Infant mortality rates according to socioeconomic status in a Brazilian city*

Mortalidade infantil e nível socioeconômico em uma cidade brasileira

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Keywords
Infant mortality.# Mortality rate.# Social inequality.# Neonatal mortality (public health).# Post-neonatal mortality.# Socioeconomic factors. Residence characteristics. Information system. Family income. Poverty areas.

Abstract

Objective
Data from municipal databases can be used to plan interventions aimed at reducing inequities in health care. The objective of the study was to determine the distribution of infant mortality according to an urban geoeconomic classification using routinely collected municipal data.
Methods
All live births (total of 42,381) and infant deaths (total of 731) that occurred between 1994 and 1998 in Ribeirão Preto, Brazil, were considered. Four different geoeconomic areas were defined according to the family head's income in each administrative urban zone.
Results
The trends for infant mortality rate and its different components, neonatal mortality rate and post-neonatal mortality rate, decreased in Ribeirão Preto from 1994 to 1998 (chi-square for trend, $p<0.05$). These rates were inversely correlated with the distribution of lower salaries in the geoeconomic areas (less than 5 minimum wages per family head), in particular the post-neonatal mortality rate (chi-square for trend, $p<0.05$). Finally, the poor area showed a steady increase in excess infant mortality.
Conclusions
The results indicate that infant mortality rates are associated with social inequality and can be monitored using municipal databases. The findings also suggest an increase in the impact of social inequality on infant health in Ribeirão Preto, especially in the poor area. The monitoring of health inequalities using municipal databases may be an increasingly more useful tool given the continuous decentralization of health management at the municipal level in Brazil.

Descritores
Mortalidade infantil.# Coeficiente de mortalidade.# Iniqüidade social.# Mortalidade neonatal (saúde pública). Mortalidade pós-neonatal.# Fatores socioeconômicos. Distribuição espacial. Sistemas de informação. Renda familiar. Áreas de pobreza.

Resumo

Objetivo
Informações de bancos de dados municipais podem ser usadas para o planejamento de investigações que visem reduzir as desigualdades no cuidado à saúde. O objetivo do estudo foi determinar a distribuição da mortalidade infantil, segundo uma classificação geoeconômica urbana, usando dados coletados rotineiramente em nível municipal.

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*The work carried out in the "Departamento de Puericultura e Pediatria da Faculdade de Medicina de Ribeirão Preto, SP, Brasil".
The publication of this article was subsidied by Fapesp (Process n. 01/01661-3).
Submitted on 4/9/1999. Reviewed on 14/3/2001. Approved on 6/4/2001.

Métodos

Todos os nascidos vivos (42.381 crianças) e todos os óbitos de menores de um ano de idade (731 casos), ocorridos no período entre 1994 e 1998 em Ribeirão Preto, SP, foram considerados para este estudo. Quatro diferentes áreas geoeconômicas foram definidas de acordo com a renda do chefe de família em cada zona administrativa urbana.

Resultados

As taxas de mortalidade infantil e de seus componentes neonatal e pós-neonatal, entre 1994 e 1998, apresentaram queda em Ribeirão Preto (χ^2 para tendência, $p<0,05$). Essas taxas relacionaram-se inversamente à distribuição de baixos salários (menor do que cinco salários-mínimos por chefe de família) nas diversas regiões urbanas (χ^2 para tendência, $p<0,05$). A área mais pobre da cidade apresentou contínuo acréscimo de excesso de mortalidade infantil nesse período.

Conclusões

Os resultados demonstram que as áreas pobres da cidade de Ribeirão Preto apresentam taxas de mortalidade infantil mais elevadas quando comparadas com áreas mais privilegiadas. O nível de desigualdade social urbana, representado pela distribuição do salário do chefe de família, apontou piora contínua da saúde das crianças residentes na área pobre da cidade em detrimento às outras áreas. O monitoramento das desigualdades em saúde, por meio de dados de sistemas municipais de informação, pode ser progressivamente útil, dada a contínua descentralização do gerenciamento da saúde para o nível municipal no Brasil.

INTRODUCTION

Vital statistics have been used to identify and monitor patterns of disease distribution in order to plan support interventions aiming at preventing and reducing social and health inequalities.

Despite a steady decrease in infant mortality rates in Brazil from 52.02/1,000 in 1989 to 35.57/1,000 in 1998,[5] high infant mortality rates have been related to less privileged socioeconomic conditions in many regions of the country.[2,11,17,18]

A significant improvement in the quality of vital data collection has occurred in Brazil over the last 30 years.[9,14] Information about births and deaths has been collected regularly at the municipal level since the early 90s using two distinct database systems, i.e., SICAEV (Sistema de Coleta de Estatísticas Vitais – Vital Statistics Collection System)[12] and SINASC (Sistema de Informação sobre Nascidos-Vivos – Live Births Database System).[4] In theory, local policy makers have been able to intervene in areas at risk, but instead these data have not been fully analyzed and ther use in defining the scale of health inequality is still unexplored.

The aim of the study was to analyze the distribution of infant mortality according to geoeconomic features in the city of Ribeirão Preto using the vital municipal statistics routinely available to evaluate the impact of social inequality on infant outcome and to identify urban areas at risk.

METHODS

A temporal study was carried out in the city of Ribeirão Preto. With 457,037 inhabitants, it's located in one of the economically richest regions of South America. Though the infant mortality rate decreased from 36/1,000 to 18/1,000[7] between 1978 and 1994, differences are likely to occur within this overall figure.

All live births and deaths in the same group of children during their first year of life were studied in 1994, 1995, 1996, 1997 and 1998. The number of deaths was obtained from SICAEV, where all deaths in the city are registered.[4] Through a systematic collection of the death certificates from all 4 registration offices, this database provides the annual number of deaths in different areas of the city. Death reporting in the state of São Paulo follows the international-based federal directives.

The numbers of live births and addresses of the mothers were obtained from SINASC, a database based on birth certificates obtained from all maternity hospitals in the city.[12] This database service was started in 1993 and provides information about hospital deliveries, which it is estimated to correspond to 99% of all deliveries. Death and live-birth rates were analyzed independently since there was no link between the two systems.

Complete information about family address in the urban area of Ribeirão Preto was included in both databases, so that each family in each administrative

Rev Saúde Pública 2001;35(3):256-61
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urban area could be located. Administrative urban areas consist of a conglomerate of census areas set by the Instituto Brasileiro de Geografia e Estatística (IBGE – Brazilian Statistics Institute),[6] disregarding any district division. Records without addresses were not included in the analysis, with the consequent exclusion of 211 live births records and 11 death records from the period 1994 to 1998.

Following a urban classification based on economic status, four geographic groups were created using the family head's income (in minimum wages) as a parameter. An income of less than 5 minimum wages per month (about 360 dollars) was used as an arbitrary cut-off value. The proportion of family heads with the cut-off monthly salary was determined in each administrative area according to the Brazilian National Census Data (1991).[6]

A geographic area was categorized as "poor" when more than 75% of the family heads earned a salary of 5 minimum wages per month or less; as "medium poor" when 75% to more than 50% of family heads earned this salary; as "medium rich" when 50% to more than 25% family heads earned this salary; and "rich" when 25% or less did so.

Infant mortality rate and its components, neonatal mortality rate and post-neonatal mortality rate, were determined in each geoeconomic area from 1994 to 1998. The chi-square for trend was calculated to indicate trends in rates according to geoeconomic areas and years.

In order to discriminate the trend of demographic inequalities between the different geoeconomic areas during this period of time the excess of infant mortality rate per geoeconomic area was calculated using the following formula: observed number of infant deaths – expected number of infant deaths/total number of live births per year in each area. The expected number of infant deaths in each area was obtained by applying the formula: (annual infant mortality rate in the city x number of live births in each area)/1,000.

RESULTS

Of the 50 administrative areas included in the geoeconomic classification, 20 were considered poor, 14 medium poor, 9 medium rich and only 7 rich. Most of the city consisted of poor and medium poor areas (Figure 1).

Overall, 42,381 live births and 731 infant deaths were identified from municipal databases between 1994 and 1998.

The largest number of live births and deaths occurred in poor and medium poor areas and this trend remained similar during the five years of the study. Proportionally, neonatal deaths predominated in all areas, although post-neonatal deaths were more frequently seen in poor areas (Table 1).

There was a clear trend towards a reduction in infant mortality in general and in its post-neonatal component in Ribeirão Preto from 1994 to 1998, while the neonatal component remained stable (Table 2).

Total infant mortality rate and its components were negatively related to the geoeconomic classification, with the poor section showing the highest rates and the rich section the lowest (Table 3). The post-

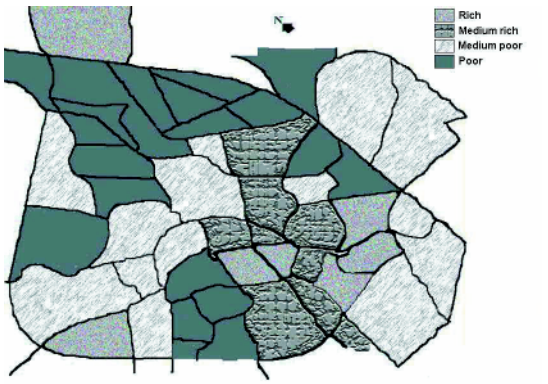

Figure 1 - The distribution of geoeconomic areas in Ribeirão Preto, Brazil, according to the income of the head of the family.

Table 1 - Neonatal deaths, post-neonatal deaths and live births from 1994 to 1998 according to geoeconomic area in Ribeirão Preto, SP, Brazil.

Year	Poor			Medium poor			Medium rich			Rich			Total		
	ND	PND	LB	ND	PND	LB	ND	PND	LB	ND	PND	LB	ND	PND	LB
1994	59	37	4,588	34	17	2,783	11	2	1,018	1	0	201	105	56	8,590
1995	58	35	4,143	38	12	2,650	9	6	1,111	2	0	172	107	53	8,076
1996	53	32	4,600	29	10	2,583	9	1	1,243	1	1	150	92	44	8,576
1997	58	27	4,749	27	16	2,780	10	8	1,062	4	0	169	99	51	8,760
1998	59	22	4,515	23	9	2,676	6	4	964	1	0	224	89	35	8,379
Total	287	153	22,595	151	64	13,472	45	21	5,398	9	1	916	492	239	42,432

ND: Neonatal deaths PND: Post-neonatal deaths LB: Live-births

Table 2 - Infant mortality rate, neonatal mortality rate and post-neonatal mortality rate from 1994 to 1998 according to geoeconomic area in Ribeirão Preto, SP, Brazil.

Year	Poor			Medium poor			Medium rich			Rich			Total		
	NMR	PNMR	IMR	NMR	PNMR	IMR	NMR	PNMR	IMR	NMR	PNMR	IMR	NMR	PNMR	IMR
1994	12.85	8.06	20.91	12.21	6.10	18.31	10.80	1.96	12.76	4.94	-	4.94	12.22	6.51	18.73
1995	13.99	8.44	22.43	14.33	4.52	18.85	8.10	5.40	13.50	11.62	-	11.62	13.24	6.56	19.80
1996	11.52	6.95	18.47	11.22	3.87	15.09	7.24	0.80	8.04	6.66	6.66	13.33	10.72	5.13	15.85
1997	12.21	5.68	17.89	9.71	5.75	15.46	9.41	7.53	16.94	23.66	-	23.66	11.30	5.82	17.12
1998	13.06	4.87	17.94	8.59	3.36	11.95	6.22	4.14	10.36	4.46	-	4.46	10.62	4.17	14.79
χ^2 for trend*	>0,05	<0,05	>0,05	>0,05	>0,05	<0,05	>0,05	>0,05	>0,05	>0,05	-	>0,05	>0,05	<0,05	<0,05

IMR: infant mortality rate; NMR: neonatal mortality rate; PNMR: post-neonatal mortality rate
*P value

Table 3 - Trend in infant mortality according to geoeconomic distribution, considering the total number of deaths and live births in 5 years in Ribeirão Preto, SP, Brazil.

Geoeconomic area	NM	95% CI	PN	95% CI	IM	95% CI
Poor	12.70	(11.28-14.24)	6.77	(5.74-7.92)	19.47	(17.71-21.36)
Medium poor	11.20	(9.44-13.13)	4.75	(3.66-6.06)	15.95	(13.91-18.21)
Medium rich	8.33	(6.07-11.13)	3.89	(2.40-5.94)	12.22	(9.46-15.52)
Rich	9.82	(4.5-18.56)	1.09	(0.02-6.00)	10.91	(5.24-19.98)
χ^2 for trend*	<0,05	-	<0,001	-	<0,001	-

NM: neonatal mortality; PN: post-neonatal mortality; IM: infant mortality;
*P Value

neonatal death rate showed the highest decline.

In terms of social inequality and its impact on infant outcome in the 4 different geoeconomic areas, only the poor area showed an excess of infant mortality rate throughout the study period, which tended to increase over time. This is true except for 1997, when a high number of deaths in the rich area were observed, with the overall excess of Infant mortality tending to null. Only the medium poor area showed a steady trend to a decrease in excess infant mortality throughout the period (Figure 2).

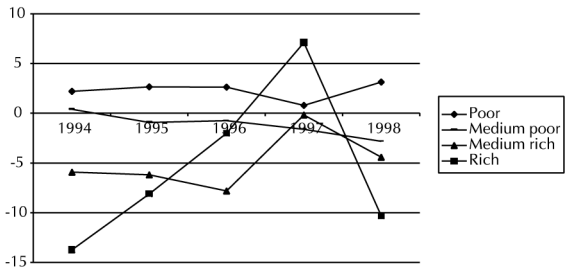

Figure 2 - Excess of infant mortality (deaths/1,000) according to geoeconomic areas in Ribeirão Preto, Brazil, from 1994 to 1998.

DISCUSSION

Today the vast majority of the Brazilian population lives in cities, where there are considerable disparities in social equity and access to health care. Infant mortality rate and income remain important demographic and social indicators and are closely associated, revealing socioeconomic disparities between different social groups, especially in less developed countries.[19]

Collecting income information is almost always problematic, with response rates ranging from 60% to 90% in different countries.[10] Non-response occurs disproportionately among the rich and the poor, leading to a loss of both tails of income distribution and an artifactual narrowing of income differences.

There are also some difficulties in using a geoeconomic distribution as a parameter for urban social inequality. For example, demographic similarities near the limits of geoeconomic areas, large geographic areas with low demographic homogeneity or geographic areas with significant random variability of events can make it difficult to discriminate areas at risk.[1] These facts can partially explain the large annual fluctuation of mortality rates in the rich area, although this finding was minimized when all observation periods were considered together.

All these considerations have to be taken into account in the analysis, resulting in highly complex systems to assess socioeconomic status. However, the rather simple technique used in this study, i.e. a single variable (income of the family head) associated to an administrative area seems to have made it quite practical and simple to discriminate areas at risk and to determine the trend of the impact of social inequality on infant outcome.

These results show a significant trend towards a decrease in infant mortality rate and its post-neonatal component throughout the study period. Surprisingly, the neonatal component per se have not decreased during this period.[7,8] Although the inclusion of a new

series can provide more accurate evaluation of these trends, this fact suggests that environmental factors are still playing an important role in the city, while strategies aimed at decreasing the neonatal component have been unsatisfactory to lead to a significant impact. The increase in low birth weight rate in Ribeirão Preto, mainly in more privileged social groups living in the rich area, from 1978 to 1994, followed by a stabilization of this rate for the rest of 90s, can partially explain this finding.[16]

The significant trend towards a decrease in infant mortality rates according to geoeconomic classification confirms that income plays an important role as a health determinant in urban areas in Brazil.[13,16,17] The results also support the hypothesis that the variations of the post-neonatal component can discriminate social inequalities with more accuracy, presumably because they are more related to the disparities in access to goods, social services, adequate environment and adequate nutritional levels than the neonatal component.[3,15]

Population mortality rates, including infant mortality, are strongly related to persistent low income and income uncertainty as well as the extent of income inequality in a population.[19,20] The study findings, taking into account the excess of infant mortality rates, suggest that there are important disparities between the four socioeconomic groups in terms of infant outcome, especially when comparing the poor area with the others, possibly indicating an increase in the social gap between them.

Finally, the recommendation is for health planners make use of municipal databases more intensively as a means of monitoring change during the process of decentralizing health policy management towards the municipal level in Brazil.

ACKNOWLEDGEMENTS

To Dr. Thomas Scanlon, of the Centre for International Child Health, Institute of Child Health, University College of London, London, UK, for comments; to Dr. Edmilson dos Santos, of Secretaria da Saúde, Prefeitura Municipal, Ribeirão Preto, SP, Brazil, for helping to collect data; and to Vinicius Godoi, of Laboratório do Ensino de Ciências, Faculdade de Filosofia, Ciências e Letras de Ribeirão Preto, for skilful secretarial assistance.

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