Cohort Profile Update

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

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Abstract

In this manuscript, we update the profile of the 1982 Pelotas Birth Cohort Study. In 1982, 5914 live births whose families lived in the urban area of Pelotas were enrolled in the cohort. In 2012–13, we tried to locate the whole original cohort; 3701 participants were interviewed who, added to the 325 known deaths, represented a follow-up rate of 68.1%. In contrast to the previous home interviews, in this wave all participants were invited to visit the research clinic to be interviewed and examined. The visit was carried out at a mean age of 30.2 years and mainly focused on four categories of outcomes: (i) mental health; (ii) body composition; (iii) precursors of complex chronic diseases; and (iv) human capital. Requests for collaboration by outside researchers are welcome.

What is the rationale for the new focus?

In our previous cohort profile,1 we described how all births that occurred in 1982 in Pelotas, a southern Brazilian city, were identified. Liveborns whose families lived in the urban area of the city were followed up until adulthood. The 1982 Pelotas birth cohort is considered one of the largest and longest-running birth cohorts in low- and middle-income countries.2 The early phases of the study have provided valuable data on the consequences of infant feeding for child health3,4 and on risk factors for infant

Key Messages

• It is possible to recruit a population-based cohort and achieve high follow-up rates after 30 years in a middle-income setting.
• The existence of three other younger birth cohorts in the same population allows the evaluation of time trends in health indicators.
• In a cohort where undernutrition was common in early life, extremely high prevalence of overweight and obesity are observed at the age of 30 years.
mortality and undernutrition. Over time the focus of the study changed, and recent visits evaluated the frequency of precursors of chronic diseases and their risk factors. We have assessed the long-term consequences of early exposures, such as caesarean sections, infant feeding patterns and early growth.

Non-communicable diseases (particularly cardiovascular disease, cancer, asthma, chronic obstructive pulmonary disease (COPD), obesity, type 2 diabetes and depression) are the major contributors to the burden of disease, in high-income as well as in middle-income countries. Although the causes of these epidemics are not fully understood, exposures taking place in utero and in early life are consistently associated with their occurrence. Models of chronic complex disease aetiology tend to focus on risk factors and physiological states relatively close (proximal) in time to the onset of disease, giving limited if any emphasis to processes that lead up to the peak or optimal phenotypic state that is achieved in late adolescence or early adulthood. Studies of the peak phenotypic state are important given its major potential role in influencing susceptibility to complex chronic diseases, being a key component of the developmental models of disease causation.

The project received a grant from the Wellcome Trust, which enabled us to equip our new university headquarters with state-of-the-art equipment for the measurement of body composition, physical activity, lung function and other precursors of chronic disease, allowing the assessment of these phenotypes in young adults.

What will be the new areas of research?

From June 2012 to February 2013, all cohort members were invited to visit the research clinic in order to be interviewed and examined. The main outcomes in the 30-year follow-up included precursors of complex chronic diseases and their risk factors such as body composition, physical activity and diet. Furthermore, human capital and mental health outcomes were also evaluated. By using data gathered in the previous wave of the cohort, we plan to evaluate the effect of socioeconomic trajectories, early-life exposures and gene-environment interactions on the main outcomes.

Who is in the cohort?

Previous to the 30-years visit, follow-up visits were carried out at the mean ages of 1, 2, 4, 13, 15, 18, 19 and 23 years. Most visits included subsamples of the cohort, except for those at 2, 4 and 23 years. In the last, we attempted to locate the whole cohort. Initially, a city census was carried out in search of cohort members, as many of them had changed address since the previous round. Those who were not located during the census were sought at their most recent available address. Participants answered a questionnaire and were examined at home, and then invited to visit the research laboratory to donate a blood sample, collected by venipuncture.

In February 2012, the research team tried to trace cohort members and update information on addresses and phone numbers. We tried to locate all participants who were not known to have died, using multiple strategies. Initially, they were sought at their last known address; those who were not located were sought at existing databases (university databases, telephone directories and social media). This strategy allowed us to locate 4534 members. A total of 3701 were interviewed, 467 were living far from Pelotas, 86 refused and another 280—although not having openly refused—did not attend the clinic in spite of repeated invitations. The follow-up rate was estimated by adding the number of interviews (n = 3701) to the number of participants known to have died (n = 325); these made up 68.1% of the original cohort. The mean age at interview was 30.2 years.

Table 1 shows that follow-up rates in 2012–13 were slightly higher among females, those who were born pre-term and those in the intermediate socioeconomic categories, whereas birthweight was not related to attrition.

What has been measured?

Unlike the previous visits, this wave of the cohort was carried out at our research clinic. Each participant stayed in the clinic for 3–4 h. The visit included an interview, physical examination, collection of biological samples and assessment of physical activity.

Interviews

The interview included three sections: confidential, interviewer-applied and computerized food frequency questionnaire. The latter evaluated the participants’ annual intake of 88 food items. Table 2 shows the main categories of the variables collected using questionnaires; mental health and intelligence quotient were evaluated for the first time.

Four psychologists assessed mental health and intelligence quotient. The Mini International Neuropsychiatry Interview V5.0 (MINI) was used to detect the presence of depression, attention deficit / hyperactivity disorder, suicidal ideation, generalized anxiety disorder, agoraphobia and social phobia. The Beck Depression Inventory (BDI-II) assessed the intensity and frequency of depression symptoms. Intelligence was measured using the Wechsler Adult Intelligence Scale, Third Version (WAIS-III).
**Table 1.** Follow-up rate at 30 years of age according to baseline characteristics of the cohort

| Variable                        | Original cohort (number) | Followed at 30 yearsa |
|---------------------------------|--------------------------|-----------------------|
| Sex                             |                          |                       |
| Male                            | 3037                     | 65.2%                 |
| Female                          | 2876                     | 71.1%                 |
| Birthweight (g)                 |                          |                       |
| < 2500                          | 534                      | 72.1%                 |
| 2500–2999                       | 1393                     | 69.1%                 |
| 3000–3499                       | 2220                     | 66.0%                 |
| ≥ 3500                          | 1762                     | 68.6%                 |
| Gestational age (weeks)         |                          |                       |
| 37                              | 294                      | 74.5%                 |
| ≥ 37                            | 4380                     | 68.1%                 |
| Family income at birth (minimum wages) |                  |                       |
| < 1                             | 1288                     | 66.1%                 |
| 1.1–3                           | 2789                     | 70.4%                 |
| 3.1–6                           | 1091                     | 69.3%                 |
| 6.1–10                          | 382                      | 61.3%                 |
| ≥ 10                            | 335                      | 60.3%                 |
| Maternal schooling (years)      |                          |                       |
| 0–4                             | 1960                     | 68.0%                 |
| 5–8                             | 2454                     | 70.5%                 |
| 9–11                            | 654                      | 66.1%                 |
| ≥ 12                            | 839                      | 62.8%                 |

aThose participants who were known to have died were considered as followed.

**Physical examinations**

In the previous visits, the physical examination had consisted of measurements of blood pressure, weight, height and waist circumference. In this wave, an increased number of physical assessments were performed. Body composition was evaluated using dual-energy X-ray absorptiometry (DXA Lunar Prodigy) and air-displacement plethysmography (BodPod). A photonic scanner (3-DPS) was used to capture body surface topography, from which extensive body shape information can be extracted using computer algorithms. We relied on traditional anthropometry to measure height, sitting height and waist circumference. The thickness of the adductor pollicis muscle and skinfolds (triceps and subscapular) was assessed with a Lange caliper. Ultrasound examination (Toshiba Xario) was used to measure visceral and subcutaneous abdominal fat, as well as carotid intima-media thickness. Pulse wave velocity was also assessed [Sphygmocor (Atcor Medical, V9.0)]. Spirometry was undertaken using a portable, Easy-One spirometer (Medical Technologies, Zurich, Switzerland) following American Thoracic Society recommended procedures, before and 15 min after inhalation of 200 μg salbutamol. A saliva sample was collected from a subsample of participants for deuterium body composition analysis (n = 204).

For the first time in the cohort, physical activity was evaluated using a GENEActiv accelerometer (ActivInsights, Kimbolton, UK). The monitor was worn on...
the non-dominant wrist for 4–7 days, and collected at the participant’s home at the end of this period.

Blood samples
Blood samples were collected and DNA was extracted from venous blood. Serum, whole blood and DNA samples were stored at adequate temperatures. Total cholesterol, HDL-cholesterol, LDL-cholesterol, C-reactive protein and glycated haemoglobin were measured. In 2012, DNA samples collected in the 2004–05 visits were genotyped using the Illumina Omni 2.5 M array.

What has it found? Key findings and publications
Data analyses are currently under way, and Table 3 presents some illustrative results that have not been published elsewhere.

Mental health. The proportion of participants diagnosed as presenting common mental disorders was slightly lower at 30 than at 23 years of age. In both waves, females had higher prevalence than males. In the 2012–13 visit, major depression was also more commonly diagnosed among females than males.

Body composition. Over a time span of 7 years, we observed a sharp increase in the mean body mass index, as well as in the prevalence of overweight and obesity. Percent fat mass and subcutaneous fat thickness (assessed through ultrasound) were higher among women, whereas visceral abdominal fat thickness was higher among men.

Precursors of complex chronic diseases. Males presented higher blood pressure and carotid intima thickness. Table 3 shows that mean systolic blood pressure increased from 2004–05 to 2012–13. On the other hand, the prevalence of smoking slightly decreased from 23 to 30 years of age, for both sexes.

Human capital. Achieved schooling was higher among females, but males participants scored higher in intelligence tests.

What are the main strengths and weaknesses?
In the 2012–13 visit, we managed to locate 68.1% of the cohort. This follow-up rate is similar to that observed in cohorts from high-income countries at a similar age, and higher than in other cohorts from LMICs.

Table 3. Characteristics of the studied population at the 2004–05 and 2012–13 visits according to mental health, body composition, precursors of complex chronic diseases and human capital variables

| Indicator | 2004–05 | | 2012–13 | |
|-----------|---------|---------|---------|---------|
|           | Men | Women | Men | Women |
| Mental health | | | | |
| Prevalence of common mental disorders | 23.5% | 32.8% | 20.0% | 31.5% |
| Prevalence of major depressive episode | NA | NA | 4.6% | 12.5% |
| Prevalence of attention deficit / hyperactivity disorder | NA | NA | 3.0% | 4.2% |
| Body composition | | | | |
| Body mass index (kg/m²) | 23.8 (4.1) | 23.4 (4.6) | 27.0 (5.0) | 26.7 (6.0) |
| Prevalence of overweight (body mass index > 25 kg/m²) | 30.7% | 25.6% | 62.9% | 52.4% |
| Prevalence of obesity (body mass index > 30 kg/m²) | 7.5% | 9.1% | 22.1% | 23.8% |
| Visceral abdominal fat thickness (cm) | NA | NA | 6.9 (2.0) | 4.9 (1.7) |
| Subcutaneous abdominal fat thickness (cm) | NA | NA | 1.9 (1.0) | 2.6 (1.2) |
| Fat mass percentage (BodPod) | NA | NA | 24.5 (9.2) | 37.4 (8.5) |
| Precursors of chronic disease | | | | |
| Systolic blood pressure (mmHg) | 123 (14) | 111 (13) | 128 (12) | 115 (12) |
| Diastolic blood pressure (mmHg) | 76 (12) | 71 (11) | 77 (9) | 74 (9) |
| Carotid intima-media thickness (µm) | NA | NA | 585 (21) | 579 (15) |
| Prevalence of tobacco smoking | 27.6 | 23.6 | 26.0 | 21.3 |
| Forced expiratory volume in 1 s (l/s) | NA | NA | 4.0 (0.6) | 2.9 (0.5) |
| Human capital | | | | |
| Achieved schooling (years) | 9.0 (3.1) | 9.8 (3.1) | 10.9 (4.0) | 11.7 (4.3) |
| Intelligence quotient (points) | NA | NA | 98.5 (12.8) | 97.5 (12.4) |

NA, data not available.

*Mean and standard deviation.
Furthermore, we were able to carry out a very thorough physical examination of participants, collecting data on several precursors of chronic diseases and evaluating some phenotypes close to their peak. In particular, this is one of the largest prospective cohort samples with data derived from DXA, plethysmography, abdominal ultrasound and 3-D photonic scanner. This plethora of information will allow a better understanding of the role of early exposures on the programming of chronic diseases and nutritional status.

Another strength is that, for some early exposures (such as breastfeeding), the confounding pattern in terms of early exposures differs from that observed in high-income settings. Comparison of cohorts with different confounding structures may allow more valid assessments of causality.21

The 1982 birth cohort included >99% of all births that took place in the city in that year, and therefore may be regarded as a representative sample of the city’s population. Likewise, we recruited a similar cohort in 1993 and in 2004, and recruitment for the 2015 cohort is currently under way. The existence of four cohorts, 11 years apart, with similar methodology and in the same population, is an important strength of our set of studies.

On the other hand, in spite of being able to follow a high proportion of the cohort, the attrition rate was slightly higher among the very poor and the wealthy participants. Nevertheless, follow-up rates among different subgroups are reasonably similar (ranging from 60% to 75% in all variables studied), so that attrition bias is unlikely.

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

We welcome requests for joint analyses with other cohorts and collaboration with outside researchers, as well as exchange of doctoral or post-doctoral fellows with other institutions. We encourage outside researchers to spend some time in Pelotas to get to know the cohort and the datasets. With respect to collaboration with other cohort studies, our group launched the COHORTS consortium,20 and have collaborated with the Avon Longitudinal Study of Parents and Children (ALSPAC).22,23 Collaborations with genetic epidemiology consortia are being established now that our genome-wide association study (GWAS) results are available.

The questionnaires and interviewer guides from all follow-up visits are available in electronic formats at [http://www.epidemio-ufpel.org.br/site/content/estudos/formularios.php]. Applications to use the data should be made by contacting the researchers of the 1982 cohort and completing the application form for the Pelotas Birth Cohorts available at [http://www.epidemio-ufpel.org.br/site/content/coorte_1982/questi onarios.php].

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References

1. Victora CG, Barros FC. Cohort Profile: The 1982 Pelotas (Brazil) Birth Cohort study. Int J Epidemiol 2006;35:237–42.
2. Harpham T, Hurley S, Wilson I, Wet TD. Linking public issues with private troubles: panel studies in developing countries. J Int Dev 2003;15:533–63.
3. 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.
4. Victora CG, Horta SR, Barros FC, Martins JC, Vaughan JP. Prolonged breastfeeding and malnutrition: confounding and effect modification in a Brazilian cohort study. Epidemiology 1991;2:175–81.
5. 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.
6. Victora CG, Barros FC, Horta 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.
7. Barros FC, Matijasevich A, Hallal PC et al. Cesarean section and risk of obesity in childhood, adolescence, and early adulthood: evidence from 3 Brazilian birth cohorts. Am J Clin Nutr 2012;95:465–70.
8. Horta BL, Gigante DP, Lima RC, Barros FC, Victora CG. Birth by caesarean section and prevalence of risk factors for non-communicable diseases in young adults: a birth cohort study. PLoS One 2013;8:e74301.
9. Victora CG, Barros FC, Horta BL, Lima RC. Breastfeeding and school achievement in Brazilian adolescents. Acta Paediatr 2005;94:1656–60.
10. Horta BL, Gigante DP, Osmond C, Barros FC, Victora CG. Intergenerational effect of weight gain in childhood on offspring birthweight. Int J Epidemiol 2009;38:724–32.
11. Horta BL, Victora CG, Lima RC, Post P. Weight gain in childhood and blood lipids in adolescence. *Acta Paediatr* 2009;98:1024–28.

12. Lopez AD, Mathers CD, Ezzati M, Jamison DT, Murray CJ. Global and regional burden of disease and risk factors, 2001: systematic analysis of population health data. *Lancet* 2006;367:1747–57.

13. Andersen LG, Angquist L, Eriksson JG et al. Birth weight, childhood body mass index and risk of coronary heart disease in adults: combined historical cohort studies. *PLoS One* 2010;5:e14126.

14. Gluckman PD, Hanson MA, Cooper C, Thornburg KL. Effect of in utero and early-life conditions on adult health and disease. *N Engl J Med* 2008;359:61–73.

15. Batty GD, Alves JG, Correia J, Lawlor DA. Examining life-course influences on chronic disease: the importance of birth cohort studies from low- and middle-income countries. An overview. *Braz J Med Biol Res* 2007;40:1277–86.

16. Amorim P, Lecrubier Y, Weiller E, Hergueta T, Sheehan D. DSM-III-R Psychotic Disorders: procedural validity of the Mini International Neuropsychiatric Interview (MINI). Concordance and causes for discordance with the CIDI. *Eur Psychiatry* 1998;13:26–34.

17. American Thoracic Society. Standardization of spirometry, 1994 update. *Am J Respir Crit Care Med* 1995;152:1107–36.

18. Power C, Elliott J. Cohort Profile: The 1958 British Birth Cohort (National Child Development Study). *Int J Epidemiol* 2006;35:34–41.

19. Elliott J, Shepherd P. Cohort Profile: The 1970 British Birth Cohort (BCS70). *Int J Epidemiol* 2006;35:836–43.

20. Richter LM, Victora CG, Hallal PC et al. Cohort Profile: The Consortium of Health-Orientated Research in Transitioning Societies. *Int J Epidemiol* 2012;41:621–26.

21. Brion MJ, Lawlor DA, Matijasevich A et al. What are the causal effects of breastfeeding on IQ, obesity and blood pressure? Evidence from comparing high-income with middle-income cohorts. *Int J Epidemiol* 2011;40:670–80.

22. Matijasevich A, Victora CG, Golding J et al. Socioeconomic position and overweight among adolescents: data from birth cohort studies in Brazil and the UK. *BMC Public Health* 2009;9:105.

23. Matijasevich A, Victora CG, Lawlor DA et al. Association of socioeconomic position with maternal pregnancy and infant health outcomes in birth cohort studies from Brazil and the UK. *J Epidemiol Community Health* 2012;66:127–35.