


Cohort Profile

Cohort Profile: The Brazilian Longitudinal Study of Ageing (ELSI-Brazil)

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Key features

- The Brazilian Longitudinal Study of Ageing (ELSI-Brazil) is a nationally representative cohort study of the population aged ≥ 50 years. The study aims to foster a better understanding of the ageing process, its determinants and impacts and, ultimately, to inform public policies to promote healthy ageing.
- The aim has been to interview individuals at 3- to 4-year intervals with a sample refreshment at each wave. Waves 1 and 2 were conducted in 2015–2016 and 2019–2021 with 9412 and 9949 participants, respectively.
- On each occasion, household and individual interviews are completed together with physical measurements. The household interview includes measures of socio-demographic characteristics of all residents. Individual interviews include an array of physical and mental health measures, and use of health services and medications. Physical measures include blood pressure, anthropometry, grip strength, gait speed and balance. Blood tests and sample storage were performed in a sub-sample of ~ 2500 participants in Wave 1. DNA extractions from saliva samples were performed from ~ 7900 participants in Wave 2. Telephone interviews on COVID-19 were performed among participants in Wave 2.
- ELSI-Brazil adopts a conceptual framework common to other large-scale longitudinal studies of ageing worldwide, namely the Health and Retirement Studies series, allowing cross-country comparisons. The core data, codebooks, protocols and other information are freely available to researchers upon registration with the ELSI-Brazil project at the following address: <https://elsi.cpqrr.fiocruz.br/en/register/>.

Why was the cohort set up?

Globally, Brazil has one of the largest ageing populations. Estimates for the year 2020 show that a quarter of the Brazilian population is aged ≥ 50 years (54 million people, equivalent to the entire population of Italy) and 30 million Brazilians are aged ≥ 60 years.¹ The Brazilian Longitudinal Study of Ageing (ELSI-Brazil) is the first large-scale population-based cohort study of ageing in Brazil. The study was designed to provide a national data resource on the ageing process and health, psychological and economic determinants and social consequences. ELSI-Brazil adopts a conceptual framework and approach common to other large-scale longitudinal studies of ageing in the world, namely the Health and Retirement Studies (HRS) series,² allowing cross-countries comparisons. The study also includes topics relevant to Brazil's specific interests.

Since the implementation of the baseline study (2015–2016), Brazil has seen dramatic political, economic and sanitary crises. The annual Gross Domestic Product (GDP) has decreased sharply since 2018.³ Social inequalities in Brazil have been decreasing since the mid-1990s, albeit at a slow pace. However, from 2015 to date, these favourable trends have been reversed.⁴ Recent reforms in social security and cuts in the publicly funded health system have unknown implications.⁵ Furthermore, Brazil has been heavily affected by the COVID-19 pandemic. As of May 2021, Brazil had the second-highest absolute number of COVID-19 deaths and the third-highest number of COVID-19 cases in the world.⁶

Therefore, ELSI-Brazil represents a unique opportunity to investigate several aspects of the ageing process in a context of social environment changes and economic crisis. Given its insertion in an international effort, the study has also potential to provide information that will be useful for the planning and evaluation of social and health policies in Brazil and other countries.

Who is in the cohort?

ELSI-Brazil is a nationally representative study composed of community-dwelling adults aged ≥ 50 years. Due to the lack of a centralized and reliable household registry, the study uses the Brazilian Institute of Geography and Statistics (in Portuguese, Instituto Brasileiro de Geografia e Estatística—IBGE) geographic operational base for stratification and selection of study areas. To ensure that the sample represents the urban and rural areas of the small, medium and large municipalities, the ELSI-Brazil sampling adopts a design with selection stages, combining stratification of primary sampling units (municipalities), census tracts and households. An inverse sampling design was

used to avoid an increase in the sample size to compensate for non-responses. Application of this method in ELSI-Brazil consisted of sequentially visiting the previously selected households until reaching the planned number of interviews. All residents in the selected households aged ≥ 50 years are eligible for interview and physical measurements. The final sample consists of residents in 70 municipalities from the five Brazilian regions (the number of planned interviews was 10 000). Replacement of the sample is planned for each new wave. Given the complexity of the sample, sample weights were derived to account for different probability of selection and differential non-response. Analyses, therefore, need to account for geographical stratification and clustering in the estimation of standard errors. The sample design and mean natural and calibrated weights of the ELSI-Brazil baseline survey are described in detail elsewhere.⁷

Waves 1 and 2 were conducted in 2015–2016 and 2019–2021 with 9412 and 9949 participants, respectively. Table 1 shows the distribution of socio-demographic characteristics, prior medical diagnosis for selected chronic diseases, blood pressure and anthropometric measures in each of the waves. The mean age of participants was 62.9 years in Wave 1 and 63.3 years in Wave 2. Half of participants were women (54% in both waves). Residence in urban areas (84.4% and 84.7%, respectively) and low educational levels (64.6% and 63.5% had < 8 years of schooling, respectively) largely predominated. As observed for Brazil as a whole, about less than half of participants resided in the Southeast region (47.2% and 42.2%, respectively). Comparisons of an array of characteristics of the ELSI-Brazil participants, at the baseline, against results of the Brazilian National Health Survey (2013) indicated that the sample was broadly representative of Brazilians aged ≥ 50 years. Similarities were found with regard to socio-demographic characteristics and an array of health and related conditions, as shown in a previous publication.⁷

How often have they been followed up?

After a 3- to 4-year follow-up (from August 2019 to March 2021), among 9412 participants who participated in Wave 1, 6172 were re-interviewed, 2270 were lost to follow-up and 970 have died. Among deaths informed by a proxy during the second-wave interview ($n = 707$), 90% ($n = 609$) were later confirmed by linkage of our data with those of the national Information System on Mortality (Sistema de Informações sobre Mortalidade, in Portuguese). Through this linkage, we were also able to identify that, among initial losses ($n = 2533$), 10.4% ($n = 263$) were due to deaths between waves. As planned for the second wave, we proceeded with the replacement of the sample to guarantee its national

Table 1 Selected characteristics of participants in the first (2015–2016) and second (2019–2021) waves of the Brazilian Longitudinal Study of Ageing (ELSI-Brazil)

Characteristics	First wave (<i>n</i> = 9412)		Second wave (<i>n</i> = 9949)	
	Mean or %	95% CI	Mean or %	95% CI
Mean age (years)	62.9	62.1–63.8	63.3	62.7–64.0
Female sex	54.0	51.0–56.9	54.4	52.3–56.5
Urban residence	84.7	78.4–88.8	84.4	78.5–88.9
Geographic region				
North	5.6	2.3–12.8	6.7	2.8–15.1
Northeast	24.1	15.9–34.8	28.2	18.7–40.1
Centre-west	6.6	3.0–13.8	8.6	4.1–17.3
Southeast	47.2	35.6–59.1	43.2	31.8–55.4
South	16.6	8.8–29.1	13.3	6.9–24.1
Schooling (years)				
<8	64.6	61.3–67.4	63.5	59.8–67.0
8–10	11.9	10.6–13.3	13.0	11.7–14.4
≥11	23.8	21.7–26.0	23.6	21.0–26.4
Prior medical diagnoses				
Diabetes	15.8	14.6–17.1	17.7	16.0–19.5
Stroke	5.3	4.7–6.0	3.9	3.1–4.8
Asthma	4.9	4.2–5.7	3.0	2.6–3.6
Cancer	5.3	4.6–6.0	4.5	3.8–5.4
Arthritis	21.0	19.4–22.7	18.6	16.7–20.6
Blood pressure and anthropometric measurements				
Mean systolic blood pressure (mm Hg)	135.8	134.8–136.9	130.4	129.5–131.3
Mean diastolic blood pressure (mm Hg)	78.6	78.0–79.3	82.0	81.4–82.6
Mean body mass index as weight (kg)/height (m) ²	27.8	27.6–28.0	27.9	27.7–28.2
Mean waist circumference (cm)	93.5	92.9–94.1	95.8	95.0–96.6

All results are percentages, except when specified. All estimates considered the complex sample design and survey weights.

representativeness. Replacement of the sample consisted of recruiting residents in the previously selected household who had completed 50 years of age between waves, as well as selecting new participants in the corresponding census tract. The final flow of respondents through Waves 1 and 2 is shown in [Figure 1](#).

With regard to longitudinal data ([Table 2](#)), we noticed differential censoring by the above-mentioned demographic factors. For example, the smallest proportion of re-interviews was found for those aged ≥80 years, who in turn were more likely to die, as expected. Residents of the Northeast and Centre-West regions were less likely to be lost, as well as those residing in rural relative to urban areas. A smaller difference by gender was also observed. These observations point to the need to use specific weights to compensate for non-responses in future longitudinal analysis of ELSI-Brazil data.

What has been measured

The aim has been to interview individuals at 3- to 4-year intervals. On each occasion, computer-assisted household

and individual interviews are completed together with physical measurements. In households with more than one resident, the household interview is done with the adult nominated by the other residents as the one who would best provide the required information. All residents aged ≥50 years are eligible for individual interview and physical measurements. A proxy is used to answer the individual interview when needed and this is annotated properly.

Measures obtained in the household interview in Waves 1 and 2 are summarized in [Table 3](#). The household interview includes measures of the house characteristics including accessibility, as well as detailed information on housing assets, consumption and income of all residents. Housing assets included house/property, mortgage payments, rental payments, house market values, other properties and their market value, as well as all owned vehicles and their market values. Consumption included money spent on eating out, utilities (electricity, water, cooking gas), condominium fees, fuel and telephone bills and private health plans, among others. For those aged ≥50 years, individual income information included employment, private and state pensions and other benefits. For residents

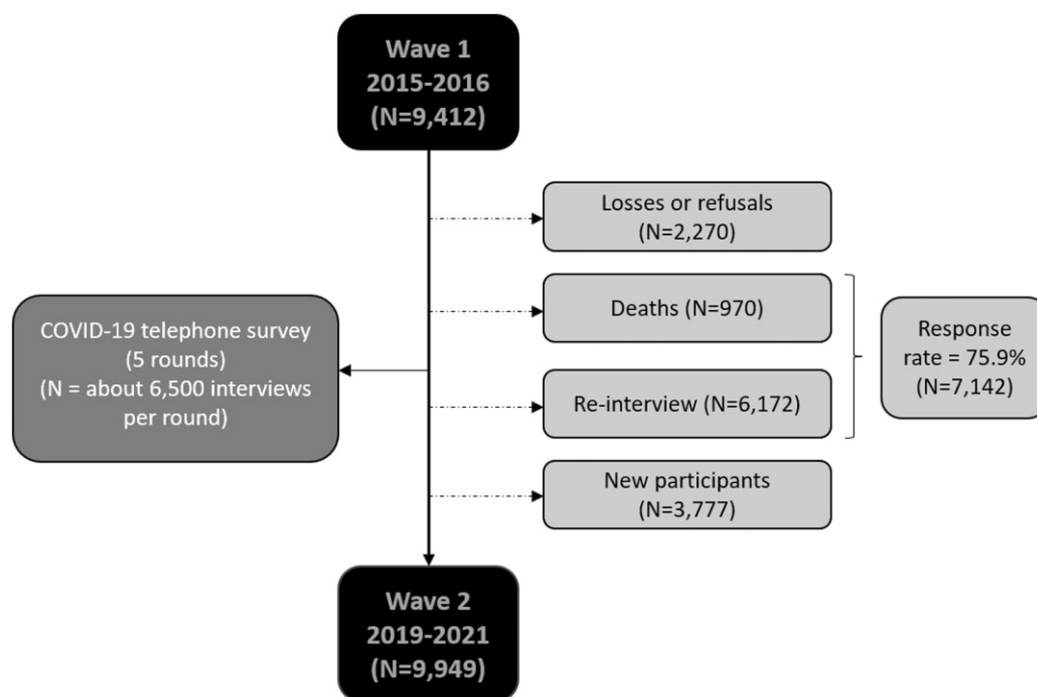


Figure 1 The flow of respondents through the Brazilian Longitudinal Study of Ageing (ELSI-Brazil)

Table 2 Selected demographic characteristics of individuals who participated in Wave 2 relative to participants in Wave 1 of the Brazilian Longitudinal Study of Ageing (ELSI-Brazil)

Characteristics	Number of participants in Wave 1	Follow-up—unweighted % (95% CI) ^a		
		Wave 1 participants who participated in Wave 2	Participants who died by the end of Wave 2	Wave 1 participants who participated in Wave 2 plus those who died by the end of Wave 2
Age group (years)				
50–59	3980	66.4 (64.9–67.8)	5.2 (4.5–5.9)	71.6 (70.1–72.9)
60–69	2875	68.0 (66.3–69.7)	8.4 (7.4–9.5)	76.4 (74.8–77.9)
70–79	1781	66.1 (63.9–68.3)	14.6 (13.0–16.3)	80.7 (78.8–82.5)
80+	776	51.3 (47.8–54.8)	34.0 (30.8–37.4)	85.3 (82.6–87.6)
Gender				
Men	4098	63.5 (62.0–64.9)	11.7 (10.7–12.7)	75.1 (73.8–76.4)
Women	5314	67.2 (65.9–68.5)	9.3 (8.5–10.1)	76.5 (75.3–77.6)
Great region				
North	743	63.5 (60.0–66.9)	11.3 (9.2–13.8)	74.8 (71.6–77.8)
Northeast	2549	69.9 (68.1–71.6)	11.5 (10.3–12.8)	81.4 (79.8–82.9)
Centre-west	920	70.9 (67.8–73.7)	9.3 (7.6–11.4)	80.2 (77.5–82.7)
Southeast	3922	63.6 (62.1–65.1)	9.5 (8.6–10.4)	73.1 (71.7–74.5)
South	1278	60.3 (57.6–63.0)	10.6 (9.0–12.4)	70.9 (68.3–73.3)
Area				
Urban	7935	63.8 (62.7–64.9)	10.1 (9.5–10.8)	73.9 (73.0–74.9)
Rural	1477	75.1 (72.8–77.2)	11.2 (9.7–12.9)	86.3 (84.4–87.9)

^aRelative to the total number of participants in the row.

aged 17–49 years, income from all sources is considered. As part of the national public health system (SUS), Brazil rolled out the Family Health Program (FHP) as a comprehensive model of community-based primary healthcare.

The household questionnaire included questions on affiliation with and use of FHP. The full household questionnaire is available on the ELSI-Brazil's homepage (<http://elsi.cpqrr.fiocruz.br>).

Table 3 Summary of data collection contents in the Brazilian Longitudinal Study of Ageing (ELSI-Brazil)

Waves 1 (2015–2016) and 2 (2019–2021)	
Household interview (all households)	Living arrangements, house characteristics and accessibility, assets, consumption, income of persons aged ≥ 50 years and total income of all residents, affiliation with the Family Health Program
Individual interview (all persons aged ≥ 50 years)	Demographics and background, neighbourhood, discrimination, mini childhood life history, work and retirement, family transfers, lifestyle, reproductive history, general health and diseases, oral health, ability to perform activities of daily living, cognition, depressive symptoms, psychosocial measures, use of medications and use of health services
Physical measurements (all persons aged ≥ 50 years)	Anthropometry, blood pressure, grip strength, walking speed, gait balance
Wave 1 (2015–2016)	
Blood collection (sub-sample of participants)	Laboratory assays (total cholesterol, high-density lipoprotein cholesterol, low-density lipoprotein cholesterol; urea; creatinine; ferritin; thyroid stimulating hormone; glycated haemoglobin; vitamin D; and haemogram). Storage of samples at -80°C
Wave 2 (2020–2021)	
COVID-19 telephone interview (participants who responded the second wave up to March 2020)	Social distancing, use of face masks, sleep, loneliness, use of health services, intention to vaccinate against COVID-19 when it becomes available
Wave 2 (2019–2020)	
Saliva collection	DNA extraction (Gentra Puragene Kit, Qiagen, Germany) and storage at -80°C

Individual interviews included a broad range of topics related to an individual's demographic characteristics, neighbourhood, experience of discrimination, living and health conditions in early life (childhood questionnaire), work and retirement, family transfers, lifestyle, reproductive history, physical and mental health, oral health, functioning and helpers, psychosocial measures and use of medications and health services. Health measures included the broad geriatric syndromes of frailty, continence and falls, and history of medical diagnosis for an array of illnesses. The interview also included information on treatment and use of preventive services for major chronic diseases. The section on functioning includes measures of mobility and the person's ability to perform basic, instrumental and advanced activities of daily living, and detailed information on sources of help to perform basic and instrumental activity tasks. Measures of psychosocial factors include sociability, social support, wellbeing, critical life events, religiosity and quality of life assessed with the 19-item Control, Autonomy, Self-Realization and Pleasure scale (CASP-19). The eight-item Center for Epidemiologic Studies—Depression Scale (CES-D-8) was used to assess depressive symptoms. Cognition assessments comprise memory and executive function. The interview also includes a broad range of indicators of access and use of health services and medications, as well as indicators of the

quality of primary care provision, user satisfaction with the care they receive and healthcare expenditures. The main exposure domains ascertained through the individual interview are shown in Table 3. The full individual questionnaire is available on the ELSI-Brazil's homepage (<http://elsi.cpqrr.fiocruz.br>).

Physical measurements are planned in all waves. At Waves 1 and 2, all participants were eligible for the following measures: anthropometric measures (weight, height and waist and hip circumference, all of them obtained in duplicate); diastolic and systolic blood pressure (measured three times in the seated position after 5 min of rest); grip strength, timed walk (3 metres) and balance tests (all measured in duplicate). Further details can be seen in Table 3 and in the measurement handbook on the research homepage (<http://elsi.cpqrr.fiocruz.br>).

It is expected that blood will be collected in selected waves. In Wave 1, non-fasting venous blood samples were obtained in a sub-sample of ~ 2500 participants in a separate visit at their household. The following tests were performed at the central laboratory: total cholesterol, high-density lipoprotein cholesterol, low-density lipoprotein cholesterol, urea, creatinine, ferritin, thyroid stimulating hormone, glycated haemoglobin, vitamin D and haemogram. Serum and plasma derived from those samples are stored at -80°C for future analysis. Details on

sample weights used for analysis of blood tests are published elsewhere.⁸ Finally, at Wave 2, saliva samples were obtained from participants during the home interview; DNA extraction from ~7900 participants was performed and stored at -80°C for future analysis. All samples are stored at the Fundação Oswaldo Cruz, Minas Gerais, Brazil.

What has it found?

Baseline results

Despite being a fairly recent cohort, there have been ~70 peer-reviewed articles published using ELSI-Brazil data covering a wide range of issues (see full list at <http://elsi.cpqrr.fiocruz.br>). Here we outline some of the key results.

ELSI-Brazil includes a broad range of socio-economic measures and marked inequalities are evident, with the poorest or those with lower educational attainment most affected. Inequalities are observed in physical activity,⁹ oral health status,¹⁰ limitations in performing basic activities of daily living,¹¹ frailty,¹² adequate control of hypertension,¹³ underutilization of medications due to financial barriers,¹⁴ source of healthcare coverage¹⁵ and capacity to work.¹⁶ Access to primary care is high by international standards¹⁵ but many hospitalizations could be prevented by more effective actions at this level of care.¹⁷ Incapacity to work,¹⁶ as well as the receipt of pensions,¹⁸ is associated with worse health conditions. However, people who receive pensions are more autonomous and have more financial security.¹⁸

Other studies showed that even though it is a highly admixed population, non-White older Brazilian adults are more likely to report discrimination¹⁹ and are more prone to increased tooth loss.²⁰ Type 2 diabetes, as assessed by glycosylated haemoglobin levels, was found to be associated with impaired memory but not with impaired verbal fluency.²¹ Frailty was found to modify the association of hypertension with cognition.²² Despite being a sunny country, results from ELSI-Brazil allowed us to estimate that ~875 000 older Brazilians have vitamin D deficiency (<30 nmol/L) and 75 million its insufficiency (<50 nmol/L), with an inverse gradient from the highest to the lowest country latitudes.⁸

International comparisons

We performed a series of analyses comparing results from the ELSI-Brazil baseline survey with those from about eight HRS family surveys, comprising >20 countries. Results showed that the prevalence of the use of dental services in the previous 12 months ranged from 18.7% in China to 81.2% in Sweden (31.7% in Brazil) with education-related inequities in all countries.²³ In a study of universal health

coverage indicators, the absence of at least one doctor visit in the previous 12 months varied from 5% in Luxembourg to 23% in Greece (17% in Brazil).²⁴ Catastrophic health-care expenditures, defined as >25% of household income, were found to be the highest in China (16%) and the lowest in France (0.44%) (10.2% in Brazil).²⁴ Another analysis examined whether three life-course risk factors (poor health in childhood, low educational attainment and multimorbidity) were associated with limitations in performing basic activities of daily living.²⁵ All life-course risk factors were associated with the likelihood of disability in Brazil, whereas both educational attainment and multimorbidity were independently associated with disability in nearly every country. Interestingly, the relationship between life-course risk factors and disability was moderated by a country's Human Development Index.²⁵

ELSI-COVID-19 survey

From May 2020 to March 2021, we conducted five rounds of telephone interviews on COVID-19 and related conditions among participants of ELSI-Brazil's Wave 2 who had already responded to the face-to-face interview as of March 2020.²⁶ A series of studies using data from the first round of the ELSI-COVID-19 survey has been published (in Portuguese and English) in a special issue of the *Cadernos de Saúde Pública*, which can be accessed through the link (<http://cadernos.ensp.fiocruz.br/csp/sumario/volume/37/fasciculo/326>).

Selected findings from the first and subsequent four rounds of the COVID-19 telephone interviews are shown in [Table 4](#). The key findings were: medical diagnosis of COVID-19 increased from 2.3% in the first to 10.2% in the fifth round; only about a third of study participants did not leave their homes in the 7 days prior to the interview and these proportions did not change over time; the main reasons for leaving home were due to basic needs such as buying medicine or food (~70%); among those who left home, ~97% reported always wearing face masks with no changes reported in this behaviour over time. Finally, by November 2020, 71% of older adults had an intention to be vaccinated when a COVID-19 vaccine became available.²⁷ This proportion increased to 91% by March 2021, representing one of the highest proportions of intentions to vaccinate against COVID-19 described in the literature to date.²⁸

What are the main strengths and weaknesses?

ELSI-Brazil represents a unique opportunity to examine the ageing process and its determinants in one of the largest countries in the Western hemisphere. The study is entirely

Table 4 Selected results of the COVID-19 telephone surveys among participants in the Brazilian Longitudinal Study of Ageing (ELSI-Brazil)

Characteristics	First round 25 May–8 June 2020 % (95% CI)	Second round 23 June–5 August 2020 % (95% CI)	Third round 23 September–10 October 2020 % (95% CI)	Fourth round 9–25 November 2020 % (95% CI)	Fifth round 1–14 March 2021 % (95% CI)
Medical diagnosis of COVID-19	2.3 (0.5–9.9)	1.6 (1.2–2.1)	1.4 (1.1–1.9)	5.9 (4.2–8.1)	10.2 (8.5–12.2)
Frequency of leaving the house, previous 7 days					
Almost every day	15.7 (12.9–18.9)	17.7 (15.0–20.7)	23.8 (21.0–26.7)	–	19.0 (16.3–22.0)
3–5 times	15.2 (12.9–17.8)	17.9 (15.4–20.7)	19.5 (17.1–22.2)	–	18.8 (16.1–21.7)
1–2 times	36.5 (33.6–39.4)	33.7 (31.1–36.4)	31.5 (29.1–33.9)	–	33.6 (30.4–36.9)
Did not leave	32.6 (29.7–35.8)	30.7 (27.5–34.2)	25.3 (22.3–28.5)	–	28.7 (25.0–32.7)
Reasons for leaving the house, previous 7 days ^a					
To work	25.1 (20.7–30.0)	28.2 (24.2–32.6)	30.3 (26.4–34.5)	–	30.5 (26.1–35.1)
To buy food or medicine	74.2 (70.2–77.8)	69.1 (65.3–72.6)	72.0 (68.3–75.4)	–	69.0 (64.7–72.8)
To meet friends or family	9.1 (7.1–11.7)	9.4 (8.0–11.1)	16.6 (14.1–19.5)	–	10.3 (8.4–12.5)
To obtain health services	10.4 (8.7–12.4)	12.9 (11.2–14.7)	19.2 (17.1–21.6)	–	19.1 (16.8–21.7)
To walk or do exercise	6.2 (4.7–8.1)	7.8 (6.0–10.1)	11.8 (9.8–14.2)	–	10.0 (8.1–12.2)
To pay bills	24.3 (21.0–27.8)	23.7 (20.2–27.5)	27.3 (23.3–31.7)	–	26.5 (21.5–32.1)
Other reason	10.7 (8.8–13.0)	15.1 (12.7–17.9)	18.2 (15.1–21.9)	–	16.4 (13.0–20.5)
Used a face mask when outside the house in previous 7 days ^a					
Always	97.3 (96.3–98.1)	98.0 (97.1–98.7)	96.4 (94.3–97.8)	–	96.7 (93.8–98.3)
Sometimes	2.0 (1.4–2.9)	1.5 (0.9–2.3)	2.6 (1.7–3.8)	–	2.3 (1.2–4.2)
Never	0.7 (0.4–1.1)	0.5 (0.3–0.9)	1.0 (0.3–2.8)	–	1.0 (0.5–2.4)
Intention to vaccinate when a COVID-19 vaccine become available					
Yes	–	–	–	70.5 (66.8–74.0)	90.9 (88.7–92.6)
No	–	–	–	16.8 (14.0–20.2)	3.4 (2.3–4.9)
Unknown	–	–	–	12.7 (10.7–15.0)	5.8 (4.5–7.3)
No. individuals (unweighted)	6149	6752	6711	6681	6309

All estimates considered the complex sample design and survey weights.

^aAmong those who left the house.

funded by the Brazilian Ministry of Health and naturally there is great interest in information that can be useful for health planning and evaluation.

The main advantages of ELSI-Brazil are the nationally representativeness of its sample and the harmonization of instruments with other large longitudinal studies of ageing around the world, enabling further cross-country comparisons. The combination of refreshment samples and additional observations over time permits the estimation of cohort effects. Another advantage is its linkage with the Brazilian Information System on Mortality that allows validation of the occurrence of deaths and to locate individuals who were lost to follow-up due to death between waves. Some characteristics specific to the Brazilian population open other lines of investigation. For example, future genotyping of the study population, based on DNA extractions already performed, will allow innovative investigations on the role of genetics and environment on the

ageing process in a highly admixed population. Brazil is one of the countries worldwide most affected by the COVID-19 pandemic. ELSI-Brazil will allow investigation of the consequences of this sanitary crisis for older Brazilians. Finally, the study also provides an opportunity to examine the consequences of other infections (such as arbovirus diseases that are epidemic in the country) for the ageing process. Given the expansive nature of the study data, there is a myriad of possibilities.

The main limitations are those inherent to large community-dwelling longitudinal studies, particularly differential censoring. To compensate for non-response, we use weights specifically derived for respondents to the interview. However, we cannot rule out the possibility of bias due to unmeasured factors that could affect our estimates. Another limitation, also inherent to most longitudinal studies of ageing worldwide, is that several indicators of health conditions and use of health services, among

others, are based on self-response and therefore subject to confirmation bias. Although some of these problems can be overcome by linkage to administrative records (as was done in the case of deaths), such an assessment via data linkage would require authorization by the responsible authorities.

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

The core baseline data (2015–2016) and documentation are freely available to researchers upon registration with the ELSI-Brazil project at <https://elsi.cpqrr.fiocruz.br/en/register/>. Following data cleaning, construction of weights and creation of the users' guide, which are estimated to occur in mid-2022, the second-wave core data will be also available under the same conditions. Additional information can be obtained from elsi@fiocruz.br.

Ethics approval

ELSI-Brazil and ELSI-COVID survey were approved by the Fundação Oswaldo Cruz (FIOCRUZ) ethics committee, Minas Gerais, Brazil (protocols numbers 34649814.3.0000.5091 and 33492820.3.0000.5091, respectively). Genotyping of the cohort population was approved by the Brazilian National Research Ethics Committee (protocol number 63725117.9.0000.5091).

Data availability

See 'Can I get hold of the data?' above.

Author contributions

M.F.L.C., F.B.A., A.L.N., J.M. and C.d.O. designed the study. M.F.L.C. wrote the first draft and was in charge of overall direction and planning of ELSI-Brazil. P.R.B.S., J.V.M.M. and M.T.L.V. designed the analytical strategy and helped to interpret the findings. All authors discussed the findings and contributed to the final manuscript.

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Conflict of interest

None declared.

References

1. Instituto Brasileiro de Geografia e Estatística (IBGE). <https://sidra.ibge.gov.br/tabela/5918> (20 December 2021, data last accessed).
2. Sonnega A, Faul JD, Ofstedal MB, Langa KM, Phillips JWR, Weir DR. Cohort Profile: The Health and Retirement Study (HRS). *Int J Epidemiol* 2014;43:576–85.
3. World Bank. GDP growth (annual %)—Brazil. <https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?locations=BR> (20 December 2021, data last accessed).
4. World Bank. Gini index (World Bank estimate)—Brazil. <https://data.worldbank.org/indicator/SI.POV.GINI?locations=BR> (20 December 2021, data last accessed).
5. Massuda A, Hone T, Leles FAG, de Castro MC, Atun R. The Brazilian health system at crossroads: progress, crisis and resilience. *BMJ Glob Health* 2018;3:e000829.
6. Hallal PC, Victora CG, Silveira MF *et al*. The challenge of conducting epidemiological research in times of pandemic and denialism: 1-year anniversary of the EPICOVID-19 project in Brazil. *Int J Epidemiol* 2021;50:1049–52.
7. Lima-Costa MF, Andrade FB, Souza PRB Jr *et al*. The Brazilian Longitudinal Study of Aging (ELSI-Brazil): objectives and design. *Am J Epidemiol* 2018;187:1345–53. doi.org/10.1093/aje/kwx387
8. Lima-Costa MF, Mambrini JVM, de Souza-Junior PRB *et al*. Nationwide vitamin D status in older Brazilian adults and its determinants: the Brazilian Longitudinal Study of Aging (ELSI). *Sci Rep* 2020;10:13521.
9. Peixoto SV, Mambrini J. V D M, Firmo JOA *et al*. Physical activity practice among older adults: results of the ELSI-Brazil. *Rev Saúde Pública* 2019;52:5s.
10. Bof de Andrade F, Antunes JLF, Souza-Junior PRB, Lima-Costa MF, de Oliveira C. Lifecourse socioeconomic inequalities and oral health status in later life: ELSI-Brazil. *Rev Saúde Pública* 2019;52:7s.
11. Bof de Andrade F, Duarte YAO, Souza-Junior PRB, Torres JL, Lima-Costa MF, Andrade FCD. Inequalities in basic activities of daily living among older adults: ELSI-Brazil, 2015. *Rev Saúde Pública* 2019;52:14s.
12. Andrade JM, Duarte YAO, Alves LC *et al*. Frailty profile in Brazilian older adults: ELSI-Brazil. *Rev Saúde Pública* 2019;52:17s.
13. Firmo JOA, Mambrini JVM, Peixoto SV *et al*. Adequate control of hypertension among older adults: ELSI-Brazil. *Rev Saúde Pública* 2019;52:13s.
14. Loyola Filho AI, Firmo JOA, Mambrini JVM *et al*. Cost-related underuse of medications in older adults: ELSI-Brazil. *Rev Saúde Pública* 2019;52:8s.
15. Macinko J, Bof de Andrade F, Souza-Junior PRB, Lima-Costa MF. Primary care and healthcare utilization among older Brazilians (ELSI-Brazil). *Rev Saúde Pública* 2019;52:6s.
16. Castro CMS, Lima-Costa MF, César CC *et al*. Life course and work ability among older adults: ELSI-Brazil. *Rev Saúde Pública* 2019;52:11s.
17. Melo-Silva AM, Mambrini JVM, Souza-Junior PRB, Bof de Andrade F, Lima-Costa MF. Hospitalizations among older adults: results from ELSI-Brazil. *Rev Saúde Pública* 2019;52:3s.

18. Andrade EIG, Cherchiglia ML, Souza-Junior PRB, Bof de Andrade F, Mambrini JVM, Lima-Costa MF. Factors associated with the receipt of pensions among older adults: ELSI-Brazil. *Rev Saúde Pública* 2019;**52**:15s.
19. Braga LS, Caiaffa WT, Ceolin APR, de Andrade FB, Lima-Costa MF. Perceived discrimination among older adults living in urban and rural areas in Brazil: a national study (ELSI-Brazil). *BMC Geriatr* 2019;**19**:67.
20. Bomfim RA, Schneider IJC, de Andrade FB *et al*. Racial inequities in tooth loss among older Brazilian adults: a decomposition analysis. *Community Dent Oral Epidemiol* 2021;**49**:119–27.
21. Cochar-Soares N, de Carvalho DHT, de Andrade FB *et al*. Does undiagnosed diabetes mitigate the association between diabetes and cognitive impairment? Findings from the ELSI-Brazil study. *J Diabetes* 2020;**12**:834–43.
22. Aliberti MJR, Szlejf C, Lima-Costa MF *et al*. Frailty modifies the association of hypertension with cognition in older adults: evidence from the ELSI-BRAZIL. *J Gerontol A Biol Sci Med Sci* 2021;**76**:1134–43.
23. Bof de Andrade F, Antunes JLF, Andrade FCD, Lima-Costa MF, Macinko J. Education-related inequalities in dental services use among older adults in 23 countries. *J Dent Res* 2020;**99**:1341–47.
24. Macinko J, Andrade FCD, Bof de Andrade F, Lima-Costa MF. Universal health coverage: are older adults being left behind? Evidence from aging cohorts in twenty-three countries. *Health Aff (Millwood)* 2020;**39**:1951–60.
25. Macinko J, Mambrini JVM, Bof de Andrade F, Andrade FCD, Lazalde GE, Lima-Costa MF. Life-course risk factors are associated with activity of daily living disability in older adults. *Eur J Public Health* 2021;**31**:520–29.
26. Lima-Costa MF, Macinko J, de Andrade FB, de Souza Júnior PRB, de Vasconcelos MTL, de Oliveira CM. ELSI-COVID-19 initiative: methodology of the telephone survey on coronavirus in the Brazilian Longitudinal Study of Aging. *Cad Saúde Pública* 2020;**36**(Suppl 3):e00183120.
27. Macinko J, Seixas BV, Mambrini JVM, Lima-Costa MF. Which older Brazilians will accept a COVID-19 vaccine? Cross-sectional evidence from the Brazilian Longitudinal Study of Aging (ELSI-Brazil). *BMJ Open* 2021;**11**:e049928.
28. Lima-Costa MF, Macinko J, Mambrini JVS. COVID-19 vaccine hesitancy in a national sample of older Brazilians: the ELSI-COVID Initiative, March 2021 [in Portuguese]. *Rev Epidemiol Serv Saude* 2022;**1**. doi:10.1590/S1679-4974202200100020.