Cohort Profile

Cohort Profile: Longitudinal Study of Adult Health (ELSA-Brasil)

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Abstract

Chronic diseases are a global problem, yet information on their determinants is generally scant in low- and middle-income countries. The Brazilian Longitudinal Study of Adult Health (ELSA-Brasil) aims to contribute relevant information regarding the development and progression of clinical and subclinical chronic diseases, particularly cardiovascular diseases and diabetes, in one such setting. At Visit 1, we enrolled 15,105 civil servants from predefined universities or research institutes. Baseline assessment (2008–10) included detailed interviews and measurements to assess social and biological determinants of health, as well as various clinical and subclinical conditions related to diabetes, cardiovascular diseases and mental health. A second visit of interviews and examinations is under way (2012–14) to enrich the assessment of cohort exposures and to detect initial incident events. Annual surveillance has been conducted since 2009 for the ascertainment of incident events. Biological samples (sera, plasma, urine and DNA) obtained at both visits have been placed in long-term storage. Baseline data are available for analyses, and collaboration via specific research proposals directed to study investigators is welcome.

Key words: Cardiovascular diseases, chronic diseases, cohort studies, developing countries, diabetes mellitus, occupational health, social determinants of health, obesity.
Why was the cohort set up?

Chronic non-communicable diseases (NCDs) are a global health problem.\textsuperscript{1,2} In Brazil, 72% of all deaths are attributable to cardiovascular diseases and other NCDs. Given population ageing and the reduction in morbidity and mortality related to infections and to maternal and child problems, the proportional burden of chronic diseases is likely to increase over the next decades. Brazil is also experiencing a rapid nutritional transition, with marked increases in overweight and obesity across all social strata but more so among the poor and those with lesser education. Not surprisingly, diabetes morbidity and mortality are increasing.\textsuperscript{3,4}

Few longitudinal assessments of chronic diseases are available in Brazil, or for that matter, in other low- and middle-income countries. Thus, the Brazilian Longitudinal Study of Adult Health (in Portuguese, ‘Estudo Longitudinal de Saúde do Adulto’, ELSA-Brasil) aims to investigate the development of chronic diseases, primarily diabetes and cardiovascular diseases, over a long-term follow-up. The ongoing demographic, nutritional and epidemiological changes occurring in a context of high social inequalities and socio-economic progress create a window of opportunity to understand how macro- and micro-level factors influence chronic disease causation and prevention.

Where is it located, who set it up, and how has it been funded?

With funding from the Brazilian government, as detailed in Acknowledgements, a group of Brazilian epidemiologists and clinicians from six institutions (Federal Universities of Bahia, Espirito Santo, Minas Gerais and Rio Grande do Sul; University of Sao Paulo; and Oswaldo Cruz Foundation), led by the authors of this article, organized the Study in centres located in state capitals of the northeastern, south-eastern and southern regions of Brazil.

Who is in the cohort?

All active or retired employees of the six institutions (and, in a few instances, also of related educational or health institutions), of both sexes, and with ages between 35 and 74 years, were eligible for the study, totalling, in 2008, 52,137 potential participants. We chose civil servants as the source of the study population in order to minimize losses to follow-up related to geographical mobility. Exclusion criteria were severe cognitive or communication impairment, intention to quit work at the institution in the near future for reasons not related to retirement, and, if retired, residence outside the corresponding metropolitan area. Women with current or recent pregnancy were rescheduled so that the first interview could take place at least 4 months after delivery.

Volunteers were recruited through on-site and radio announcements, mailings, outdoor billboards and telephone calls, the latter more commonly used to attract retirees. A randomly ordered list of employees, stratified by sex, age and occupational category, was also used to actively recruit eligible participants. Efforts were made to recruit similar proportions of men and women as well as predefined proportions of age groups and occupational categories.\textsuperscript{5} From a total of 16,435 who expressed interest in participation, 15,821 were pre-enrolled, gave written consent, responded to an initial interview and were scheduled for the baseline examination. Only 716 (4.5%) of those pre-enrolled did not complete the baseline examination.

Key Messages

- Baseline findings from ELSA-Brasil show a high frequency of behavioural risk factors and clinical milestones for non-communicable diseases: 63.1% excess weight, 61.5% high cholesterol, 35.8% high blood pressure and 20.3% impaired glucose tolerance. The main diseases of interest are also frequently observed, diabetes is present in 19.7%, common mental disorders in 26.7% and a history of coronary heart disease in 4.7%.
- Subjective social status, assessed by three 10-rung ladders, was independently associated with poor self-rated health and weakly associated with former smoking.
- The use of antidepressant and benzodiazepine medication was less frequent than in high-income countries. Increasing age and educational achievement were associated with greater use of these medications. The presence of major depression and generalized anxiety disorder were poor predictors of such use, suggesting misuse/overuse among those without and underuse among those with psychiatric conditions.
- Starting in the midst of the obesity epidemic and having information on a wide range of exposures, including the role of neighbourhood and social life-course adversities, ELSA-Brasil will permit novel investigations which will allow the testing of more comprehensive causal models for diabetes, cardiovascular and other chronic diseases.
A total of 15,105 participants were enrolled, 6,887 men and 8,218 women, thus giving reasonably large numbers for sex-specific analyses. Table 1 shows that, as assessed through self-identification, 52.2% considered themselves to be White, 16.1% Black and 28.2% Brown (‘pardo’). Given the nature of the sample, about half had a university degree and a smaller proportion (12.7%) did not have a complete secondary level of education. Worth noting, however, as indicated by the frequency of maternal schooling, the background of the cohort participants was very different: only a small proportion (6.5%) of participants’ mothers had a university degree and about half had never attended or did not complete elementary school.

In collaboration with economists from the Centre of Regional Development and Planning (CEDEPLAR) of the University of Minas Gerais, information concerning present (or last, if retired) and first employment together with educational achievement and income were used to classify participants according to social class, nature of occupation and social mobility (based on nature of occupation). One-fourth of participants were classified as being of low social class and over half as having non-manual, non-routine jobs and an ascending job trajectory. These results will allow us to investigate new aspects of the social determinants of health in a changing social environment of an emerging economy.

**How often have they been followed up?**

**What has been measured?**

After about 4 years (August 2009 to December 2013) of follow-up, 178 (1.2%) participants have died. All participants who are alive are being invited for the second visit of interviews and examinations according to the date of enrolment. As of December 2013, 9,916 (66.2%) have completed this examination.

Table 2 summarizes the broad categories of measurements taken at baseline (detailed description can be found in a previous report) and at the second visit to the ELSA centres. Annual telephone interviews include questions on self-rated health, new diagnosis of conditions of interest, hospitalizations and specific medical procedures such as dialysis, revascularization and cancer biopsy. Potential events are then investigated and classified according to study protocol by a panel of physicians trained according to international classification criteria. Surveillance of clinical events is also conducted through employer reports and linkage to national databases such as the National Mortality System. Main clinical endpoints are acute myocardial infarction, unstable angina pectoris, cardiac revascularization, sudden cardiac death, heart failure, peripheral arterial disease, stroke, hypertension, chronic kidney diseases and diabetes. The study also ascertains diabetes-related events (blindness, amputation) and acute complications resulting in hospitalizations (ketoacidosis, hyperosmolar state and severe hypoglycaemia), chronic kidney disease, venous thrombosis, pulmonary embolism.

| Characteristics                          | N  | %  |
|------------------------------------------|----|----|
| **Sex**                                  |    |    |
| Men                                      | 6887 | 45.6 |
| Women                                    | 8218 | 54.4 |
| **Age (years)**                          |    |    |
| 35–44                                    | 3340 | 22.1 |
| 45–54                                    | 5939 | 39.3 |
| 55–64                                    | 4234 | 28.0 |
| 65–74                                    | 1592 | 10.6 |
| **Self-identified skin colour / race category** |    |    |
| White                                    | 7791 | 52.2 |
| Black                                    | 2397 | 16.1 |
| Brown (‘pardo’)                          | 4202 | 28.2 |
| Asian                                    | 374  | 2.5 |
| Indigenous                               | 157  | 1.0 |
| **Region**                               |    |    |
| North-east                               | 2029 | 13.4 |
| South-east                               | 11015 | 72.9 |
| South                                    | 2061 | 13.7 |
| **Educational level**                    |    |    |
| Never attended school or incomplete elementary school | 894 |  5.9 |
| Complete elementary school or incomplete secondary school | 1028 |  6.8 |
| Complete secondary school                | 5233 | 34.6 |
| University degree                        | 7950 | 52.7 |
| **Maternal educational level**           |    |    |
| Never attended school or incomplete elementary school | 8357 |  56.7 |
| Complete elementary school or incomplete secondary school | 2869 |  19.5 |
| Complete secondary school                | 2558 | 17.3 |
| University degree                        | 955  | 6.5 |
| **Social class**                         |    |    |
| Low                                      | 4317 | 25.1 |
| Middle                                   | 5974 | 43.5 |
| High                                     | 3455 | 31.4 |
| **Occupation**                           |    |    |
| Manual                                   | 3019 | 18.4 |
| Routine, non-manual                      | 2360 | 29.0 |
| Non-routine, non-manual                  | 7355 | 53.0 |
| **Intragenerational social mobility**    |    |    |
| Descending                               | 3019 | 23.7 |
| Stable                                   | 2360 | 18.5 |
| Ascending                                | 7355 | 57.8 |

Small differences in total N for each variable are due to missing values. Social class coded for the 13,746 with available information, and occupation and intragenerational social mobility for the 12,734 with this information.
and common sites of cancer. Additionally, we will investigate changes in weight, lipids and other metabolic markers, urinary albumin-to-creatinine ratio, cognitive function and the diagnosis of specific common mental disorders.

**What has it found? Key findings and publications**

As seen in Table 3, behavioural risk factors at baseline were highly prevalent, especially among men, illustrating the study’s potential for risk factor analyses with relevant outcomes; of note, the prevalence of ex-smokers is high, reflecting the decline in smoking observed in Brazil over the past two decades. Table 3 also presents the frequency of self-reported chronic clinical or subclinical conditions relevant to the investigation of diabetes and cardiovascular diseases at baseline. As the study was initiated within the global obesity epidemic, overweight and obesity are highly prevalent (63.1% presenting excess weight). Other chronic conditions such as mild chronic inflammation, hypertension/pre-hypertension, hypercholesterolaemia, high triglycerides and low high-density lipoprotein-C (HDL-C), diabetes/pre-diabetes, elevated urinary albumin-to-creatinine ratio and low estimated glomerular filtration rate are also prevalent. Seropositivity for Chagas disease, seen in 115 participants (0.8%), will permit better...
Table 3. Prevalence of selected behavioural risk factors, measured diseases or conditions and self-reported chronic diseases in the Brazilian Longitudinal Study of Adult Health, N = 15,105, 2008–10

| Factors                                      | Overall | N  | %  | Men | N  | %  | Women | N  | %  |
|----------------------------------------------|---------|----|----|-----|----|----|--------|----|----|
| Behavioural risk factors                     |         |    |    |     |    |    |        |    |    |
| Excessive drinking                            | 1125    | 7.5|     | 838 | 12.2|     | 287    | 3.5|     |
| Binge drinking                                | 1993    | 13.2|     | 1438| 20.9|     | 555    | 6.8|     |
| < recommended daily fruit intake              | 6413    | 42.5|     | 3543| 51.5|     | 2870   | 35.0|    |
| < recommended daily vegetable intake          | 7249    | 48.1|     | 3747| 54.5|     | 3502   | 42.7|    |
| Low leisure time physical activity            | 11436   | 76.9|     | 4984| 73.4|     | 6472   | 79.9|    |
| Current smoking                               | 1977    | 13.1|     | 984 | 14.3|     | 993    | 12.1|    |
| Former smoking                                | 4533    | 30.0|     | 2436| 35.4|     | 2097   | 25.5|    |
| Measured diseases/conditions                  |         |    |    |     |    |    |        |    |    |
| Obesity (BMI ≥30 kg/m²)                       | 3463    | 22.9|     | 1426| 20.7|     | 2037   | 24.8|    |
| Overweight (25 ≤ BMI < 30 kg/m²)              | 6072    | 40.2|     | 3113| 45.2|     | 2959   | 36.0|    |
| Hypertension                                 | 5402    | 35.8|     | 2760| 40.1|     | 2642   | 32.2|    |
| Pre-hypertension                             | 3546    | 23.5|     | 2020| 29.4|     | 1526   | 18.6|    |
| Hypercholesterolemia                         | 9282    | 61.5|     | 4056| 58.9|     | 5226   | 63.6|    |
| Low HDL-C                                   | 2712    | 18.0|     | 1009| 14.7|     | 1703   | 20.7|    |
| Hypertriglyceridaemia                         | 4704    | 31.2|     | 2813| 40.9|     | 1891   | 23.0|    |
| Diabetes                                     | 2969    | 20.0|     | 1603| 23.3|     | 1366   | 16.6|    |
| Impaired fasting glucose, ADA                 | 7947    | 52.6|     | 4050| 58.8|     | 3897   | 47.4|    |
| Impaired fasting glucose, WHO                 | 2887    | 19.1|     | 1680| 24.4|     | 1207   | 14.7|    |
| Impaired glucose tolerance                   | 3066    | 20.3|     | 1456| 21.1|     | 1610   | 20.0|    |
| Elevated hsCRP                               | 4229    | 28.0|     | 1565| 22.8|     | 2664   | 32.5|    |
| Elevated UACR                                 | 736     | 5.0 |     | 408 | 6.1 |     | 328    | 4.1 |    |
| Low eGFR (<60 ml/min)                         | 681     | 4.6 |     | 359 | 5.3 |     | 322    | 4.0 |    |
| Hypothyroidy                                 | 119     | 0.8 |     | 49  | 0.7 |     | 70     | 0.8 |    |
| Chagas disease seropositivity                | 115     | 0.8 |     | 57  | 0.8 |     | 58     | 0.7 |    |
| Common mental disorders                       | 4036    | 26.7|     | 1265| 18.4|     | 2771   | 33.7|    |
| Depression                                   | 637     | 4.2 |     | 159 | 2.3 |     | 478    | 5.8 |    |
| Anxiety                                      | 2436    | 16.1|     | 762 | 11.1|     | 1674   | 20.4|    |
| Self reported chronic diseases                |         |    |    |     |    |    |        |    |    |
| Coronary heart disease                       | 721     | 4.7 |     | 393 | 5.7 |     | 328    | 4.0 |    |
| Heart failure                                | 251     | 1.7 |     | 128 | 1.9 |     | 123    | 1.5 |    |
| Stroke                                       | 197     | 1.3 |     | 90  | 1.3 |     | 107    | 1.3 |    |
| Rheumatic fever                              | 433     | 2.9 |     | 155 | 2.2 |     | 278    | 3.4 |    |
| Chagas disease                               | 64      | 0.4 |     | 31  | 0.4 |     | 33     | 0.4 |    |
| Cancer                                       | 695     | 4.6 |     | 284 | 4.1 |     | 411    | 5.0 |    |
| Asthma                                       | 1758    | 11.6|     | 691 | 10.0|     | 1067   | 13.0|    |
| COPD                                         | 308     | 2.0 |     | 124 | 1.8 |     | 184    | 2.2 |    |
| Cirrhosis or hepatitis                       | 1303    | 8.6 |     | 608 | 8.8 |     | 695    | 8.5 |    |
| Polycystic ovary syndrome                    | –       | –   |     | –   | –   |     | 903    | 11.1|    |

Small differences in number of participants for each outcome are due to missing values.

* Excessive drinking defined as >210 g alcohol/week for men and 140 g alcohol/week for women.

* Defined as the consumption of 5 or more doses of alcohol in a period of 2 h at least 2–3 times per month over the past 12 months.

* Defined as systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg, or verified treatment with anti-hypertensive medication during the past 2 weeks.

* Defined as systolic blood pressure ≥120 and diastolic blood pressure ≥80 mmHg.

* Non-hypertensive participants with systolic blood pressure 120–139 mmHg or diastolic blood pressure 80–89 mmHg.

* Fasting glucose 5.5–6.9 mmol/l (100–125 mg/dl), American Diabetes Association.

* Fasting glucose 6.1–6.9 mmol/l (110–125 mg/dl), World Health Organization.

* 2-h glucose 7.8–11.0 mmol/l (140–199 mg/dl).

* Thyroid-stimulating hormone (TSH) >4.0 mU/l and thyroxine (T4) <1.16 pmol/l (0.9 ng/dl).

* Defined as a score ≥12 obtained in the Clinical Interview Schedule-Revised (CIS-R).

* Myocardial infarction, coronary revascularization or a physician diagnosis of angina pectoris.

* Rheumatic fever/rheumatic heart disease.

* 14.2% (99) of cancers were non-melanoma skin cancer.

* Chronic obstructive pulmonary disease.
characterization of cardiovascular events eventually found in such patients. Additionally, common mental disorders were frequently observed, especially among women; two main disorders stand out: depression and anxiety.

Although the first reports regarding the main baseline findings are in preparation and will be submitted for publication in 2013 and early 2014, three articles have been published focusing on specific topics. First, part of the generally unfavourable risk factor profile here described was reported within highlighting new priorities for research and management of non-communicable disease in Brazil. Second, subjective social status, assessed by three 10-rung ladders, was independently associated with poor self-rated health and weakly associated with former smoking. Third, the use of antidepressant and benzodiazepine medication was less frequent than in high-income countries. Increasing age and educational achievement were associated with greater use of these medications, but the presence of major depression and generalized anxiety disorder were poor predictors of such use, suggesting misuse/overuse among those without and underuse among those with psychiatric conditions.

Seven additional studies addressing methodological and operational aspects of study design and implementation, including validity and reliability of several key measurements, have been published. Verbal fluency tests, commonly used to assess executive functions and language over time, showed between-supervisor reliability coefficients of 97.9% or higher in all ELSA centres (repeat judging of 120 animals and 120 F letter tests). Reliability coefficients for silhouette scales, used to assess body image, varied across centres from 0.92 to 0.97 (repeated over a 7- to 14-day interval). The MacArthur Scale of Subjective Social Status, which measures subjective social status via three numbered stepladder image scales, showed kappa values of 0.62 (0.58 to 0.64) for the overall society ladder, of 0.58 (0.56 to 0.61) for the community-related ladder and of 0.67 (0.66 to 0.72) for the work-related ladder. The reliability coefficients ranged from 0.64 for the community-related ladder to 0.75 for the work-related ladder. The reliability of the food frequency questionnaire was assessed against 3-day food records collected on two separate occasions during a 12-month period. Coefficients for energy and nutrients ranged from 0.55 for protein to 0.83 for vitamin E. Reproducibility of endothelial dysfunction measured by peripheral arterial tonometry was assessed with examinations performed twice during the same day, yielding a coefficient of variation of 18% and a reliability coefficient of 0.61.

Finally, the making of a study of this size and complexity in a middle-income country striving to give the priority needed to research of non-communicable diseases was addressed in detail (in English and Portuguese) in a recent supplement of the Revista de Saúde Pública which can be accessed through the link http://www.scielo.br/scielo.php?script=sci_issuetoc&pid=0034-891020130008&lng=pt&nrm=iso.

What are the main strengths and weaknesses?

First, the importance of the study outcomes is globally recognized, particularly in a scenario of scarcity of relevant information for low- and middle-income countries with rapid demographic, epidemiological and nutritional transitions. Of note in this regard, the ELSA-Brasil cohort includes participants born before 1950, a period in which Brazil was characterized as having low rates of schooling and low socioeconomic development. As ELSA-Brasil started in the midst of the obesity epidemic, it will allow novel investigations into the aetiology of diabetes and cardiovascular diseases within this current context, taking into account the life course experienced by the cohort, which may be of great relevance to many similar low- and middle-income countries.

Second, the extensive characterization of the cohort in terms of social, psychological and biomedical dimensions will permit the analysis of associations between social and health gradients, as well as mediating mechanisms, within Brazil’s unique social and skin colour/race context. Neighbourhood characteristics, life-course adversities, social mobility, gender relations and family context, job stress, social class and nature of occupational, dietary patterns, body weight history and body image, postprandial metabolism, chronic inflammation and clinical and subclinical outcomes will permit ample investigation of aetiological hypotheses and the construction and testing of conceptual frameworks for the determination of chronic diseases. Although recognizing that the choice of the ELSA-Brasil sampling strategy limits investigation in the domains of the extremely poor and the unemployed, as demonstrated by the tables here presented, the racial, social and regional diversity captured in the cohort will permit in-depth investigation of important inequities in health in Brazil.

Additional strengths include: ELSA-Brasil’s major governmental financial support; measurements uncommonly done in other large cohort studies, such as the oral glucose tolerance test, 12-h urine, cognitive function and comprehensive mental health assessment; stored serum (including post-load samples), DNA and urine samples; and facility of follow-up within the institutional context.

ELSA-Brasil, being an occupational cohort, was not planned with the aim of producing prevalence data
Table 4. Prevalence of selected self-reported behavioural risk factors and chronic conditions in adults ages 35–74 years in the Brazilian Longitudinal Study of Adult Health, 2008–10 and in the VIGITEL survey, 2010.\textsuperscript{16}

| Self-reported characteristic | ELSA-Brasil | VIGITEL |
|-----------------------------|------------|--------|
| Binge drinking\textsuperscript{a} | 13.2 | 15.0 |
| Less than 5 day/week fruit intake | 34.3 | 39.3 |
| Less than 5 day/week vegetable intake | 37.1 | 51.0 |
| Low leisure time physical activity\textsuperscript{b} | 76.9 | 75.2 |
| Current smoking | 13.1 | 15.7 |
| Former smoking | 30.0 | 30.1 |

\textsuperscript{a}ELSA-Brasil: consumption of 5 or more doses of alcohol in a period of 2 h at least 2–3 times per month over the past 12 months.\textsuperscript{b} VIGITEL: consumption of 5 or more doses of alcohol for men and 4 or more doses of alcohol for women in the past 30 days.

\textsuperscript{b}ELSA-Brasil: defined using the International Physical Activity Questionnaire (IPAQ) – Short Form, according to the IPAQ Guidelines for Data Processing and Analysis.\textsuperscript{7} VIGITEL: no leisure time physical activity or \textless 150 min/week total physical activity.

\textsuperscript{c}ELSA-Brasil: based on measured height and weight.

concerning chronic diseases or risk factors for the Brazilian population, particularly since Brazil is well served by a series of periodically repeated health surveys. However, since these surveys are predominantly based on self-report, the measures performed in ELSA-Brasil, in many ways, can provide more accurate assessment and add important supplemental information on relevant outcomes such as diabetes, chronic renal failure and common mental disorders, strongly dependent on laboratory values or on more sophisticated clinical measures or questionnaires. The applicability of these ELSA-Brasil estimates to Brazilian adults is supported by the similarities in prevalence (Table 4) of behavioural risk factors and chronic conditions selected for having been assessed with similar procedures in ELSA-Brasil and in VIGITEL,\textsuperscript{16} an annually performed telephone-based behavioural risk factor survey producing representative data for adults living in Brazil’s 27 state capitals and Federal District.

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

Collaboration in data analysis and publication will be welcome through specific research proposals sent to individual ELSA investigators. Additional information can be obtained from estatisticaelsa@ufrgs.br.

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References

1. World Health Organization. Global Status Report on Noncommunicable Diseases, 2010. Geneva: WHO, 2011. Available at: www.who.int/nmh/publications/nccd_report_full_en.pdf (23 December 2011, date last accessed).

2. United Nations. General Assembly. Political Declaration of the High-Level Meeting of the General Assembly on the Prevention and Control of Non-Communicable Diseases. 2011. Available at: http://www.un.org/ga/search/view_doc.asp?symbol=A/66%2F9F1&Lang=E (5 February 2012, date last accessed).

3. Schmidt MI, Duncan BB, de Silva GA et al. Chronic non-communicable diseases in Brazil: burden and current challenges. Lancet 2011;377:1949–61.

4. Victora CG, Barreto ML, do Carmo Leal M et al. Health conditions and health-policy innovations in Brazil: the way forward. Lancet 2011;377:2042–53.

5. Aquino EML, Araujo MJ, Almeida M da CC et al. Participants recruitment in ELSA-Brasil (Brazilian Longitudinal Study for Adult Health). Revista de Saúde Pública 2013;47:10–18.

6. Aquino EML, Barreto SM, Bensenor IM et al. Brazilian Longitudinal Study of Adult Health (ELSA-Brasil): objectives and design. Am J Epidemiol 2012;175:315–24.

7. Barreto SM, Ladeira RM, Bastos M et al. ELSA-Brasil strategies for outcome identification, investigation and ascertainment. Revista de Saúde Pública 2013;47:79–86.

8. Duncan BB, Chor D, Aquino EML et al. [Chronic non-communicable diseases in Brazil: priorities for disease management and research]. Rev Saúde Publica 2012;46(Suppl 1):126–34.

9. Camelo LV, Giatti L, Barreto SM. Subjective social status, self-rated health and tobacco smoking. Brazilian Longitudinal Study of Adult Health (ELSA-Brasil). J Health Psychol 2014;19:1388–99.

10. Brunoni AR, Nunes MA, Figueiredo R et al. Patterns of benzodiazepine and antidepressant use among middle-aged adults. The Brazilian longitudinal study of adult health (ELSA-Brasil). J Affect Disord 2013;151:71–77.

11. Passos VM de A, Giatti L, Barreto SM et al. Verbal fluency tests reliability in a Brazilian multicentric study, ELSA-Brasil. Arquivos de Neuro-Psiquiatria 2011;69:814–16.

12. Gripp RH, Aquino EML, Chor D, Kakeshita JS, Gomes ALC, Nunes MAA. [Test-retest reliability of the scale silhouettes figures of body image in Brazilian Longitudinal Study of Adult Health]. Cad Saude Publica 2012;28:1790–94.
13. Giatti L, Camelo I do V, Rodrigues JF de C, Barreto SM. Reliability of the MacArthur scale of subjective social status – Brazilian Longitudinal Study of Adult Health (ELSA-Brasil). *BMC Public Health* 2012;12:1096.

14. Molina MDCB, Benseñor IM, Cardoso L de O et al. [Reproducibility and relative validity of the Food Frequency Questionnaire used in the ELSA-Brasil]. *Cad Saude Publica* 2013;29:379–89.

15. Brant LCC, Barreto SM, Passos VMA, Ribeiro ALP. Reproducibility of peripheral arterial tonometry for the assessment of endothelial function in adults. *J Hypertens* 2013;31:1984–90.

16. Brasil. Ministério da Saúde. Departamento de Análise de Situação de Saúde. *Vigilância de Fatores de Risco e Proteção para Doenças Crônicas por Inquérito Telefônico, Vigitel, 2010* [Surveillance of Risk and Protective Factors for Chronic Diseases, Vigitel, 2010]. Brasília: Ministério da Saúde, 2011.