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Risk factors for early neonatal mortality

ABSTRACT

OBJECTIVE: To assess risk factors for early neonatal mortality.

METHODS: A population-based case-control study was carried out with 146 early neonatal deaths and a sample of 313 controls obtained among survivals of the neonate period in the south region of the city of São Paulo, in the period of 8/1/2000 to 1/31/2001. Information was obtained through home interviews and hospital charts. Hierarchical assessment was performed in five groups with the following characteristics 1) socioeconomic conditions of mothers and families, 2) maternal psychosocial conditions, 3) obstetrical history and biological characteristics of mothers, 4) delivery conditions, 5) conditions of newborns.

RESULTS: Risk factors for early neonate mortality were: Group 1: poor education of household head (OR=1.6; 95% CI: 1.1;2.6), household located in a slum area (OR=2.0; 95% CI: 1.2;3.5) with up to one room (OR=2.2; 95% CI: 1.1;4.2); Group 2: mothers in recent union (OR=2.0; 95% CI: 1.0;4.2), unmarried mothers (OR=1.8; 95% CI: 1.1;3.0), and presence of domestic violence (OR=2.7; 95% CI: 1;6.5); Group 3: presence of complications in pregnancy (OR=8.2; 95% CI: 5.0;13.5), previous low birth weight (OR=2.4; 95% CI: 1.2;4.5), absence of pre-natal care (OR=16.1; 95% CI: 4.7;55.4), and inadequate pre-natal care (block 3) (OR=2.1; 95% CI: 2.0;3.5); Group 4: presence of clinical problems during delivery (OR=2.9; 95% CI: 1.4;5.1), mothers who went to hospital in ambulances (OR=3.8; 95% CI: 1.4;10.7); Group 5: low birth weight (OR=17.3; 95% CI: 8.4;35.6) and preterm live births (OR=8.8; 95% CI: 4.3;17.8).

CONCLUSIONS: Additionally to proximal factors (low birth weight, preterm gestations, labor complications and unfavorable clinical conditions in gestation), the variables expressing social exclusion and presence of psychosocial factors were also identified. This context may affect the development of gestation and hinder the access of women to health services. Adequate prenatal care could minimize the effect of these variables.

KEY WORDS: Early neonatal mortality. Risk factors. Socioeconomic factors. Perinatal care. Maternal-child health services. Case-control studies.

INTRODUCTION

Infant mortality rate in Brazil has a decreasing trend with greatest decrease in the postneonatal component in the North and Northeast regions. There is also an expressive decrease of the neonatal component in the South and Southeast regions and as a result there is a concentration of infant deaths in the first days of life. The association of low birth weight, preterm births. pregnancy and delivery problems with early neonatal mortality have been widely described in the literature.[1,2,8,14] However, the cause pathway of these factors is complex encompassing biological maternal and newborns characteristics with live conditions, of he families and health care and its social context.[2,7,12,18]

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Many studies were carried out on risk factors of neonatal mortality in Brazil, in recent years, mainly due to the improvement of access, quality, and utilization of linkage techniques of the data bases of mortality and live births information systems. Additionally to risk factors that express more biological conditions of the development of pregnancy and of newborns, we have also included variables that express socioeconomic dimension, maternal schooling and prenatal and delivery care.[1,16]

Recent studies addressed new elements to the causal pathway of neonatal mortality: the inclusion of other variables that express socioeconomic dimension, in addition to maternal schooling, such as father's occupation, income and housing.[2,5,14] Others studies ha identified also the presence of psychosocial factors in this pathway. These factors may generate stressful conditions (absence of partner, [11,21,22] presence of domestic violence,[13] smoking habit[19] and drug use[11]) resulting in adverse influence in the development of the pregnancy. The present study aimed at identifying risk factors associated with early neonatal mortality in the south region of the city of São Paulo.

METHODS

Data were taken from a survey on perinatal mortality in the city of São Paulo[3] aiming at exploring risk factors for early neonatal mortality. Interviews with mothers and examining hospital charts led to detailed socioeconomic information on the psychosocial context where pregnancies developed. Thus, we could understand better the risk factors for early neonatal mortality in big urban cities in Brazil, especially prenatal care conditions and risk factors proximal to early neonatal deaths.

As part of this survey, a case-control study was performed. We have considered early neonatal deaths (less than seven days of age) as cases, and survivors of the neonatal period as controls, obtained through random sampling. All births in the period of 8/1/2000 to 1/31/2001 constituted a cohort of live births from mothers living in the south side of the city of São Paulo, obtained through linked data of Mortality (SIM) and and Live Births (SINASC) Information System. The original databases were obtained from in the State System Foundation on Data Analysis (SEADE). All early neonatal deaths occurred in the reference period in the study area have been considered and included, and the controls represented the profile of survivors to the neonatal period. Births occurred outside hospitals were excluded. The initial sample has been defined for the study of perinatal mortality; however, preliminary assessment of the outcomes indicated differences between risk factors for early neonatal and fetal deaths. Thus, we have decided to assess these events separately, keeping the number of controls previously established. Therefore the study sample included 146 early neonatal deaths and 313 controls. Loss on house interviews was 3.6% (cases) and 2.2% (controls) and in the examination of the charts 5.7% (cases) and 5.4% (controls). There were few refusals; home interviews (3.0% and 2.4% for cases and controls, respectively) and slightly higher in hospital (5.7% and 6.2% for cases and control, respectively).

Variables have been grouped into five hierarchical blocks according to the conceptual model. Block 1: socioeconomic characteristics mothers' and families – occupation of household head (adapted from the British classification[5]), schooling of the household head and mothers. The following characteristics of the house have been considered: located in slum area, type of housing (construction material), number of rooms, and number of people per room. We have also included the following variables: mother's work during pregnancy, having private health insurance plan during pregnancy. Ethnic group was self referred by mothers.

Block 2: maternal psychosocial characteristics – mother union status (partner; without partner and recent union - less than 1 year), family composition was based on the relationship of the mother and the household head) and was categorized in (mother; partner and others), perception of the pre-gestational health status (self-referred by mothers,) pregnancy planning, reaction of the mother, of the father and of the family towards pregnancy. Abortion attempt during pregnancy has also been considered. The presence of domestic violence during pregnancy was measured using Abuse Assessment Screning.[17] Adolescent mothers (less than 18 years of age) have been included in this block though social and psychological conditions are associated with pregnancy in adolescence.

Block 3: biological characteristics and maternal reproductive history – the variable "problems during pregnancy" was based on mothers self report and the presence of at least one of these conditions was considered: risk of premature labor, renal disease, diabetes, bleeding and hypertension during pregnancy. Prenatal care was considered adequate when the 1st appointment took place in the first quarter of pregnancy and at least 4 appointments were reported, and in at least one of these appointments maternal blood pressure and fetal heart rate were assessed, as well as urine and blood tests were performed at least once. This group included reproductive maternal history: previous parity, presence of previous death of children younger than 1 year old and previous low birth weight (<2500g) baby. We have also included: aggression to the abdominal region during pregnancy; smoking, and alcohol intake during pregnancy, maternal height, BMI[20] and birth interval.

Block 4: delivery characteristics – delivery performed in the first health service accessed by the mother, type of delivery, presence of problems during labor was self referred by mothers, transport to hospital in delivery and time spent by the mother to leave the house and be seen in hospital to perform delivery.

Block 5: newborn characteristics – gender and birth weight were obtained from hospital charts. Gestational age was obtained through the following algorithm: 1) LMP (last menstrual period) recorded in the obstetric chart (79.7%); 2) LMP obtained from mothers (home interview) (12.6%) and gestational age at the pediatric chart defined by different hospital methods (Dubowitz, Ballard and Capurro) (7.7%).

A univariate analysis was performed to select variables. Later, logistic regression was performed including previously selected variables for each of the 5 blocks, in these modeling, descriptive level considered was $p<0.20$. Then a multivariate analysis was performed with the variables selected in the former stage in each group, following hierarchization presented in the conceptual model; the criteria established in this stage of the analysis, so that the variables remained in the model, was $p<0.05$.

The project was approved by the Ethical Committee in Research of the Faculdade de Saúde Pública – FSP/USP.

RESULTS

Losses and refusals were inferior to 10%, and did not interfere in the results obtained. Almost all early neonatal deaths occurred in the same hospital where delivery was performed (97.9%), few newborns were transferred to more complex hospitals (1.4%), and only one newborn was discharged after delivery (0.7%) and died later.

Tables show only variables pre-selected in the univariate analysis ($p<0.20$) for the adjustment stage with the remaining variables of each block.

Socioeconomic characteristics (block 1) associated with outcome were: household head education, number of rooms and location of the house (Table 1). Variables usually studied to assess socioeconomic characteristics, such as maternal work, ethnic group, having private health insurance plan and type of housing were not related with the outcome ($p>0.20$) in the unvaried analysis (outcomes not shown on tables). Other variables presented strong adjustment in this analysis, and were excluded: family income per capita and maternal education.

Maternal psychosocial characteristics (block 2) associated with outcome were: adolescent mothers and presence of domestic violence. The variables mothers union status and reaction of the family to pregnancy were selected after adjustment in the group ($p<0.20$). Pregnancy planning, self-perception of pre-gestational health status and family composition of lost their effect after adjustment by the others variables of this block (Table 2). Mother and father reaction to pregnancy and abortion attempt during pregnancy were tested in the univariate analysis, but were not selected (data no shown).

Biological characteristics and maternal reproductive history (block 3) associated with neonatal deaths were: problems during pregnancy, inadequate or no prenatal care, smoking during pregnancy and previous low birth weight baby. Abdominal aggression was strongly adjusted and was selected to the next stage in modeling (Table 3). Mothers' parity has been eliminated in the multivariate analysis. Pre-gestational BMI was pre selected in the univariate analysis, but was excluded at this step. The variables: maternal height, birth interval, presence of previous death of children less than one year and alcohol use during pregnancy were excluded in the univariate analysis.

Delivery characteristics (block 4) such as problems in labor, transport used to go to hospital, and type of delivery were selected for the next stage of the analysis (Table 4). Delivery in another health service –other than the first accessed by the mothers – and a long time between mothers leaving home and being seen in hospital (over one hour) have been excluded in the univariate analysis ($p>0.20$).

All the characteristics of newborns (group 5) have been selected for the next stage of modeling (Table 4). A reduction of low birth weight and preterm births odds ratio on the multivariate analysis was observed.

Logistic regression has been performed with variables of groups 1 and 2, adding selected variables from the other groups and considering only variables that presented $p<0.05$ in the adjustment of groups. In the first stage of modeling all variables selected in group 1 maintained association with early neonatal mortality (household head education, place of residency, and number of rooms in the house). Variables of group 2 that remained in the model were: mothers' union status and domestic violence (Table 5). After this adjustment the following variables have been excluded: family reaction to pregnancy and adolescent mother.

The same process has been performed adding variables previously selected from group 3 (Table 5). Variables from group 3 that remained in the model were: problems in pregnancy, previous low birth weight and prenatal care adequacy and those that lost statistical significance: smoking during pregnancy, and abdominal aggression.

In the following stage we have added to the significant variables from groups 1, 2 and 3 the variables from group 4. The variables delivery problems and transport to the hospital were associated with outcome, whereas type of delivery lost its protective effect (Table 5). In the final stage, with the inclusion of variables from block 5 they remained associated with the outcome: birth weight and duration of pregnancy; however, the gender of the newborn lost its significance.

Final model encompassed the following risk factors: block 1 – household head education (less than 4 years

Table 1. Number, percentage and odds ratio for cases and controls according to variables related to socioeconomic characteristics (group 1). City of São Paulo, Brazil, 2000.

Variable	Case	%	Control	%	Crude OR	p	CI 95%	Adjus. OR	p	CI 95%
Household head occupation										
Qualified and semi qualified	33	22.6	99	31.6	1.0					
Manual	95	65.1	177	56.5	1.6	0.04	1.0;2.6	1.2	0.4	0.7;2.0
Does not work outside the house	11	7.5	27	8.6	1.2	0.62	0. 5; 2.7	1.6	0.4	0. 5; 4.7
Unemployed	7	4.8	10	3.2	2.1	0.15	0. 7; 6.0	0.9	0.9	0. 4; 2.2
Schooling of household head (years of study)										
Less than 4	43	29.4	129	41.2	1.0					
4 or over	98	67.1	172	54.9	1.7	0.03	1. 1; 2.6	1.6	0.03	1. 0; 2.5
Ignored	5	3.4	12	3.8	0.2	0.69	0. 4; 3.8	1.0	0.94	0. 3; 3.3
Income per capita in MW										
≤1	70	47.9	175	55.9	1.0					
>1	76	46.6	126	40.2	1.3	0.14	0. 9; 2.0	1.0	0.87	0. 7; 1.6
Ignored	8	5.5	12	3.8	1.7	0.28	0. 7; 4.3	1.1	0.86	0. 5; 3.3
House located in slum area										
No	112	76.7	276	87.9	1.0					
Yes	34	23.3	38	12.1	2.2		1. 3; 3.7	2.0	0.01	1. 2; 3.3
Type of housing (construction)										
Masonry	93	63.7	245	78.7	1.00					
Other materials	53	36.3	68	21.7	2.05		1.3;3.2	1.4	0.35	0.7;2.6
Number of rooms										
≥2	123	84.3	292	93.3	1.00					
1	23	15.7	21	6.7	2.6		1.4;4.9	2.39	0.01	1.26;4.53
Density of people per room										
<3	98	67.1	245	78.3	1.00					
≥3	48	32.9	68	21.7	1.76	0.01	1.1;2.7	1.1	0.87	0.6;1.8

MW: minimum wages

of study), place of residency (slum) and number of rooms (one room); block 2 – mothers union status (no partner and recent union) and presence of domestic violence; block 3 – problems in pregnancy, adequacy of prenatal care (inadequate or absent) and previous low birth weight baby; block 4 – delivery problems and transport to hospital (ambulance, police car, firefighter car); block 5 – low birth weight (<2,500g) duration of pregnancy (preterm).

Hosmer-Lemeshow goodness of fit test[10] was $\chi^2(8gl)=9.01$, a non-significant difference (p=0.34) among the predicted and observed probabilities, indicating good adjustment of the model.

DISCUSSION

Early neonatal mortality rate in the south side of São Paulo was 7.9, whereas in the city of São Paulo it was 7.7 per 1000 live births,* in 2000. In developed countries this rate is 2.0** in Canada and 3.7*** in the United States per 1000 live births. Most proximal risk factors for early neonatal mortality (low birth weight, preterm births, pregnancy, and delivery problems) are the same found in developed countries. Therefore, this excess may be mostly due to social exclusion, once the causes found include births from mothers living in slums, in one-room houses and household heads with less than 4 years of study. There are also

* Fundação SEADE. Anuário Estatístico do Estado de São Paulo: 2002. [Accessed on 5/5/2007]. Available from http://www.seade.gov.br/produtos/anuario

** Government of British Columbia. Selected vital statistics and health status indicators. Trends of infant mortality: British Columbia and Canada, 1965 – 2000. [Accessed on 5/3/2007]. Available from: http://www.vs.gov.bc.ca/stats/annual/2000/tab04.html

*** National Center for Health Statistics. Health, United States, 2004: with chartbook on trends in the health of Americans. Hyattsville, Maryland: 2004.

Table 2. Number, percentage and odds ratio for cases and controls according to variables related to psychosocial characteristics (group 2). City of São Paulo, Brazil, 2000.

Variable	Case	%	Control	%	Crude OR	p	CI 95%	Adjus. OR	p	CI 95%
Mothers'union status										
1yr or over	96	65.7	243	77.6	1.0					
less than 1 year	17	11.6	22	7.1	2.0	0.05	1.0;3.9	1.9	0.08	0.9;3.7
No partner	33	22.6	48	15.3	1.7	0.03	1.1;2.9	1.4	0.26	0.8;2.4
Self Perception of the pre-gestational health status										
Excellent or good	118	80.8	276	88.2	1.0					
Regular or bad	28	19.1	37	11.8	1.7	0.03	1.0;3.0	1.4	0.29	0.8;2.4
Pregnancy planning										
Planned	39	26.7	116	37.1	1.0					
Unplanned	107	73.3	197	62.9	1.6	0.03	1.0;2.5	1.2	0.45	0.7;1.9
Reaction of the family to pregnancy										
Happy	82	56.2	211	67.4	1.0					
Indifferent or dissatisfied	60	41.1	90	28.7	1.7	0.01	1.1;2.6	1.5	0.09	0.9;2.3
Does not know	4	2.7	12	3.8	0.8	0.80	0.3;2.7	0.6	0.36	0.2;1.9
Presence of domestic violence										
No	133	91.1	303	96.8	1.0					
Yes	13	8.9	10	3.2	2.9	<0.001	1.3;7.0	2.8	0.02	1.2;6.7
Adolescent mother										
No	132	85.2	303	93.4	1.0					
Yes	14	14.8	10	6.6	3.2	<0.001	1.4;7.5	2.8	0.02	1.1;6.9

Table 3. Number, percentage and odds ratio for cases and controls according to variables related to biological characteristics of maternal reproductive history (group 3). City of São Paulo, Brazil, 2000.

Variable	Case	%	Control	%	Crude OR	p	CI 95%	Adjus. OR	p	CI 95%
Problems during pregnancy										
No	42	28.8	239	76.4	1.0					
Yes	104	71.2	74	23.6	8.0	<0.001	4.9;13.2	8.2	<0.001	5.2;13.9
Prenatal care adequacy										
Adequated	81	55.5	239	76.3	1.0					
Not adequated	44	30.1	70	22.4	1.9	0.01	1.2;2.9	2.1	0.01	1.2;3.6
No	21	14.4	4	1.3	15.5	<0.001	4.8;49.8	16.3	<0.001	4.7;56.5
Previous parity (number of children)										
< 4	122	83.6	283	90.4	1.0					
≥ 4	24	16.4	30	9.6	1.9	0.03	1.0;3.3	0.8	0.61	0.4;1.8
Previous low weight birth										
No	111	76.1	281	89.8	1.0					
Yes	35	23.9	32	10.2	2.8	<0.001	1.6;4.7	1.9	0.05	1.0;3.5
Aggression to the abdominal region										
No	141	96.6	312	99.7	1.0					
Yes	5	3.4	1	0.3	11.1	<0.001	1.3;97.5	6.0	0.19	0.4;89.3
Smoking during pregnancy										
No	98	61.1	254	81.2	1.0					
Yes	48	32.9	59	18.8	2.1	<0.001	1.3;3.3	1.8	0.03	1.1;3.2

Table 4. Number, percentage and odds ratio for cases and controls according to variables related to labor characteristics (group 4) and of newborns (group 5). City of São Paulo, Brazil, 2000.

Variable	Case	%	Control	%	Crude OR	p	CI 95%	Adjust. OR	p	CI 95%
Group 4										
Type of delivery										
Vaginal	92	63.0	166	53.1	1					
C-section	54	37.0	147	46.9	0.7	0.04	0.4;1.0	0.7	0.06	0.4;1.0
Presence of delivery problems										
No	114	78.1	289	92.3	1					
Yes	32	21.9	24	7.7	3.3	<0.001	1.8;5.9	3.2	<0.001	1.7;5.7
Transport to the hospital										
Own car	22	15.1	75	23.0	1					
Borrowed car or bus	101	69.2	224	71.6	1.5	0.11	0.9;2.6	1.7	0.07	1.0;2.9
Ambulance/ police /fire fighter	23	15.7	14	4.5	5.6	<0.001	2.3;13.6	5.3	<0.001	2.3;12.2
Group 5										
Birth weight										
≥ 2500g	27	18.5	288	92.0	1					
< 2500g	119	81.5	25	8.0	50.8	<0.001	21.3;120.8	15.0	<0.001	7.5;30.0
Sex										
Female	58	39.7	156	49.8	1					
Male	88	60.3	157	50.2	1.5	0.04	1.0;2.3	1.8	0.07	1.0;3.5
Pre-term (weeks of gestation)										
≥ 37	30	20.5	287	91.7	1					
< 37	116	79.5	26	8.3	42.7	<0.001	18.9;96.4	10.0	<0.001	5.0;20.0

other dimensions of social exclusion, in the present study represented by the lack of social support during pregnancy (single mothers, short term relationships), presence of domestic violence and absence or inadequate prenatal care.

The increase in early neonatal mortality observed in births of families living in slum areas is close to that obtained in another study performed in a great urban center, where it was found an association between neonatal mortality and houses located in areas of illegal occupation.[6] The association between neonatal deaths and births in families headed by functional illiterates, in the present study may indirectly express low maternal schooling, because some studies showed an association between both.[6] There was no association between maternal schooling and income per capita and the outcome, these variables traditionally indicate socioeconomic conditions of the families. However, household head schooling may describe social insertion of this population Association between maternal schooling and neonatal mortality[15] was found in studies which generally use secondary data (SIM, Sinasc and hospital charts) and this is the only variable present of social dimension of the newborns' families.[16] Studies in which social dimension is expressed by a set of indicators, not always find association of maternal schooling and the risk of neonatal mortality.[2,4,14]

We have considered as maternal psychosocial characteristics (block 2) some variables that other studies have considered as sociodemographic variables. Adolescent pregnancy is a complex phenomenon and expresses not only biological risk of the maternal age, but may also express stress of unplanned and unwanted pregnancies, and the difficulty of the families to accept it. When psychosocial characteristics are added to the variables of the group socioeconomic variables in the modeling process, the effect of adolescent mothers on the risk of early neonatal death lost its effect, possibly due to its greater frequency in poorer groups with low schooling.[9]

The psychosocial variables: family reaction to pregnancy, family composition and pregnancy planning found to be associated to the outcome in the univariate analysis lost its effect after the adjustment of the block This fact indicates the presence of associations between this set of variables and suggests that some of them may be mediated by the effect of others, present in the same block (Table 2).

Unwanted pregnancies can be difficult to assess and aiming to approach this issue we tried to measure acceptance of pregnancy by mothers, fathers and families. Only family reaction was selected in the multivariate analysis of block 2, however, it was withdrawn when variables from block 3 were added, suggesting that the presence of stress may be mediated by variables expressing adverse (biological) conditions in pregnancy (group 3).

Another variable of this group – mothers' union status (single mothers and recent union) may demonstrate, at least in part, the absence of emotional and social support in pregnancy (table 2 and table 5). These results agree with other studies that point out paternal absence during pregnancy as a risk factor for neonatal death.[11,21,22] Recent union (less than 1 year) may express difficulties of pregnant women in dealing with a new affective relationship together with pregnancy. The presence of domestic violence is in the pathway of early neonatal mortality (Table 5) is similar to the results found by other studies relating domestic violence and preterm, low birth weight and with neonatal mortality.[13]

Variables that could have been considered as a behavioral component have been included in block 3, such as smoking during pregnancy and abdominal aggression. These variables have been included in this block because their already known biological mechanism on pregnancy. This set of variables expresses what Misra et al[15] call biomedical variables. The effect pregnancy problems have been widely described in the literature.[2,14] The negative effect of previous pregnancies outcomes on early neonatal mortality more frequently studied are fetal losses or previous preterm births[19,21] and in the present study we found the effect of mothers having had previous low birth weight baby. Possibly, this set of variables expresses the presence of placental problems or adverse maternal conditions which affect the development of pregnancy and contribute to the occurrence of early neonatal death.

The negative effect of inappropriate or absent prenatal care on early neonatal mortality may be due to lack of detection and treatment of adverse conditions of pregnancy. Several Brazilian studies have found association between the absence or small number of prenatal care appointments with perinatal and neonatal deaths.[1,2,14] The present study goes further and considered also the beginning of prenatal care in the first quarter, requiring complementary examinations, measuring uterine height, assessing mother's blood pressure and fetus's heart rate in at least one appointment. Even though these criteria represent only partially the quality of care, this indicator was sensitive.

Kramer et al[11] discuss that the absence or low frequency of prenatal appointments have been pointed out as risk

Table 5. Final model of the risk factors associated with early neonatal mortality. City of São Paulo, Brazil, 2000.

Variable	OR	p	CI 95%
Group 1			
Schooling of the household head (years of study)			
Less than 4 years			
4 or over	1.6	0.03	1.1;2.6
Ignored	1.2	0.75	0.4;3.8
House located in slum area			
No			
Yes	2.0	0.01	1.2;3.5
Number of rooms			
>2			
1	2.2	0.02	1.1;4.2
Group 2			
Length and type of relationship			
>1			
<1 year	2.0	0.05	1.0;4.2
No partner	1.8	0.03	1.0;3.0
Presence of domestic violence			
No			
Yes	2.7	0.03	1.1;6.5
Group 3			
Problems during pregnancy			
No			
Yes	8.2	<0.001	5.0;13.5
Appropriateness of prenatal			
Appropriate			
Inappropriate	2.0	0.01	2.0;3.5
Did not do	16.1	<0.001	4.7;55.4
Previous low weight birth			
No			
Yes	2.4	0.01	1.2;4.5
Group 4			
Presence of problems during labor			
No			
Yes	2.9	<0.001	1.4;5.1
Transport to hospital			
Own car			
Borrowed car or bus	1.3	0.38	1.4;6.0
Ambulance/ police car/ fire fighter car	3.8	0.01	1.4;10.8
Group 5			
Weight at birth			
≥2500g			
<2500g	17.3	<0.001	8.4;35.6
Pre-term (weeks of pregnancy)			
37 and over			
Less than 37	8.8	<0.001	4.3;17.8

factors for early neonatal, perinatal death and low birth weight. However, this outcome is not confirmed by controlled trials in developed countries, suggesting that this condition may indicate the presence of unwanted pregnancies. This fact may also be expressed in the results of the present study, although in poorer areas difficult access to care can also be one of the dimensions of social exclusion.

Association between labor complications and early neonatal mortality has been found, similarly to other studies.[2,8] Association between the outcome and mothers being taken to hospital by ambulance, police car, or fire fighter car indicates an emergency situation to perform delivery which contributes to the occurrence of early neonatal deaths (Table 5). Other variables have been excluded from the modeling process, such as the protective effect C-sections, and not performing delivery in the first health service mothers accessed, due to lack of hospital beds (Table 3). A case-control study may not be the better strategy to measure negative effect on early neonatal deaths of delay on delivery care due to the delivery in another hospital rather than the first assessed by mothers we found that a large number of cases (20.5%) and controls (17.9%) in this situation clearly, suggesting difficulties of access to delivery care. However, information obtained may have not been enough to assess the effect of this delay.

The strong effect of proximal variables (preterm births and low birth weight[2]) reflects also the high prevalence of these conditions (approximately 80%) in live births that died in the first days of life. (Table 4). Adjustment on odds ratio of these variables indicates that part of the low birth weight are also preterm (Table 5).

This is a retrospective study and may present bias in mothers' memories and assessment bias during data collection. Some mothers whose birth led to death may have been touched in the interview and may have not mentioned something important or may have hidden information regarding accepting pregnancy or behavior during pregnancy (smoke, alcohol) among others. Additionally, the power of the study may have not been enough to assess some variables and the outcomes may not reflect the complexity of the interrelations present among these variables.

The study highlights the importance of prenatal care in the pathway of early neonatal mortality. Improving access and quality of health services may have a positive impact in the reduction of early neonatal death, special care should be given to mothers in recent unions or single and living in slums. Information on mothers with previous low birth weight baby and domestic violence should be sought to offer more suitable conditions to the follow-up of these pregnant women.

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