

COHORT PROFILE

Cohort Profile: The 1982 Pelotas (Brazil) Birth Cohort Study

Cesar G Victora^{1*} and Fernando C Barros²

How did the study come about?

Pelotas is a city in the extreme south of Brazil, near the border of Uruguay, with 214 000 urban inhabitants in 1982. At the time, we were assistant professors, each working in one of the two medical schools in the city, and both undergoing post-graduate training at the University of London. We were inspired by the findings of the British perinatal study, and one of us (FCB) decided to do a similar study for his doctoral thesis. The lack of reliable data on perinatal mortality in Brazil, due to poor registration of births and deaths—particularly stillbirths—justified the launch of the study. Funding from the International Development Research Center (Canada) was obtained for the perinatal survey, which led to FCB's PhD thesis.^{1,2}

While perinatal data collection was underway, we obtained a grant to visit a sub-sample of these newborns at the age of 12 months. Later funds were obtained for two visits to the entire cohort, at the approximate ages of 2 and 4 years.

Little did we imagine that our study would eventually become one of the largest and longest running birth cohorts in the developing world.³

What does the study cover? (and how has this changed)

Initially, the study focus was on perinatal, infant, and early childhood morbidity and mortality. We were particularly interested in breastfeeding patterns and nutritional status, as well as social and environmental factors. Deaths of cohort members were identified by regular visits to all hospitals, cemeteries, offices of civil registrations, and local health authorities, since 1982.

By mid-childhood, the study shifted in emphasis to child care, utilization of health services, selected morbidity indicators, and child development. A random sub-sample of 360 four-year-olds was selected for an in-depth study of psychomotor development.

In adolescence, issues related to sexual and reproductive behaviours (including teenage pregnancies), habits such as smoking and alcohol drinking, mental health, and education became the focus of the investigation. A sub-study investigated oral health in a random sample of 900 adolescents, and an ethnographic study of 96 cohort members, stratified by sex and

socioeconomic status, has included repeated in-depth visits from the age of 15 to 23 years, aimed at understanding the role of adolescent development in influencing high-risk behaviours.

In more recent phases, with cohort members being young adults, the main emphasis has shifted to risk factors for chronic disease (including smoking, diet, physical exercise, and overweight), reproductive history, and mental health.

Who is in the sample?

During the whole of 1982, the three maternity hospitals in the city were visited daily and 7392 births were recorded. Of these, 6011 infants were born to mothers living in the urban area of Pelotas. Using data from birth registration and from a city census, we identified another 46 children who were delivered at home in 1982, so that our hospital sample accounts for 99.2% of all births in the city. The 5914 live born infants constitute our original cohort.

Brazil is a country with wide social disparities, and a population-based sample covering the entire social spectrum allows the detailed study of long-term consequences of poverty on health.

How often have they been followed-up, and what was attrition like?

Follow-up procedures have been somewhat haphazard, depending on the availability of funding. Table 1 summarizes the main visits to the cohort. Earlier publications provide further details about each visit.^{4,5}

In early 1983, the available funding was barely sufficient for visiting one-third of the cohort children. We opted for examining those born from January to April 1982, who were ~1 year old at the time. This visit was funded by the World Health Organization. Using the addresses available from hospital records, we examined 1457 children who, added to those known to have died, comprised ~80% of the target group (Table 1).

We became quite worried about the loss of one-fifth of the cohort in a single year, and decided to change the search strategy in the next visits. The 1984 and 1986 visits were planned well in advance, and received substantial funding from the United Kingdom's Department for International Development (then known as Overseas Development Administration). The objective was to examine every cohort child who was still living in the urban area. Rather than relying on addresses, in early 1984 we decided to visit every household in the city in search of children born in 1982. This led to 87% of the original cohort being traced,

¹ Programa de Pós-Graduação em Epidemiologia, Universidade Federal de Pelotas, Brasil.

² PAHO/WHO Latin American Centre for Perinatology, Montevideo, Uruguay.

* Corresponding author. Avenida Duque de Caxias, 250, CEP: 96030-002, Pelotas, Rio Grande do Sul, Brasil. E-mail: cvictora@terra.com.br

Table 1 Main phases of the Pelotas birth cohort study (reproduced with minor changes from ref. 5, with permission)

Year	Target population		Main sampling strategy	Mean age (range)	Number of subjects		Losses to follow-up ^a (%)
	Description	Number			Interviewed	Deceased ^a	
1982	All hospital births from January to December 1982	5914	Daily visits to all city hospitals	0 months	5914	0	–
1983	All children born from January to April 1982	1916	Visit to addresses obtained in hospital	11.3 months (8–16)	1457	66	20.7
1984	All cohort children	5914	Census of all households in the city (~70 000)	19.4 months (12–29)	4934	227	12.8
1986	All cohort children	5914	Census of all households in the city (~80 000)	43.1 months (35.4–53.0)	4742	237	15.9
1995	20% of cohort adolescents	1100	Visits to households based on the addresses collected in previous visits	13.1 years (12.5–13.7)	715	47	30.1
1997	27% of cohort adolescents	1597	Visits to all households in a systematic sample of 27% of the city's census tracts	14.7 years (14.0–15.6)	1076	70	28.2
2000	All male cohort adolescents	3037	Identification of adolescents attending the compulsory Army recruitment examination	18.2 years (17.6–19.1)	2250	143	21.1
2001	27% of cohort adolescents	1597	Visits to all households in a systematic sample of 27% of the city's census tracts	18.9 years (18.1–19.9)	1031	71	31.0
2004–05	All cohort members	5914	Census of all households in the city (~98 000) plus visit to previous addresses	22.8 years (21.9–23.7)	4297	282	77.4
On-going	Whole cohort	5914	Continuous monitoring of deaths in the State death registration database				

^a This includes those known to have died for the 1983, 1984, 1986, 2000, and 2005 visits, and 27% of those known to have died for the 1997 and 2001 visits.

a substantial improvement over the follow-up rate obtained a year earlier. Of those located, 45% of families had already changed addresses since the cohort child had been born, indicating a very high rate of mobility. The same approach was used in early 1986, leading to a follow-up rate of 84%.

At that stage, we had a massive amount of data to analyse as a small research unit. Because our primary interest was in child health, we assumed that the cohort study had been completed and set out to write up our results and become involved in other studies.

There was no new data collection until 1995, when we were approached by the United Nations Children's Fund (UNICEF) and Development Fund for Women (UNIFEM) to collect information on issues related to adolescent sexuality. Limited funds were available, and the addresses obtained in 1986 were used to trace a random sample of 1100 cohort members. Only 70% of them could be located.

This visit renewed our interest in the cohort, and in 1997 we decided to apply a similar approach to that used in the city censuses of 1984 and 1986. As funds—this time from the Brazilian government—were not available to cover the whole city, we systematically selected 70 census tracts (27% of the total) and visited every household in those tracts. This led to 72% of the cohort members expected to be living in those tracts to be traced.

A special opportunity for follow-up was provided by the compulsory Army recruitment examination, held in 2000. All cohort males who were still living in the city were legally

required to attend a local Army base to undergo a physical examination in August and September. Our research team was deployed to the base and was able to examine 79% of males from the cohort. Funds from the Brazilian government supported this examination.

2001 marked the end of adolescence for the cohort. We had special interest in investigating the high rates of teenage childbearing in the cohort, and obtained funding from the World Health Organization for this purpose. Using the national computerized birth registration system put in place in the late 1990s, we identified over 400 of cohort women who had delivered an infant up to March 2001, and visited them at home. To obtain a comparison group for a case-control analysis, we revisited all households in the 70 census tracts from the 1997 sample and examined all cohort subjects living in these tracts. An extensive interview was carried out with women and a shorter version with men, who had already been examined in the Army in 2000. The follow-up rate was 69%.

At this time, it was evident that we had the largest running birth cohort outside high-income countries, and our interest was renewed. We were able to obtain substantial funding from the Wellcome Trust to visit the whole cohort once again. From October 2004 to August 2005, we visited all 98 000 households in the city and located 3924 cohort members. The system for monitoring mortality had identified 282 deaths. For those who had not been located and were not known to have died, we used the last known address and existing databases (including universities, secondary schools, telephone directories) for

another attempt. This allowed us to interview 4297 subjects. Added to those known to have died, these represent a follow-up rate of ~77% in relation to the original cohort.

We have carried out several analyses of attrition rates according to baseline characteristics.⁵ The pattern of follow-up varies slightly according to the search strategy used, but in general subjects born to middle-class families are easier to trace than those born in either the upper or lower ends of the social distribution. There are no consistent differences in follow-up according to sex, birthweight, or skin colour. Subjects born to unmarried mothers are consistently harder to trace than those born in wedlock.

What has been measured?

The 1982 questionnaire was extremely short. Owing to our lack of experience, we worried about having several sheets of paper that might become separated and decided to use the longest sheet of paper commercially available (a bit longer than A4 size) and restrict the questionnaire to both sides of this sheet. All the information contained in this form took 80 columns in a punch card, which also made it rather convenient.

Table 2 shows the main categories of variables collected in the early phases of the study. In the hospital interview, mothers answered questions on socioeconomic, demographic, and health-related variables. Their infants were weighed with regularly calibrated paediatric scales (Filizolla, Brazil) to the nearest 10 g. Birth length was not recorded. Mothers were weighed and measured.

As we grew more confident, our questionnaires grew longer—possibly too much so—and the examinations more thorough. Table 3 shows the main categories of variables included in recent visits. The questionnaires now include two forms, one applied by an interviewer and another self-applied confidential form that is identified only by a questionnaire number.

In 2000, biological materials were collected from males (blood samples from which sera were extracted and frozen at -70°C) and in 2005 for both sexes (extracted DNA samples as well as sera). In 2000, males were weighed with an electronic Tanita Body Fat Analyzer scale (model TBF-305; Tokyo, Japan), which also provided information on body composition through bio-impedance. These results were validated in a sub-sample of 48 subjects by comparison with total body water estimated through isotopic methods.⁶

Ethical requirements evolved considerably during the study period. In the early phases, verbal consent was obtained, and there were no local ethical review committees. Recent phases comply with current requirements of ethical review and include written informed consent. Special provisions are made for the ethical use of biological materials.

What has it found?

A full list of all publications to date from the study is available as supplementary data at IJE Online.

The first publications from the cohort addressed perinatal issues, highlighting the magnitude of the problems of perinatal mortality and low birthweight, and describing risk factors for these outcomes.^{1,7,8} The extremely high rate of caesarean sections (28%) was also highlighted in the publications,⁹ as were infant mortality levels, causes, and risk factors.^{10–12}

Table 2 Main variables collected in the early phases of the cohort study (1982–86) (reproduced with minor changes from ref. 5, with permission)

Category	Examples of variables
Socioeconomic status and demographic variables	Family income Maternal and paternal education Household assets Parental occupation Family structure Number of siblings
Maternal characteristics	Maternal age Reproductive history Height Pre-pregnancy weight Smoking Skin colour
Pregnancy	Date of last menstrual period Birth interval Smoking during pregnancy Weight gain during pregnancy Antenatal care (attendances, when started) Health problems during pregnancy
Delivery	Birthweight Gestational age Type of delivery Perinatal morbidity
Mortality	Age of death Cause of death
Environmental characteristics	Water supply Sanitation Parental smoking Indoor pollution Crowding Type of housing
Health services utilization and morbidity	Medical attendances (number, reasons) Growth monitoring Number and cause for hospital admissions Vaccinations Type of health care provider Use of medicines Incidence of selected illnesses
Nutrition	Duration of breastfeeding Age at introduction of other foods 24 h food recall Weight and length/height Sitting height Head circumference
Child care	Who looks after the child Day-care attendance Role of father in child care
Maternal health	Minor psychiatric disorders score Reported morbidity Subsequent gestations
Psychosocial development	Age of attainment of developmental milestones Sphincter control

Table 3 Main variables collected in the late phases of the cohort study (1995–2005) (reproduced with minor changes from ref. 5, with permission)

Instrument	Variables	
Interviewer-applied questionnaire	Family situation	
	Schooling history, including performance	
	Study habits	
	Employment/salary	
	Participation in home chores	
	Friendship patterns	
	Leisure activities	
	Religious practices	
	Dietary habits	
	Smoking	
	Alcohol drinking	
	Physical activity	
	Community participation and sense of belonging	
	Romantic/intimate relationships: patterns, preferences, history	
	Knowledge of contraceptive options	
	Recent negative and positive events of household members	
	Morbidity history (accidents/violence, asthma, mental health, other health problems)	
	Use of health services	
	Offspring (dates of births, birthweight, breastfeeding duration)	
	Confidential questionnaire	Illicit drug use (self and friends)
		Knowledge about AIDS/STDs
		Exposure to sex education
		Body image
Self esteem		
Relationship with parents		
Age at first intercourse		
Frequency of intercourse		
Number of partners		
Contraceptive practices		
Condom use		
Use of health services		
Reproductive history (pregnancies, abortions, deliveries)		
Physical examination	Mental health assessment	
	Weight	
	Standing and sitting ^a height	
	Subscapular and triceps skinfold ^a	
	Body composition (bioimpedance) ^a	
	Waist circumference	
	Blood pressure	
Oral health		

^a Males only (Army examination in 2000).

Infant feeding patterns and their influence on health has been a major theme in our study.^{13–16} Given the prospective nature of our data, it has been possible to avoid some of the biases arising from using recalled breastfeeding duration in retrospective cohorts, and to investigate the long-term effects of

breastfeeding on health and educational attainment, while adjusting for several early life factors.^{17–19}

During the childhood phase, we investigated issues related to malnutrition and infection,^{20,21} as well as the associations between health and nutrition outcomes with maternal education²² and birth spacing.²³

A cross-cutting theme in our cohort study has been the effect of social inequalities on health.²⁴ In 1988, our book entitled 'Epidemiology of Inequality' came out in Portuguese, addressing social differentials in terms of perinatal, infant, and childhood outcomes.²⁵ Five thousand copies were sold, and the Spanish version was published by the Pan-American Health Organization in 1992.

More recent publications address issues of adolescent health, including the current epidemics of overweight,²⁶ adolescent pregnancy,²⁷ and asthma.²⁸

Much of our current work is aimed at investigating the effects of low birthweight (which we can separate into intrauterine growth restriction and preterm delivery) and growth in childhood on several outcomes. These include blood pressure,²⁹ overweight,²⁶ and lung function.²⁸ Analyses are forthcoming on blood lipids, glycaemia, body composition, oral health, and educational achievement.

What are the main strengths and weaknesses?

Cohorts from low-income and middle-income countries are needed because findings are likely to differ from those obtained in developed countries. Some exposures may have different characteristics—for example, most physical activity among males in our cohort is from occupation, rather than from leisure time activities. Another example is breastfeeding—whereas non-breastfed babies in high-income countries are likely to receive infant formula, in our setting cow's milk is the main breast milk substitute so the results of comparisons of breastfed and artificially fed infants may differ between populations. Also, some exposures—for example low birthweight or childhood malnutrition—are much more common than in developed countries, and their long-term effects can be studied with greater precision. Finally, confounding factors may act in different directions in rich and poor countries. For example, while breastfeeding tends to be associated with high socioeconomic status in wealthy populations, the reverse is often the case in low-income and middle-income countries. As a consequence, residual confounding—a critical issue in the study of the effects of breastfeeding on adult health—may operate in different directions.

A review by Harpman *et al.*³ identified our study as the largest and longest running prospective birth cohort study in a developing country. About 4000 variables are available for subjects seen in all phases of the study, including anthropometric measurements not only at birth but also at different ages in childhood. Other strengths include the population base and relatively high follow-up rates. Although the latter are considerably lower than some of the studies from developed countries, we have had to face the challenge of tracing people actively, rather than passively through national databases.

Our success is largely related to the characteristics of the city. Pelotas is a middle-size city with relatively low rates of

in-migration and out-migration. The number of annual births provides sufficient statistical power for the study, while being still logistically manageable. Also, concerns with personal and home security are not as manifest as in larger Latin American cities and refusals are rare.

On the negative side, there are many things that we—given the benefit of hindsight—would have done differently. At the perinatal interview, we should have measured birth length and assessed gestational age through physical examination (~20% of the mothers were unable to recall the dates of their last menstrual period). We collected data on family income as a grouped variable rather than recording it as a continuous variable.

In retrospect, obtaining information on the whole cohort at a smaller number of visits would probably have been better than using sub-samples. To date, we have data on the entire cohort for the original perinatal interview, the 1984, 1986, and 2004–05 follow-up visits, as well as for the 2000 Army examination for males. The 1983, 1995, 1997, and 2001 visits were based on sub-samples, with different sampling approaches. This means that only a few hundred subjects have complete data from all follow-up visits.

Some lessons were learned from the Pelotas cohort that may be relevant to other studies. A critical issue in all cohorts is that of attrition. Two successful strategies were used in our study: household sampling and Army enlistment. The first entailed visiting all, or a sample of, the city's households to identify individuals born in 1982, and later tracing them to their cohort records. The second included taking advantage of the compulsory Army enlistment process. Attempts at locating cohort members using available addresses, both in 1983 and in 1995, led to high rates of attrition.

Lessons can also be learned regarding administrative and financial aspects of the study. Funding agency fatigue means that few are prepared to support more than one to two rounds of the study. This precluded a more regular schedule of visits, and sampling fractions were sometimes determined by availability of funds rather than by scientific principles, as for example in the 1983 and 1995 follow-ups. Large birth cohort studies present specific funding issues that should deserve special treatment by grant-making agencies.

As cohort members reach adult age, it is likely that they will increasingly move out of the city, where job opportunities are scarce. This may lead to higher attrition in the near future. Alternative approaches will have to be conceived, including passive follow-up through death certificates and nested case-control studies, among others. Nevertheless, the large amount of data already available from the study will certainly lead to many additional analyses on health, behaviour, and development in childhood and adolescence.

Eleven years after the first cohort, we started another study—the 1993 Pelotas Birth Cohort—including all births in the city. The original plan was to launch it in 1992, a decade later than the first study, but of course funding was delayed. This study is underway and 87% of them were traced at the age of 12 years. In 2004, again 11 years later, the 2004 birth cohort was launched. The existence of three parallel birth cohorts is allowing a unique comparison of secular trends in child health, and in the future in adolescent and adult health.³⁰

Research groups involved in cohort studies have long realized that it is difficult, if not impossible, to stop the studies while at least some of the participants are still alive. We are finding it hard not only to stop our ongoing cohorts but also to refrain from starting a new one every 11 years. Watch this space for the 2015 Pelotas Birth Cohort Study!

Can I get hold of the data? Where can I find more?

We welcome joint analyses of the cohort data. We have collaborated successfully with investigators from the UK (London School of Hygiene and Tropical Medicine, Institute of Child Health), USA (Cornell, Emory and Michigan Universities) and Australia (University of Newcastle) as well as several Brazilian institutions. Our most fruitful experiences have been from having doctoral or post-doctoral fellows come to Pelotas for a few months at a time, to analyse data and write.

For interested young researchers from Latin America, we launched a Wellcome-Trust sponsored post-graduate programme in Life Course Epidemiology in 2005, which now includes six MSc and PhD students from the region who receive full scholarships to work on our cohorts. Applications are welcome.

For further information contact our website at http://www.epidemiio-ufpel.org.br/projetos_de_pesquisas/estudos/coorte_1982 or e-mail cvictora@terra.com.br.

Supplementary Data

Supplementary data are available at IJE Online.

Acknowledgements

This analysis was supported by the Wellcome Trusts initiative entitled Major Awards for Latin America on Health Consequences of Population Change. Earlier phases of the 1982 cohort study were funded by the International Development Research Center (Canada), the World Health Organization (Department of Child and Adolescent Health and Development, and Human Reproduction Programme), the Overseas Development Administration (UK), the United Nations Development Fund for Women, the National Program for Centers of Excellence (Brazil), the National Research Council (Brazil), and the Ministry of Health (Brazil). Special thanks to Patrick Vaughan who helped us launch the study in its early phases. We would also like to thank our many colleagues who participated in the several phases of the study, particularly Ana Maria Borges Teixeira, Angela Maas, Angela Oliveira, Ari Lemos Jr, Aydin Nazmi, Beatriz Guimarães, Bernardo Horta, Celene Longo da Silva, Cintia Lombardi Nash, Cora Araújo, Denise Gigante, Dominique Behague, Gicele Minten, Helen Gonçalves, Isabel Oliveira, Jorge Umberto Béria, José Carlos Martines, Luciana Anselmi, Magda Damiani, Mario Azevedo Jr, Paulo Orlando Monteiro, Paulo Post, Pedro Olinto, Rosângela Lima, Sharon Huttly, and Vera Silveira.

References

- Barros FC, Victora CG, Vaughan JP, Estanislau HJ. Perinatal mortality in southern Brazil: a population-based study of 7392 births. *Bull World Health Organ* 1987;**65**:95–104.

- 2 Barros F. *The Epidemiology of Perinatal Health in Southern Brazil: A Study of Perinatal Mortality, Low Birth Weight and the Utilisation of Health Care*. London, UK: University of London, 1985.
- 3 Harpham T, Huttly S, Wilson I, DeWet T. Linking public issues with private troubles: panel studies in developing countries. *J Int Dev* 2003;**15**:353–63.
- 4 Victora CG, Barros FC, Martines JC, Beria JU, Vaughan JP. Longitudinal study of children born in Pelotas, RS, Brazil in 1982. Methodology and preliminary results. *Rev Saude Publica* 1985;**19**:58–68.
- 5 Victora CG, Barros FC, Lima RC *et al*. The Pelotas birth cohort study, Rio Grande do Sul, Brazil, 1982–2001. *Cad Saude Publica* 2003;**19**:1241–56.
- 6 Wells JCK, Gigante DP, Wright A, Hallal PC, Victora CG. Validation of leg-to-leg impedance for body composition assessment among Brazilian males aged 16–19 years. *Int J Body Composition Res* 2003;**1**:1–6.
- 7 Barros FC, Victora CG, Vaughan JP, Jair Estanislau H. Low-birth weight in the municipality of Pelotas, Brazil: risk factors. *Bol Oficina Sanit Panam* 1987;**102**:541–54.
- 8 Barros FC, Huttly SR, Victora CG, Kirkwood BR, Vaughan JP. Comparison of the causes and consequences of prematurity and intrauterine growth retardation: a longitudinal study in southern Brazil. *Pediatrics* 1992;**90**:238–44.
- 9 Barros FC, Vaughan JP, Victora CG, Huttly SR. Epidemic of caesarean sections in Brazil. *Lancet* 1991;**338**:167–69.
- 10 Barros FC, Victora CG, Vaughan JP, Teixeira AM, Ashworth A. Infant mortality in southern Brazil: a population based study of causes of death. *Arch Dis Child* 1987;**62**:487–90.
- 11 Victora CG, Barros FC, Vaughan JP, Teixeira AM. Birthweight and infant mortality: a longitudinal study of 5914 Brazilian children. *Int J Epidemiol* 1987;**16**:239–45.
- 12 Victora CG, Barros FC, Huttly SR, Teixeira AM, Vaughan JP. Early childhood mortality in a Brazilian cohort: the roles of birthweight and socioeconomic status. *Int J Epidemiol* 1992;**21**:911–15.
- 13 Barros FC, Victora CG, Vaughan JP, Smith PG. Birth weight and duration of breast-feeding: are the beneficial effects of human milk being overestimated? *Pediatrics* 1986;**78**:656–61.
- 14 Barros FC, Victora CG, Vaughan JP. Breastfeeding and socioeconomic status in Southern Brazil. *Acta Paediatr Scand* 1986;**75**:558–62.
- 15 Victora CG, Huttly SR, Barros FC, Vaughan JP. Caesarean section and duration of breast feeding among Brazilians. *Arch Dis Child* 1990;**65**:632–34.
- 16 Victora CG, Huttly SR, Barros FC, Martines JC, Vaughan JP. Prolonged breastfeeding and malnutrition: confounding and effect modification in a Brazilian cohort study. *Epidemiology* 1991;**2**:175–81.
- 17 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.
- 18 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**:901–04.
- 19 Victora C, Barros F, Horta B, Lima R. Breastfeeding and school achievement in Brazilian adolescents. *Acta Paediatrica* 2005;**94**:1656–60.
- 20 Victora CG, Barros FC, Kirkwood BR, Vaughan JP. Pneumonia, diarrhoea, and growth in the first 4 y of life: a longitudinal study of 5914 urban Brazilian children. *Am J Clin Nutr* 1990;**52**:391–96.
- 21 Huttly SR, Victora CG, Barros FC, Teixeira AM, Vaughan JP. The timing of nutritional status determination: implications for interventions and growth monitoring. *Eur J Clin Nutr* 1991;**45**:85–95.
- 22 Victora CG, Huttly SR, Barros FC, Lombardi C, Vaughan JP. Maternal education in relation to early and late child health outcomes: findings from a Brazilian cohort study. *Soc Sci Med* 1992;**34**:899–905.
- 23 Huttly SR, Victora CG, Barros FC, Vaughan JP. Birth spacing and child health in urban Brazilian children. *Pediatrics* 1992;**89**:1049–54.
- 24 Victora CG, Vaughan JP, Barros FC, Silva AC, Tomasi E. Explaining trends in inequities: evidence from Brazilian child health studies. *Lancet* 2000;**356**:1093–98.
- 25 Victora CG, Barros FC, Vaughan JP. Epidemiologia da desigualdade: um estudo longitudinal de 6000 crianças brasileiras. São Paulo: HUCITEC, 1989.
- 26 Monteiro PO, Victora CG, Barros FC, Monteiro LM. Birth size, early childhood growth, and adolescent obesity in a Brazilian birth cohort. *Int J Obes Relat Metab Disord* 2003;**27**:1274–82.
- 27 Gigante DP, Victora CG, Gonçalves H, Lima RC, Barros FC, Rasmussen KM. Risk factors for childbearing during adolescence in a population-based birth cohort in southern Brazil. *Rev Panam Salud Publica* 2004;**16**:1–10.
- 28 Lima Rda C, Victora CG, Menezes AM, Barros FC. Respiratory function in adolescence in relation to low birth weight, preterm delivery, and intrauterine growth restriction. *Chest* 2005;**128**:2400–07.
- 29 Barros FC, Victora CG. Increased blood pressure in adolescents who were small for gestational age at birth: a cohort study in Brazil. *Int J Epidemiol* 1999;**28**:676–81.
- 30 Barros FC, Victora CG, Barros AJ *et al*. The challenge of reducing neonatal mortality in middle-income countries: findings from three Brazilian birth cohorts in 1982, 1993, and 2004. *Lancet* 2005;**365**:847–54.