controls (percentages). Bivariate and multivariate associations (OR and 95% CI) between independent variables and fetal mortality

| Variables                       | Cases<br>N = 287<br>(%) | Control<br>N = 1132<br>(%) | Bivariate OR |              | Multivariate<br>OR <sup>a</sup> (model A) |              | Multivariate<br>OR <sup>b</sup> (model B) |              |
|---------------------------------|-------------------------|----------------------------|--------------|--------------|---|--------------|---|--------------|
|                                 |                         |                            | OR           | 95% CI       | OR  | 95% CI       | OR  | 95% CI       |
| <i>Socio-economic variables</i> |                         |                            |              |              |   |              |   |              |
| Educational level mother        |                         |                            |              |              |   |              |   |              |
| University                      | 29.2                    | 33.0                       | 1            |              | 1   |              | 1   |              |
| Secondary                       | 37.2                    | 45.4                       | 0.92         | (0.66, 1.29) | 1.03                                      | (0.73, 1.47) | 1.01                                      | (0.62, 1.63) |
| Primary                         | 33.6                    | 21.6                       | 1.76         | (1.23, 2.51) | 1.84                                      | (1.26, 2.69) | 1.53                                      | (0.90, 2.60) |
| Social class mother             |                         |                            |              |              |   |              |   |              |
| I, II, III                      | 64.4                    | 66.6                       | 1            |              |   |              |   |              |
| IV, V                           | 35.6                    | 33.4                       | 1.10         | (0.80, 1.50) |   |              |   |              |
| Social class father             |                         |                            |              |              |   |              |   |              |
| I, II, III                      | 66.6                    | 67.2                       | 1            |              |   |              |   |              |
| IV, V                           | 33.8                    | 32.8                       | 1.03         | (0.75, 1.41) |   |              |   |              |
| <i>Other variables</i>          |                         |                            |              |              |   |              |   |              |
| Sex                             |                         |                            |              |              |   |              |   |              |
| Female                          | 49.3                    | 49.0                       | 1            |              | 1   |              | 1   |              |
| Male                            | 50.7                    | 51.0                       | 0.99         | (0.76, 1.29) | 1.01                                      | (0.76, 1.34) | 0.82                                      | (0.55, 1.22) |
| Hospital of delivery            |                         |                            |              |              |   |              |   |              |
| Private                         | 50.5                    | 54.4                       | 1            |              |   |              |   |              |
| Public                          | 49.5                    | 45.6                       | 1.17         | (0.90, 1.52) |   |              |   |              |
| Mother age (years)              |                         |                            |              |              |   |              |   |              |
| <25                             | 9.3                     | 8.2                        | 1            |              | 1   |              | 1   |              |
| 25-29                           | 24.5                    | 30.2                       | 1.41         | (0.82, 2.40) | 0.86                                      | (0.48, 1.55) | 1.56                                      | (0.68, 3.58) |
| 30-34                           | 42.1                    | 42.7                       | 1.16         | (0.70, 1.92) | 1.15                                      | (0.66, 2.00) | 1.65                                      | (0.73, 3.70) |
| >34                             | 24.1                    | 19.0                       | 0.90         | (0.52, 1.54) | 1.39                                      | (0.77, 2.50) | 1.62                                      | (0.69, 3.79) |
| Primipara                       |                         |                            |              |              |   |              |   |              |
| No                              | 40.7                    | 43.2                       | 1            |              |   |              |   |              |
| Yes                             | 59.3                    | 56.8                       | 1.11         | (0.82, 1.49) |   |              |   |              |
| Primigravida                    |                         |                            |              |              |   |              |   |              |
| No                              | 50.9                    | 55.2                       | 1            |              |   |              |   |              |
| Yes                             | 49.1                    | 44.8                       | 1.19         | (0.88, 1.59) |   |              |   |              |
| Mother working                  |                         |                            |              |              |   |              |   |              |
| Yes                             | 69.6                    | 78.2                       | 1            |              |   |              |   |              |
| No                              | 30.4                    | 21.8                       | 1.56         | (1.13, 2.17) |   |              |   |              |
| <i>Explanatory variables</i>    |                         |                            |              |              |   |              |   |              |
| Gestational age (weeks)         |                         |                            |              |              |   |              |   |              |
| ≥37                             | 30.4                    | 95.6                       | 1            |              |   |              | 1   |              |
| <37                             | 69.6                    | 4.5                        | 49.0         | (32.9, 72.9) |   |              | 41.1                                      | (26.8, 63.0) |
| Birthweight                     |                         |                            |              |              |   |              |   |              |
| ≥2.500 g                        | 32.4                    | 95.8                       | 1            |              |   |              |   |              |
| <2.500 g                        | 67.6                    | 4.2                        | 47.6         | (32.1, 70.5) |   |              |   |              |
| IUGR <sup>c</sup>               |                         |                            |              |              |   |              |   |              |
| No                              | 72.9                    | 90.9                       | 1            |              |   |              | 1   |              |
| Yes                             | 27.1                    | 9.1                        | 3.69         | (2.60, 5.26) |   |              | 2.35                                      | (1.40, 3.95) |

OR – odds ratio; IUGR – intrauterine growth retardation.

<sup>a</sup> Number of cases included in the model: 1213.<sup>b</sup> Number of cases included in the model: 1181.

Another variable that has been related with perinatal mortality in this study is the hospital of delivery, greater risk being observed for the public centres compared to the private ones. This is logical because risky pregnancies are usually referred to public centres (which are the specialised centres in prenatal care) both for control and for the delivery. Other variables described in the literature which are related

with perinatal mortality have not had any association in this study in the multivariate models (primiparity and primigravidity) or have not been obtained from the follow-back survey (smoking status, other complications of the pregnancy, etc.).

Socio-economic inequalities in perinatal mortality found in this study may be due to many different factors related with pregnancy and labour: Poor liv-

**Table 5.** Neonatal mortality, cases and controls (percentages). Bivariate and multivariate associations (OR and 95% CI) between independent variables and neonatal mortality

| Variables                       | Cases<br>N = 136<br>(%) | Control<br>N = 1132<br>(%) | Bivariate OR |              | Multivariate<br>OR <sup>a</sup> (model A) |              | Multivariate<br>OR <sup>b</sup> (model B) |              |
|---------------------------------|-------------------------|----------------------------|--------------|--------------|---|--------------|---|--------------|
|                                 |                         |                            | OR           | 95% CI       | OR  | 95% CI       | OR  | 95% CI       |
| <i>Socio-economic variables</i> |                         |                            |              |              |   |              |   |              |
| Educational level mother        |                         |                            |              |              |   |              |   |              |
| University                      | 33.9                    | 33.0                       | 1            |              | 1   |              | 1   |              |
| Secondary                       | 32.2                    | 45.4                       | 0.69         | (0.43, 1.10) | 0.66                                      | (0.41, 1.08) | 0.64                                      | (0.35, 1.17) |
| Primary                         | 33.9                    | 21.6                       | 1.53         | (0.95, 2.45) | 1.14                                      | (0.67, 1.93) | 0.88                                      | (0.45, 1.71) |
| Social class mother             |                         |                            |              |              |   |              |   |              |
| I, II, III                      | 60.4                    | 66.6                       | 1            |              |   |              |   |              |
| IV, V                           | 39.6                    | 33.4                       | 1.31         | (0.86, 1.99) |   |              |   |              |
| Social class father             |                         |                            |              |              |   |              |   |              |
| I, II, III                      | 61.4                    | 67.2                       | 1            |              |   |              |   |              |
| IV, V                           | 38.6                    | 32.8                       | 1.29         | (0.85, 1.97) |   |              |   |              |
| <i>Other variables</i>          |                         |                            |              |              |   |              |   |              |
| Sex                             |                         |                            |              |              |   |              |   |              |
| Female                          | 45.9                    | 49.0                       | 1            |              | 1   |              | 1   |              |
| Male                            | 54.1                    | 51.0                       | 1.14         | (0.79, 1.63) | 1.33                                      | (0.89, 1.99) | 1.38                                      | (0.84, 2.28) |
| Hospital of delivery            |                         |                            |              |              |   |              |   |              |
| Private                         | 38.2                    | 54.4                       | 1            |              | 1   |              | 1   |              |
| Public                          | 61.8                    | 45.6                       | 1.92         | (1.33, 2.78) | 2.12                                      | (1.37, 3.31) | 1.76                                      | (1.02, 3.02) |
| Mother age (years)              |                         |                            |              |              |   |              |   |              |
| <25                             | 9.7                     | 8.2                        | 1            |              | 1   |              | 1   |              |
| 25-29                           | 26.4                    | 30.2                       | 1.36         | (0.67, 2.75) | 1.32                                      | (0.57, 3.05) | 2.96                                      | (1.03, 8.51) |
| 30-34                           | 38.9                    | 42.7                       | 1.31         | (0.66, 2.56) | 1.41                                      | (0.62, 3.22) | 2.60                                      | (0.92, 7.39) |
| >34                             | 25.0                    | 19.0                       | 0.88         | (0.43, 1.80) | 1.98                                      | (0.84, 4.66) | 3.64                                      | (1.23, 10.7) |
| Primipara                       |                         |                            |              |              |   |              |   |              |
| No                              | 54.8                    | 43.2                       | 1            |              |   |              |   |              |
| Yes                             | 45.2                    | 56.8                       | 0.63         | (0.42, 0.94) |   |              |   |              |
| Primigravida                    |                         |                            |              |              |   |              |   |              |
| No                              | 69.2                    | 55.2                       | 1            |              |   |              |   |              |
| Yes                             | 30.8                    | 44.8                       | 0.55         | (0.35, 0.84) |   |              |   |              |
| Mother working                  |                         |                            |              |              |   |              |   |              |
| Yes                             | 64.4                    | 78.2                       | 1            |              |   |              |   |              |
| No                              | 35.6                    | 21.8                       | 1.98         | (1.29, 3.04) |   |              |   |              |
| <i>Explanatory variables</i>    |                         |                            |              |              |   |              |   |              |
| Gestational age (weeks)         |                         |                            |              |              |   |              |   |              |
| ≥37                             | 37.8                    | 95.6                       | 1            |              |   |              | 1   |              |
| <37                             | 62.2                    | 4.5                        | 35.3         | (22.1, 56.3) |   |              | 30.06                                     | (17.9, 50.6) |
| Birthweight                     |                         |                            |              |              |   |              |   |              |
| ≥2.500 g                        | 37.6                    | 95.8                       | 1            |              |   |              |   |              |
| <2.500 g                        | 62.4                    | 4.2                        | 37.8         | (23.8, 60.2) |   |              |   |              |
| IUGR                            |                         |                            |              |              |   |              |   |              |
| No                              | 73.8                    | 90.9                       | 1            |              |   |              | 1   |              |
| Yes                             | 26.2                    | 9.1                        | 3.53         | (2.23, 5.57) |   |              | 3.08                                      | (1.67, 5.69) |

OR – odds ratio; IUGR – intrauterine growth retardation.

<sup>a</sup>Number of cases included in the model: 1085.<sup>b</sup>Number of cases included in the model: 1069.

ing conditions (type of job, housing circumstances, deprived neighbourhood, etc.), smoking or poor nutrition during pregnancy; but also less health care during pregnancy and labour. These factors may be related with low birthweight and low gestational age and thereafter with perinatal mortality. Although Spain has a National Health System, women of disadvantaged classes are less likely to make their first

visit to the physician during the first trimester of pregnancy and less likely to have an ultrasound study in the fifth month, than women of privileged classes (data not presented).

As we have stated above, in Spain it is not possible to study social inequalities in mortality at individual level because data on occupation are usually not completed in the death certificate nor in the live birth

and abortion certificate [9]. However perinatal inequalities have been reported at an ecological level: i.e. Spains 52 provinces and 17 autonomous communities. The inequalities are related with income and also with indicators related with availability of prenatal and neonatal health care [6, 7]. In Barcelona, there are no differences in availability of health care because services are available in the whole of the city, but there are social class inequalities in the accessibility of preventive health services for children [31] and preventive practices in adults (odontology, screening of breast cancer, etc.) the privileged social classes having greater access [32]. Although in Spain the National Health Service implies practically universal and free health coverage, an important part of the population, mainly of the upper social classes has some private coverage, in addition to public coverage [32]. These private health insurance schemes may facilitate a different control of the pregnancy and delivery among women of different social classes.

This study has described the existence of inequalities by educational level in perinatal mortality and one of its main components (fetal mortality). These results point out the necessity of improving the living conditions, behavioural factors such as smoking and also the management of pregnancy, labour and the health care of the newborn of these mothers with greater risk in order to reduce factors related to inequalities in perinatal mortality such as low birth-weight and low gestational age.

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