Infant mortality: comparison between two birth cohorts from Southeast and Northeast, Brazil

Mortalidade infantil: comparação entre duas coortes de nascimentos do Sudeste e Nordeste do Brasil

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Keywords
Infant mortality. Mortality rate. Neonatal mortality (public health). Post-neonatal mortality. Socioeconomic factors. Risk factors. Infant, low birth weight.

Abstract

Objective
To obtain population estimates and profile risk factors for infant mortality in two birth cohorts and compare them among cities of different regions in Brazil.
Methods
In Ribeirão Preto, southeast Brazil, infant mortality was determined in a third of hospital live births (2,846 singleton deliveries) in 1994. In São Luís, northeast Brazil, data were obtained using systematic sampling of births stratified by maternity unit (2,443 singleton deliveries) in 1997-1998. Mothers answered standardized questionnaires shortly after delivery and information on infant deaths was retrieved from hospitals, registries and the States Health Secretarys' Office. The relative risk (RR) was estimated by Poisson regression.
Results
In São Luís, the infant mortality rate was 26.6/1,000 live births, the neonatal mortality rate was 18.4/1,000 and the post-neonatal mortality rate was 8.2/1,000, all higher than those observed in Ribeirão Preto (16.9, 10.9 and 6.0 per 1,000, respectively). Adjusted analysis revealed that previous stillbirths (RR=3.67 *vs* 4.13) and maternal age <18 years (RR=2.62 *vs* 2.59) were risk factors for infant mortality in the two cities. Inadequate prenatal care (RR=2.00) and male sex (RR=1.79) were risk factors in São Luís only, and a dwelling with 5 or more residents was a protective factor (RR=0.53). In Ribeirão Preto, maternal smoking was associated with infant mortality (RR=2.64).
Conclusions
In addition to socioeconomic inequalities, differences in access to and quality of medical care between cities had an impact on infant mortality rates.

Descritores
Mortalidade infantil. Coeficiente de mortalidade. Mortalidade neonatal (saúde pública). Mortalidade pós-neonatal. Fatores socioeconômicos. Fatores de risco. Recém-nascido de baixo peso.

Resumo

Objetivo
Obter estimativas populacionais e fatores de risco de mortalidade infantil em coortes de nascimentos e comparar esses fatores entre cidades de diferentes regiões do País.
Métodos
Em Ribeirão Preto, SP, a mortalidade infantil foi avaliada em 1/3 dos nascidos vivos hospitalares (2.846 partos únicos) em 1994. Em São Luís, MA, foi feita amostragem

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sistemática de partos estratificada por maternidade (2.443 partos únicos) em 1997/98. As mães responderam a questionários padronizados logo após o parto e as informações sobre os óbitos foram coletadas nos hospitais, nos cartórios e nas secretarias estaduais de saúde. Risco relativo (RR) e intervalo de confiança de 95% foram estimados pela regressão de Poisson.

Resultados

O coeficiente de mortalidade infantil (CMI) em São Luís foi 26,6/1.000 nascidos vivos, o coeficiente de mortalidade neonata (CMN)l 18,4/1.000 e o coeficiente de mortalidade pós-neonatal (CMPN) 8,2/1.000, valores superiores aos de Ribeirão Preto, com CMI 16,9/1.000, CMN 10,9/1.000,CMPN 6,0/1.000. Na análise ajustada, nas duas cidades, natimorto prévio (RR=3,67 vs *4,13) e idade materna <18 anos (RR=2,62* vs *2,59) foram fatores de risco para a mortalidade infantil. Apenas em São Luís, o pré-natal inadequado (RR=2,00) e o sexo masculino (RR=1,79) foram fatores de risco, e domicílios com 5 ou mais moradores foram fatores protetores (RR=0,53). Em Ribeirão Preto, o hábito materno de fumar foi associado à mortalidade infantil (RR=2,64).*

Conclusões

Além de desigualdades socioeconômicas, diferenças no acesso e na qualidade da atenção médica entre as cidades influenciaram as taxas de mortalidade infantil.

INTRODUCTION

In some Brazilian cities, infant mortality rates (IMR) remain higher than national and regional averages, and their decline has been slower than in other cities. In São Luís, a city of northeast Brazil, the only previous study on infant mortality carried out using secondary data showed an IMR ranging from 33.7 to 38.8 per 1,000 live births, while neonatal mortality rates (NMR) ranged from 10.4 to 28.2 per 1,000 live births between 1979 and 1996.[13] A 1997-1998 population study indicated some factors that may contribute to infant mortality such as poor quality of prenatal care, inadequate newborn care and high prevalence of teenage pregnancies.[1,5]

In Ribeirão Preto, a city of southeast Brazil, a declining trend in IMR (from 18.7 to 14.8 per 1,000 live births) and NMR (from 12.2 to 10.6 per 1,000 live births) was observed between 1994 and 1998, showing an inverse relationship with the distribution of low wages.[4] However, an increase in some risk factors for infant mortality was observed during this period, such as adolescent pregnancy (17.5%), delivery by cesarean section (50.2%), and low birth weight (LBW) (10%), among others.[2,3]

The purpose of the present study was to obtain population estimates of infant mortality and to profile related risk factors in a birth cohort studied in São Luís during 1997-98[15] and to compare these data to a perinatal investigation carried out in Ribeirão Preto in 1994 using similar methodology.[3] The aim was to determine whether different risk factors were associated with infant mortality in cities located in different regions of Brazil.

METHODS

São Luís, located in the northeast of Brazil, is the capital of the state of Maranhão and one of the poorest regions in the country. It situated on an island along the north coast of the state close to the equator. Its population comprises 906,567 inhabitants according to the 2000 census. Only 50% of the residences are connected to a sewage network and only about 75% has a piped water system. Its economic activity is associated with the aluminum and steel industry, exported from the Serra de Carajás, and exportation of soy production, in addition to commerce and services.[7] There were 15 maternity hospitals in São Luís in 1997.

Ribeirão Preto, located in the northeastern region of the state of São Paulo, the richest one in the country, has 520,501 inhabitants and is one of the most developed cities in Brazil, where 99% of the residences have a piped water system and sanitary facilities. It has one of the highest per capita income in the country. Its main economic activity is sugar cane agricultural industry, in addition to commerce and services.[7] The city is also a regional university center. In 1994, there were 10 maternity hospitals in Ribeirão Preto.

In São Luís, a longitudinal cohort study was carried out, and data were obtained by systematic sampling of births stratified by maternity hospital with the share being proportional to the number of deliveries occurring at each unit. For each hospital and maternity unit, a random beginning from one to seven was selected by drawing lots. By summing up the random beginning to the interval value (seven) and so forth, all research units were obtained. The sampling process took place over a one-year period

(March 1997 to February 1998). When the population size was divided by the sample size, the sampling interval was eight. By working with an interval of eight, the sample size was 2,511 births. Bearing in mind the losses during the study, it was opted to work with an interval of seven, which yielded a sample size of 2,870 births. After the sampling was completed, there were 2,981 births. But there was a 4.8% loss due to mother's refusal to be interviewed or early discharge, remaining 2,831 births in the sample. Considering only residents in the municipality and singletons, the final study sample comprised of 2,443 liveborns.

Hospital births represented 96.3% (95% CI: 94.1-98.6) of all births in 1996, which guaranteed the sample's representativeness. The study was conducted at 10 maternities consisting of public and private centers and institutions covered by the Brazilian Unified Health System (Sistema Único de Saúde - SUS). The maternities that had less than 100 deliveries in 1996 were excluded from the study, corresponding to only 2.2% of the deliveries for the year. Thus, the study included a 94% sample of all births that occurred in the municipality during the study period.

Neonatal and post-neonatal deaths observed in the birth cohort were checked at hospitals, registries and at the State Health Secretary's Office. After identification, the death certificate was copied and hospital records were located and analyzed. The instrument used was a questionnaire adapted from the Inter-American Investigation of Mortality in Childhood.[12]

Data for Ribeirão Preto were collected from hospital records of all births that occurred during a consecutive period of four months (a third of all annual births) from May to August 1994. This sampling was based on a previous study which did not show seasonality in births along the year or in the variables studied (e.g., low birth weight, preterm birth, maternal age at delivery and twinning).[3] A total of 3,850 births was recorded. The total number of births in 1994 was 10,963 as confirmed by the Information System on Live Births of the Ministry of Health. Excluding losses (3.2%) and considering only live singleton births from families living in the municipality, the sample consisted of 2,843 births.

Some procedures were applied to both samples. For São Luís subjects, gestational age was calculated based on the date of the last normal menstrual period reported by the mother, and day 15 was adopted for those cases in which the mother only recalled the month. Birth weights incompatible with gestational age (above the 99th percentile of the English curve[1]) or with an unlikely gestational age (less than 22 and more than 50 weeks) were reclassified as unknown. A multiple imputation process[14] was followed for all cases with unknown gestational age using a multiple linear regression model, including birth weight, parity, sex, and family income as predictor variables. Newborns with a gestational age of less than 37 weeks were classified as preterm. Newborns with a weight below the 10th percentile of Williams' curve[18] were considered to be small for gestational age. Adequate prenatal care was determined using a new index created on the basis of the minimum number of visits recommended by the Ministry of Health and adjusted to the pregnancy duration. Prenatal care was considered to be adequate when initiated up to the fourth month and when the pregnant woman attended at least six visits in the case of term pregnancy, or a smaller number of visits according to gestational age.[15]

A standardized questionnaire was used with small differences between cities. The methodology was basically the same and has been described in detail elsewhere.[3,15]

IMR and neonatal and post-neonatal components were then calculated. Since it is a rare event, a 95% confidence interval of infant mortality was also estimated assuming a Poisson distribution.[19] Indeed, when working with a cohort, the measure obtained is the probability of death of infants younger than one year and not necessarily the infant mortality rate, which is an estimate of the probability of death.

The relative risk (RR) was estimated by Poisson regression using models adjusted or not to the other variables. Birth weight and gestational age were excluded from the adjusted analysis since they were intervening variables and did not fulfill the criteria defining confounding factors. Risk factors for infant mortality were identified based on a yes/no answer to the occurrence of infant death. Variables presenting a p-value below 0.20 entered the adjusted analysis and those with a p-value below 0.10 remained in the model. The data were analyzed using the Stata software. The Chi-square test was used to compare proportions.

RESULTS

The IMR observed in São Luís was higher than that observed in Ribeirão Preto (26.6 *vs* 16.9 per thousand) as well as the NMR (18.4 *vs* 10.9 per thousand). However, although the PNMR was higher in São Luís (8.2 per thousand) than in Ribeirão Preto (6.0 per thousand), it did not differ significantly between cities. The prevalence of LBW was lower in São Luís than in Ribeirão Preto (7.5% *vs* 10.7%), the prevalence of preterm birth (PTB) was identical in the two cities (12.6%), and the prevalence of small-for-gestational-age (SGA) infants was higher in São Luís (12.8% *vs* 14.2%).

Table 1 - Infant mortality rates according to period, birth weight, preterm birth and small-for-gestational-age status among singleton hospital births in São Luís, MA (1997/1998) and Ribeirão Preto, SP (1994).

Variable	São Luís			Ribeirão Preto					
	Liveborns (N=2,443)	Deaths	IMR	Liveborns (N=2,846)	Deaths	IMR	RR	95% CI*	p**
Period									
Infant		65	26.6		48	16.9	1.58	1.09-2.29	0.015
Neonatal		45	18.4		31	10.9	1.69	1.07-2.67	0.022
Post-neonatal		20	8.2		17	6.0	1.37	0.72-2.62	0.336
Birth weight									
<1,500 g	26	18	692.3	36	16	444.4	1.56	0.79-3.05	0.053
1,500-2,499 g	160	12	75.0	267	12	44.9	1.67	0.75-3.71	0.192
≥2,500 g	2,253	34	15.1	2,536	19	7.5	2.01	1.15-3.53	0.012
Not known	4	1		7	1				
Preterm birth									
Yes	307	31	101	359	26	72.4	1.39	0.83-2.35	0.189
No	2,136	34	15.9	2,487	22	8.8	1.79	1.05-3.08	0.028
SGA									
Yes	347	19	54.8	364	16	44.0	1.24	0.64-2.42	0.506
No	2,092	45	21.5	2,475	31	12.5	1.72	1.09-2.71	0.018
Not known	4	1		7	1				

*95% confidence interval for relative risk assuming that infant mortality is a rare event that follows Poisson distribution
**p-value calculated by Chi-square test comparing infant mortality rates for each category of each variable between São Luís and Ribeirão Preto
IMR: Infant mortality rates expressed as 1,000 live births
RR: Relative risk
SGA: Small-for-gestational-age

As for birth weight, the IMR in São Luís was double than that observed in Ribeirão Preto among infants weighing ≥2,500 g (15.1 *vs* 7.5 per thousand) and higher among very low birth weight (VLBW) infants (692.3 *vs* 444.4), a marginally significant difference. Similarly, a higher IMR was seen in São Luís among term newborns (15.9 *vs* 8.8 per thousand) and among newborns not considered SGA (21.5 *vs* 12.5 per thousand) (Table 1).

Non-adjusted analysis revealed a higher risk of death in Ribeirão Preto for small-for-gestational-age infants (RR=3.51 *vs* 2.55), preterm infants (RR=8.19 *vs* 6.34), low birth weight infants (RR=12.33 *vs* 10.69), and mothers with previous stillbirths (RR=5.62 *vs* 3.76). In contrast, the category of public hospital admissions showed a higher risk in São Luís than in Ribeirão Preto (3.90 *vs* 1.99). Inadequate prenatal care, living with a partner and mothers with no partner were risk factors for infant mortality in São Luís only. Also, infants from families with five or more residents in the same dwelling showed a lower risk of death in São Luís only (RR=0.60). On the other hand, maternal smoking was associated with the risk of infant death in Ribeirão Preto only (RR=2.62) (Table 2).

In the adjusted model, the following variables were associated with infant mortality risk in São Luís and Ribeirão Preto, respectively: previous stillbirths (RR=3.67 *vs* 4.13) and maternal age <18 years (RR= 2.62 *vs* 2.59). Inadequate prenatal care and male sex were risk factors for infant mortality in São Luís only, and living in a dwelling with five or more persons remained a protective factor against infant mortality (RR=0.53). In Ribeirão Preto, maternal smoking was also independently associated with higher risk of infant death (Table 3). Among smoking mothers whose children died, most (58.8%) of the deaths occurred during the post-neonatal period.

DISCUSSION

The infant mortality observed in São Luís in 1997-98 was higher than that of Ribeirão Preto in 1994, especially regarding the neonatal component and the deaths among newborns weighing 2,500 g or more, who were not preterm or small for gestational age. In São Luís the highest risk for infant mortality was associated with "male sex," "inadequate prenatal care," "obstetrical stillborn history," and "adolescent mothers". However, "families with more than five members" was a protective factor against infant mortality. In Ribeirão Preto, only "obstetrical stillborn history," "maternal smoking," and "adolescent mothers" were associated with a higher risk of infant death.

Among the limitations of the present study is the small number of deaths in the cohorts, which reduced the precision of some estimates. Since this was a population study, clinical data were not evaluated.

Comparison of the infant mortality rates between settings may not reflect the reality with accuracy. Differences in the practice of registering infants close to viability and/or the classification used to distinguish stillborns from liveborns may hamper such comparisons. This was observed when indicators for developed countries were compared after removing infants with birth weights below 750 g from the analysis, with less divergent mortality rates being obtained.[8]

The IMR observed in São Luís was 58% higher than that observed in Ribeirão Preto (p=0.015). More recent

data from Ribeirão Preto (1998) indicate an even lower rate (14.8 per thousand).[3,4] In São Luís, using secondary data, an IMR of 38.9 per thousand was observed in the year 1996.[13] This emphasizes the importance of population studies in locations where official sources are not reliable, especially due to under-notification of deaths and births. Population studies carried out in the 1990s showed much lower IMR in southern cities such as Pelotas (21.1 per thousand) and Porto Alegre (12.2 per thousand), i.e. rates closer to those seen in Ribeirão Preto.[5,11]

The NMR for São Luís was exactly the same as that observed in 1991,[13] and about 70% higher than that observed in Ribeirão Preto (p=0.022), showing that this indicator is stationary in São Luís. Despite the better performance of Ribeirão Preto, a deceleration in the decline of this indicator has been reported along the 1990's, as also observed in other Brazilian cities, associated with increasing LBW rates.[2,5,11]

Preterm birth, LBW and SGA are strongly associated with infant mortality in developing countries.[5,9] It is worth emphasizing the occurrence of a higher prevalence of LBW in Ribeirão Preto (10.7%) than in São Luís (7.6%), apparently an epidemiological paradox. Previous studies have related this finding to a

Table 2 - Non-adjusted analysis of factors associated with infant mortality in São Luís (1997/1998) and Ribeirão Preto (1994).

Variable	São Luís (N=2,443) N	IMR	RR	95% CI*	p	Ribeirão Preto (N=2,846) N	IMR	RR	95% CI	p
Weight/gestational age ratio					0.002					<0.001
AGA	2,092	21.5	1			2,475	12.5	1		
SGA	347	54.8	2.55	(1.49-4.35)		364	44.0	3.51	(1.92-6.42)	
Term birth					<0.001					<0.001
No	2,136	15.9	1			2,487	8.8	1		
Yes	307	101.0	6.34	(3.90-10.32)		359	72.4	8.19	(4.64-14.44)	
Low birth weight					<0.001					<0.001
No	2,253	15.1	1			2,536	7.5	1		
Yes	186	161.3	10.69	(6.54-17.46)		303	92.4	12.33	(6.89-22.09)	
Sex					0.062					0.185
Female	1,105	19.9	1			1,397	13.6	1		
Male	1,338	32.1	1.61	(0.97-2.70)		1,448	20.0	1.47	(0.83-2.63)	
Maternal schooling					0.313					0.161
≥9 years	981	21.4	1			980	12.2	1		
5 to 8 years	1,036	28.0	1.31	(0.75-2.29)		1,041	17.3	1.41	(0.68-2.93)	
≤4 years	420	35.7	1.67	(0.86-3.24)		633	25.3	2.06	(0.98-4.36)	
Family income (minimum wage)					0.183					0.491
More than 3	772	18.1	1			1,181	11.9	1		
1 to 3	718	26.5	1.46	(0.73-2.91)		595	16.8	1.42	(0.63-3.19)	
Up to 1	790	32.9	1.81	(0.95-3.48)		238	21.0	1.77	(0.64-4.92)	
Marital status					0.014					0.055
Married	704	12.8	1			1,679	13.1	1		
Living with a partner	1,146	34.0	2.66	(1.29-5.50)		702	21.4	1.63	(0.85-3.14)	
No partner	592	28.7	2.25	(1.00-5.04)		347	31.7	2.42	(1.17-4.99)	
Maternal age					0.012					0.166
18 to 34 years	2,019	23.3	1			2,357	14.8	1		
≥35 years	102	9.8	0.42	(0.06-3.05)		271	22.1	1.49	(0.63-3.54)	
<18 years	320	53.1	2.28	(1.31-3.97)		211	33.2	2.23	(0.99-5.03)	
Maternal smoking					0.296					0.002
No	2,298	25.7	1			2,156	13.0	1		
Yes	145	41.4	1.61	(0.70-3.73)		588	34.0	2.62	(1.48-4.65)	
Parity					0.779					0.136
2 to 4	1,148	25.3	1			1,496	18.0	1		
1	1,190	28.6	1.13	(0.69-1.86)		1,156	13.0	0.72	(0.38-1.35)	
≥5	105	19.0	0.75	(0.18-3.16)		166	36.1	2.00	(0.83-4.85)	
Adequacy of prenatal care					0.018					0.098
Adequate	1,254	17.5	1			1,839	13.1	1		
Intermediate	374	37.4	2.13	(1.09-4.17)		307	19.5	1.50	(0.61-3.66)	
Inadequate	815	35.6	2.03	(1.17-3.53)		700	25.7	1.97	(1.07-3.63)	
Category of hospitalization					0.017					0.035
Private	269	7.4	1			1,003	11.0	1		
Public	2,174	29.0	3.90	(0.95-15.93)		1,699	21.8	1.99	(1.01-3.89)	
Type of delivery					0.984					0.118
Vaginal	1,619	26.6	1			1,399	20.7	1		
Cesarean section	824	26.7	1.01	(0.60-1.68)		1,447	13.1	0.63	(0.36-1.13)	
History of stillbirths					0.005					0.001
No	2,367	24.5	1			2,756	15.2	1		
Yes	76	92.1	3.76	(1.72-8.23)		70	85.7	5.62	(2.39-13.23)	
Mother working outside the home					0.125					0.217
No	1,836	29.4	1			1,709	19.9	1		
Yes	606	18.2	0.62	(0.32-1.18)		1,032	13.6	0.68	(0.37-1.27)	
Number of residents in the dwelling					0.037					0.635
1 to 4	965	35.2	1			1,906	16.8	1		
≥5	1,477	21.0	0.60	(0.37-0.97)		823	19.4	1.16	(0.64-2.11)	

*95% confidence interval for relative risk
AGA: Adequate for gestational age
Total values sometimes differ due to missing data

Table 3 - Adjusted analysis of factors associated with infant mortality in São Luís (1997/1998) and Ribeirão Preto (1994).

Variable	São Luís (N=2,277) RR*	95% CI	P	Ribeirão Preto (N=2,476) RR	95% CI	p
Sex		0.037				
Female	1					
Male	1.79	1.04-3.10				
Adequacy of prenatal care according to the Ministry of Health's recommendations			0.044			
Adequate	1					
Intermediate	1.95	0.97-3.91				
Inadequate	2.00	1.11-3.58				
Number of residents in the dwelling		0.016				
1 to 4	1					
≥5	0.53	0.32-0.89				
Maternal smoking						0.001
No				1		
Yes				2.64	1.46-4.76	
History of stillbirths			0.006			0.003
No	1			1		
Yes	3.67	1.45-9.33		4.13	1.61-10.60	
Maternal age			0.003			0.068
18 to 34 years	1			1		
≥35 years	0.49	0.07-3.57		1.44	0.60-3.45	
<18 years	2.62	1.46-4.70		2.59	1.14-5.87	

*Adjusted relative risk (RR) and respective 95% confidence interval (95% CI) obtained by Poisson regression. Non-significant estimates from variables dropped from the models are not shown in the table.

higher prevalence of cesarean delivery in Ribeirão Preto (50.8% *vs* 33.7%), maternal smoking (21.4% *vs* 5.9%) and better perinatal care in Ribeirão Preto.[2,15,16]

However, the IMR for São Luís was also higher among infants with birth weight of 2,500 g or more (p=0.012), and among non-PTB (p=0.028) and non-SGA (p=0.018) infants, demonstrating problems in the quality of care and/or difficulties in access to health services in this city.

The lower relative risk of infant mortality in São Luís associated with LBW, PTB and SGA was in contrast to the lower mortality in Ribeirão Preto. In other words, the richer city (Ribeirão Preto) has lower mortality rates associated with a higher prevalence of LBW and with high risk of infant mortality among LBW, PTB and SGA infants. This dissociation can be explained in part by better identifying fetal distress and lower mean birth weight among PTB (2,430 g *vs* 2,691 g; p<0.001) and SGA (2,424 g *vs* 2,544 g; p<0.001) infants in Ribeirão Preto. It is likely that, in São Luís, fewer "small preterm babies with fetal distress" are rescued alive from the mother's uterus, than in Ribeirão Preto. However, even with the availability of better neonatal care in Ribeirão Preto, some of these newborns do not survive because they are lower weight and consequently more fragile and more susceptible to death than preterm and SGA in São Luís.

Low rescue of fetuses with fetal distress from the mother's uterus in São Luís contributes to the higher prevalence of stillborns there (19.1 per thousand in 1997/98) than in Ribeirão Preto (9.6 per thousand in 1994). In addition, the number of LBW liveborns might have been underestimated in São Luís, especially regarding those of lower social status, as observed in a previous study,[10] explaining in part the lower prevalence of low birth weight in São Luís. In addition, a frequent mistake in São Luís is to consider as stillborn infants that were born live but died a few minutes later. In any case, these facts emphasize the differences in access to and quality of perinatal care in the cities under study.

These differences may also be explained by the fact that the IMR was lower in private hospitals in São Luís than in Ribeirão Preto, suggesting a greater selectivity of patients in private hospitals in São Luís, which may result in a lower IMR.

Maternal smoking was found to be a risk factor for infant mortality only in Ribeirão Preto, coinciding with the higher prevalence of this habit in this city,[2,5] and being especially associated with post-neonatal mortality (p<0.001). This association, which has also been observed in developed countries such as Sweden,[6] reveals the harmful effects of maternal smoking and supports the importance of effective programs for the reduction of smoking during pregnancy as a way of reducing infant mortality.

Maternal age of less than 18 years was a risk factor for infant mortality in both cities. In São Luís, during 1997-98, the prevalence of adolescence pregnancy was 29.9%,[15] whereas in Ribeirão Preto, in 1994, it was 17.5%.[3] Despite the efficacy of programs of planned pregnancy control during adolescence, the number of specialized services in the country is small, representing a great challenge for public policy.

Inadequate prenatal care was a risk factor only in São Luís, coinciding with the low coverage provided

in this city in 1997-98 (65% of pregnant women attending five or more visits), with 9.3% of all pregnant women receiving no care during pregnancy.[16] It was also showed that in São Luís inadequate prenatal care is related, among other factors, to the care provided by public services,[16] again showing greater selectivity of patients at local private hospitals.

On the other hand, surprisingly in São Luís the category "families with more than five members" was found to be a protective factor against infant mortality. In this case, the assumption is that in large families, there may be more people available to take care of the children or that the mothers themselves have more experience with maternal care. On this basis, in some situations, small families are not necessarily related to better conditions for infant survival in economically less privileged populations.

The difference in the coefficients of mortality between São Luís and Ribeirão Preto could be attributed, in principle, mainly to socioeconomic conditions. The difference in infant mortality between different social strata is known, even within the same city, as already verified in Ribeirão Preto[4] and Salvador,[17] among other cities. However, since family income and maternal schooling had no relevance in the non-adjusted analysis, it can be concluded that differences in access to and in the quality of medical care between cities, rather than socioeconomic inequalities, affected most infant mortality rates. Specific actions are needed in order to improve the quality of prenatal and newborn care with early identification of risk pregnancies. Thus, the universal access to health services and the regional availability and qualification of care prove to be effective interventions for the reduction of differences in infant mortality in Brazil.

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