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Monitoring mortality in Pelotas birth cohort from 1982 to 2006, Southern Brazil

Bernardo L Horta[I], **Denise P Gigante**[I], **Juliana S Candiota**[I], **Fernando C Barros**[II], and **Cesar G Victora**[I]

[I] Programa de Pós-Graduação em Epidemiologia. Universidade Federal de Pelotas. Pelotas, RS, Brasil

[II] Programa de Pós-Graduação em Saúde e Comportamento. Universidade Católica de Pelotas. Pelotas, RS, Brasil

Abstract

OBJECTIVE: To assess mortality in a birth cohort followed between 1982 and 2006 and its associated factors.

METHODS: In 1982, all of the 5914 children born in hospitals in the city of Pelotas, Southern Brazil, were identified and followed up prospectively. Between 1982 and 1987, deaths were identified through regular visits to hospitals, cemeteries and death registries. As of 1987, death data were obtained through the Mortality Information System. The studied variables were: gender, color of mother, mother's schooling rate, family income, weight at birth, weight and height per age. Poisson regression was used to estimate the relative mortality risk.

RESULTS: Between 1982 and 2006 there were 288 deaths. The infant mortality coefficient was 36 deaths/1 000 live births; and in the age brackets 1-4, years, 5-14 years and 15-24 years the mortality rates were, respectively, 14.4, 4.1 and 5.4 deaths for every 1 000 live births at the beginning of the period. In all age brackets, mortality was higher for individuals from low-income families, with a relative risk of 2.89 (95% CI: 2.08; 4.03) when comparing the first and third terciles after control for gender and skin color. Low weight at birth and height-for-age and weigh-for-height deficits were found to be associated to a higher mortality rate until age 4, but not after that age.

CONCLUSIONS: The effects of social inequalities during childhood can be felt until the beginning of adult life, but birth weight and childhood nutritional status do not have a long-lasting effect on mortality rates for adolescents or young adults.

Keywords

Mortality; Risk Factors; Socioeconomic Factors; Cohort Studies; Brazil

Correspondence: Bernardo Lessa Horta Programa de Pós-Graduação em Epidemiologia – UFPEL R. Marechal Deodoro, 1160 96020-220 Pelotas, RS, Brasil E-mail: blhorta@uol.com.br.

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INTRODUCTION

Infant mortality is inversely related to family income[8] and weight at birth.[13] Low socioeconomic level during childhood can also have long-term effects, such as higher cardiovascular disease mortality.[4, 12]

In most of the studies that have analyzed the effects of poverty on childhood and adult mortality, the data on socioeconomic status were obtained retrospectively, which may have lead to an underestimation of the magnitude of the effect measures.[4] The Pelotas birth cohort study enables the assessment of the effect on mortality of weight at birth, socioeconomic and nutritional status during childhood, based on data gathered prospectively.

The goal of this study is to assess mortality of birth cohorts Born in 1982 and followed up until 2006, and to assess associated factor.

METHODS

In 1982, all the 5 914 children Born in all the three martenity hospitals in the city of Pelotas (Southern Brazil) were examined and their mothers interviewed. The babies represented 99.2% of the total births in Pelotas, in Rio Grande do Sul. In addition to perinatal information, the data used in this study were gathered in 1984 and 1986, when the average age of the children was 19.4 and 43.1 months, respectively. The visits were preceded by census-bureau visits covering the entire city area, and aimed at locating all the children born in 1982. Methodological details on the birth cohort and follow-ups have been published in another paper. [1]

In all of the follow-ups during infancy, the mother or guardian answered a standardized and pre-coded questionnaire. In follow-ups during adolescence, one questionnaire was applied to the teenager and another to the mother or guardian. In the study carried out with the conscripts and in the 2004-5 follow-up, only the subject was interviewed.

From the beginning of the study, in order to identify cohort deaths, all the hospitals, cemeteries, death registries and the Regional Secretariat for Health were visited. It was found that, as of 1987, the civil registry was registering all the deaths occurred in the city, therefore, the other sources of data were no longer consulted. The causes of death were classified according to the Portuguese language edition of the International Statistical Classification of Diseases and Related Health Problems - ICD, versions 9 and 10.[10]

Cumulative incidence of mortality was estimated for the following periods: infancy; pre-school; five to 14 years, and 15 to 24 years. The infant mortality coefficient was based on the number of deaths children under one year of age per one thousand, and the denominator was the total number of live births. The cumulative incidence of mortality in the pre-school period was estimated from the number of deaths between one and four years of age per 1 000 children that reached their first year of age. Infant deaths and children lost during the follow-up study before turning one year old were excluded. To estimate the cumulative incidence of mortality between ages five and 14 and ages 15 to 24, deaths and follow-up losses of individuals younger than the age-brackets concerned were disregarded, in other words, individuals younger than five years of age for mortality analysis of the 5 to 14 group and individuals younger than 15 for deaths between 15 and 24 years.

The independent variables assessed were: sex, skin color of mother (observed by the interviewer); mother's schooling in years at the time of delivery; family income at birth (tertiles); weight at birth; weight and height for age, converted into z scores according to World Health Organization standards.16

Poisson regression was used to estimate relative risk of mortality during the 24-year study period.

Informed oral consent was given by the adult responsible for the children during the 1982-1986 stages of the study. This form of consent was a common practice at the time because there was no Ethics Committee at the *Universidade Federal de Pelotas*. In more recent stages, the Ethics in Research Committee, which is recognized by the National Ethics in Research Committee (*Conselho Nacional de Ética em Pesquisa* - CONEP), gave its approval, and informed consent was obtained through written statements given by the interviewees.

RESULTS

Between 1982 and 2006, 288 cohort deaths were identified. Table 1 shows that during infancy, the main causes of death were medical conditions originated during the perinatal period (42.8% of deaths) and infectious and parasitic diseases. In the pre-school period, parasitic and infectious diseases (31% of deaths) and respiratory diseases (24.1%) were the prevailing cause of the death. Between age five and 14, there was a small number of deaths and there was no prevailing cause of death. Whereas, in the 15 to 24 age group, external causes were responsible for approximately two out of every three deaths.

Table 2 shows mortality coefficients for the following groups: infants, pre-school, five to 14 years, and 15 to 24 years according to socioeconomic variables, demographics, weight at birth, weight and height for age. During infancy, mortality rates were higher for poor children born to black mothers, and with low birth weight. Among children between age one and four, low socioeconomic status at birth, low weight at birth, low height at birth and low weight-for-height at two years of age were associated with increased risk of death. In this last analysis, only deaths occurring between age two and four years and 11 months were considered. Among individuals aged five to 14, the only variable associated with mortality was mother's schooling rate. Among those aged 15 to 24, the male sex and low family income at birth were associated to a higher mortality rate.

Table 3 shows findings on the effects of sex, skin color and family income at birth on mortality rates during the 24-year period of study, the increased risk of death among children born to black or mixed mothers was mediated by socioeconomic variables, because after control for family income and sex, the relative risk of mortality decreased from 1.82 (95% CI: 1.42; 2.33) to 1.21 (95% CI: 0.93; 1.58). On the other hand, even after control for sex and skin color of father, the mortality risk was higher among those born to low-income families in the first tertile.

Deaths due to external factors were more frequent in males whose mothers' were black or mixed and who were born to low-income families in the first tertile. After control for family income at birth, mother's schooling rate and sex, the relative risk of death due to external causes among individuals born to black or mixed mothers decreased from 5.10 (95% CI: 2.08;12.51) to 3.77 (95% CI: 1.11;12.74). The effect of low family income at birth remained significant after control for sex and skin color of mother. (Table 4)

DISCUSSION

This study enabled the assessment of the effects of early determinants (socioeconomic and nutritional) on mortality, from infancy to early adulthood. The prospective nature of this

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study makes it less subject to information bias. Studies that assess mortality at different stages of life are relevant, because they provide cues on the effect of exposure at different moments in the life cycle.

The low socioeconomic level in infancy was associated to higher mortality rates during the whole period of the study, whereas, during infancy, low income was associated to a higher risk of death due to infectious diseases and perinatal causes.[14] During adolescence and the beginning of adult life, a lower socioeconomic level at birth was associated to deaths due to external causes.

Mortality rate due to external causes was also higher among children of black or mixed mothers; however, family income at birth was only able to explain part of this association. The higher mortality rate due to external factors among children born to black or mixed mothers corroborates national data. In Brazil, between 1996 and 2000, homicide mortality rates were higher among Blacks, mainly during adolescence and beginning of adult life, which mirrors the racial inequality in Brazil where violence predominates among young black males.

Low weight at birth was associated to a higher mortality rate only in the first four years of life. This was not found by Kajantie et al,[6] who reported, in a study carried out in Finland a correlation between low weight at birth and higher mortality in adult life. Studies analyzing mortality due to cardiovascular diseases also reported a higher mortality rate among individuals born underweight.[3,7] The follow-up period may be a possible explanation for these differences, because in Finland, individuals were followed-up until age 74,[6] whereas in this study, follow-up was carried out until age 24, which is an age at which cardiovascular diseases do not yet represent an important cause of morbidity and mortality.

Overweight in the first years of life has been considered an early exposure that can have long-term effects on the occurrence of cardiovascular diseases[2] or its risk factors, such as dyslipidemy,[9] high blood pressure[5] and obesity.[15] In poor populations, sub-nutrition has been associated to short-term mortality.[11] The findings of this study confirm the negative effect of poor nutrition on mortality up to age five, but no long-term association between nutritional status – due to deficit or excess – and mortality was found. The lack of correlation with excess weight can also be due to the shorter period of follow up.

In conclusion, the effect of social inequalities during infancy are observed at least until the beginning of adult life, whereas weight at birth and nutritional status during infancy did not have any long lasting effects on mortality rates for adolescents and young adults.

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Table 1

Mortality rate according to cause of death. Pelotas, Southern Brazil, 1982 – 2006.

Cause of death	Death during infancy n (%)	Death between 1-4 years n (%)	Death between 5-14 years n (%)	Death between 15-24 years n (%)
Some parasitic and infectious diseases	43 (20.0%)	9 (31.0%)	2 (10.5%)	1 (4.0%)
Neoplasias	0	0	2 (10.5%)	2 (8.0%)
Endocrinal, nutritional and metabolic diseases	0	0	2 (10.5%)	0
Diseases of the nervous system	0	0	1 (5.3%)	1 (4,0%)
Diseases of the circulatory system	0	0	4 (21,1%)	4 (16.0%)
Diseases of the respiratory system	26 (12.1%)	7 (24.1%)	1 (5.3%)	0
Diseases of the digestive system	0	0	1 (5.3%)	0
Conditions originated in the perinatal period	92 (42.8%)	0	0	0
Congenital malformations, deformities and chromosome anomalies	26 (12.1%)	2 (6.9%)	0	0
Ill-defined	23 (10.7%)	4 (13.8%)	0	1 (4.0%)
External causes	0	0	3 (15.8%)	16 (64.0%)
Other	5 (2.3%)	7 (24.1%)	1 (5.3%)	0
Total	215	29	19	25

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Table 2

Cumulative incidence of mortality (per 1 000) according to demographic and socioeconomic variables, condition at birth and breastfeeding period. Pelotas, Southern Brazil, 1982-2006.

Variable	Death during Infancy	Death between 1-4 years	Death between 5-14 years	Death between 15-24 years
Sex	p=0.29 *	p=0.99 *	p=0.53 *	p=0.04 *
Male	38.9	5.4	4.8	7.7
Female	33.4	5.4	3.2	2.8
Mother's skin color	p<0.001 *	p=0.10 *	p=0.51 *	p=0.04 *
White	32.2	4.5	3.7	4.2
Black or Mixed	55.7	9.4	6.0	10.9
Mother's level of schooling (years)	p<0.001 **	p=0.001 **	p=0.04 *	p=0.41 **
0 – 4	53.1	10.3	1.3	6.0
5 – 8	35.4	4.0	6.5	6.1
≥ 9	16.1	1.5	3.5	3.5
Family income at birth	p<0.001 **	p=0.03 **	p=0.93 *	p=0.02 **
1st tertile	61.6	8.7	4.0	9.4
2nd tertile	30.8	4.3	3.7	3.7
3rd tertile	16.7	3.3	4.5	3.3
Weight at birth (g) – 3 groups	p<0.001 **	p=0.02 **	p=0.39 *	p=0.86 **
< 2500	207.9	12.7	0.0	6.0
2500 – 2999	35.2	7.1	5.4	5.5
≥ 3000	13.1	4.0	4.0	5.3
Height-for-age at 2 years (Z scores)		p=0.001 **	p=0.12 *	p=0.72 *
1st tertile		73	3.5	5.0
2nd tertile		1.8	2.1	6.4
3rd tertile		0.6	6.9	4.2
Weight-for-height at 2 years of age (Z scores)		p=0.002 **	p=0.80 *	p=0.73 **
1st tertile		6.7	4.3	5.7
2nd tertile		2.5	5.0	5.0
3rd tertile		0.6	3.4	4.8
Height-for-age at 4 years of age (Z scores)			p=0.67 *	p=0.12 **
1st tertile			4.3	7.3
2nd tertile			2.9	7.2
3rd tertile			4.9	2.8
Weight-for-height at 4 years of age (Z scores)			p=0.58 **	p=0.61 **
1st tertile			2.9	2.9
2nd tertile			5.0	5.0
3rd tertile			4.2	4.2
Total	36.3	5.4	4.1	5.4

*Categorical

** Test for linear trend

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Table 3

Relative risk of mortality according to family income, mother's skin color and sex. Pelotas, Southern Brazil, 1982-2006.

Variable	Relative Risk (95% IC)	
	Crude	Adjusted*
Sex		
Male	1.26 (1.00;1.59)	1.25 (0.99;1.57)
Female	1.00 (reference)	1.00 (reference)
Mother's skin color		
White	1.00 (reference)	1.00 (reference)
Black or Mixed	1.82 (1.42;2.33)	1.21 (0.93;1.58)
Family income at birth		
1st tertile	3.07 (2.25;4.19)	2.89 (2.08;4.03)
2nd tertile	1.58 (1.12;2.23)	1.58 (1.11;2.24)
3rd tertile	1.00 (reference)	1.00 (reference)

*Adjusted for: gender, family income and color of skin.

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Table 4

External causes mortality rate according to demographic and socioeconomic variables and weight at birth. Pelotas, Southern Brazil, 1982-2006.

Variable	Mortality coefficient External Causes (10 000)	Relative risk (95% IC) Crude	Adjusted
Sex	p<0.001 *		
Male	3.6	15.7 (2.10;117.4)	15.3 (2.04;115.4)
Female	0.2	1.00 (reference)	1.00 (reference)
Mother's skin color	p<0.001 *		
White	1.2	1.00 (reference)	1.00 (reference)
Black or Mixed	6.0	5.10 (2.08;12.51)	3.77 (1.11;12.74)
Family income at birth	p=0.02 **		
1st tertile	3.7	3.80 (1.06;13.60)	1.79 (0.19;16.51)
2nd tertile	1.5	1.59 (0.38;6.62)	1.07 (0.17;6.74)
3rd tertile	1.0	1.00 (reference)	1.00 (reference)
Weight at birth (grams)	p=0.38 *		
< 2500	3.0	1.29 (0.30;5.60)	1.23 (0.28;5.46)
2500 – 2999	0.9	0.39 (0.09;1.71)	0.40 (0.09;1.71)
≥ 3000	2.3	1.00 (reference)	1.00 (reference)
Total	2.1		

* Categorical

** Linear trend test