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envelhecimento: metodologia e resultados preli-
minares de coorte de estudo de idosos no Brasil

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The Bambuí health and ageing study (BHAS): methodological approach and preliminary results of a population-based cohort study of the elderly in Brazil*

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Keywords

Ageing health[#]. Ageing[#]. Cohort studies[#]. Health surveys[#]. Elderly. Epidemiology. Brazil.

Abstract

Objective

A cohort study has been designed to identify predictors of adverse health events in the elderly. The methodology of the study and preliminary descriptive results are presented.

Methods

The study population comprises all residents of Bambuí (Minas Gerais, Brazil), aged 60 or more years (n=1.742). From these, 92.2% were interviewed and 85.9% underwent clinical examination, consisting of haematological and biochemical tests, serology for *Trypanosoma cruzi*, anthropometric and blood pressure measures and electrocardiogram. Aliquots of serum, plasma and DNA were stored for future investigations. The baseline interview included sociodemographic characteristics, self-referred health condition and history of selected diseases, medication use, health service use, source of medical care, physical activities, smoking, drinking and eating habits, reproductive history, physical functioning, life events, social support and mental health. Individuals are being followed up annually.

Results

The following characteristics predominated among participants: women (60.0%), married (48.9%) or widowed (35.4%), people living in households with up to 2 residents (73.8%), heads of family (76.7%), people with monthly income between 1.00 and 2.99 Brazilian minimum wages (62.0%) and people with up to 4 years of schooling (89.1%). The median age was 68 years. Among the cohort members, only 1.7% were lost in the first follow-up.

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Descritores

Saúde do idoso[#]. Envelhecimento[#].
Estudo de coorte[#]. Levantamentos
epidemiológicos[#]. Epidemiologia.
Idosos. Brasil.

Conclusions

In general, the characteristics of the study population were very similar to those from other epidemiological studies of the elderly based on large Brazilian cities. The small number of losses to follow-up indicates that the choice of Bambuí was adequate, assuring the feasibility of a long term cohort study.

Resumo

Objetivo

Um estudo de coorte está sendo desenvolvido para identificar fatores preditores de eventos adversos à saúde em idosos. São apresentados a metodologia do estudo e os resultados descritivos preliminares.

Métodos

A população estudada é constituída por todos os residentes na cidade de Bambuí, Minas Gerais, com 60 ou mais anos de idade (n=1.742). Destes, 92,2% foram entrevistados e 85,9% foram submetidos a exames hematológicos e bioquímicos, sorologia para Trypanosoma cruzi, medidas antropométricas e de pressão arterial e eletrocardiograma. Alíquotas de soro, plasma e DNA foram estocadas para futuras investigações. A entrevista da linha de base do estudo incluiu: características sociodemográficas, percepção da saúde e morbidade auto-referida, uso de medicamentos, acesso a serviços de saúde e a planos de saúde, atividades físicas, uso de fumo e de álcool, hábitos alimentares, história reprodutiva, função física, eventos da vida, recursos sociais e saúde mental. Os participantes estão sendo acompanhados anualmente.

Resultados

As seguintes características predominaram entre os participantes: mulheres (60%), casados (48,9%) ou viúvos (35,4%), residentes em domicílios com até 2 pessoas (73,8%), chefes de família (76,7%), pessoas com renda mensal entre 1 e 2,99 salários-mínimos (62%) e pessoas com 4 ou menos anos de escolaridade (89,1%). A mediana da idade foi igual a 68 anos. Somente 1,7% dos membros da coorte foram perdidos no primeiro acompanhamento.

Conclusões

Em geral, as características da população estudada foram muito semelhantes às de participantes de outros estudos epidemiológicos sobre envelhecimento, desenvolvidos em grandes cidades brasileiras. A pequena perda para acompanhamento mostra que a escolha de Bambuí foi adequada, garantindo a viabilidade de um estudo prospectivo de longa duração.

INTRODUCTION

Ageing of the population is the most important demographic change facing many countries in the world and represents a public health challenge for the coming century. Although increases in the sizes of elderly populations were first observed in developed countries, in recent years this pattern is being seen to a greater extent in the developing world. Demographic projections indicate that five of the 10 nations in the world with the largest ageing population in 2,025 will be developing countries, including Brazil with an estimated 27 million people aged 60 or more years.³¹ Between 1950 and 1991, the percentage of the Brazilian population aged 60 or more years doubled (from 3.5% to 7.3%) and the percentage aged 65 or more years almost tripled (1.7% to 4.5%).¹⁰ An important consequence of this expanding population is an increasing demand for health and

social services. A measurable impact of the increase of the elderly population is evident, for instance, in the use of hospitals. In 1996, those aged 60 or more years made up about 22.9% (US\$ 659 million) of the Brazilian public expenditure on hospital care, even though they accounted for only 7.3% of the population.¹⁹

In recent decades, several population-based cohort studies of the elderly have been launched in developed countries.^{4,6,12,13,17,21,25,26,30} In Brazil, to our knowledge, there have been few population based studies on the epidemiology of the aged. All of them were carried out in large urban areas and all but one²⁴ were cross-sectional studies.^{22,23,29}

Epidemiologic studies of the ageing population in developing countries are important, among other reasons, to: (1) estimate the prevalence of diseases, as

well as risk factors and behaviours, guiding preventive strategies appropriate to the current situation; (2) contribute to the understanding of the aetiology of some diseases and (3) study cultural features, behaviours and life style factors, which vary between countries and communities, and that might be associated with undesirable health events. In addition, we do not know the effect of some chronic infectious diseases, still prevalent in many developing countries, on the survival or on the incidence of other adverse health events on the aged. In Brazil, for example, Chagas' disease remains an important cause of death with mortality rates of 34.4 and 23.5 per 100,000 in males and females respectively aged 60 or more years.*

The methodology of a population based cohort study of the elderly in Brazil and preliminary descriptive results of the baseline survey were presented. The investigation is being carried out in a town of 15,000 inhabitants in the State of Minas Gerais. The main objective of the present study is to identify predictors of mortality, hospitalisation and physical and cognitive deficits in the population aged 60 and over. A secondary objective is to describe the baseline health and social conditions of this population and to compare them with those of younger residents in the town.



Figure 1 - Geographical localization of Bambuí in the State of Minas Gerais, Brazil.

proportion of urban residents in the municipality increased from 16% to 73% between 1950 and 1991.¹⁰ Life expectancy increased from 59.9 in 1970 to 70.2 years in 1991.¹¹ In 1980, 56.2% of the deaths were of people aged 50 or more years, increasing to 74.8% by 1990. Cardiovascular diseases (ICD-9: 390-459) were the primary cause of death in Bambuí in 1991 (34%) and were the second cause of public hospitalisations in 1993 (18,5%).^{18,19} Further details are presented in Table 1.

Table 1 - Selected sociodemographic indicators for the municipality of Bambuí (1970, 1980 and 1991).

Sociodemographic indicator	1970	1980	1991
Population	21,439	20,529	20,573
Life expectancy (years)	59.9	66.7	70.2
Infant mortality (per 1,000 live births)	92.8	62.2	48.4
Percentage of the population aged 25 years or more with less than 4 years of education	75.9	59.9	42.6
Mean income per capita (in CR\$ 1,000 of 01/09/91)	13.3	14.1	33.5
Proportion of poor people (income inferior to 0.5 minimum wage)	0.81	0.41	0.46
Index of Human Development (IHD)**	0.45	0.73	0.70

** IHD- Index created by United Nations in the 90s based on populations longevity, income and education.
Source: Fundação João Pinheiro Instituto de Pesquisas Econômicas Aplicadas.¹¹ (1970, 1990, 1991)

METHODS

Choice of the study population

One of the main constraints for the development of a cohort study, besides its cost, is the loss of participants over time, due to refusal, change of address or emigration. This is particularly important in developing countries, where lack of follow-up resources is the rule. Our choice of the town of Bambuí (Figure 1) took into consideration the feasibility of the study in terms of co-operation of inhabitants and facilities for follow-up participants.

The population of Bambuí has remained stable in the last decades (around 20,000 inhabitants).^{10,11} The

Bambuí was formerly an important endemic area for Chagas' disease.⁸ Even though transmission of *Trypanosoma cruzi* has now been interrupted, we can expect the prevalence of the infection among the aged to remain high because of cohort effect, this being another reason for the choice of the area. The presence of *T. cruzi* infection would allow testing for interactions between this and other factors associated with adverse health effects among the aged for the first time.

The Posto Emmanuel Dias (run by the Fundação Oswaldo Cruz) provided important logistical support for fieldwork in this study. In addition there is only one general hospital and one office where deaths in the town are registered, simplifying the monitoring of the events of interest to the investigation.

* Lima e Costa MFF, Guerra HL, Barreto SM, Guimarães RM. Diagnóstico de saúde da população idosa brasileira: um estudo da mortalidade e das internações hospitalares públicas. *Informe Epidemiológico do SUS (in press)*

Community approach and ethical issues

The research strategy to approach the community was based on the following: (1) to call the community's attention to ageing questions, stressing the idea of healthy ageing; (2) advertise the project widely, stimulating inhabitant's participation in the study; (3) improve the local health information system (death and hospitalisations); (4) promote refresher courses for local doctors, covering topics of the project.

The project started with an anthropological study aimed at identifying means of thinking and acting regarding ageing in the community.* The results of this study were fundamental to conceive the material used to advertise the project, to adapt some questions in the questionnaire and to prepare the fieldwork team.

Both the information and call for participation were made using the local radio stations, newspapers and meetings with leaders and authorities. The folders and posters produced for the project used the slogan "And how about your health?". The folder introduced the present study and included information on the history of Chagas' disease in Bambuí, the importance of the "Posto de Saúde Emmanuel Dias" for its control, the town's present health problems and the need for medical research into these subjects. A folder and a letter from the project co-ordinator (MFFLC) were sent to all participants in the study. This letter explained the project and all the procedures involved in it and how and what benefits the participants would receive. Ethical aspects, such as data confidentiality and voluntary participation were also stressed in this letter. A copy of the informed consent was enclosed to familiarise local people with this document; a signed copy being requisite for all participants.³

The results of the laboratory tests and clinical exams were promptly delivered to all participants, together with the reports signed by qualified doctors. Participants were advised to seek medical attention when there was any indication of a health problem. The health authority of Bambuí assured participants of medical assistance under the public health system when required. A local ethical committee composed of a medical doctor, a dentist and three community leaders was created to observe the project activities. The project was approved by the Ethical Committee of the Fundação Oswaldo Cruz.

Study design

The Bambuí Health and Ageing Study (BHAS) project design is prospective.² The study includes

an initial baseline survey and follow-up activities (Figure 2).

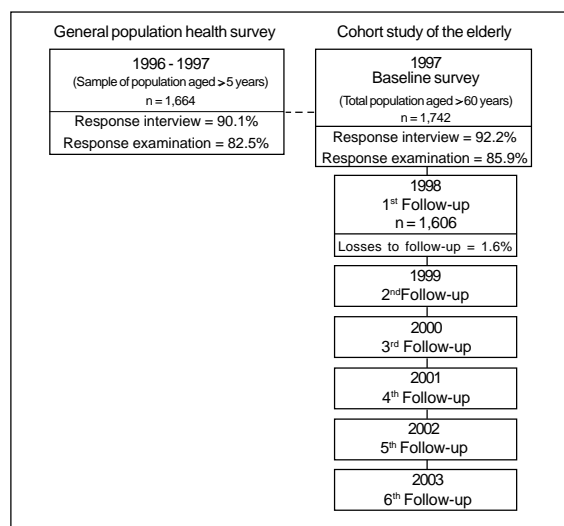


Figure 2 - The Bambuí study design.

Study population

A complete census was carried out in November and December of 1996 for identification of participants. All residents in the urban area of the town aged 60 or more years in 01/01/1997 were eligible for the study (n=1,742).

The baseline survey questionnaire

The BHAS baseline survey questionnaire consisted of: (1) social and demographic characteristics; (2) self-perceived health conditions and history of selected diseases; (3) medication use; (4) health service utilisation and source of medical care; (5) life style (physical activities, smoking, drinking and eating habits); (6) psycho-social aspects (personality traits, social support and life events); (7) reproductive history; (8) physical functioning and (9) mental health (depressive symptoms, cognitive functioning and sleeping habits).

The interviews lasted about ninety minutes and were carried out in participants' homes. Each interview was completed in one or two visits (within a one week period) depending on the respondent's need for rest. Neither interviewer nor interviewee knew about the clinical results at the time of the interview.

When a respondent was unable to participate because of cognitive deficit or for some other health reason, an appropriate proxy was used.²⁰ Proxies were identified in relation to age, gender, schooling and relationship with respondent. They were not asked

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questions that required personal judgement such as psychosocial well-being and mental health. A sample of 10% of participants was selected for assessment of reliability. The repeat interviews consisted of a subset of questions from the original baseline BHAS questionnaire.

Laboratory tests

The following blood tests were performed: (1) biochemical analysis (glucose, creatinine, urea, total protein, albumin, uric acid, calcium, phosphorus, magnesium, total cholesterol, HDL cholesterol, LDL cholesterol, VLDL cholesterol, and tryglicerides), using an automated analyser (*Eclipse Vitalab*, Merck, Netherlands); (2) haematological tests (red blood cell count, haemoglobin, hematocrit, red blood cell indices, white blood cell count, and platelet count), employing an electronic counter (*Coulter Counter T890*, USA), and (3) Chagas' disease serological tests (indirect hemagglutination and enzyme linked immunoabsorbent assay; Biolab and Abbott Brazil, respectively).

Blood samples were taken at the "Posto Emmanuel Dias", after pre-arranged appointment and a recommended 12-hour fast (snacks and coffee were offered afterwards). The blood sample was collected at home, when the participant could not go to the health centre. Samples were separated and sent refrigerated to our laboratory in Belo Horizonte.

Sample storage and DNA banking

Individually identified serum, plasma, buff coat and DNA aliquots were stored in -80°C freezers, using software to control storage. DNA was extracted from the buff coat samples (Wizard^R Genomic DNA Purification System; Promega, USA).

Physical measurements

Physical measurements of all participants were taken at the "Posto Emmanuel Dias" or at home when there was a health limiting condition.

For blood pressure measure (BP), standard desk mercurial sphygmomanometers (Tyco's 5097-30, USA) and stethoscopes (Littman's Cardiology II, USA) were used. BP was measured 30 or more minutes after the last caffeine intake or cigarette smoked. Three measures were taken after 5 min of initial rest and subsequently at 2-minute intervals. When a raised diastolic or systolic BP was recorded (mean diastolic ≥ 90 and/or mean systolic BP ≥ 140 mm Hg), the whole process was repeated in two separate days.¹⁵

Weight, height, arm circumference, wrist circumference, waist circumference, hip circumference, triceps skin fold and demi-span were measured, using standard equipment (CMS Weighing Equipment Ltd, UK).

Electrocardiogram

The electrocardiogram was obtained using equipment designed to store heart readings in diskette reader (Hewlett Packard M1700A, USA). When the elderly person was unable to walk, he/she was examined at home, using portable equipment of the same label.

Fieldwork team

The fieldwork team consisted of one co-ordinator, a supervisor, 20 interviewers, 9 health technicians and 5 persons for general support. All the fieldwork team except the co-ordinator, was selected from among applicants residing in Bambuí. A high school degree (about 11 years of schooling) was required for interviewers and health technicians.

General population health survey

Another cross-sectional study was conducted to diagnose the health condition of the general population and compare the elderly health characteristics measured in the baseline survey with those observed in younger residents. A non-replaceable random sample of 1,664 residents aged up to 5 years, including 200 aged 60 or more years was selected. The following assumptions were used for sampling calculations: (a) population size = 14,239; (b) precision = 0.025; (c) confidence interval = 0.95; (d) prevalence of characteristic = 0.50; (d) losses = 0.20.⁷

The questionnaire and the procedures adopted were the same previously described, except: (1) the census to define the sampling frame was carried out between October and November 1994; (2) the electrocardiogram was not performed for people aged 5-59 years; (3) a simplified version of the BHAS questionnaire was applied to persons aged < 18 years and physical measurements were not performed on them (Figure 2).

Measures of outcome and follow up interview

The main endpoints of the Bambuí cohort study are: (1) mortality, (2) hospitalisation, (3) physical and (4) cognitive deficits. The sources used to ascertain these outcomes are annual interviews, death

certificates, medical records and the database of public hospitalisations.

The vital status of each participant is established at each annual follow-up interview and through regular visits to the local death registration office. Copies of the death certificates are obtained to confirm the death and validate death certificate information.

Hospitalisations are ascertained in the annual interview and using information provided by the hospital discharge database for Bambuí and four neighbouring towns. The validity of the data collected on hospitalisation is being determined using the public health system. Information on hospitalisations occurring outside the public system is being validated for a sample of cases, using hospital records.

Cognitive and physical deficits were determined in the baseline survey (BHAS questionnaire) and at each annual interview. Physical deficits were assessed by a questionnaire on daily living activities and physical function, including levels of difficulty and need of assistance to perform some selected tasks.^{4,16} Cognitive functioning was assessed by the Mini Mental State Examination.⁹

The follow up questionnaire also includes questions on medication use and selected habits; these questions being aimed at detecting annual changes in exposure status.

The first follow-up interviews were carried out in participants' homes and lasted about forty minutes. Appropriate proxies²⁰ were used in the following situations: (1) participant's death in the year before the interview; (2) participant with cognitive deficits; (3) participant too ill to attend. All those interviewed in the baseline survey were eligible for the follow-up interview (Figure 2).

Data processing

Most questions of the BHAS questionnaire, physical measurements and electrocardiogram results have coded responses. Medication use and self referred morbidity were the sections that subsequently required coding, done under the supervision of a qualified doctor. The data were double entered into a computer. The results of the laboratory tests were automatically stored into a computer, avoiding coding and data entry.

Data analysis

Descriptive statistics will be used to fully explore the data.²⁸ Dependent variables will be related with

independent variables using adequate regression models such as linear, logistic, Poisson or Cox proportional hazard.^{1,5,14} For person-time counting, the date of the loss to follow up, as well as that of the events that are not dated, will be taken as occurring halfway through the follow-up time interval.²

Internal validity of the study and preliminary results

The list of individuals eligible to participate in the study was made based on the previously mentioned censuses of the town (1994 and 1996). In these censuses we collected basic sociodemographic information on the population. This allowed us to compare selected characteristics of the participants in the study with those of the eligible inhabitants. The results of this comparison are presented in this article.

Selected characteristics of the elderly observed in the baseline survey are also presented. The aim is to describe the profile of the study population and to compare their characteristics with those from participants of epidemiological studies of the elderly carried out in two large cities of Brazil.^{24,29} The following characteristics were considered: demographic (age, gender, marital status and living arrangements); socio-economic (income and education); satisfaction with social network and with free time arrangements; main problem reported and self perception of health. The associations between discrete variables and their magnitudes were estimated using the odds ratio and 95% confidence intervals. The Wilcoxon rank test was used for comparisons between medians.¹ The analysis was carried out using Epi Info and Stata softwares.^{26,27}

RESULTS

Of 1,742 residents aged 60 years or more, 92.2% participated in the interview and 85.9% were examined (blood sample, laboratory tests, physical measurement and electrocardiogram) in the baseline cohort study. Among 1,664 subjects eligible for the general population survey, 90.1% were interviewed and 82.5% examined. Only 1.7% of the 1,606 eligible subjects in the cohort study were lost or refused to participate in the first follow-up in 1998; the mortality in the cohort during this period being 4.6%.

Table 2 shows the distribution of selected socio-demographic characteristics in the population of the town aged 60 or more years and in the study population. Participants in the interview and examinations were similar to the town population aged 60 or more years in all the characteristics considered: age, gender, number of residents in the household, marital status, family income and education.

Table 2 - Distribution of selected socio-demographic characteristics in the population of Bambuí (1977) aged 60 or more years and in the study population (interviewed and examined).

Characteristics	Population N=1,742 % or median	Interviewed N=1,606 % or median	Examined [*] N=1,496 % or median
Gender			
Males	39.8	40.0	39.2
Females	60.2	60.0	60.8
Age group (years)			
60-69	57.7	58.1	59.0
70-79	30.6	30.6	30.9
80+	11.7	11.3	10.1
Median age(range)	68(60-95)	68(60-95)	68(60-95)
Marital status			
Married	48.5	48.9	49.1
Single	10.7	10.6	10.7
Widowed	34.4	35.4	35.1
Separated	4.7	5.1	5.1
NI	1.7	0.0	0.0
Median number of residents in the household(range)	2(1-12)	2(1-12)	2(1-12)
Monthly family income**			
< 2.00	2.0	1.5	1.6
2.00-3.99	66.1	66.6	65.8
4.00+	30.3	31.7	32.4
NI	1.6	0.2	0.2
Education (yrs)			
Illiterate	32.1	32.6	31.8
1-4	55.4	56.5	57.1
5-8	4.5	4.8	4.9
9-11	3.9	4.0	4.1
12+	1.8	1.9	1.9
NI	2.2	0.1	0.1

^{*} Blood sample, laboratory tests, physical examinations and electrocardiogram;

** In Brazilian minimum wages (US\$ 120.00);

NI: not informed

The sampled population (aged 5 or more years) was similar to the town population in all the above mentioned characteristics, as expected. As observed with the elderly, non- participation in the general population survey did not affect the similarities between participants and the sampled population in any of the studied characteristics (Table 3).

The distribution of some socio-demographic characteristics of the participants in the baseline of the cohort study, according to sex, are presented in Table 4. Among participants the following characteristics predominated: women (60.0%), people between 60-69 years (58.1%), married (48.9%) or widowed (35.4%), people living in households with \leq 2 residents (73.8%), heads of family (76.7%), people with monthly income between 1.00 and 2.99 Brazilian minimum wages (62.0%) and with \leq 4 years of schooling (89.1%). Males and females differed in all aspects but age. In comparison with males, females were more often single (OR=3.3; 95% CI=2.3, 4.7), widow (OR=8.6; 6.5, 11.3) or separated (OR=1.9; 1.2, 3.0), lived alone (OR=2.3; 1.4, 3.8) and in households with smaller

number of residents ($p<0.001$), were not the head of the family (OR=12.9; 8.6, 19.4), had lower income (OR=56.6; 22.1, 145.3 - for none income) and had lower education level (OR=2.3; 1.2, 5.2 - for illiteracy).

Table 3 - Distribution of selected socio-demographic characteristics in the population of Bambuí (1977) aged 5+ years, in the sample and in the study population (interviewed and examined).

Characteristics	Population N=14,228 % or median	Sample N=1,664 % or median	Interviewed N=1,500 % or median	Examined [*] N=1,373 % or median
Gender				
Males	47.4	46.8	46.3	45.2
Females	52.6	53.2	53.7	54.8
Age group (years)				
5-17	25.2	26.7	27.6	28.1
18-39	38.6	37.3	37.1	36.2
40-49	23.9	24.0	24.2	24.3
60+	12.3	12.0	11.1	11.4
Median (range)	32(5-96)	30(5-95)	30(5-92)	30(5-92)
Marital status				
Married	43.3	41.0	41.3	41.9
Single	22.9	23.6	22.9	21.8
Widowed	5.9	6.6	5.8	5.8
Separated	2.6	2.2	2.3	2.3
Children(5-17 years)	25.2	26.7	27.6	28.1
NI	0.1	0.0	0.0	0.0
Median number of residents in the household (range)	4(1-13)	4(1-3)	4(1-13)	4(1-12)
Monthly family income**				
< 2.00	8.5	8.5	8.9	9.2
2.00-3.99	65.9	65.9	66.2	65.7
4.00+	25.6	25.6	24.9	25.1
Education (years)				
Illiterate	15.1	17.6	17.5	17.8
1-4	44.4	41.7	42.2	41.7
5-8	23.0	23.3	23.5	23.7
9-11	13.6	12.6	12.4	12.4
12+	3.8	4.8	4.4	4.4

^{*} Blood sample, laboratory tests, physical examinations and electrocardiogram

** In Brazilian minimum wages (US\$ 120.00)

NI: not informed

Most of participants were satisfied with their social network (88.6%) and free time arrangements (83.8), and there was no difference between males and females regarding these variables. The most frequently reported problems were related to health (43.5%), both for males and females. Females reported less money problems than males (10.5 vs. 19.6%). Health was regarded as good/very good by 24.7% and as bad/very bad by 26.1%; women tending to be more pessimistic about their health (Table 5).

DISCUSSION

This is the first population-based study on the epidemiology of the ageing conducted outside large urban areas of Brazil^{22-24,29} and it is the first study designed to compare the health and related conditions of the elderly with those of the younger population. To our knowledge,

Table 4 - Selected socio-demographic characteristics of the elderly in the baseline of the cohort study, according to gender (Bambuí, 1997).

Characteristics	Females (N=964) %	Males (N=642) %	Total (N=1,606) %	OR (95% CI)
Age group (years)				
60-69	57.7	58.7	58.1	1.0
70-79	30.7	30.4	30.6	1.0 (0.8, 1.2)
80+	11.6	10.9	11.3	0.9 (0.7, 1.3)
Median(range)	68(60-95)	67(60-93)	68(60-95)	p=0.185
Marital status				
Married	32.8	73.0	48.9	1.0
Single	12.1	8.3	10.6	3.3 (2.3, 4.7)
Widow	50.3	13.1	35.4	8.6 (6.5, 11.3)
Separated	4.8	5.6	5.1	1.9 (1.2, 3.0)
Number of residents in the household				
5+	5.2	7.5	6.1	1.0
3-4	18.7	20.1	19.2	1.3 (0.8, 2.1)
2	57.0	60.0	58.2	1.4 (0.9, 2.1)
Live alone	18.5	11.4	15.6	2.3 (1.4, 3.8)
NI	0.6	1.1	0.8	-
Median(range)	2.0(1-12)	3.0(1-12)	2.0(1-12)	p=0.000
Head of the family				
Yes	63.1	94.7	75.7	1.0
No	36.2	4.2	23.4	12.9 (8.6, 19.4)
NI	0.7	1.1	0.9	-
Monthly personal income*				
4+	6.4	20.9	12.2	1.0
2.00-3.99	11.1	19.3	14.4	1.9 (1.3, 2.8)
1.00-1.99	65.7	56.4	62.0	3.8 (2.7, 5.2)
0.01-0.00	2.9	2.5	2.7	3.8 (1.9, 7.5)
None	13.6	0.8	8.5	56.6(22.1, 145.3)
NI	0.3	0.1	0.2	-
Education (yrs)				
12+	1.3	2.8	1.9	1.0
9-11	4.3	3.7	4.0	2.4 (1.0, 5.7)
5-8	5.3	4.1	4.8	2.7 (1.2, 6.4)
1-4	54.4	59.8	56.5	1.9 (1.9, 3.9)
Illiterate	34.7	29.3	32.6	2.5 (1.2, 5.2)
NI	0.0	0.3	0.1	-

OR (95% CI): Odds ratio (95% confidence interval; Woolf method)

p: p value (Wilcoxon rank test)

NI: Not informed (excluded from the statistical analysis)

* In Brazilian minimum wages (US\$ 120.00)

this study also constitutes the first effort to carry out a population-based cohort study of the elderly in this country which permits the long-term follow-up of the population. The long-term follow-up in this study is possible because the investigation is based in a small and demographically stable community, which makes the tracing of subjects easier and losses to follow-up small, conditions essential for the success of a cohort study.²

All efforts were made to avoid bias in this study by: encouraging participation, reducing losses to follow-up, collecting information double blinded, assessing the reliability of the data gathered, standardising procedures and instruments and through exhaustive training of field work and laboratory teams. The internal validity was assured in the baseline of the cohort study, in the general population health survey and in the first

Table 5 - Degrees of life satisfaction, main problem and health perception reported by the elderly in the baseline of the cohort study, according to gender (Bambuí, 1997).

Characteristics	Females (N=925) %	Males (N=591) %	Total (N=1,516) %	OR (95% CI)
Satisfaction with social network				
Satisfied	89.5	87.3	88.6	1.0
Indifferent	4.3	7.6	5.6	0.6 (0.4, 0.9)
Unsatisfied	6.1	5.6	5.7	1.2(0.7, 1.8)
NI	0.1	0.0	0.1	-
Satisfaction with free time arrangements				
Satisfied	83.7	83.1	83.8	1.0
Indifferent	7.8	7.1	7.5	1.1(0.7, 1.6)
Unsatisfied	8.4	9.0	8.6	0.9(0.6, 1.4)
NI	0.1	0.0	0.1	-
Main problem				
Other*	26.3	25.7	26.1	1.0
Money	10.5	19.6	14.1	0.5 (0.4, 0.7)
Social network	16.5	15.2	16.0	1.1 (0.8, 1.5)
Health	46.1	39.4	43.5	1.1 (0.9, 1.5)
NI	0.7	0.0	0.4	-
Perception about his/her own health				
Very good	2.1	4.1	2.8	1.0
Good	17.8	28.3	21.9	1.2 (0.7, 2.4)
Reasonable	50.2	47.7	49.2	2.1 (1.1, 3.9)
Bad/very bad	29.9	20.0	26.1	3.0 (1.6, 5.9)

* House, food, transportation

NI: Not informed

follow-up interview. Non-participation was within the expected, participants were similar to the town population in any of the studied characteristics and only 1.7% of the elderly were lost in the first year of follow-up. Death rate among cohort members during the first follow-up (4.6%) was similar to that observed for the Brazilian population in 1996 (4.3% among those aged 60 years or more).¹⁸ However, some caution must be taken during interpretation of results. Although the choice of an area exposed in the past to *T. cruzi* infection allows the testing of new hypothesis concerning the epidemiology of ageing, on the other hand it may restrict the external validity of the study. This potential problem might be overcome through stratification and/or adjustment in data analysis.

A potential source of bias in this cohort study relates to possible changes in exposure status after the baseline survey. All participants received their examination results and were encouraged to seek medical attention when necessary. This might have influenced healthier behaviours and/or produced changes in health condition due to treatment. To avoid knowledge of clinical results becoming a source of bias in the study, selected exposure indicators are being monitored in the follow-up interview. Nevertheless, we cannot discard the possibility of misclassifying some individuals based on their baseline status. Any residual non-differential misclassification would reduce the magnitude of the association, tending to favour the direction of the association found.

The fundamental question of this cohort study is: in people who have reached the age of 60 or more, what are the main predictors of mortality, hospitalisation and physical and cognitive deficits? Thus the study was planned to follow individuals up for a prolonged time span, in order to obtain stable estimates of the incidence of major adverse health events, and their associations with the characteristics identified in the baseline survey. The choice of a cohort design was based on its major advantages, i.e., that it allows determination of the incidence of events and avoids recall bias.² Another extremely attractive aspect of the present study is the storage of material (serum, plasma and DNA) that can be further analysed in the future and may contribute more information to the study.

Regarding characteristics of the elderly participants in our study, the high proportion of widows and the greater number of women was also observed in previous epidemiological studies of the elderly performed in Rio de Janeiro²⁹ and S. Paulo.²⁴ The proportion of aged individuals living alone (16%) was surprising for a town as small as Bambuí, and comparable to that found in S. Paulo (14%) and Copacabana, one of the wealthier areas of Rio de Janeiro (16%).

The proportion of elderly people with no income in Bambuí (9%) was very close to that in Rio de Janeiro (10%).²⁹ Satisfaction with social network was quite high in Bambuí (89%) and was similar for males and females, agreeing with results of the Rio de Janeiro study.

In relation to age distribution and education up to 4 years of schooling, the study population tended to be closer to the population of Santa Cruz, the poorest area studied in Rio de Janeiro.²⁹ And it is interesting to note that the age distribution of participants was close to that of the Brazilian population. Among the participants, 57.7, 30.6 and 11.7% were aged 60-69, 70-79 and 80 or more years, respectively; the corresponding data for Brazil in

1996 were 58.3, 30.9 and 11.7%.¹⁸

A smaller proportion of individuals reported that their health was good/very good (25%) in the Bambuí study compared to the population studied in Rio de Janeiro²⁹ (44%) and S. Paulo (70%).²⁴ This result is consistent with the high proportion of people who have reported health (44%) as the main problem in Bambuí, while in Rio de Janeiro the most frequently reported problem was income (30%).

Overall, women were worse off than men, both in economic and educational terms, agreeing with the previous mentioned studies.^{24,29}

In spite of the differences in study period (the Rio de Janeiro study was carried out in the late 1980s)²⁹ and methodological aspects (the S. Paulo study was restricted to the population aged 65 years or more),²⁴ most socio-demographic characteristics and degrees of life satisfaction reported by the elderly participants of the Bambuí study were similar to those of participants in the above mentioned studies. In addition, age distribution and mortality rate of cohort members were similar to those observed in Brazil for those aged 60 years or more. These similarities suggest that the study population of Bambuí is not special and that results obtained in the BHAS cohort might express situations encountered in other communities of this country.

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