

Methods used in the 1982, 1993, and 2004 birth cohort studies from Pelotas, Rio Grande do Sul State, Brazil, and a description of the socio-economic conditions of participants' families

Métodos utilizados nos estudos das coortes de nascimentos de 1982, 1993 e 2004 de Pelotas, Rio Grande do Sul, Brasil e descrição das condições sócio-econômicas das famílias de participantes

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Abstract

Three birth cohorts are currently being followed in Pelotas, Southern Brazil, in order to assess changes in birth conditions, growth, development, morbidity, and infant mortality, as well as the influence of pre- and perinatal factors on the subsequent morbidity of participants in their adult lives. We provide a description of the methodology used for the cohort studies that began in 1982, 1993, and 2004 in Pelotas, and a description of the economic conditions of the families involved. For the three cohorts, similar strategies were used to recruit babies born to mothers living in the municipality's urban area. These included daily visits to maternity hospitals where births were identified, mothers interviewed, and newborns examined. Over this time frame, there has been a significant reduction in the number of births due to declining fertility rates amongst the target population. Salaries (measured as a multiple of the minimum wage) were stable across cohorts, but quality of life indicators – such as the availability of piped water, flushing toilets and refrigerators – showed clear improvements. Mothers' levels of education improved markedly. Important changes in the demographic profile of risk factors and health outcomes are being recorded by the Pelotas cohorts.

Cohort Studies; Methods; Socioeconomic Factors

Introduction

The first Pelotas birth cohort took place in 1982 in the city of Pelotas, Southern Brazil ¹, prompted by an interest in studying birth conditions, including gestation, delivery, and newborn care, and in documenting the development of mother-child health indicators. Although the cohort study was originally intended as a perinatal study, its original subjects are still being studied to the present day, totaling 24 years of follow-up.

Given the importance of monitoring epidemiological profiles in relation to health outcomes and risk factors, a second birth cohort study was begun in Pelotas in 1993, 11 years after the first ². The success of these two studies, as measured by the amount and relevance of publications and the training of post-graduate researchers, encouraged us to undertake a third birth cohort in the same city in 2004 ³.

Standard medical records of health indicators have their limitations, including under-registration, incomplete coverage, a lack of standardization, and the fact that disaggregated statistics, such as socioeconomic status and skin color, are not possible ⁴. Birth cohort studies have the advantage of involving the collection of data at a time close to its occurrence, in addition to allowing for efficient data quality control, minimizing the problems mentioned above. However, the recently renewed interest in cohort studies is largely due to Barker's hypothesis of the fetal ori-

gin of cardiovascular disease⁵, formulated in the late 1980s, and to interest in possible long-term health effects, such as that of breastfeeding on asthma⁶ or obesity⁷.

In the 22-year period between 1982 and 2004, Brazilians have undergone radical changes in certain aspects of their lives. Noteworthy among these changes, in the field of politics and economy, are the end of the military dictatorship in 1985, followed by periods of financial chaos – including hyperinflation and frustrated attempts to contain it by means of price controls, monetary confiscations, and five currency changes, from the Cruzeiro to the Real, until inflation was finally controlled. In spite of these changes, inequities in income distribution in the country have persisted, with the Gini coefficient remaining stable at 0.6 between 1982 and 1993. A slight reduction (to 0.57) was recorded in 2004.

When compared to the State of Rio Grande do Sul, the Pelotas region has become progressively poorer. In 1980, its per capita GDP was equivalent to 81.4% of the state average⁸. This proportion fell to 70% in 1999, and to 58% in 2002 (Brazilian Institute of Geography and Statistics – IBGE. <http://www.ibge.gov.br/home/estatistica/economia/pibmunicipios/2002/tab01.pdf>, accessed on 07/Feb/2006).

Health care has also undergone significant changes. At the time of the 1982 cohort, there was a clear distinction between public health and medical care, the former under the coordination of the Brazilian Ministry of Health, and the latter the responsibility of the Brazilian Ministry of Social Security and Assistance. Only persons with formal employment were insured by the public system. Rural workers began to have access to medical care through the FUNRURAL, whereas the poorer population received care through a network of philanthropic hospitals⁹. These differences were reflected in the 1982 cohort by the variable “type of payment for delivery”, which included, in addition to “private care and private health insurance”, the categories “INAMPS”, “FUNRURAL”, and “indigent”. The Sanitary Renewal Movement, driven by intense engagement on the part of civil society, led to the implementation of a unified and decentralized health care system. This system was incorporated into the 1988 constitution and led to the establishment in law of the Unified National Health System (SUS), based on the principles of equity, universal coverage, and integrated health care⁹. The 1993 study reflects such changes, and includes only the INSS (Brazilian Institute of Social Security) as the single government source of payment for birth deliveries. SUS was only included as a category in the 2004 cohort study.

The study of infant mortality trends, based on medical records and the use of indirect techniques involving demographic censuses, shows an important decline in mortality at the national level. Considering Brazil as a whole, infant mortality, which was 82.8 per thousand live births in 1980, fell to 36.6 per thousand in 1995 and 29.7 per 1,000 in 2000 (IBGE estimates). In the State of Rio Grande do Sul, infant mortality fell from 33.2 per thousand live births in 1982 to 19.2 in 1993¹⁰, 15.9 in 1997, and 16.0 in 2003 (Rede Interagencial de Informações para a Saúde – RIPSAs: <http://tabnet.datasus.gov.br/cgi/idb2005/c01.htm>, accessed on 12/Mar/2008).

The three longitudinal studies described here are a source of information that is unparalleled in Brazil. All three studies began with the identification, in the hospitals of Pelotas, of all live births to mothers living in the municipality. Subjects are still followed prospectively, by tracing either the entire group or a sub-sample of subjects, depending on the resources available for each visit. Our experience of data analysis has shown that the sub-sample strategy may, with time, lead to a small subset of subjects with complete follow-ups. Thus, the 2004 cohort was designed to include only follow-up visits to the entire sample, in spite of a consequent widening of the intervals between visits.

Generally speaking, the aim of the Pelotas birth cohort studies is to maintain a record of changes in the epidemiological profile of the population, from the standpoint of both health outcomes and risk factors, evaluating in detail the perinatal health situation of newborns, as well as to allow for the study of associations between early-life determinants and outcomes in adulthood. Specifically the aim of these studies is to:

- a) Evaluate the antenatal and perinatal conditions of all live births in Pelotas in the reference year;
- b) Characterize the population of mothers who gave birth in maternity hospitals in the three years studied by socioeconomic, demographic, and environmental variables;
- c) Identify all fetal and infant deaths, defining causes of death and evaluating potential preventive interventions;
- d) Study early-life characteristics and outcomes, such as breastfeeding, development, infections, and accidents;
- e) Investigate the impact of early-life exposures on health outcomes measured during adolescence and adulthood;
- f) Evaluate health care access, use, and financing;

g) Study inequities in health conditions and medical/sanitary characteristics between different ethnic and social groups;

h) Contribute to the planning of health programs and initiatives at the local, national, and global levels.

The present article provides a summary of the design and methodology of the three cohort studies currently in progress in Pelotas, with an emphasis on comparisons, since detailed accounts of the methods of each study have been published elsewhere^{1,2,3,11,12,13}. We also present a comparison of the number of children included in each study and of losses during the first 12 months of follow-up. In addition, this article describes the socio-demographic characteristics of study subjects and evaluates trends and changes that took place over these two decades. The major results of the three cohort studies are presented in comparative form in the other articles of this supplement.

Methods

Study settings

Pelotas is a city with 323,158 inhabitants (301,000 of which live in the urban area, according to the 2000 Demographic Census, IBGE), located in the extreme south of Brazil, in the State of Rio Grande do Sul. Estimates for 2004 point to a total population of approximately 340,000 inhabitants. The major economic activities of the municipality are agriculture, trade and services. The city has two universities, one private and one public.

Perinatal study

Similar recruitment strategies were employed for the three cohorts, based on the high percentage of hospital deliveries in the city (always above 98%). From 1 January to 31 December 1982, 1993, and 2004, all the city's hospitals (four in 1982 and five in 1993 and 2004) were visited on a daily basis by team members who were trained especially for the task. Eligible mothers – those living in the urban area of Pelotas municipality and in the Jardim América neighborhood (which became part of the municipality of Capão do Leão in May 1982) – were interviewed soon after delivery using a standardized, pre-coded questionnaire. Non-hospital deliveries were also included in the cohorts, since mothers normally sought a maternity ward after delivery, and were thus recruited to the study at this stage.

The size and complexity of the questionnaire increased substantially between cohorts. In 1982,

80 questions were listed across two A4 pages. In 1993, the questionnaire comprised 16 pages and 212 questions, and in 2004, the number of pages increased to 25, with 273 questions (some of which were formatted as boxes that included large amounts of information). In addition to the questionnaire, all babies were weighed and measured. Length measurements were taken using ARTHAG infantometers¹⁴, and weight was determined using the hospital scales, which were regularly calibrated by researchers. Birth weight was measured by the nursing professional overseeing delivery. In 1993 and 2004 the cephalic, thoracic, and abdominal perimeters were also measured using inelastic tape measures with 1mm precision, and gestational age was evaluated using the Dubowitz method¹⁵. Mothers were also measured and weighed in the 1982 and 1993 studies; in 2004 these measurements were taken at the three-month visit.

Infant mortality in the three cohorts was evaluated by recording any deaths of children participating in the study, which was carried out by means of regular visits to hospitals, cemeteries, notary offices, and the regional health office. In 2004, data from the Mortality Information System (SIM) were also used to track infant deaths. In 1993 and 2004, underlying causes of death were determined by two independent referees based on information from the child's medical records.

Follow-ups

The 1982 cohort has had eight follow-ups to date. The first one took place early in 1983, and included children born between January and April 1982, who were then aged between 9 and 15 months (mean age c. 12 months). Subsequent follow-ups were carried out in 1984 (mean age c. 20 months) and 1986 (mean age c. 42 months). In the first follow-up we attempted to locate the 1,820 children born in the first four months of 1982 using the addresses provided by mothers during the perinatal interview. In the second follow-up, we conducted a census of all 68,590 households in the urban area of Pelotas in order to identify all children still living in the city.

In addition to these, we carried out another six follow-ups, in 1986 (entire cohort), 1995 and 1997 (sub-samples), 2000 (all males, during mandatory registration for military service), 2001 (sub-sample), and 2005 (entire cohort). In this last follow-up, which was based on a new census of the municipality, we were able to trace 77.4% of the cohort's subjects¹⁶.

In the 1993 cohort, due to the growing interest in events that took place during the first year

of life, there was an increase in the intensity of follow-ups during this period. Samples of urban live births were selected, and these children were visited at home, based on the addresses given at the time of the hospital visit, at ages one, three, six, and 12 months. At the one-month and three-month visits we attempted to trace a systematic sample of 20% of the cohort, selected according to birth date. This sample also included all children born weighing under 2,500g, since these had been identified as a high risk group in the previous cohort. There were also follow-ups in 1997, when children were about four years old (sub-sample), and in 2004 (entire cohort).

While analyzing the 1982 cohort it became clear that, in certain situations, there only a small number of children with data from all follow-ups because of the different sub-samples used. Therefore the 2004 cohort included only complete follow-ups, at ages three, 12, and 24 months, all of which included the entire cohort sample. To this end, we made a concerted effort to collect contact information data from families. This process was facilitated by the large expansion of telephone services, especially mobile phones. We were therefore able to achieve very high follow-up rates, as described in the following section.

Child development was studied in all three cohorts, with some small methodological differences. For the 1982 cohort, we conducted a study of child development in 1986, which included 2,000 children born between January and April 1982. An additional sample of children born

weighing under 2,500g was also included in the study. Children were evaluated using the Griffiths scale¹⁷. In the 1993 cohort, development was studied at the one, three, six and 12-month follow-ups, using the Denver II test¹⁸. In the 2004 cohort, we evaluated development using the same items of Denver II used in the 1993 cohort plus the Battelle screening test¹⁹.

Study protocols were approved by the Medical Research Ethics Committee of the Federal University of Pelotas. In 1982 and 1993 we obtained verbal consent from mothers for participation in the study. In 2004, written consent was also obtained.

Results

The absolute number of births declined substantially across the three cohorts, from 6,011 in 1982 to 5,304 (-11.8%) in 1993 and 4,287 (-19.2%) in 2004. This was the result of the decrease in fecundity observed during this period, which is analyzed in another article in this Supplement²⁰. Refusal to participate in the study, including visits that took place during the first year of all three cohorts was always below 1%. Table 1 shows the 12 month follow-up rates for the three cohorts, defined as the number of subjects traced plus the number of deaths in the period, divided by the total number of live births. Follow-up rates were high in the three cohorts, for all groups of income and birth weight. The follow-up rate for the 1982 study was lower than those of the two more recent cohorts due to the strategies employed in the former. Note that the follow-up rates described in Table 1 differ from those published previously, given that current numbers include all deaths detected among subjects that were traced.

The distribution of families according to total income as a multiple of the minimum wage (Figure 1) was quite stable throughout the 22-year period, despite the number of changes in the economy. The slight deviation to the right seen in 1993 when compared to 1982 was no longer observed in 2004, when the distribution was more similar to 1982 than to 1993. According to Brazilian Central Bank estimates, there was a 24% decrease in the purchasing power of the minimum wage between 1982 and 2000²¹. Therefore, the socioeconomic conditions of 2004 mothers may actually have been worse than those of 1982 mothers.

To complete the panorama of changes that took place during the period spanned by the cohorts, in Table 2 we present selected socioeconomic indicators. The proportion of mothers living without a partner increased from 1982 to 2004, both in general and across almost all in-

Table 1

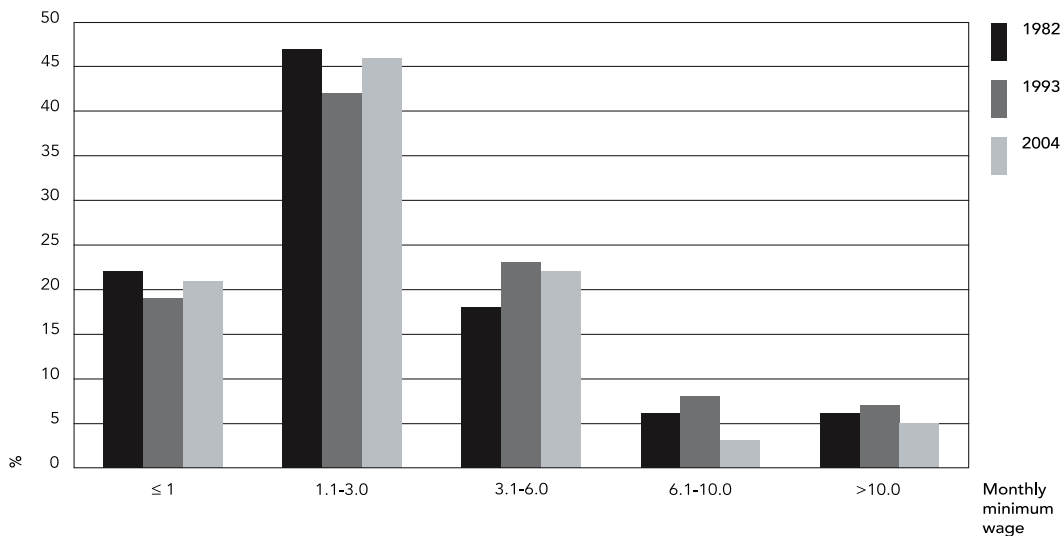
Follow-up rates at 12 months in each cohort, according to family income and birth weight. Pelotas, Southern Brazil, 1982, 1993, and 2004.

Groups	Follow-up rate *		
	1982	1993	2004
Family income (multiple of the minimum wage)			
≤ 1	68	92	93
1.1-3.0	85	93	96
3.1-6.0	81	95	96
6.1-10.0	75	93	89
> 10.0	79	96	96
Birth weight (g)			
< 2,500	80	92	93
≥ 2,500	78	94	94
Total follow-up	79	93	94
Total live births	5,914	5,249	4,231

* % follow-up = (interviewed + deaths) / total live births.

Figure 1

Distribution of children in the Pelotas birth cohorts according to family income in multiples of the Brazilian minimum wage based on total births in each year. Pelotas, Southern Brazil, 1982, 1993, and 2004.



Note: total births - 1983 (6,011), 1993 (5,304), and 2004 (4,287).

come strata. Likewise, the proportion of working mothers increased from 33% to 38% between 1982 and 1993, reaching 39% in 2004. In 2004, 70% of mothers in the group earning more than ten times the minimum wage worked; this was higher than the 58% and 54% of working mothers found in 1993 and 1982, respectively. However, in the group earning up to one minimum wage, the number of working mothers fell from 36% in 1982 to 28% in 2004.

Education indicators for mothers showed very positive changes. Mothers with less than four years of schooling – a factor often associated with greater risks for the child's health, was by 2004 almost non-existent among families with an income of more than six times the minimum wage. In the poorest group, there was a 63% reduction in the proportion of such mothers, from 43% in 1982 to 16% in 2004. There was a comparable reduction (59%) in the group earning one to three times the minimum wage. At the other end of the spectrum, the proportion of mothers with more than eight years of schooling increased in the total sample by about 70%. This increase was roughly seven-fold among the poorest stratum – from 3% in 1982 to 20% in 2004. Interestingly, this increase occurred entirely between 1993 and 2004, while there was in fact a slight reduction in the proportion of mothers with more than eight

years of schooling between 1982 and 1993 in certain income groups.

The last two decades also saw very positive improvements in living conditions (Table 3). Practically all the population currently has access to piped water and at least one flushing toilet (97% in the poorest group for both variables). In 1982, only half the poorest families were connected to piped water or had flushing toilets. The presence of a radio, television set, and refrigerator in households also increased markedly, from 37% to 68% among the poorest families. Owning a refrigerator, which is particularly important for improving food conservation, increased among the poorest stratum from 45% in 1982 to 73% in 2004.

There was also an important reduction across all income groups in the number of persons per household, but important differences between the richest and the poorest still remain. In 2004, there were a mean 3.2 persons per bedroom among the poorest group, compared to 2.0 among the richest.

The financing of births has changed over time, mainly because of the changes that took place in the public healthcare system. In 1982, 85.6% of deliveries were financed by the public system (Figure 2). Of these, 6.4% were in the indigent category and 0.4% were through FUNRURAL, the

Table 2

Mother's schooling and work and presence of father in household according to monthly family income. Pelotas, Southern Brazil, 1982, 1993, and 2004.

Variables	Family income groups *					All
	≤ 1.0	1.0-3.0	3.1-6.0	6.1-10.0	> 10.0	
Mother without partner (%)						p < 0.001 **
1982	20	6	4	2	1	8
1993	16	13	12	12	5	12
2004	25	16	12	10	9	17
Mother's schooling < 4 years (%)						p < 0.001 **
1982	43	22	9	2	0	22
1993	33	17	9	6	2	16
2004	16	9	2	1	0	8
Mother's schooling > 8 years (%)						p < 0.001 **
1982	3	14	43	75	91	25
1993	5	16	31	57	78	26
2004	20	33	66	84	90	43
Mean schooling (years)						p < 0.001 ***
1982	3.8	5.5	8.2	11.4	13.9	6.5
1993	4.5	6.0	7.4	9.3	11.7	6.7
2004	6.3	7.3	9.7	11.4	13.1	8.1
Working mother (%)						p = 0.004 **
1982	36	24	38	57	54	33
1993	33	32	43	55	58	38
2004	28	33	51	57	70	39
Total births						
1982	1,321	2,837	1,105	383	336	5,982
1993	984	2,165	1,218	437	386	5,190
2004	899	1,969	951	246	208	4,273

* Data on family income could not be obtained for 29 children in 1982, 114 in 1993, and 14 in 2004;

** χ^2 for linear trend;

*** ANOVA linear trend.

remaining deliveries being paid for by INAMPS. In later cohorts, the proportion of deliveries financed by the public system decreased slightly, to 83.2% in 1993 and 81.1% in 2004. On the other hand, deliveries financed by private health insurance increased about three-fold, whereas those paid for directly by the client (out of pocket payments) fell by half.

Discussion

Although cohort studies are still scarce in Brazil, a number have been initiated in the last decade or so, including the older adult cohort from Bambuí, Southeastern Brazil ²², and the Longitudinal Study of Adult Health (ELSA; [\[incubadora.fapesp.br/portal\]\(http://incubadora.fapesp.br/portal\)\). Despite the methodological difficulties they pose, there are a number of advantages of such studies. Exposures are measured before the beginning of the disease or disorder under investigation, preventing reverse causality. Selection and memory bias, which often plague case-control studies, are also less frequent or relevant. The collection of information at or close to the time of interest ensures quality in long-term evaluations \(e.g. changes in socioeconomic levels\) ²³ and in the study of early-life exposures to adult life outcomes \(e.g., breast-feeding and obesity\) ²⁴. These advantages mean that the design of the cohort study is particularly appropriate for evaluating social determinants of health, one of the current research priorities around the world.](http://elsa.</p>
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Table 3

Household characteristics according to monthly family income. Pelotas, Southern Brazil, 1982, 1993, and 2004.

Variables	Family income groups *					All
	≤ 1	1.1-3.0	3.1-6.0	6.1-10.0	> 10.0	
Piped water (%)						p < 0.001 **
1982	50	72	93	99	100	75
1993	65	85	93	99	100	85
2004	97	99	100	100	100	99
Flushing toilet (%)						p < 0.001 **
1982	51	71	93	100	100	75
1993	62	84	94	99	100	84
2004	97	98	100	100	100	99
Have radio, TV, refrigerator (%)						p < 0.001 **
1982	37	66	90	98	100	69
1993	37	66	83	93	100	69
2004	68	82	92	98	97	83
Mean persons per bedroom						p < 0.001 ***
1982	3.7	3.2	2.6	2.2	1.9	3.0
1993	3.7	3.3	3.1	2.7	2.3	3.2
2004	3.2	3.0	2.5	2.3	2.0	2.8
Mean persons per household						p < 0.001 ***
1982	5.3	4.9	4.5	4.6	4.4	4.8
1993	5.1	4.9	4.9	4.5	4.8	4.9
2004	4.7	4.5	4.3	4.0	4.1	4.4
Total births						
1982	1,321	2,837	1,105	383	336	5,982
1993	984	2,165	1,218	437	386	5,190
2004	899	1,969	951	246	208	4,273

* Data on family income could not be obtained for 29 children in 1982, 114 in 1993, and 14 in 2004;

** χ^2 for linear trend;

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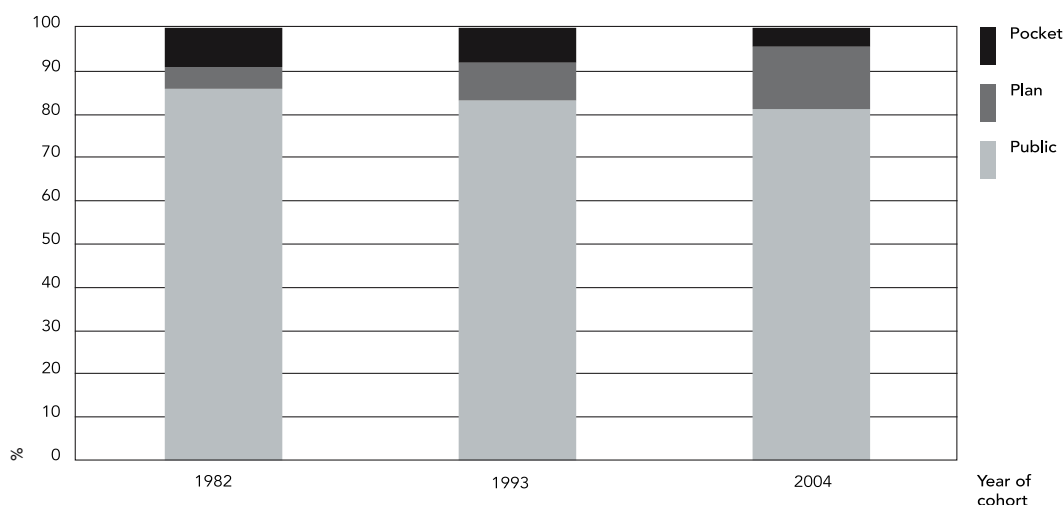
A major difficulty in longitudinal studies is the risk of losses during follow-up. In the Bambuí cohort, a strategy similar to the Pelotas cohorts was employed to minimize such losses: the study was located in a city with low migratory flows. ELSA is based on a different strategy, which is to use staff at public universities as the study population. Regardless of the study's strategy, great efforts must be invested in minimizing losses. In the first follow-up of the 1982 cohort, which was based on the addresses obtained during the hospital visit, almost 18% of children were lost. For the second follow-up, we employed a more effective, but more costly, strategy, which was to search all households in the city in order to identify cohort children. In 2004, a more complete set of information on location was obtained, with questionnaires including a chart with home,

work, and a relative's addresses, as well as land-line and mobile phone numbers. The increased use of mobile phones facilitated the process of locating mothers. These factors contributed to achieving a high follow-up rate for the entire cohort in 2004 without the need for a new city-wide "census".

Another limitation inherent to this type of study is that data collection is based on self-reporting (from the mother or the subject him or herself after a certain age). With the exception of a few measures, such as weight and length at birth, Dubowitz gestational age, weight and height at follow-ups, and development evaluation, the vast majority of information was obtained through reporting. Thus, data on morbidity during pregnancy, antenatal care, labor induction, infant morbidity, etc. are collected based on what

Figure 2

Method of financing of delivery in the Pelotas birth cohorts, in three categories: public, private health insurance, and out-of-pocket based on total births in each year. Pelotas, Southern Brazil, 1982, 1993, and 2004.



is stated by the interviewee. The quality of this information is variable, and depends on characteristics relating to the interviewee (such as age and schooling), and also on the type of information (personal, medical). On the other hand, the cohort strategy allows for this information to be collected close to its occurrence, thus minimizing recall bias.

The decrease in the number of births between 1993 and 2004 was even more marked than in the previous 11-year period. Such a decline shows that the process of reduction of fecundity²⁵, acknowledged previously, has intensified.

Family income in the city remained quite stable in terms of the distribution of income as a multiple of the minimum wage. Considering the Brazilian Central Bank estimate regarding a decrease in the purchasing power of the minimum wage, we may conclude that there was a reduction in the population's purchasing power. However, other indicators of living conditions indicate a general improvement, with important increases in mothers' schooling, a reduction in the number of children per family, a greater availability of household consumer goods, and fewer people per household and per bedroom. We also

observed an improvement in sanitation conditions, with piped water and flushing toilets becoming almost universal in households.

Public financing of births fell slightly. However, there was a reduction in the number of privately paid deliveries and an increase in the use of private health insurance. Other studies have shown that roughly one-quarter of the Brazilian population are covered by private health insurance²⁶, and that coverage varies greatly according to socio-economic conditions, from less than 10% among the poorest to about 70% among the richest²⁷.

Improvements in the living conditions of this population are reflected in the comparative analyses presented in this supplement, which address the characteristics of mothers and their families, birth weight, perinatal and infant mortality, hospital admissions, breastfeeding and diet, growth, development, and healthcare utilization. Comparisons focus on delivery, the puerperal period, and the first year of life. The existence of three birth cohorts with 11-year intervals in the same city provides a unique opportunity to understand the changes that have taken place in health indicators and their major determinants.

Resumo

Três coortes de nascimento estão sendo acompanhadas em Pelotas, Rio Grande do Sul, para avaliar mudanças nas condições de parto, crescimento, desenvolvimento e morbi-mortalidade infantil, assim como a influência de fatores pré e perinatais sobre a morbidade dos participantes na idade adulta. O artigo descreve a metodologia utilizada para os estudos de coorte que se iniciaram em 1982, 1993 e 2004 em Pelotas, além das condições econômicas das famílias dos participantes. Nas três coortes, foram utilizadas estratégias semelhantes para recrutar crianças cujas mães residiam na área urbana do município, inclusive visitas diárias às maternidades para identificação dos nascimentos, entrevistas com as mães e exames neonatais. Ao longo desse período houve uma redução significativa no número de nascimentos, em função da queda na taxa de fecundidade na população. A renda familiar (medida como múltiplos do salário mínimo mensal) mostrou-se estável nas coortes, mas houve uma melhoria clara nos indicadores de qualidade de vida – tais como a disponibilidade e água encanada, vaso sanitário com descarga e geladeira. A escolaridade materna melhorou de maneira significativa. Estão sendo registradas mudanças importantes no perfil demográfico dos fatores de risco e dos desfechos de saúde nas coortes de nascimentos de Pelotas.

Estudos de Coortes; Métodos; Condições Socioeconômicas

Contributors

A. J. D. Barros and A. Matijasevich carried out the new analyses, relating to the 2004 cohort, and prepared the first draft of this article. C. G. Victora, I. S. Santos, C. L. Araújo, F. C. Barros, D. P. Gigante, A. M. B. Menezes, B. L. Horta and E. Tomasi helped with the analysis of results and revisions, and contributed in the redrafting. All authors were involved in the study design and read and approved the final version.

Acknowledgements

The 1982 cohort study, in its many stages, was supported by the International Development Research Center (Canada), the World Health Organization (WHO), the Overseas Development Administration (U.K.), the Brazilian Council for Scientific and Technological Development (CNPq), and the Rio Grande do Sul State Research Foundation (FAPERGS). The 1993 cohort was supported by the European Economic Community, WHO, CNPq, and FAPERGS. The 2004 cohort visits described in the present article were supported by WHO (HQ/04/072979), CNPq (process no. 476727/2003-0), and Pastoral da Criança and the Brazilian Ministry of Health/National Health Foundation (partnership no. 4589/2004). We would especially like to thank all colleagues, too numerous to be listed individually, that collaborated during the different stages of the three studies, and the mothers who generously agreed to participate in our research, and who have made these three studies possible.

References

1. Barros FC, Victora CG, Vaughan JP. The Pelotas (Brazil) birth cohort study 1982-1987: strategies for following up 6,000 children in a developing country. *Paediatr Perinat Epidemiol* 1990; 4:205-20.
2. Victora CG, Barros FC, Halpern R, Menezes AM, Horta BL, Tomasi E, et al. Estudo longitudinal da população materno-infantil da região urbana do Sul do Brasil, 1993: aspectos metodológicos e resultados preliminares. *Rev Saúde Pública* 1996; 30:34-45.
3. Barros AJ, Santos IS, Victora CG, Albernaz EP, Domingues MR, Timm IK, et al. Coorte de nascimentos de Pelotas, 2004: metodologia e descrição. *Rev Saúde Pública* 2006; 40:402-13.
4. Laurenti R, Jorge MHP, Lebrão ML, Gotlieb SLD. *Estatísticas de saúde*. São Paulo: EPU/Edusp; 1985.
5. Barker DJ. Fetal origins of cardiovascular disease. *Ann Med* 1999; 31 Suppl 1:3-6.
6. Da Costa Lima R, Victora CG, Menezes AM, Barros FC. Do risk factors for childhood infections and malnutrition protect against asthma? A study of Brazilian male adolescents. *Am J Public Health* 2003; 93:1858-64.
7. Araujo CL, Victora CG, Hallal PC, Gigante DP. Breastfeeding and overweight in childhood: evidence from the Pelotas 1993 birth cohort study. *Int J Obes (Lond)* 2006; 30:500-6.
8. Instituto Técnico de Pesquisa e Assessoria. Banco de dados da zona sul, RS. Pelotas: Universidade Católica de Pelotas; 1995. (Boletim Informativo, 6).
9. Barros E. Financiamento do sistema de saúde no Brasil: marco legal e comportamento do gasto. In: *Série técnica do projeto de desenvolvimento de sistemas e serviços de saúde*. v. 4. Brasília: Organização Pan-Americana da Saúde; 2003. p. 17-70.

10. Secretária da Saúde e do Meio Ambiente. Estatísticas de saúde: mortalidade 1993. Porto Alegre: Divisão de Informação em Saúde, Assessoria Técnica e de Planejamento, Secretária da Saúde e do Meio Ambiente; 1995.
11. Victora CG, Barros FC, Tomasi E, Menezes AM, Horta BL, Weiderpass E, et al. Tendências e diferenciais na saúde materno-infantil: delineamento e metodologia das coortes de 1982 e 1993 de mães e crianças de Pelotas, Rio Grande do Sul. *Cad Saúde Pública* 1996; 12 Suppl 1:S7-14.
12. Victora CG, Barros FC, Lima RC, Behague DP, Gonçalves H, Horta BL, et al. Estudo de coorte de nascimentos em Pelotas, Rio Grande do Sul, Brasil, 1982-2001. *Cad Saúde Pública* 2003; 19:1241-56.
13. Victora CG, Araujo CL, Menezes AM, Hallal PC, Vieira ME, Neutzling MB, et al. Methodological aspects of the 1993 Pelotas (Brazil) Birth Cohort Study. *Rev Saúde Pública* 2006; 40:39-46.
14. Barros FC, Victora CG. *Epidemiologia da Saúde Infantil: um manual para diagnósticos comunitários*. São Paulo: Fundo das Nações Unidas para a Infância/Editora Hucitec; 1991.
15. Dubowitz LM, Dubowitz V, Goldberg C. Clinical assessment of gestational age in the newborn infant. *J Pediatr* 1970; 77:1-10.
16. Victora CG, Barros FC. Cohort profile: the 1982 Pelotas (Brazil) birth cohort study. *Int J Epidemiol* 2006; 35:237-42.
17. Griffiths R. *The abilities of young children: a comprehensive system of mental measurement for the first eight years of life*. London: Child Development Research; 1970.
18. Frankenburg WK, Doods JB. *The Denver II developmental screening test*. Denver: Denver Developmental Materials; 1992.
19. Newborg J, Stock JR, Wnek L, Guidabaldi J, Svinicki J. *Battelle developmental inventory*. Itasca: Riverside Publishing; 1988.
20. Santos IS, Barros AJD, Matijasevich A, Tomasi E, Medeiros RS, Domingues MR, et al. Mothers and their pregnancies: a comparison of three population-based cohorts in Southern Brazil. *Cad Saúde Pública* 2008; 24 Suppl 3:S381-9.
21. Banco Central do Brasil. Informações econômico-financeiras – salário mínimo. <http://www4.bcb.gov.br/pec/series/port/metadados/mg659Ap.htm> (accessed on 02/May/2005).
22. Costa MF, Uchoa E, Guerra HL, Firmo JO, Vidigal PG, Barreto SM. The Bambui health and ageing study (BHAS): methodological approach and preliminary results of a population-based cohort study of the elderly in Brazil. *Rev Saúde Pública* 2000; 34:126-35.
23. Barros AJ, Victora CG, Horta BL, Gonçalves HD, Lima RC, Lynch J. Effects of socioeconomic change from birth to early adulthood on height and overweight. *Int J Epidemiol* 2006; 35:1233-8.
24. Victora CG, Barros F, Lima RC, Horta BL, Wells J. Anthropometry and body composition of 18 year old men according to duration of breast feeding: birth cohort study from Brazil. *BMJ* 2003; 327:901.
25. Frias LA, Carvalho JAM. Diferenciais da transição dos níveis e padrões de fecundidade. In: *Anais do IX Encontro de Estudos Populacionais*. Belo Horizonte: Associação Brasileira de Estudos Populacionais; 1994. p. 23-46.
26. Instituto Brasileiro de Geografia e Estatística. *Acesso e utilização de serviços de saúde. PNAD 1998*. Rio de Janeiro: Instituto Brasileiro de Geografia e Estatística; 2000.
27. Barros AJD, Victora CG, Cesar JA, Neumann NA, Bertoldi AD. Brazil: are health and nutrition programs reaching the neediest? In: Gwatkin DR, Wagstaff A, Yazbeck AS, editors. *Reaching the poor with health, nutrition and population services. What works, what doesn't and why*. Washington DC: World Bank; 2005. p. 281-306.

Submitted on 29/Mar/2007

Final version resubmitted on 07/Nov/2007

Approved on 09/Jan/2008