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Consequences of sociodemographic inequalities on birth weight

ABSTRACT

OBJECTIVE: To analyze sociodemographic inequalities in prenatal and childbirth care and their consequences on birth weight.

METHODS: The study was based on a sample of 10,072 postpartum women treated at public (those outsourced by the National Health System) and private maternity hospitals in Rio de Janeiro, Brazil, from 1999 to 2001. To test the association between birth weight and maternal sociodemographic and biological characteristics and prenatal care (modified Kotelchuck index), postpartum women were stratified by level of schooling and two multiple linear regressions were performed. The bootstrap technique was used in addition to accurate confidence intervals for the estimated effects.

RESULTS: For nearly all of the variables analyzed in the bivariate analysis, birth weight was lower among children of mothers with low schooling. In the multivariate analysis, among women with low schooling, there was a direct association between birth weight and the modified Kotelchuck index and gestational age. The variables black skin color, smoking, and history of premature birth were negatively associated with birth weight, while maternal age and parity showed distinct behaviors from the central range of data at the extremes. In the group with high schooling, only parity, gestational age, and modified Kotelchuck index were significant and directly associated with birth weight. The protective effect of prenatal care was observed, as well as the negative effect of smoking, regardless of the mother's level of schooling.

CONCLUSIONS: The variables associated with neonates' birth weight of mothers with high schooling in Rio de Janeiro were biological, in contrast to the social determinants in the group with low schooling.

KEYWORDS: Birth weight. Social inequity. Health inequity. Equity in access. Maternal and child health. Prenatal care.

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INTRODUCTION

Birth weight is the best predictor of immediate and future health standards of a newborn. In the perinatal and neonatal periods, low birth weight is directly associated with morbidity and mortality.[5,18] During the first year of life, other than elevated risks of sickness and death, its effects also extend into the area of infant growth and development which demand intensive use of health services.[17,18] The impact on cognitive development, which is more easily perceived after entering school, determines future professional life possibilities.[5,16] More recently, the consequences of low birth weight (<2,500 g) and inadequate birth weight (<3,000 g) have been associated with chronic diseases such as arterial hypertension later on in life.[1,8]

The frequency of low birth weight is related to maternal health factors and the social conditions of the family of origin. The higher the percentage of low birth weight within a community, the greater the role of social determinants in its occurrence.

Monteiro et al[16] analyzed the secular tendency of low birth weight in the city of São Paulo using an explanatory model for low birth weight that included proximate determinates (length of gestation period and speed of intra-uterine growth); intermediate determinates (maternal age, nutritional status of the pregnant woman, obstetric history, pregnancy pathologies, smoking history, stress during pregnancy, adequate pre-natal care) and distal conditions (socioeconomic determinates).

In Brazil, where the social inequalities are elevated, 8% of births in the health care services reported low birth weight in 2002, as compared to developed countries which have a low birth weight average of 5%.[12,15]

In a study realized in Rio de Janeiro, Gama et al[4] found a positive association between new-born birth weight and the use of adequate prenatal care among pregnant women, and a negative association between difficulty in access to a maternal ward at the time of giving birth indicating the importance of prenatal care in determining birth weight.

In the present study, the effects of sociodemographic inequalities and access to prenatal and childbirth care on birth weight were analyzed among a sample of post-partum women that were hospitalized during childbirth.

METHODS

Based on a proportionate stratified sample, health facilities were grouped according to percentage of low birth weight in three strata: 1) city and federal establishments; 2) private establishments associated with the Brazilian Health System (SUS), military, state, and philanthropic associations; 3) private establishments. In each strata, approximately 10% of the planned number of women who would give birth in each hospital were selected. Hospitals with less than 200 births per year were excluded as they only correspond to 3.7% of total births. The information regarding the number of births per year was taken from the Live Births Information System database, tabulated and provided by the directorate of the Epidemiological Programs of the Municipal Health Secretariat in Rio de Janeiro.

The size of the sample in each strata was established with the objective of comparing percentages in equal samples with a significance level of 5% and to detect differences in percentages of low birth weight of at least 3% with a power of 90%. The sample size as calculated to be 3,282 postpartum women. To adjust for the possibility of losses, the total in each strata was established at 3,500 postpartum women. After defining the number of women to be interviewed, all women who gave birth in the maternity ward were interviewed until the number of interviews for each establishment was completed. The only ineligibility criteria was abortion (age of the fetus less than 22 weeks).

A total of 47 institutions were selected, 12 in the first sample strata (34.8% of births); 10 in the second strata (34.4%); and 25 in the third strata (30.8% of births).

Data was collected through the use of standardized questionnaires, which were applied to mothers immediately after giving birth and through the collection of information included in their hospital file daily. Both the interviews with the postpartum women and the review of the hospital file were conducted by medical and nursing students. These students were appropriately trained in how to apply the questionnaire and were assisted by three doctors who supervised the fieldwork.

The losses of the study included 4.5% of the total sample, of which 2.6% were in the first strata, 1.9% in the second, and 9.3% in the third. In the first two strata, the main reason for the losses was the mother's delicate condition and in the third strata, it was primarily due to refusal to participate in the study.

The variables used in this study were: "mother's age"; "skin color" (white, yellow, light brown, black, self-defined); "live with father of baby" (yes/no); "parity"; "smoke during pregnancy" (yes/no); "previous premature births" (yes/no); "Kotelchuck modified index" (without prenatal care, inadequate, intermediate, adequate, more than adequate); "sought more than one maternity ward at the time of giving birth" (yes/no); "gestational age" and "birth weight."

Skin color as self defined by the postpartum woman interviewed was considered an alternative to racial classification.

The Koltelcheck index evaluates the adequate use of prenatal services, taking into account the number of doctor's visits and the month that prenatal care in relation to the age of the fetus. Gama et al[4] used this score, adjusting it to the characteristics of the population of postpartum women in the city.

A total of 439 women were excluded from the study. Of those, 225 self defined themselves as yellow, a small group which represented 2.2% of the initial sample, which led to their being excluded. The exclusion of women who gave birth to twins (n=214; 2.1%) were excluded due to the fact that twins have lower birth weight which could lead to a bias in interpreting the results.

In the bivariate analysis, the average birth weight was calculated for two levels of schooling: those who did not finish high school and those who finished high school and beyond. Variance analysis (ANOVA) was used to investigate the differences in the averages of birth weights for the categorical and ordinal variables.

With the goal of verifying the association between maternal characteristics and birth weight, two multiple linear regressions were conducted, stratifying the postpartum women by level of schooling. The variables introduced into the model were selected though the metanalysis conducted by Kramer[10] and a bivariate analysis of possible predictors.[12] Birth weight, maternal age, parity, and gestational age entered the model as continuous variables; skin color with the reference category "white" and the Kotelchuck index as ordinal variables.

The predictive power of each model was evaluated using the bootstrap technique, a technique of re-sample size calculation with the goal of obtaining nonbiased estimates of the performance of the model, as well as accurate confidence intervals to estimate the effects of the variables.[6] For each model, the goodness of fit test was conducted. In both models, for the continuous variables, the estimates were made based on the amplitude between quartiles (the difference between the first and third quartiles of the variable). Quadratic terms were added to the variables "maternal age" and "parity" as the initial analysis found a non-linear relationship.

This study was approved by the Ethics Committee

Table 1 - Newborn birth weight of women who did not finish high school, organized according to selected characteristics. Rio de Janeiro, 1999-2001.

Variable	N	Average	Standard deviation	p
Maternal age group				
Up to 19 years	1,680	3078.7	587.0	0.000
20 to 34 years	3,704	3194.0	585.9	
35+	490	3169.2	647.2	
Skin color				
White	2,391	3185.9	589.8	0.005
Light brown	2,049	3154.1	597.9	
Black	1,437	3121.6	592.4	
Parity				
First birth	2,450	3111.7	568.1	0.000
1-2	2,628	3205.7	602.0	
3+	793	3150.3	631.4	
Lives with father of baby				
No	1,215	3084.1	592.9	0.000
Yes	4,658	3178.3	592.5	
Previous premature births				
No	5,321	3187.4	571.9	0.000
Yes	550	2882.5	716.5	
Adapted Kotelchuck score				
Did not do prenatal care	307	2934.9	723.0	0.000
Inadequate	1,978	3087.9	642.8	
Intermediate	1,998	3203.1	546.9	
Adequate	991	3315.4	496.9	
More than adequate	176	3231.2	510.0	
Smoked during prenancy				
No	4,874	3188.7	593.1	0.000
Yes	1,000	3016.2	574.8	
Sought more than one maternity ward to give birth				
No	4,018	3183.0	572.6	0.000
Yes	1,852	3108.5	633.6	
Prematurity				
No	4,752	3276.0	477.9	0.000
Yes	732	2489.2	773.5	

Table 2 - Newborn birth weight of women who finished high school, organized according selected characteristics. Rio de Janeiro, 1999-2001.

Variable	N	Average	Standard deviation	p
Age group				
Up to 19 years	144	3157.5	570.6	0.178
20-34 years	2,729	3222.3	531.8	
35+	599	3188.5	605.4	
Skin color				
White	2,476	3218.4	536.8	0.580
Light brown	670	3210.3	565.7	
Black	327	3185.3	582.6	
Parity				
First Birth	2,136	3192.2	555.1	0.009
1-2	1,256	3248.3	526.0	
3+	76	3275.1	568.0	
Lives with the father of the baby				
No	323	3179.8	508.4	0.244
Yes	3,147	3217.1	550.8	
Previous premature births				
No	3,313	3227.1	530.5	0.000
Yes	156	2943.6	753.9	
Adapted Kotelchuck score				
Did not have prenatal care	20	3327.0	430.7	0.000
Inadequate	279	3086.7	713.8	
Intermediate	807	3152.8	564.5	
Adequate	1,734	3247.8	505.1	
More than adequate	572	3263.1	524.1	
Smoked during pregnancy				
No	3,248	3218.2	544.8	0.069
Yes	216	3148.5	552.0	
Sought more than one maternity ward to give birth				
No	3,065	3220.2	532.3	0.059
Yes	397	3165.3	636.8	
Prematurity				
No	3,167	3288.6	448.0	0.000
Yes	283	2389.6	804.7	

of the Escola Nacional de Saúde Pública da Fundação Oswaldo Cruz. A written consent form that explained the objectives of the study and solicited written consent was given to each postpartum woman, or the legal guardian in the case of minors, included in the sample.

RESULTS

Among the women with lower levels of schooling, birth weight was lowest among adolescents, women 35 years and older where it was their first birth, women with three children or more, those who did not live with the father of the newborn, and those who smoked during pregnancy. Birth weight was also lower among women who reported inadequate prenatal care, history of premature birth, and those who reported going to more than one maternity ward before being seen. Aside from these variables, the premature birth of the newborn was also associated with lower birth weight. There was a gradual decrease in birth weight depending on skin color, with the newborns of white women representing the highest birth weights, the women reporting light brown skin color in an intermediate situation, and black women with the lowest values (Table 1)

Among women with greater schooling, only the following variables are significant: parity, previous and current premature birth, and the Kotelchuck index. The rest of the variables did not present statistically significant differences (Table 2).

Table 3 - Multiple linear regression analysis of newborn birth weight of mothers who did not complete high school.Rio de Janeiro, 1999-2001.

Variable	β	Confidence interval	
Maternal age	237.28	97.01	377.55
Quadratic term of maternal age	-208.49	-344.00	-72.99
Light brown skin color	-25.25	-54.39	3.90
Black skin color	-44.11	-77.96	-10.25
Parity	68.99	49.42	88.56
Quadratic term of parity	-6.19	-8.66	-3.72
Lives with father of baby	16.44	-14.18	47.07
Smoked during pregnancy	-141.46	-174.99	-107.93
Sought more than one maternity ward to give birth	-21.98	-48.04	4.07
Previous premature births	-143.86	-190.69	-97.03
Modified Kotelchuck index	52.24	20.94	83.54
Current gestational age	260.13	248.44	271.82

R^2=0.37

Table 4 - Multiple linear regression analysis of newborn birth weight of mothers who completed high school or beyond. Rio de Janeiro, 1999-2001.

Variable	β	Confidence interval	
Maternal age	195.36	-28.69	419.42
Quadratic term of maternal age	-175.97	-375.14	23.19
Light brown skin color	23.60	-16.12	63.33
Black skin color	-18.86	-69.64	31.92
Parity	92.17	59.40	124.95
Quadratic term of parity	-13.68	-24.21	-3.15
Lives with father of baby	43.50	-8.16	95.16
Smoked during pregnancy	-46.41	-116.49	23.67
Sought more than one maternity ward to give birth	-30.45	-79.55	18.65
Previous premature births	-78.46	-160.16	3.23
Modified Kotelchuck index	47.58	9.81	85.36
Current gestational age	321.65	304.44	338.86

R^2=0.37

Table 3 and Table 4 present the results of multiple linear regression for the women with low and high levels of schooling. For the first ones, black skin color, smoking during pregnancy and previous premature births were predictors of low birth weight. In terms of age and parity, the extreme values present distinct behavior from the central range of data, which is what motivated the use of Chi-square. The modified Kotelchuck index and gestational age were positively correlated with birth weight.

The variables associated with the birth weight of the postpartum women with higher levels of schooling (Table 4) were the modified Kotelchuck index, parity, and gestational age of the newborn.

DISCUSSION

The bivariate analysis shows that for nearly all of the variables analyzed, the average newborn birth weight was lower among women with less schooling. These women represent a social group not only with material disadvantages, but also in need of social support as shown by Leal et al[12] in 2004. In this group, the percentage of adolescent mothers, those who lived without partners, and reported being physically abused during pregnancy was higher.

The only indicators which showed increased birth weight among the group of women with less schooling were the Kotelchuck index in the category with more than adequate prenatal care and the premature birth of the current newborn.

In the multiple regression analysis among the group with less schooling, maternal age was selected as an explanatory variable of the newborn birth weight. Pregnant women 35 and older are recognized as a high risk group for pregnancy, due to the high percentage of low birth weight, premature births, and other unfavorable outcomes.[11] Even though this study has confirmed this, the inclusion of maternal age in the model is primarily due to the lower values of birth weight among the adolescents with less schooling. Various national studies have showed that adolescent pregnancy is higher among population groups living in worse/unfavorable social conditions, meaning, at times, that pregnancy has become an expected life path for young people with lower incomes.[12,13] There are conflicts within the literature regarding the association between birth weight and adolescent pregnancy. For some authors, adolescence is not a risk factor for low birth weight, although it does represent a social condition among this group of women that initiate their sexual life early. Nonetheless, the same relationship for adolescents of a better socioeconomic situation has not been verified,[14] as is presented in this study. Other authors agree that there is a real effect among very young adolescents, in the pronounced growth stage.[15] In these studies referred to above,[14,15] the grouping of adolescents in different socioeconomic classes does not permit a more refined analysis of the mother's age as a factor in the low birth weight. In this article, the majority of the pregnant adolescents were older than 15; 95.7% with less schooling and 100% of those with greater schooling.

The association between black skin color and low birth weight only among the group with less schooling provokes several reflections. The first is the reaffirmation of race as an expression of the health condition subordinate to the social conditions of the population. The second is to emphasize the force of its presence, which was strong enough to continue as an explanatory variable even among the group already stratified as being less schooling. The third aspect is that low birth weight may be a result of the social discrimination experienced by women with black skin color and less schooling. As such, its absence among women with greater schooling neutralizes the role of racial discrimination, as it alone was not sufficient to produce an effect on birth weight.

Leal et al[12] verified a persistent unfavorable situation among women with black skin color in relation to those who describe themselves as light brown and in relation to white women in terms of social conditions, healthy lifestyles and habits, and access to health care services during pregnancy and childbirth. In the group with greater schooling, the indicators improve, but the same pattern repeats itself in scale that contemplates level of schooling and the darkening of skin color.

In Pelotas, in Southern Brazil, Barros et al[2] in their analysis of a sample of newborns in a longitudinal study, found a higher prevalence of unfavorable indicators among children of blacks and those with light brown skin in relation to whites. In a logistic regression model adjusted for marital status, maternal age, parity, planned birth, social support, smoking, and prenatal care, it was observed that the statistical significance associated with parent's skin color and adverse results in the birth, such as low birth weight, premature birth, newborn small for its gestational age, fetal mortality, neonatal and infant prematurity disappeared.

Smoking is also recognized as a risk factor for low birth weight, as was found in this study. However in comparing the two linear regression models, the explanatory power attributed to smoking was greater among women with less schooling, the group with the highest prevalence of smokers.[12] In the current study, women with greater schooling stopped smoking with greater frequency during pregnancy than those with less schooling (58.4% compared to 33.8%), possibly benefiting from more available information regarding the detrimental effects of smoking on the fetus.

Parity, history of premature births, and gestational age also had differential affects on the explanation of birth weight between the two groups. In their study of the differences in fertility between neighborhoods in São Paulo, Martins & Almeida[14] showed that women who lived in areas with lower human development indicators had a larger average number of children and at younger ages. A history of premature births may also reflect lower access and/or lower quality prenatal care received in previous pregnancies by women in worse social conditions.[13]

Gestational age is a proximate determinate of newborn weight.[15] The greater explanatory power of this variable on birth weight among those women with higher levels of formal education is coherent with the findings of Monteiro et al[15] who analyzed the secular tendency of newborn weight in São Paulo during the period of 1976 to 1998. They verified an increase in the prevalence of prematurity among the group of women with greater schooling without being able to identify its cause. In the past few decades, an increase in premature births has been observed in developed countries,[3] without a perinatal epidemiological explanation. As such, this increase is considered one of the greatest current public health challenges, especially for countries with very low fertility rates.

The protective effects of prenatal care, evaluated by the modified Kotelchuck index, benefited all pregnant women, independent of their level of schooling. While the quality of prenatal care was not evaluated, the more adequate the woman's use of these services in terms of the number of visits and the period of her gestation, the greater the benefits.

The effectiveness of prenatal care in preventing low birth weight and premature birth is currently the topic of a big debate, especially in the USA where the reach and number of medical visits are very high.[9] It is important to note that in the city studied, adequate prenatal care operates as a protective factor among newborns, especially among women with less schooling. One of the possible explanations for the difference between the current results and those in the United States may be in the prevalence of low birth weight here, which is nearly two times that of the USA. It is possible that in the United States and other developed countries the reduction in low birth weight is due to the universal access to quality prenatal care in previous periods which decreased the occurrence of other factors related to low birth weight that are detected and prevented in prenatal medical visits. In Brazil, this stage has still not been carried out as it should be, which has not allowed the country to reach the level of other countries.

In conclusion, this study showed that the variables associated with newborn birth weight of mothers with greater schooling in the city of Rio de Janeiro were strictly biological, in contrast to the strong presence of social determinants found in the group with less schooling. The protective role of prenatal care, regardless of the educational level of the mother, and the negative effects of smoking, also stand out.

The limitations of this study include that due to its cross-sectional nature, it relied on data collected simultaneously regarding the weight of the baby and the variables available to explain this outcome. The self definition of skin color is subjective and influenced by the social inclusion of the respondents.

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