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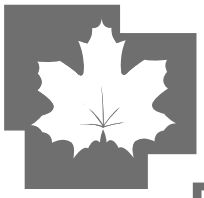

Revista Brasileira de Geriatria e Gerontologia

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Revista Brasileira de Geriatria e Gerontologia é continuação do título *Textos sobre Envelhecimento*, fundado em 1998. Tem por objetivo publicar e disseminar a produção científica no âmbito da Geriatria e Gerontologia, e contribuir para o aprofundamento das questões atinentes ao envelhecimento humano. Categorias de publicação: Artigos originais, Revisões, Relatos, Atualizações e Comunicações breves. Outras categorias podem ser avaliadas, se consideradas relevantes.

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Ways of living in old age: lessons from the FIBRA Study

In December 2020, coinciding with the peak of the COVID-19 pandemic, the United Nations General Assembly (UN)[1] declared the beginning of the Decade of Healthy Aging (2020-2030), in support of actions in favor of an egalitarian society for all ages, in all nations around the world. This is a far-reaching global initiative that focuses on older adults, unifying the efforts of governments and international entities, in order to improve the quality of life of these populations. Despite the health, economic and humanitarian crises caused by the COVID-19 pandemic, and despite prevailing socioeconomic inequalities between nations, and against the resurgence of war in the cradle of Western civilization, the UN initiative, supported by the World Health Organization, comes at an opportune moment. It is essential to create and encourage public policies that promote the well-being of aging populations in different population contexts.

The demographic process of human aging, beginning in the nineteenth and twentieth centuries and experienced worldwide over the last few decades, has brought with it different ways of aging. These trajectories are strongly influenced by social determinants and by the individual experiences of older adults throughout their life course. The health and functionality of older adults are heavily impacted by the socioeconomic adversities experienced in the course of their lives and by the cultural heterogeneity of the environment in which they live. As a result of these influences, important differences are observed between population groups in terms of health outcomes and levels of physical performance and functional capacity. Apart from the purely biological aspects, these differences are a reflection of gender inequalities and experiences of adversity lived in childhood, adulthood and old age. Among these, we should mention the experience of hunger in childhood, social gender role discrepancies, domestic violence, and financial abuse in adulthood, as important risk factors associated with declining health, functionality, and well-being in older adults.

Since the second half of the twentieth century, an accelerated process of demographic aging has been taking place, with profound repercussions in various spheres of Brazilian society. A series of distinct characteristics of this process can be enumerated, including urbanization and the feminization of old age. Since Brazil is a country of continental dimensions, full of cultural nuances and marked by social inequalities, mainly and particularly in the area of health, the population aging process in Brazil presents in a heterogeneous and complex manner.

Different aging phenotypes are observed in the presentation of geriatric syndromes in the Brazilian population. Through its publications over the last 15 years, the FIBRA Study[2], one of the most important population-based studies on frailty developed in Brazil and funded by the National Council for Scientific and Technological Development (CNPq), has been providing important evidence concerning the strong influence of the environment on the presentation of clinical status linked to aspects of health and functionality in

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older adults. Previously observed in another epidemiological study conducted on populations with different aging profiles[3], this data contributes to explanations concerning the clinical presentation of comorbidities and functional decline in this population.

Professor Anita Liberalesso Neri of the State University of Campinas, one of the coordinators of the FIBRA Study, has provided us with scientific publications that provide important evidence regarding the profile of aging and its nuances in Brazil. She established continuity in the FIBRA Study through the formation of cohorts of older adults and through longitudinal observation of the changes in various aspects of health status and functionality, in population subsamples from the original study. To achieve this, FIBRA data from the city of Campinas, SP, and Ermelino Matarazzo, a district located in the east side of the city of São Paulo (SP), were used originally collected from older adults who participated in the baseline survey in 2008 and 2009 and who were interviewed again between 2016 and 2018. This follow-up initiative gave rise to a new wave of important publications for Brazilian gerontology.

In this issue, the Revista Brasileira de Geriatria e Gerontologia publishes a set of articles originating from the results of the cohorts studied in the FIBRA Study. The collection of works was opportunely called *Modos de viver a velhice* [Ways of living in old age], and was designed to draw attention to the heterogeneity present in the aging process. The content of the articles published in this issue offer the reader an in-depth look at advanced old age (80 years old or over) in part of the texts, compared with early old age (72 to 79 years old). Likewise, it invites us to analyze several dimensions of aging: frailty, functional capacity, mobility in the living space, activity, oral health, depression, cognitive deficit, social relationships, social participation, satisfaction, neuroticism, and purpose in life.

Herein, results of clinical and psychosocial interest can be found, including the effects of the association between frailty and depressive states on the survival and mortality of this population. Another finding of interest in clinical practice reveals that the ability of older adults to move among the various levels of living spaces can be a viable tool in screening for frailty and the risk of sarcopenia. According to another study published in the collection, the presence of urinary incontinence negatively influences social life, while clinical and psychosocial initiatives for people with this condition can result in a decrease in the negative psychological effects and a reduction in social isolation.

The articles draw attention to the different implications of population aging and the different modes of aging in this country. Reading the articles should enable productive reflection on the need to develop new approaches to efficient and effective community intervention for the Brazilian older adult population.

Ricardo Oliveira Guerra

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Chronic non-communicable diseases considering sociodemographic determinants in a cohort of older adults

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Flávia Silva Arbex Borim[1,3]

Abstract

Objective: To analyze the differences between the proportions of chronic non-communicable diseases (CNCDs) at two time periods, in a cohort of older adults, based on sociodemographic determinants. *Method:* This is a retrospective longitudinal study with baseline data obtained in 2008-2009 and follow-up in 2016-2017, from the FIBRA Study. The McNemar test was used to compare the frequencies of CNCDs according to sex, age, and education, with a significance level of 5% ($p<0.05$). Results: The sample consisted of 453 older adults (mean age 72±5.2 years old; 69.4% women). There was an increase in the proportions of arterial hypertension (64.4% versus 71.1%) and diabetes mellitus (21.9% versus 27.5%) in the periods studied, and a reduction in rheumatologic disease (43.6% versus 35.8%) and depression (21.7% versus 15.7%). Hypertension increased in older women, in those aged 65-74 years old and those with low education levels. Diabetes increased in older men, in those over 65 years of age and those with low education levels. A reduction in the proportions of rheumatologic diseases and depression was observed in women, in those aged 65-74 years old and those with low education levels. Conclusion: The data reflect the need to understand the sociodemographic health determinants involved in the health-disease-care process to reduce social inequities and the burden of CNCDs in the most vulnerable population segments, especially in the older adult population with multimorbidity.

Keywords: Chronic Disease; Health of the Elderly; Epidemiology; Noncommunicable Diseases; Elderly.

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INTRODUCTION

Chronic non-communicable diseases (CNCDs) are the leading cause of disability and premature mortality in the world, responsible for the death of 41 million people each year, equivalent to 71% of all deaths.[1] The advance of CNCDs is due to the gradual aging of the population associated with the epidemiological transition process, characterized by the increase in chronic-degenerative diseases and the reduction of acute infectious diseases. Among the CNCDs, cardiovascular diseases, diabetes, cancer and chronic respiratory disease are those that most contribute to the burden of morbidity and mortality, causing worsening quality of life, permanent clinical complications, loss of autonomy and functional disability, especially in the older adult population.[2–4]

CNCDs are a global public health problem, more serious in tropical, middle- and low-income countries like Brazil, which have age-standardized mortality rates higher than those of high-income countries.[4,5] This condition reflects the socioeconomic and political context marked by structural problems, such as low education, inadequate nutrition, worse living conditions, infectious diseases, insufficient regulation of tobacco and alcohol, and health care subject to precarious and inaccessible resources.[2,3,5] Evidence shows that most of the burden of CNCDs and health inequities occur due to social determinants of health, a term used to encompass social, economic, political, cultural and environmental determinants of health.[6,7]

In recent decades, the study of social determinants of health has gained prominence around the world, given the need to combat inequities that hinder access and the right to health.[8] In Brazil, the Ministry of Health has implemented measures to control CNCDs, with emphasis on the "Plan of Strategic Actions to Combat CNCDs." Launched in 2011, the plan aims to develop goals and promote policies that guarantee reductions in morbidity, mortality and disabilities caused by CNCDs, through highly cost-effective actions, such as health promotion, early detection, treatment of CNCDs and the reorganization of health services.[2]

According to data from the *Pesquisa Nacional de Saúde* (National Health Survey) (PNS, 2013), the prevalence of CNCDs is high in Brazil (45.1%), with a predominance of systemic arterial hypertension, chronic back problems, depression, arthritis and diabetes mellitus.[9] CNCDs affect all socioeconomic strata, though are more intense in vulnerable groups, especially older adults and those on low income and who have low education levels.[2] The highest prevalence of CNCDs is observed with increasing age[2] and among women, who use health services more (both consultations and hospitalizations), and report more limitations due to CNCDs.[10]

Comprehensive care for the older adult population assumes an essential role in the control of CNCDs and the possibility of longitudinal observation of the occurrence of CNCDs in the older adult population should enable us to understand the magnitude and behavior of these diseases. In this context, sociodemographic determinants can influence the illness profile of the older adult population, given the complexity of the health-disease binomial. Therefore, the purpose of the study was to analyze the differences between the proportions of CNCDs, at two time points, in a cohort of older adults, based on sociodemographic determinants.

METHODS

This is a retrospective longitudinal study with community-dwelling older adults. Data were obtained from the FIBRA (Frailty Profile of Elderly Brazilians) Study conducted at two time periods: baseline (2008-2009)[11] and during follow-up (2016-2017), in Campinas and in Ermelino Matarazzo, a sub-district of the city of São Paulo.

At baseline, minimum sample sizes were estimated for each of the locations of 4 to 5 percentage points. To achieve the sample size, 90 urban census sectors in Campinas and 62 in Ermelino Matarazzo were randomly selected and, for each sample, proportional quotas of men and women by age group were estimated (65-69, 70-74, 75-79 and ≥ 80 years old), according to the census distribution of these segments in the population. The households of the selected census tracts were visited by recruiters trained to identify the presence of older adults eligible for the study: 65 years of age or older, who understood instructions to answer the questionnaire, who agreed to participate in the

survey, and who were permanent residents in the household and within the census sector.

The older adults who met the eligibility criteria were invited to attend public locations with easy access for data collection, which began with the administration of the Mini-Mental State Examination (MMSE), sociodemographic, anthropometric and clinical variables (blood pressure and oral health) and testing for frailty. The score obtained on the MMSE determined the continuity of the interview, taking into account that impairments in cognitive skills could make it impossible to answer self-report questions on CNCDs, the use of medical services, and other subjects. The cutoff scores used in the MMSE were 17 for illiterates, 22 for individuals with 1 to 4 years of education, 24 for those with 5 to 8 years, and 26 for those with 9 years or more of education.[12]

In all, 1,284 older adults were interviewed at baseline (900 in Campinas and 384 in Ermelino Matarazzo), with a mean age of 72.6 ± 5.8 years old and 68.7% women. In 2016-2017, addresses recorded in the baseline database were traversed to locate older adults for a follow-up study. Recruiters made up to three attempts per participant. Of the original sample, 549 older adults were located, 192 had died since baseline, and a further 543 older adults were lost because they could not be located, the application of exclusion criteria, refusal to participate, interruption of the interview by a family member or the older adult, and presence of risk to the physical and psychological integrity of the interviewers. Among the 549 located, 96 were excluded because they did not have complete records of all the variables of interest.

Figure 1 presents the flowchart of the decision-making process for the composition of the sample for this study. The interviews were conducted in the households by a pair of trained recruiters, with a family member or other companion who was available at the time.

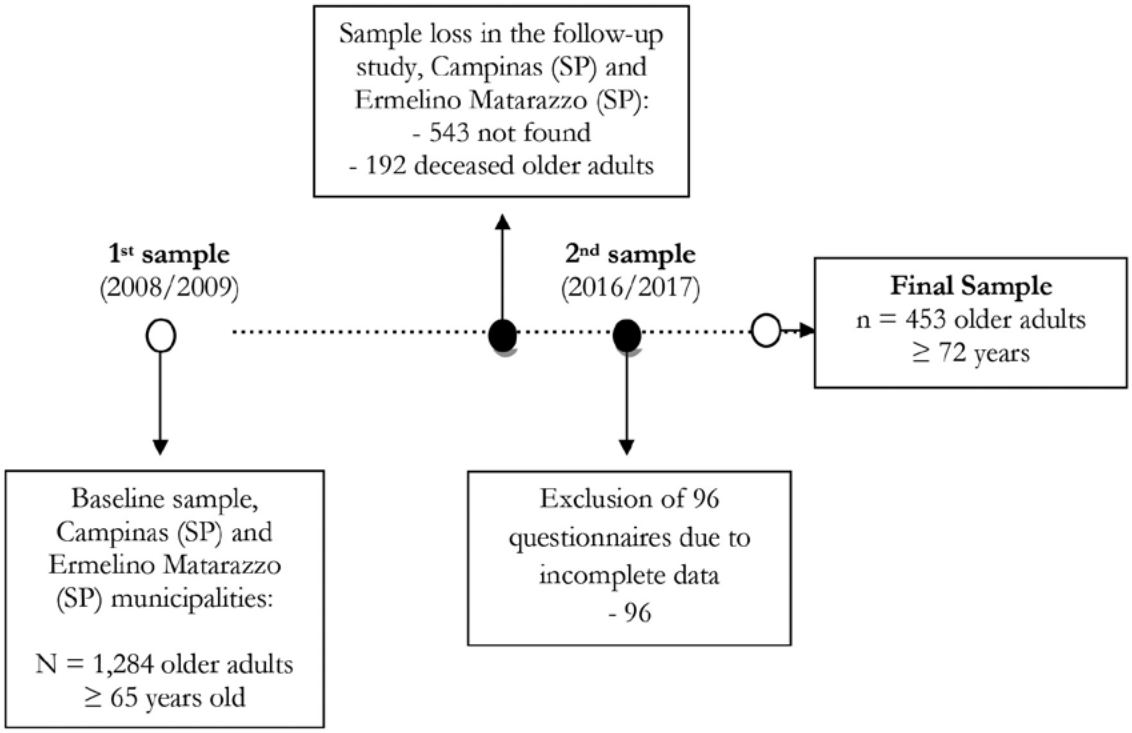

Figure 1. Sample composition flowchart. FIBRA Study, Older Adults, Campinas and Ermelino Matarazzo, SP, Brasil, 2008-2009 and 2016-2017.

The variables of interest in this study were chronic diseases contained on a checklist that, according to the older adults, had been diagnosed by a physician during the last year. The checklist contained nine dichotomous items (yes x no): heart disease (such as angina, myocardial infarction, or heart attack); systemic arterial hypertension (SAH); stroke; diabetes mellitus (DM); neoplasm/cancer; and rheumatologic disease (arthritis/rheumatism). The variables sex (male or female), age (65 to 74 years old or 75 years old and over) and education (0-4 or above 5 years of education) – taken from the baseline study – were considered to assess their relationship with the occurrence of diseases during the period.

Absolute and relative frequency values were computed for each chronic disease recorded at baseline and at follow-up. The proportions of occurrence were estimated according to sociodemographic variables. The McNemar statistical test was used to compare the proportions of chronic diseases in the two time periods. A critical p value of less than 0.05 was considered.

This study was approved by the Research Ethics Committee (REC) of the State University of Campinas (CAAE 37597220.7.0000.5404), following expert report no. 4,356,611, October 23, 2020. The baseline FIBRA Study projects (CAAE 39547014.0.1001.5404) and follow-up (CAAE 49987615.3.0000.5404 and 92684517.5.1001.5404) were also approved following expert reports, no. 907.575 of December 15, 2014, no. 1.332.651 of November 23, 2015, and no. 2.847.829 of November 23, 2015, and no. 2.847.829 of August 27, 2018, by above mentioned ethics committee. All participants signed a term of free, informed consent regarding the objectives, procedures, rights and duties of the participants and ethical commitments of the researchers.

RESULTS

The sample consisted of 453 older adults. At baseline, the mean age was 72.0 ± 5.2 years old, the majority were women (69.4%) and had between 0 and 4 years of education (71.8%). Table 1 presents the data resulting from the comparison of CNCD proportions at baseline and follow-up. A statistically significant increase was observed in the occurrence of SAH (64.4% versus 71.1%; p = 0.001) and DM (21.9% versus 27.5%; p = 0.001). Decreases were observed in the accumulated proportions of rheumatologic disease (43.6% versus 35.8%; p = 0.003) and depression (21.7% versus 15.7%; p = 0.004).

When evaluating the occurrence of chronic diseases according to sex, an increase in the proportion of DM was observed among men (21.5% versus 30.5%; p = 0.010) and of SAH in women (68.6% versus 75.1%; p = 0.010). Neoplasms, rheumatologic diseases and depression were less frequent at follow-up compared with baseline for women (Table 2).

Table 1. Comparison of the frequency of occurrence of CNCD in older adults over time. FIBRA Study, Older Adults, Campinas and Ermelino Matarazzo, SP, Brazil, 2008-2009 and 2016-2017.

CNCD	BL n (%)	FU n (%)	*p value**
Heart Disease	100 (22.4)	100 (22.4)	1.000
SAH	290 (64.4)	320 (71.1)	**0.001**
Stroke	40 (8.9)	39 (8.7)	1.000
DM	98 (21.9)	123 (27.5)	**0.001**
Neoplasms	44 (9.8)	31 (6.9)	0.085
Rheumatologic Disease	195 (43.6)	160 (35.8)	**0.003**
Pulmonary Disease	45 (10.2)	41 (9.3)	0.689
Depression	97 (21.7)	70 (15.7)	**0.004**
Osteoporosis	127 (28.5)	118 (26.5)	0.463

BL: baseline; FU: follow-up; SAH: systemic arterial hypertension; DM: diabetes *mellitus*.

* McNemar test: p < 0.05.

Table 2. Comparison of the frequency of occurrence of CNCDs in older adults over time, according to sex. FIBRA Study, Older Adults, Campinas and Ermelino Matarazzo, SP, Brazil, 2008-2009 and 2016-2017.

CNCD	MALE			FEMALE		
	BL n (%)	FU n (%)	*p value**	BL n (%)	FU n (%)	*p value**
Heart Disease	28 (19.4)	28 (19.4)	1.000	72 (23.7)	72 (23.7)	1.000
SAH	80 (55.6)	90 (62.5)	0.075	210 (68.6)	230 (75.1)	**0.010**
Stroke	18 (12.5)	17 (11.8)	1.000	22 (7.2)	22 (7.2)	1.000
DM	31 (21.5)	44 (30.5)	**0.010**	67 (22.0)	79 (26.0)	0.057
Neoplasms	17 (11.9)	16 (11.2)	1.000	27 (8.9)	15 (4.9)	0.042
Rheumatologic Disease	38 (26.4)	28 (19.4)	0.121	157 (51.8)	132 (43.5)	**0.015**
Pulmonary Disease	15 (10.5)	7 (4.9)	0.076	30 (10.0)	34 (11.3)	0.635
Depression	18 (12.6)	14 (9.8)	0.503	79 (26.0)	56 (18.5)	**0.005**
Osteoporosis	12 (8.3)	8 (5.5)	0.480	115 (38.1)	110 (36.4)	0.690

BL: baseline; FU: follow-up; SAH: systemic arterial hypertension; DM: diabetes *mellitus*.

* McNemar test: $p < 0.05$.

The analyzes stratified by age group show that, among older adults aged between 65 and 74 years old, the occurrence of SAH and DM increased, while those of rheumatologic diseases and depression decreased during the course of the study ($p < 0.05$). For the oldest age group, a statistically significant increase in the occurrence of DM was observed (Table 3).

Among older adults with low education levels, an increase in the occurrence of SAH and DM and a reduction in the occurrence of neoplasms, rheumatologic diseases and depression was observed over the period. Among the most educated, there was stability regarding the the conditions evaluated ($p > 0.05$), except for depression, which showed a reduction (20.4% versus 12.0%; $p = 0.049$), when comparing the two periods (Table 4).

Table 3. Comparison of the frequency of occurrence of CNCD in older adults over time, according to age group. FIBRA Study, Older Adults, Campinas and Ermelino Matarazzo, SP, Brazil, 2008-2009 and 2016-2017.

CNCD	65 - 74 YRS OLD			75 YRS OLD & OVER		
	BL n (%)	FU n (%)	*p value**	BL n (%)	FU n (%)	*p value**
Heart Disease	75 (22.4)	80 (23.9)	0.660	25 (22.1)	20 (17.7)	0.458
SAH	218 (64.9)	242 (72.0)	0.003	72 (63.1)	78 (68.4)	0.237
Stroke	31 (9.3)	32 (9.6)	1.000	9 (7.9)	7 (6.1)	0.726
DM	79 (23.6)	95 (28.4)	0.025	19 (16.6)	28 (24.5)	0.011
Neoplasms	29 (8.7)	21 (6.3)	0.229	15 (13.3)	10 (8.9)	0.301
Rheumatologic Disease	149 (44.7)	124 (37.2)	0.017	46 (40.3)	36 (31.6)	0.098
Pulmonary Disease	31 (9.4)	31 (9.4)	1.000	14 (12.3)	10 (8.8)	0.424
Depression	81 (24.2)	50 (15.0)	0.001	16 (14.1)	20 (17.7)	0.503
Osteoporosis	88 (26.3)	83 (24.8)	0.657	39 (34.8)	35 (31.2)	0.627

BL: baseline; FU: follow-up; SAH: systemic arterial hypertension; DM: diabetes *mellitus*.

* McNemar test: $p < 0.05$.

Table 4. Comparison of the frequency of occurrence of CNCD in older adults over time, according to education. FIBRA Study, Older Adults, Campinas and Ermelino Matarazzo, SP, Brazil, 2008-2009 and 2016-2017.

CNCD	0 - 4 YEARS			5 YEARS OR MORE		
	BL n (%)	FU n (%)	*p value**	BL n (%)	FU n (%)	*p value**
Heart disease	74 (21.9)	70 (20.7)	0.752	25 (23.1)	29 (26.8)	0.523
SAH	221 (65.0)	245 (72.0)	0.003	68 (62.4)	74 (67.9)	0.263
Stroke	33 (9.7)	28 (8.3)	0.458	7 (6.4)	10 (9.2)	0.548
DM	77 (22.8)	96 (28.4)	0.005	20 (18.3)	26 (23.8)	0.179
Neoplasms	30 (8.9)	17 (5.0)	0.024	14 (12.8)	14 (12.8)	1.000
Rheumatologic disease	144 (42.7)	120 (35.6)	0.025	50 (45.9)	40 (36.7)	0.075
Pulmonary disease	35 (10.4)	29 (8.6)	0.440	10 (9.35)	12 (11.2)	0.790
Depression	75 (22.2)	57 (16.8)	0.038	22 (20.4)	13 (12.0)	0.049
Osteoporosis	98 (29.2)	87 (25.9)	0.294	28 (25.7)	30 (27.5)	0.850

BL: baseline; FU: follow-up; SAH: systemic arterial hypertension; DM: diabetes *mellitus*.

* McNemar test: $p < 0.05$.

DISCUSSION

The results obtained in the study show the proportions of self-reported CNCDs in older adults living in the community at two time points, considering the variables of sex, age and education. The natural aging process promotes organic changes that can cause increased vulnerability to the development of CNCDs.[13] In this study, an increase in the occurrence of SAH and DM was observed among older adults, a finding that is consistent with those of other studies.[14,15] These diseases show high prevalence and stand out among the public health problems and the main causes of morbidity and mortality in the older adult population.[16,17]

SAH is the most prevalent chronic disease in the Brazilian geriatric population and its prevalence increases with age[16]; it represents a risk factor for cognitive decline, stroke, Alzheimer's dementia and loss of functionality.[18,19] The global prevalence of SAH in older adults aged 60-69 years old is estimated at 57.0% in men and 61.6% in women. Over 70 years of age, this increases to 68.6% in men and 75.8% in women,[20] data also observed in this study.

There was an increase in the occurrence of SAH in women. Women's greater demand for health services and their greater sensitivity to health status predispose them to frequent reporting of diseases, high rates of diagnosis[21] and, probably, higher rates of survival. This process leads to an increase in the proportion of older adult women in the population, a phenomenon known as the feminization of old age.[22] It is also worth noting that premenopausal women experience a decline in estrogen levels, which can trigger vasomotor symptoms (hot flushes, sweating, palpitations) and psychological symptoms (nervousness, irritability, insomnia and depression), in addition to being associated with increased risk of cardiovascular diseases and osteoporosis.[23]

Education is an important determinant of health status and illness, especially in old age. Brazilian older adults with low education levels show a higher prevalence of SAH and DM, which denotes poor living conditions and health behaviors, which have an important impact on the health of older adults.[24] A systematic review found that low levels of education increased the probability of multimorbidity by 64% (OR: 1.64, 95%CI 1.41-1.91), and that this association is stronger in aging populations than in younger ones.[25] Bento et al.[26] investigated the association between contextual and individual variables and SAH in Brazilian older adults and observed an inverse association between hypertension and education. This result likely reflects the greater difficulty that older adults with low education levels experience in recognizing their health needs and adhering to treatments, as well as a reflection of poor medical

care, poorer functional literacy and difficulties in accessing health services.[25,26]

DM is another very important CNCD, since it is associated with functional disability, multisystem complications (cardiovascular, renal and neurological), high rates of hospitalization and premature mortality.[27] Estimates indicate that between 2010 and 2030 there will be a 69% increase in the number of adults with DM in developing countries and a 20% increase in developed countries.[28] In Brazil, according to data from the 2013 PNS, the prevalence of DM was 6.2%; an estimated 9.2 million Brazilians have the disease. Among older adults, the prevalence reached 14.5% (60-64 years old) and around 20.0% (65 years old and over).[29] The prevalence of DM in older Brazilians increased from 22.2% to 25.9% ($p = 0.001$) between 2012 and 2016, according to data from a telephone survey conducted by the Ministry of Health.[30]

For Brazilian adults of advanced age (75 years old or over), an increase in the occurrence of DM ($p=0.011$) was observed similar to that reported in the national and international literature.[17,31] This increase may be influenced by greater access to health services and understanding of the diagnosis, the adherence to free treatment and interventions for improved disease control, such as the Hiperdia program, which reduces mortality and increases the incidence (accumulation of treated patients) and, consequently, the survival of older adults living with DM.

A reduction in the frequencies of depression and rheumatologic diseases was observed from baseline to follow-up, in this present study, possibly related to losses in follow-up or to the selective survival bias – following diagnosis, the patient changes habits, adopting healthier practices and behaviors. Depression is a frequent condition in the older adult population, associated with chronic diseases, functional limitation in daily activities and cognitive deficit.[32] Reynolds et al.[33] conducted a study on psychiatric disorders in a representative sample of 12,312 older adults in the United States and observed a decrease in the rates of psychiatric disorders with increasing age. The authors reported that the limited perception of time by older adults, together with the search for the fulfillment of emotionally significant goals, reduces stressful social situations and increases the probability of experiencing positive emotions.[33] Our results seem to replicate this finding.

The occurrence of neoplasms decreased in follow-up compared with baseline, suggesting a higher probability of death for part of the cohort that presented chronic disease. In a study using data from the 2013 PNS, the prevalence of cancer diagnosis was identified in 5.6% of older adults, and was higher in men (7.1%) than in women (4.7%; $p<0.001$),[34] similar to this study, which showed a higher occurrence of neoplasms in older men. Older adults with cancer who participated in the 2013 PNS showed an even higher prevalence of arterial hypertension, heart diseases, depression and chronic respiratory diseases, which reflects the association between CNCDs (multimorbidity), their clinical implications and in oncogeriatric care.[34]

Several measures have been implemented in recent years to control CNCDs in Brazil, with free access to drug treatment forming an essential strategy for health policies. Matta et al.[35] identified the pharmacy of the Unified Health System as the main source of obtaining medicines in Brazil. However, relevant regional differences in drug dispensing were identified, particularly in the North and Northeast regions of the country. The accreditation of pharmacies and commercial drugstores through the *Programa Farmácia Popular* (a low-price drugstore program) in Brazil is an alternative to ensure access for the population to essential medicines for the treatment of chronic diseases, such as SAH, DM and asthma.[35]

Although the baseline of the FIBRA Study did not adopt a perfect sampling design, this investigation represents a relevant contribution to the study of old age in Brazil, since it is a pioneer in the study of frailty, it involves adults aged 65 years old and over, because of its multicentric nature, and because it presents an acceptable level of sample randomization. The composition of the sample may have been affected by the selection of the fittest survivors, through the exclusion of those who did not meet the cognitive performance criteria established to respond to the complete protocol.

After an average of nine years since the baseline study, locating the oldest adults posed a challenge and a major obstacle to recruitment, as much as moving residence among part of the older adults to a child's home or to an institution, their children imposing a ban on further participation in the study, and the fear some older adults present about having strangers in their home. Self-reported data may have been hampered by memory biases or social desirability. The fact that simple or multiple imputation techniques were not used to calculate the estimates of proportions should also be taken into consideration, a factor that requires further studies on the subject. Thus, estimates may be low for some of the indicators presented.

CONCLUSION

The study presented changes in the proportion of older adults with CNCDs, considering sociodemographic determinants of the health-disease process. An increase in the occurrence of SAH and DM was observed in the older adult population, together with a decrease in the prevalence of rheumatologic disease and depression after an average of nine years since the baseline measurements were taken. Differences in the prevalence of CNCDs according to sex, age and education were also identified. These data can contribute to the elaboration of health promotion actions among older adults, given the need to reduce the incidence and prevalence of CNCDs in old age.

Organic alterations secondary to the aging process determine greater vulnerability among older adults to the development of CNCDs, which implies the need for a better understanding of the social determinants of health. Educational measures, treatment, the control of risk factors (smoking, alcoholism, etc.), the promotion of healthy behaviors (healthy eating, physical activity) and management of CNCDs are a challenge for public health. Collaborative efforts are urgently needed to tackle the burden of chronic disease and multimorbidity in the most vulnerable population segments, especially the older adult population.

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Direct and indirect associations between self-rated health, objective health indicators and neuroticism in older adults

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Abstract

Objective: to analyze the direct and indirect associations between self-rated health, objective health indicators and neuroticism in older adults. *Method:* Data were extracted from follow-up records (2016-2017) of the Study of Frailty in Brazilian Elderly (FIBRA Study), a population-based study of frailty and associated variables in old age. Three hundred and ninety-seven individuals aged 73 years and over at follow-up answered an item on self-rated health. Polimedication, chronic pain and multimorbidity were self-reported, fatigue was measured by CES-D, depression by GDS and neuroticism by NEO-PI-R. Path analysis was performed to verify direct and indirect associations between self-rated health, objective health indicators and neuroticism in the follow-up. *Results:* Neuroticism mediated the relationship between sex and age with self-rated health, and between depression and self-rated health. More robust relationships were observed between depression and neuroticism, pain and neuroticism, and sex and neuroticism; the least robust occurred between age and fatigue. Conclusion: Neuroticism is an important mediator of the relationship between self-rated health and objective health indicators. Longitudinal work is needed to explain the observed relationships.

Keywords: Elderly. Chronic Diseases. Pain. Neuroticism. Self-Assessment.

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INTRODUCTION

Self-rated health is considered a multi-factorial construct[1] which reflects a number of different influences, ranging from genetic to environmental[2]. Also, self-rated health can be regarded as an important measure of global, physical and mental health of an individual and of a population. The measure has been widely used in epidemiological studies and in both medical and social sciences[3,4].

Previous studies have shown that negative self-rated health is associated with negative health outcomes such as depression[5], polypharmacy[6], fatigue[7] and multimorbidities[8]. Evidence has also shown that the presence of chronic diseases which develop with the process of aging can lead to a negative self-rated health and worsen depressive factors[9]. More specifically, the study by Lee et al.[9] found that negative self-rated health and pain were risk factors for depressive symptoms. A study by Krug et al.[10] assessing older adults aged 80 years or over, found that participants without depressive symptoms had higher self-rated health scores than individuals with depressive symptoms. In the studies cited above, self-rated health was associated with physical and mental health. More specifically, with regard to mental health, the neuroticism personality trait plays an important role.

Personality is an important psychological resource that can attenuate or exacerbate the impact of physical conditions on self-rated health[11]. The Big Five Personality Traits Model of Costa and McCrae[12], or so-called Big Five, constitutes an empirical generalization of the covariation of personality traits, a concept which seeks to explain what defines a person on an individual level[12]. The Big Five comprises the following five explanatory latent variables (traits) of the construct: neuroticism, introversion-extraversion, openness to experience, agreeableness and conscientiousness[12].

Neuroticism reflects the tendency of individuals to respond to threats with negative emotions[12]. Studies show that neuroticism is associated with deleterious health behaviors (smoking, alcoholism and sedentarism) that can result in depression[13] and chronic conditions[14]. Individuals who score highly on neuroticism tend to be more worried, nervous, emotional, insecure, feel inadequate, and hypochondriac, whereas those scoring low tend to be calm, relaxed, unemotional, engaged, secure and satisfied with themselves[12].

The literature on the relationship of personality traits with self-rated health is vast[4], but little is known about the interaction of the neuroticism trait with self-rated health in older adults[11]. Some studies show that older individuals with high neuroticism scores tend to rate their health as poor[3,4]. Regarding development over the life span, neuroticism tends to increase over time[15]. Understanding the determinants and correlates of self-rated health can help professionals prioritize actions aimed at health promotion and disease prevention, positively impacting the lives of the older population.

In the present study, multi-morbidity, fatigue and polypharmacy were used as indicators of physical health, whereas depression and neuroticism were adopted as indicators of mental health. The hypothesis tested holds that sex and age influence the distribution of objective health indicators (multimorbidity, polypharmacy, fatigue, chronic pain and depression), as well as self-rated health and neuroticism, and that neuroticism mediates the relationship between objective health indicators and self-rated health.

METHODS

A longitudinal study was conducted whose initial data collection was performed between 1st September 2008 and 30th June 2009. This baseline sample comprised 1,284 older adults, born between 1st January and 31st December 1935, from Campinas city, São Paulo state and from Ermelino Matarazzo, a subdistrict of São Paulo city, all of whom participated in the first wave of measurements for the Frailty in Brazilian Older Adults (FIBRA) study. The sample included subsamples of men and women, representative of the respective age and sex segments, who resided in census sectors randomly selected from those within the urban area of the two study sites.

The second wave (follow-up) of measurements of the FIBRA study was carried out between 1st January 2016 and 30th June 2018 and centered on participants

born between 1st January 1936 and 31 December 1944. Of the initial total 1,284 individuals surveyed in the 1st wave, 543 were not included in the 2nd wave of measurements. Reasons for non-inclusion were: individual not found (57.9%), refusal to take part by respondent or family member (34.5%), exclusion based on study criteria (5.5%), session halted by family member or respondent (1.6%), and interview not conducted because venue posed a risk to psychological or physical well-being of interviewers (0.5%).

Thus, 549 participants with full baseline and follow-up records remained in the study. According to data from the Mortality System of Campinas and information furnished by family members and neighbors, 194 participants were no longer included in the database due to death during the follow-up period between the surveys. Therefore, 549 participants met the criteria for inclusion in the sample for the follow-up study. Of this follow-up group, 419 attained the score on Mini-Mental State Examination (MMSE) required for inclusion. The cut-off score in the study was based on the mean MMSE scores for each educational band minus 1 standard deviation: 17 for illiterate individuals or those with no formal schooling; 22 for participants with 1-4 years of education; 24 for 5-8 years; and 26 for participants with ≥ 9 years of study[16]. Conversely, 130 participants failed to meet MMSE performance criteria and were therefore not included in the part of the protocol that involved scales which placed higher cognitive demands, such as the measures of objective and subjective health and neuroticism, which were the focus of the present study. Of the participants that answered these items, 22 did not provide answers for all of the questions and were subsequently excluded. Therefore, the final sample for the present analysis of follow-up data comprised 397 participants.

Data for the variables sex, age, objective physical and mental health indicators (multimorbidity, polypharmacy, fatigue, chronic pain and depressive symptoms), self-rated health and neuroticism were measured. The follow-up study included additional variables of interest, namely: brachial circumference, skin fold measurements, nutritional behavior, marital status, religiosity, purpose in life, neuroticism, quality of life and sarcopenia. Sex and age were assessed by self-report questions, with the options male/female for gender, and date of birth information for age, calculated by subtracting birth date stated from the date of interview to give respondent age in years.

The number of clinically-diagnosed diseases in the past 12 months was obtained by presenting a list of nine descriptive items of the most common non-communicable conditions in older adults (cardiovascular diseases, hypertension, stroke, diabetes mellitus, cancer, arthritis or rheumatism, pulmonary diseases, depression and osteoporosis) and tallying the number of diseases reported (0=no and 1=yes). Multimorbidity was defined as the presence of ≥ 2 chronic diseases[17]. The number of medications prescribed by physicians or self-administered in the past 3 months was recorded. From this data, total number of medications was determined, where polymedication or polypharmacy was defined as daily use of ≥ 5 medications[18].

Fatigue was measured using the Center for Epidemiologic Studies - Depression Scale (CES-D)[19], with four possible answers for each question (most or all of the time, occasionally or a moderate amount of time, some or little of the time, and rarely or none of the time). Responses to either of the two items with *most or all the time* were taken to indicate fatigue. Chronic pain was evaluated by a question on type of occurrence in the past 12 months, with answers yes or no. Depression was assessed using the Geriatric Depression Scale, a screening instrument containing 15 dichotomous items describing dysphoric moods. A GDS score >5 was deemed suggestive of depression[20]. Self-rated health was measured by an item scored on a scale with 5 levels of intensity (1 = very poor, 2 = poor, 3 = fair. 4 = good, and 5 = very good) in response to the question: *How do you rate your health now?*

Neuroticism was measured by applying the Brazilian version of the neuroticism subscale, part of the personality test battery called the NEO-PI-R (Neuroticism, Extraversion, Openness to experience, Agreeableness and Conscientiousness), or the so-called Big Five Personality Factors[12]. Comprising 12 items scored on a Likert-type scale with 5 possible responses (ranging from 1 = totally disagree to 5 + totally agree) and a total score of 12-60 points, the scale has no pre-established cut-off relative to a gold-standard score nor normative values for the

Brazilian population aged 60 or over. Thus, the distribution of the values derived from its application among the participants was treated as a continuous variable. Agreement with 8 items indicated maximum neuroticism, whereas disagreement with the other 4 items indicated a calm and relaxed personality. Accordingly, these 4 items (1, 3, 6, and 7) were inverted for analysis. Thus, higher scores indicated greater intensity of neuroticism, while lower scores indicated lower intensity of neuroticism[21].

The sample was characterized by a descriptive analysis with categorical variables expressed as absolute and relative frequency, and quantitative variables as mean, median and standard deviation. The normality of the data distribution was checked using the Kolmogorov-Smirnov test, which showed most of the continuous variables had a non-normal distribution. In order to study the variables of interest, as per the theoretical model devised for the study (Figure 1), structural equation modelling was performed using path analysis. Path Analysis is an extension of multiple regression that goes further than regression in providing an analysis of complex models. Thus, path analysis is regarded as a statistical analysis of multiple regression used to assess causal models examining the relationships between 1 dependent variable and 2 or more independent variables. This method allows estimation of both the magnitude and significance of causal connections between variables (β coefficient). The model features straight arrows indicating direct and indirect associations, and elliptical arrows indicating covariance. After adjusting indicators and significance tests, the final model of the paths analysis is constructed, retaining or rejecting relationships from the previous theoretical model. The tests and acceptance values were: Goodness of Fit >0.05; Chi Square ratio (X2/DF) <2; SRMR (Standardized Root Mean Square Residual) ≤0.10; RMSEA (Root Mean Square Error of Approximation) ≤0.08; CFI (Comparative Fit Index) ≥0.90 and TLI (Tucker-Lewis Index) ≥0.90.

In order to analyze the goodness-of-fit of the data for the paths proposed, significance tests were performed for the path coefficients. Absolute values of t>1.96 indicate the path has a statistically significant coefficient.

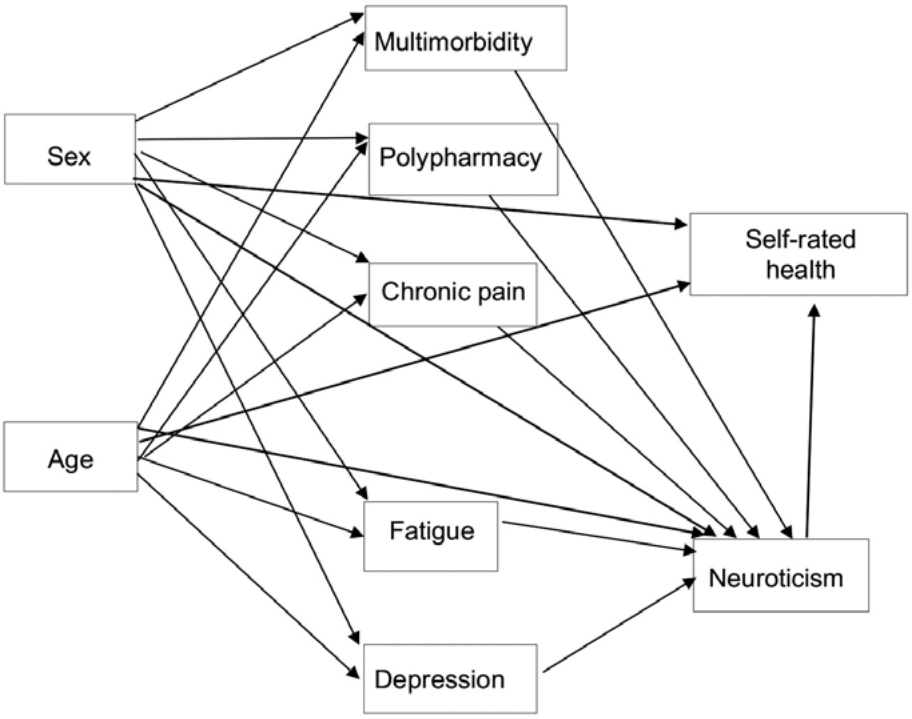

Figure 1. Theoretical model of associations between sex, age, objective health indicators, neuroticism and self-rated health. FIBRA study, participants from Campinas and Ermelino Matarazzo, São Paulo, Brazil, 2016-2017.

The data were collected at respondents´ homes by pairs of trained researchers who wore uniforms and were duly identified by the visual material of the study. The respondents participated on a voluntary basis. Prior to interview, all participants signed a free and informed consent form explaining the interview aims and contents, the confidential nature of the data, participants´ rights and obligations, and the ethical code of the researchers. The research projects were approved by the Research Ethics Committee of the State University of Campinas on 23/11/2015, under permit 1.332.651, CAAE 49987615.3.0000.5404 and permit 2.847.829, of 27/08/2018, CAAE 92684517.5.1001.5404.

RESULTS

The sample comprised 397 older adults, of whom 44.5% were aged 72-79 years (mean = 80.3 ± 4.64) and 55.5% aged ≥80 years. There was a predominance of women in the sample, with a ratio of 70.0% female to 30% male. The majority of participants were classified as exhibiting multimorbidity (≥3 diseases) and 41% as polypharmacy. Overall, 20.1% of participants scored above the cut-off on the depression screening scale. Most participants rated their health positively (good and very good). Over half (56.1%) of respondents reported chronic pain, whereas only 29.2% had fatigue. Participant scores on the neuroticism scale were generally low, reflected in the mean of 26 (standard deviation of 8.4) points obtained on each item and the total scale (Table 1).

Goodness-of-fit measures were calculated to check the fit of the variable to perform the path analysis. The first revision suggested exclusion of the following direct associations: age with multimorbidity, sex with fatigue, age with chronic pain, age, fatigue and multimorbidity with neuroticism, plus exclusion of the polypharmacy variable. Also at the first stage, the direct associations of sex and age with self-rated health and age and sex with depression were excluded. The second revision added the reciprocal relation between fatigue and chronic pain, the direct association between multimorbidity and chronic pain, and of each of these with depression, and the direct association between multimorbidity and fatigue, and both with neuroticism. The third revision included the association of chronic pain with morbidity, fatigue with depression, fatigue with multimorbidity, and multimorbidity with self-rated health. Results are shown in Table 2.

The directions of the statistically significant ($p<0.05$) direct relations between pairs of variables, together with their respective β coefficients indicating strength of these associations, are shown in Figure 2. The most robust relations were found between depression and neuroticism, pain and neuroticism, and sex and neuroticism. These results suggest that: individuals with high depression scores also scored higher for neuroticism; there were more participants who scored for chronic pain among those who scored high for neuroticism; and more women than men scored for neuroticism. In addition to these relations, negative associations were evident between pain and self-rated health, between neuroticism and self-rated heath, as well as positive associations between pain and multimorbidity, and between multimorbidity and depression. The least robust relations were between age and fatigue, suggesting there were fewer reports of vitality loss among the group containing more oldest-old individuals. The association between sex and multimorbidity suggests there was a high proportion of women in the group reporting multiple diseases. The relationship between chronic pain and depression may indicate a higher number of individuals with chronic pain among those with higher depression scores.

Four variables were identified as mediators of the associations of the variable pairs assessed: neuroticism, depression, multimorbidity and chronic pain. Neuroticism proved a mediator of the associations of the variables sex, age, depression, chronic pain and multimorbidity with self-rated health. Depression mediated the association of fatigue, chronic pain and multimorbidity with neuroticism, and likewise of fatigue, chronic pain and multimorbidity with self-rated health. Multimorbidity mediated the relationship of sex, fatigue and pain with neuroticism, and also of chronic pain with self-rated health. Lastly, chronic pain mediated the associations of sex with multimorbidity, depression and neuroticism (see Table 3).

Table 1. Sociodemographic characteristics, health indicators, self-rated health and neuroticism. FIBRA study, participants from Campinas and Ermelino Matarazzo, São Paulo state, Brazil, 2016-2017.

	n (%)
Sociodemographics	
Sex	
Male	119 (30.0)
Female	278 (70.0)
Age	
73-79	177 (44.5)
≥ 80	220 (55.5)
Health indicators	
Multimorbidity	
No	127 (33.2)
Yes	255 (66.8)
Medications used	
0-4	215 (59.0)
≥ 5	149 (41.0
Fatigue	
No	281 (70.8)
Yes	116 (29.2)
Chronic pain	
No	174 (43.9)
Yes	223 (56.1)
Depression	
No	317 (79.8)
Yes	80 (20.1)
Self-rated health	
Very poor (1)	8 (2.0)
Poor (2)	23 (5.8)
Fair (3)	156 (39.3)
Good (4)	160 (40.3)
Very good (5)	50 (12.6)
Neuroticism	26 (8.4)*

*Representing mean and standard deviation

Table 2. Goodness-of-fit measures for variables investigated in Path Analysis. FIBRA study, participants from Campinas and Ermelino Matarazzo, São Paulo state, Brazil, 2016-2017.

	Theoretical model	After 1st revision	After 2nd revision	After 3rd revision
Chi-square test for goodness-of-fit	<0.001	<0.001	<0.001	0.764
Chi-Square Ratio (χ2/GL)	<0.001	<0.001	<0.001	<0.001
TLI-Tucker-Lewis Index	0.012	0.580	0.911	1.000
CFI - Comparative Fit Index	0.690	0.765	0.782	1.032
SRMR - Standardized Root Mean Square Residual	0.103	0.104	0.064	0.018
RMSEA - Root Mean Square Error of Approximation	0.163	0.119	0.082	<0.001

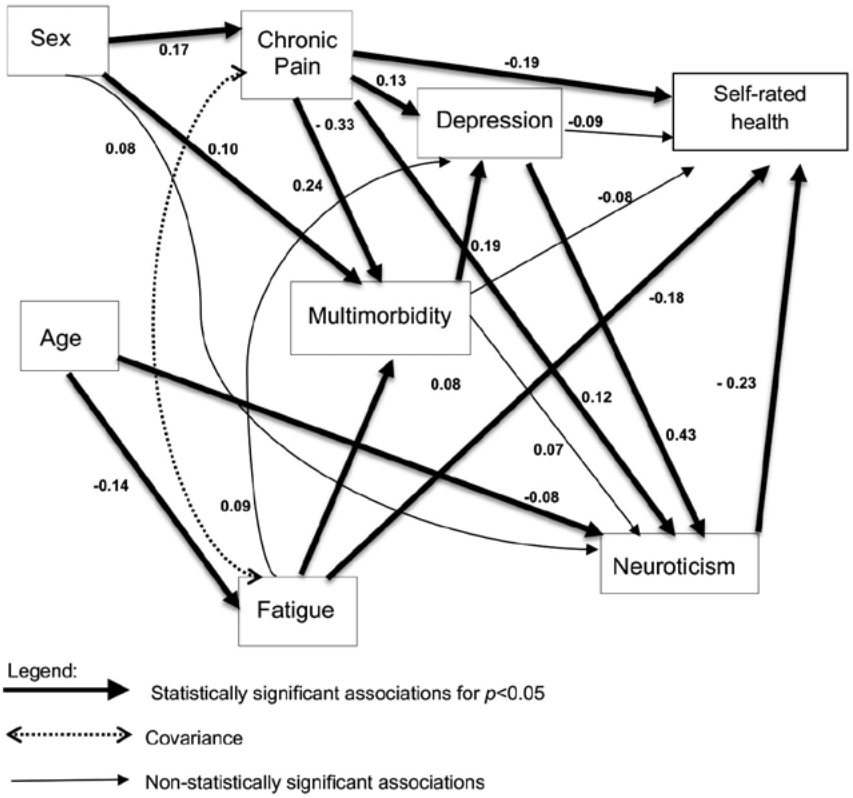

Figure 2. Direct associations between sex, age, objective health indicators, neuroticism and self-rated health. FIBRA study, participants from Campinas and Ermelino Matarazzo, São Paulo state, Brazil, 2016-2017.

Table 3. Indirect association between pairs of variables and corresponding mediating variables. FIBRA study, participants from Campinas and Ermelino Matarazzo, São Paulo state, Brazil, 2016-2017.

Indirect associations	Mediating variables	β Coefficient	s.e	*p-value**
Sex → Multimorbidity	Chronic pain	0.042	0.015	0.005
Sex → Depression	Chronic pain	0.043	0.014	0.002
Sex → Neuroticism	Chronic pain	0.968	0.297	0.001
Sex → Self-rated health	Chronic pain	-0.149	0.038	<0.001
Chronic pain → Depression	Multimorbidity	0.038	0.012	0.003
Fatigue → Neuroticism	Multimorbidity → depression	0.095	0.433	0.022
Chronic pain → Neuroticism	Depression	1.58	0.440	<0.001
Multimorbidity → Neuroticism	Depression	1.49	0.421	<0.001
Fatigue → Self-rated health	Depression	-0.213	0.024	<0.001
Age → Self-rated health	Neuroticism	0.088	0.028	0.002
Chronic pain → Self-rated health	Neuroticism	-0.148	0.036	<0.001
Multimorbidity → Self-rated health	Depression → neuroticism	-0.098	0.031	0.002
Depression → Self-rated health	Neuroticism	-0.213	0.052	<0.001

s.e = standard error

*Statistically significant for p <0.05

DISCUSSION

The present study is relevant in elucidating the relationship between self-rated health, objective health indicators and neuroticism in community-dwelling older adults. This study is probably the first of its kind investigating the strength of association between these variables in the Brazilian milieu.

Neuroticism proved a mediator of the associations of the variables sex, age, depression, chronic pain and multimorbidity with self-rated health. Depression mediated the association of fatigue, chronic pain and multimorbidity with neuroticism, and likewise of fatigue, chronic pain and multimorbidity with self-rated health. Multimorbidity mediated the relationship of sex, fatigue, and pain with neuroticism, and also of chronic pain with self-rated health. Lastly, chronic pain mediated the associations of sex with multimorbidity, depression and neuroticism.

It is known that health conditions, such as pain secondary to chronic diseases, are associated with negative self-rated health[11]. The present study found a positive correlation between multimorbidity and chronic pain, corroborating the results of the study by Cai et al.[22]. These authors noted the presence of chronic diseases can result in pain and physical disability, leading to negative self-perceived health and increased levels of depression in older adults. The study by Jang et al.[23] concluded that chronic diseases and functional disability were strongly associated with a negative rating of health and with depressive symptoms in Chinese Americans and Korean Americans aged over 60 years. A study involving Swiss older adults found a positive association of fatigue with self-rated health[24].

In the present study, depression mediated the association of fatigue, pain and multimorbidity with neuroticism, and of fatigue, pain and multimorbidity with self-rated health. The prevalence of depression was 20.1%, similar to the 17% rate reported by Leite et al.[25] in community-dwelling elderly from Cuiabá (Mato Grosso state). Depression is a disease that can manifest at any point in the life course and represents a leading cause of disability, increasing the risk of premature death, negatively impacting quality of life and placing a burden on health systems[26]. In the present study, depression had a positive direct correlation with multi-morbidities (66.8%). Similarly, Read et al.[27] found depression to be 2-3 times more likely in individuals with multi-morbidities than those without multi-morbidities or chronic physical conditions.

However, depression was negatively associated with self-rated health in the present study, suggesting that older individuals with depressive symptoms rated their health as poor or very poor. The prevalence of chronic pain in the study was 56.1%, higher than the 48.1% rate found by Carvalho et al.[28]. This disparity might be explained by racial, ethnic or cultural factors. In the study of IsHak et al. (2018), a positive reciprocal correlation was found between depression and chronic pain, and also between recovery time and symptoms duration[29].

Higher levels of neuroticism have been associated with chronic pain[30], sex and age[31]. Results of the study by Banzonic et al.[32] found an association between neuroticism and experimentally-induced pain in the laboratory, showing that in situations such as pain, neuroticism can influence the way in which a person can construe pain as a threat. Individuals with high neuroticism can interpret stressors such as pain and functional limitation in a more intense and problematic way because they exhibit a greater tendency to worry about health, report numerous symptoms and ruminate over problems than people with low neuroticism[32].

The present study confirmed the hypothesis that neuroticism is negatively associated with objective and subjective health variables. This finding is similar to the results found by Cachioni et al.[3] in a study involving Portuguese older adults. The present study revealed that chronic pain mediated the relationship between sex and multimorbidity and between sex and depression. Women appear to be more sensitive to pain, exhibit more negative responses to it, be involved in pain behaviors for longer periods, show a tendency to dwell on the negative emotions associated with pain [30] . A more recent study by Peng et al.[33] found similar results to those of the present investigation, showing pain acted as a mediator of the adverse effects of multimorbidity on disability and on impairment of physical performance in women.

The study of Velly & Mohit[34] suggested pain and depression are reciprocally related, i.e. one can increase the risk and severity of the other. This co-occurrence is defined as comorbidity or concomitant occurrence of 2 or more clinically-diagnosed disease in the same individual[34]. The prevalence of depression in individuals with chronic pain is generally high, as seen in a Brazilian study in which 56.1% of the older adults experiencing chronic pain suffered from depression[35]. Chronic pain also moderated the relationship between sex and neuroticism. Moreover, women are more likely to experience negative emotions and have higher neuroticism scores than men[31].

Although the cross-sectional design of the present study precludes drawing meaningful conclusions regarding the cause and effect relationships for the associations between self-rated health, objective health and neuroticism, particularly for the type and analyses presented in the study, it can be confirmed that they are influenced by shared genetic variables[2]. Evidence points to a genetic overlap between neuroticism and objective health conditions such as coronary heart diseases, smoking and high Body Mass Index (BMI)[2].

The present study has several limitations. The first involves the fact that the variables were assessed based on self-report, introducing a risk of memory, social desirability and comprehension bias. Secondly, although the rate of attrition was not sufficiently high so as to weaken the data, fewer sample losses would have been more desirable. Thirdly, the long period elapsed between baseline and follow-up may have contributed to the losses observed. Lastly, it is important to note that the lack of reliable psychometric data for the Brazilian version of the neuroticism scale weakens the conclusions somewhat, since no parameters are available to judge whether the respondents deal with the items and scale in a uniform manner.

Nevertheless, conducting a study that involved the neuroticism variable was valid in drawing attention to aspects relevant in the diagnosis and management of chronic pain, disability, and depression that are often overlooked in older patients. Another strength of this investigation was the application of path analysis using the structured equations modeling, a modality of multivariate analysis acknowledged as an important tool for promoting advances in theory. The fact the study centered on a sample of oldest old (>70 years) puts it in step with the sociodemographic and economic needs of Brazilian elderly, constituting a valuable contribution in addressing the problems of the population.

CONCLUSIONS

The study showed the mediating role of neuroticism in the relationship between chronic pain, multimorbidity, depression and self-rated health in community-dwelling older adults.

Understanding the determinants and correlates of self-related health can help professionals involved in the area of aging to prioritize strategies aimed at promoting health and implementing effective interventions. Furthermore, optimistic attitudes towards objective health, perceptions and more positive beliefs can help individuals better maintain or improve their subjective health status and establish strategies to optimize the physical and mental health conditions of older individuals. In this respect, intervention strategies which reduce levels of neuroticism can help older adults prevent the negative effects of subjective health, given that self-rated health is an important tool for promoting the health of this population.

Objective and subjective health should be analyzed while taking into account level of neuroticism, since older individuals who exhibit high neuroticism rate their health as poor. This study is relevant in the area of human aging given the importance of multi-dimensional assessment of older individuals, serving to help Geriatric and Gerontology professionals devise better health promotion and intervention strategies.

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Diabetes mellitus in older adults, prevalence and incidence: results of the FIBRA study

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Abstract

Objective: to estimate the prevalence and incidence of diabetes *mellitus* in a retrospective cohort of older adults, identify the main factors associated with the disease for both periods 2008-2009 and 2016-2017 and describe the prevalence of diabetes according to overweight status. *Method:* a retrospective longitudinal study with 442 community-dwelling older adults (≥65 years old) participating in the FIBRA study (baseline 2008-2009 and follow-up 2016-2017) in Campinas and Ermelino Matarazzo (São Paulo State). Prevalences were estimated and associations were verified using Pearson's chi-square test or Fisher's exact test (p<0.05). Crude and adjusted prevalence ratios for sex, age and education were also estimated using Poisson regression. *Results:* the prevalence of diabetes *mellitus* increased from 21.95% to 27.46% in nine years (p=0.001), and the incidence was 5.51%. At baseline, the prevalence was higher among older adults who were overweight and had a worse perception of health. Overweight status remained associated at follow-up, together with the presence of two or more chronic diseases and the consumption of 3 to 5 snacks/day. *Conclusion:* in 2008-2009, one in five older adults had diabetes and, in 2016-2017, this ratio was about one in four. The importance of being overweight in determining the disease in both periods is highlighted. Educational interventions, expansion of care coverage, greater frequency of care and multi-professional assessment that considers comorbidities, the social and family insertion of the older adult, and their support network are required.

Keywords: Diabetes Mellitus. Chronic Disease. Health of the Elderly. Aging. Obesity. Longitudinal Studies.

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INTRODUCTION

Data on morbidity and mortality from diabetes demonstrate the importance of the disease as a public health problem in the world population – globally, one in five people aged between 65 and 69 years live with diabetes (about 136 million)[1]. The number of individuals over 65 years of age with diabetes is projected to reach 195.2 million in 2030 and 276.2 million in 2045[2,3]. This progressive increase is mainly due to the increase in type 2 diabetes mellitus (insulin resistance), which represents 90% to 95% of cases and mostly affects adults and the elderly[4].

Worldwide, the prevalence of diabetes is driven by a complex interplay of socioeconomic, demographic, environmental, genetic and behavioral factors. Growing levels of the adoption of unhealthy lifestyles (unhealthy diets and a sedentary lifestyle that can lead to obesity) and progressive urbanization are largely responsible for the increase in the incidence and prevalence of diabetes. Chronic complications or those that develop over a long time may appear in people with diabetes, especially in older adults, at the time of diagnosis. In this sense, early detection and treatment are essential to prevent disability and death[5].

For the majority of countries, the greater use of health services by individuals with diabetes, the loss of productivity and long-term care required to treat their chronic complications (kidney failure, heart problems, diabetic foot, among others) represents an expense between 5 and 20% of total health expenditure, and a major challenge for health systems[5]. In Brazil, in 2018, the Unified Health System (SUS) expenses on hospitalizations, outpatient procedures and medications corresponded to 30% for diabetes (more than BRL 1 billion) and 11% for obesity (more than BRL 370 million). The costs of obesity as a risk factor for diabetes are also high[6].

In Brazil, the economic[4,7] and social costs of diabetes – those attributable to premature mortality, temporary and permanent disabilities, compromised quality of life, and feelings of family responsibility – are expressive both for families and the SUS[4,7]. According to data from the 2019 *Pesquisa Nacional de Saúde* (PNS) [National Health Survey], about 7.7% of the population was diagnosed with the disease (12.3 million people) and 80.0% reported medical assistance in the preceding year, which corresponds to 9.7 million people. It is worth noting that 66.5% received care within the public health network (SUS), with half of all consultations carried out at health centers throughout the country[8]. Data on the prevalence of diabetes in population subgroups are frequent, though estimates of the incidence of the disease are reported less in the national literature.

Although aging is not synonymous with illness, in older adults there is an increase in clinical-functional vulnerability and predisposition to chronic non-communicable diseases (NCDs)[9]. Regarding the prevalence of diabetes in Brazilian older adults, PNS data from 2013 and 2019 indicated 17.7% and 19.9%, respectively, for the age group 65 to 74 years old, while for those 75 years of age and over, the values were 19.5% and 21.1%, with no significant increase between these surveys[10,11]. The prevalences observed in population-based studies make deeper analyses of the importance of chronic complications resulting from diabetes possible, while also indicating the magnitude of the disease burden for older adults, family members, health services and for society as a whole[4].

In the United States, a survey of adults aged 20 years or older (n=58,186) identified higher prevalence of type 2 diabetes in males, in individuals with lower levels of education and family income, in those who were overweight, and in older adults (age ≥65 years old), in whom prevalence reached 18.2%[12]. In the population-based longitudinal study on older adults known as EpiFloripa, the prevalence of diabetes was 22.1%, higher in older adults who had no formal education, in those who studied between 5 and 8 years versus ≥12 years, and in those whose waist circumference increased and who had arterial hypertension[13]. A study conducted in the city of Viçosa, MG, on 621 older adults (aged 60 to 98 years old) determined a prevalence of 22.4% of diabetes and that occurrence was higher in women, in those with worse perception of health, with a history of hypertension, with dyslipidemia, and with abdominal obesity; education level was inversely associated with disease[14].

As a measure of disease frequency, new cases (incidence) of diabetes in older adults estimate the average risk of this population acquiring the disease, while also constituting a parameter for evaluating the impact achieved by prevention measures[4]. In addition, identifying risk factors associated with the disease enables the finance strategies for health promotion and prevention, at the individual and collective levels, in order to reduce the burden of diabetes regarding the for the SUS, the individual and society. The objectives of this study were to estimate the prevalence and incidence of diabetes mellitus in a retrospective cohort of older adults, to identify the main factors associated with the disease in two periods, 2008-2009 and 2016-2017, and to describe the prevalence of diabetes according to overweight status.

METHODS

A retrospective longitudinal study on older adults aged 65 years and over, was conducted using baseline (2008-2009) and follow-up (2016-2017) data from the FIBRA study in Campinas, SP, and Ermelino Matarazzo, a subdistrict of the city of São Paulo, Brazil.

At baseline, 90 urban census tracts in Campinas and 62 in Ermelino Matarazzo were selected through simple sampling, for which samples for the population of men and women by age were estimated: 900 older adults in Campinas and 384 in Ermelino Matarazzo[15]. In the follow-up (2016-2017), recruitment began with lists of household addresses registered in the baseline databases, which were visited the recruiters to carry out data collection. In both cities, up to three attempts were made to locate the participant and confirmation of deaths and information on the deceased were obtained from a family member and/or an acquaintance or neighbour of the older adult.

In this study, we considered older adults who were present at baseline and at follow-up, and who answered the question on the medical diagnosis of diabetes (n=442). For the analysis of factors associated with diabetes in older adults, the following variables were considered:

- *Sociodemographics*: sex (female or male), age group (65 to 69, 70 to 79 and 80 years old or over), education in years of study (0, 1 to 4 and 5 or more), and living arrangements (alone, with a partner, or with children/others).

- *Number of chronic diseases and depressive symptoms*: the number of diseases (0 to 1, 2 or more) was obtained through self-reporting by older adults regarding previous diagnosis of the following chronic diseases/conditions: systemic arterial hypertension, heart disease, stroke/ischemia, cancer, arthritis or rheumatism, depression, lung disease, and osteoporosis (yes or no). The Brazilian version of the Geriatric Depression Scale (GDS-15), composed of 15 dichotomous items (yes or no) was applied and a cutoff point of ≥6 was adopted for screening older adults with depressive symptoms[16].

- *Overweight status and health-related behaviors*: the waist-to-height ratio (WHR) was used to classify the older adults as overweight, calculated by measuring waist circumference divided by height, in centimeters. WHtR values were categorized according to cutoff points defined for male and female older adults: WHtR values ≥0.58 were considered indicative of being overweight[17]; smoking (never smoked, ex-smoker, smoker); and consumption of alcohol (non-drinker, 1 to 4 times/month, ≥2 times/week). Physical activity was assessed through physical exercises and active sports performed during leisure time, extracted from the Brazilian version of the Minnesota Leisure Time Activity Questionnaire, consisting of 16 items[18]. The purpose was to investigate whether the older adult practiced the activity or not (yes or no), how many times a week and how many minutes per session. Then, the absolute intensities were calculated in metabolic equivalents[19], after which the total was classified into quintiles, according to sex. Older adults located in the 1st quintile of the distribution obtained were considered inactive in the context of leisure time activities.

- *Snacks* (follow-up): assessed through the question, "How many snacks between meals do you have per day?", scored as 0 to 1, 2, and 3 or more.

Descriptive statistics (mean, standard deviation and proportion) were used to characterize the older adults in terms of age and sex at baseline and

follow-up. The prevalence of diabetes at baseline and follow-up was estimated and its association with the variables considered in the study was verified using Pearson's chi-square test or Fisher's exact test, considering a significance level of 5%. Next, crude and adjusted prevalence ratios for sex, age and education (characteristics related to the occurrence of chronic noncommunicable diseases and the use of health services) were estimated[7,20,21] using Poisson regression with robust variance.

The frequency (exact and confidence interval, 95%CI) of older adults with diabetes was also verified, according to overweight status (yes or no). Considering the losses during the interval, the non-response pattern was initially analyzed and, later, a fully conditional method of multiple imputation, involving five imputations and the following predictor variables were performed: age, sex, education, diabetes, hypertension and overweight status at baseline to recompose missing data.

The FIBRA study projects were submitted and approved by the Research Ethics Committee of the State University of Campinas, under protocol numbers CAAE - 39547014.0.1001.5404 (baseline) and 49987615.3.0000.5404 and 92684517.5.1001.5404 (follow-up). All the older adults were informed regarding the research objectives, procedures and their rights, and signed a term of free and informed consent.

RESULTS

The criteria used to select the older adult participants in this study are shown in Figure 1 (n=442).

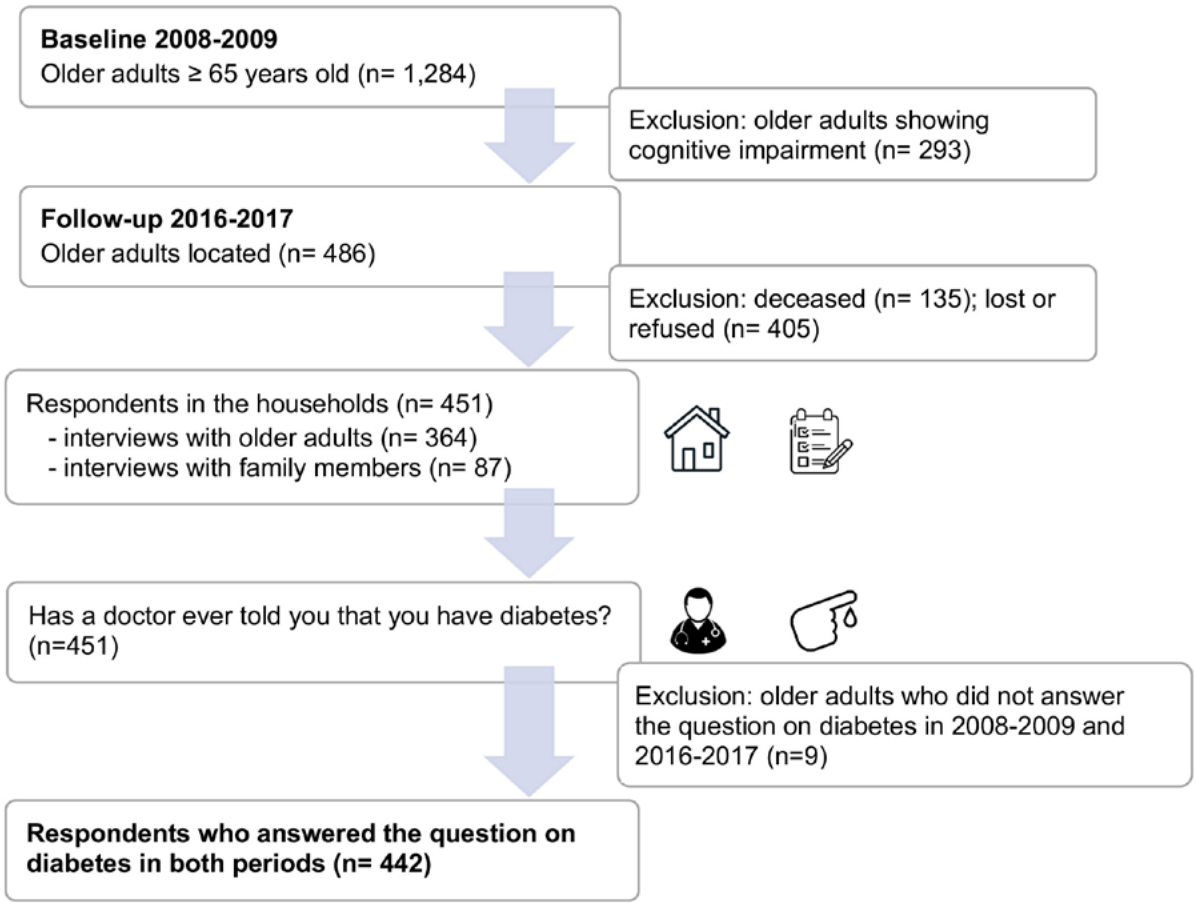

Figure 1. Sample selection flowchart. FIBRA study, Older adults, Campinas and Ermelino Matarazzo, SP, Brazil.

At baseline and follow-up, the mean age of the older adults was 72.07 (±5.12) and 80.62 years old (±4.69), respectively, and 67% were women. For the entire group of older adults, disease prevalence increased (p=0.001) from 21.95% (n=97) to 27.46% (n=121) between assessments, with an incidence of 24 cases of diabetes (5.51%) during this follow-up period. Table 1 presents the results for the occurrence of the disease at baseline and at follow-up, according to the variables considered in the study. At baseline (2008/2009), higher prevalences were observed among older adults who were overweight (p<0.001) and who rated their health worse (p=0.005). At follow-up, in addition to being overweight (p<0.001), the presence of two or more chronic diseases (p=0.038) and the consumption of snacks/day (p=0.015) were associated with diabetes (Table 1).

At baseline, the prevalence of diabetes was higher among older adults who were overweight (PR=1.99; 95%CI: 1.36-2.91) and worse perception of health (PR=1.80; 95%CI%: 1.15-2.80). Overweight status remained associated at follow-up (PR=1.47; 95%CI: 1.05-2.06), together with the presence of two or more chronic diseases (PR=1.60; 95%CI: 1.12-2.28) and the consumption of 3 to 5 snacks/day (PR=2.01; 95%CI: 1.36-2.96) (Table 2).

Table 1. Characterization of the sample and prevalence of diabetes in older adults (≥ 65 years) according to sociodemographic variables, health status, self-rated health, lifestyle, and consumption of snacks. FIBRA study, Older adults, Campinas and Ermelino Matarazzo, SP, Brazil, 2008-2009 and 2016-2017.

Variables	2008-2009		2016-2017	
	n (%)	Prevalence (%)	n (%)	Prevalence (%)
Sex		*p=0.925*[a]		*p=0.380*[a]
Male	143 (32.4)	21.7	143 (32.4)	30.7
Female	299 (67.6)	22.1	299 (67.6)	26.1
Total	442	21.9	442	27.4
Age group (in years)		*p=0.106*[b]		*p=0.696*[a]
65 to 69	163 (36.9)	25.1	--	--
70 to 79	239 (54.1)	21.7	187 (42.3)	28.3
80 or over	40 (9.0)	10.0	255 (57.7)	26.7
Education (in years)		*p=0.123*[a]		*p=0.065*[a]
0	71 (16.1)	31.0	61 (13.8)	34.4
1 - 4	265 (59.9)	20.7	264 (59.7)	29.2
5 or more	106 (24.0)	18.9	117 (26.5)	19.7
Living arrangements		*p=0.903*[a]		*p=0.926*[a]
Alone	66 (15.0)	19.7	78 (17.8)	28.2
With a partner	239 (54.3)	22.2	196 (44.9)	26.5
With children/others	135 (30.7)	22.2	163 (37.3)	28.2
Overweight		***p<0.001***[a]		***p=0.012***[a]
No	226 (51.1)	14.2	184 (42.1)	21.2
Yes	216 (48.9)	30.1	253 (57.9)	32.0
Number of chronic diseases		*p=0.292*[a]		***p=0.038***[a]
0 or 1	161 (36.5)	19.2	163 (38.1)	22.1
2 or more	280 (63.5)	23.6	265 (61.9)	31.3

to be continued

Continuation of Table 1

Variables	2008-2009		2016-2017	
	n (%)	Prevalence (%)	n (%)	Prevalence (%)
Self-rated health		***p=0.005***[a]		*p=0.059*[a]
Very good/Good	193 (43.9)	16.6	190 (53.4)	22.1
Regular	176 (40.0)	22.7	139 (39.0)	30.2
Poor/Very poor	71 (16.1)	35.2	27 (7.6)	40.7
Depressive symptoms		*p=0.061*[a]		*p=0.065*[a]
No	358 (81.6)	20.1	292 (82.0)	24.7
Yes	81 (18.4)	29.6	64 (18.0)	35.9
Smoking		*p=0.224*[a]		*p=0.746*[b]
Never smoked	255 (57.7)	19.6	145 (42.3)	26.9
Ex-smoker	145 (32.8)	23.4	187 (54.5)	26.7
Smoker	42 (9.5)	30.9	11 (3.2)	36.4
Alcohol consumption*		*p=0.770*[a]		*p=0.231*[a]
Non-drinker	292 (66.8)	22.9	231 (65.5)	28.6
1 to 4 times a month	103 (23.6)	20.4	88 (24.9)	26.1
≥ 2 times a week	42 (9.6)	19.0	34 (9.6)	14.7
Practice of leisure-time physical activity**		*p=0.666*[a]		*p=0.318*[a]
Active	281 (63.7)	21.3	165 (46.5)	24.2
Inactive	160 (36.3)	23.1	190 (53.5)	28.9
Number of snacks/day***	--	--		***p=0.015***[a]
0 to 1	--	--	206 (47.0)	22.3
2	--	--	165 (37.7)	28.5
3 to 5	--	--	67 (15.3)	40.3

[a] Pearson's chi-square p-value: in bold p<0.05; [b] Fisher's exact test p-value; *Loss of information (n = 89); ** Measures not comparable at baseline and follow-up (n=355); *** Evaluated at follow-up only.

Table 2. Crude, sex-adjusted and age-adjusted prevalence ratios for diabetes in older adults (≥65 years old), according to the year of study. FIBRA study, Older adults, Campinas and Ermelino Matarazzo, SP, Brazil, 2008-2009 and 2016-2017.

Variables 2008-2009	Crude PR[a] (95%CI)	Adjusted PR[b] (95%CI)
Sex		
Male	1	--
Female	1.02 (0.70 - 1.49)	--
Age group (in years)		
65 to 69	1	
70 to 79	0.86 (0.60 - 1.24)	--
80 or over	0.40 (0.15 - 1.05)	--
Education (in years)		
0	1	
1 - 4	0.67 (0.44 - 1.02)	--
5 or more	0.61 (0.36 - 1.03)	--

to be continued

Continuation of Table 2

Variables 2008-2009	Crude PR[a] (95%CI)	Adjusted PR[b] (95%CI)
Overweight		
No	1	1
Yes	2.12 (1.45 - 3.11)	**1.99 (1.36 - 2.91)**
Self-rated health		
Very good/Good	1	1
Regular	1.37 (0.90 - 2.08)	1.25 (0.82 - 1.89)
Poor/Very poor	2.12 (1.36 - 3.32)	**1.80 (1.15 - 2.80)**
Variables 2016-2017		
Sex		
Male	1	--
Female	0.87 (0.63 - 1.19)	--
Age group (in years)		
65 to 69	1	
70 to 79	0.94 (0.69 - 1.28)	--
80 or over	0.28 (0.23 - 0.36)	--
Education (in years)		
0	1	
1 - 4	0.85 (0.57 - 1.26)	--
5 or more	0.57 (0.34 - 0.95)	--
Overweight		
No	1	1
Yes	1.51 (1.08 - 2.10)	**1.47 (1.05 - 2.06)**
Number of chronic diseases		
0 or 1	1	1
2 or more	1.42 (1.01 - 1.99)	**1.60 (1.12 - 2.28)**
Number of snacks/day*		
0 or 1	1	1
2	1.27 (0.90 - 1.81)	1.30 (0.90 - 1.86)
3 to 5	1.80 (1.22 - 2.66)	**2.01 (1.36 - 2.96)**

[a] Crude PR (95%CI): Crude prevalence ratio and 95% confidence interval. [b] Adjusted PR (95%CI): prevalence ratio adjusted for sex, age and education and 95% confidence interval. *Evaluated at follow-up only.

Figures 2a and 2b show the prevalence of diabetes and the distribution of older adults with diabetes, according to overweight status for 2008-2009 and 2016-2017 data. A higher frequency of those overweight was observed in both periods, with maintenance of the pattern observed (roughly twice as many). It is worth highlighting that, through multiple imputation, the prevalence of diabetes was 30.28% (95%CI: 27.40-33.15), statistically similar to the values observed, considering the losses during the follow-up period (27.46%; 95%CI: 23.28-31.64). Regarding overweight status, again no significant difference was observed: 18.54% (95%CI: 14.89-22.18) and 21.76% (95%CI: 19.17-24.34) for data without and with multiple imputation, respectively.

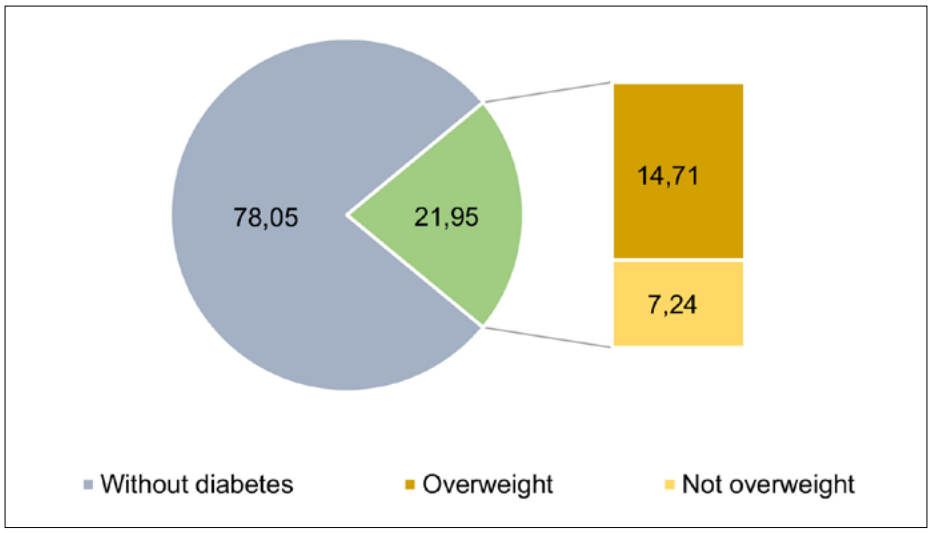

Figure 2a. Prevalence of diabetes, according to overweight status. FIBRA study, Older adults, Campinas and Ermelino Matarazzo, SP, Brazil, 2008-2009.

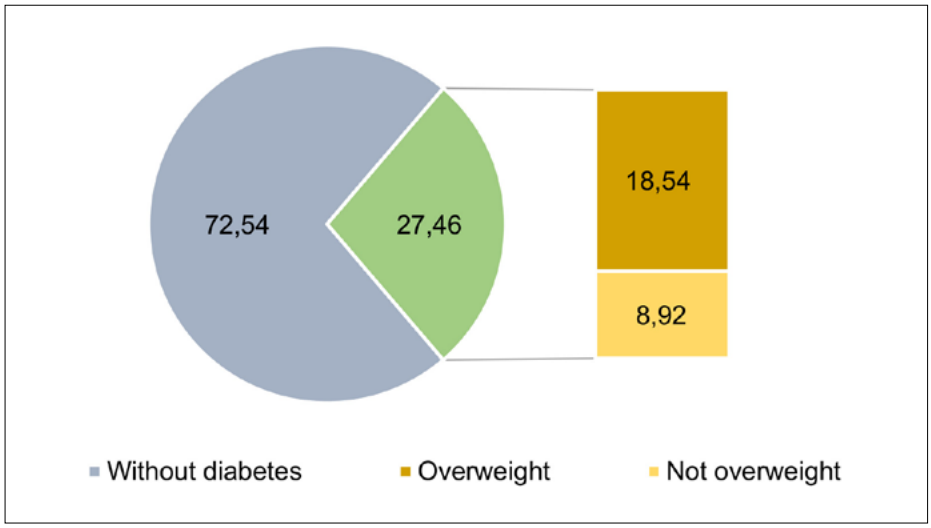

Figure 2b. Prevalence of diabetes, according to overweight status. FIBRA study, Older adults, Campinas and Ermelino Matarazzo, SP, Brazil, 2016-2017.

DISCUSSION

The results obtained in this study showed that in 2008-2009, one in five older adults had diabetes, while in 2016-2017, this ratio was around one in four. For the entire period (average of 9 years) the disease incidence in older adults was 5.51%. Worse perception of health and overweight status were associated with diabetes in older adults at baseline; at follow-up, the latter remained associated, together with the presence of two or more chronic diseases and the consumption of 3 to 5 snacks/day.

Regarding prevalence, similar data were observed for older adults from Florianópolis, SC, (age ≥60 years old) in 2009-2010 (22.1%; 95%CI: 20.1-24.1) during the EpiFloripa study; in relation to disease incidence, after a mean of four years follow-up, 8.3% (95%CI: 6.7-10.3) presented the disease[13]. Data from the 2013 PNS showed that the mean age

at diagnosis of diabetes was 58.5 years old among older adults aged ≥65 years, and about 75% had received a medical diagnosis before reaching this age[22]. This highlights the importance of preventing its occurrence (primary) and, for those affected, its acute and chronic complications (secondary), considering the prolonged course of diabetes mellitus – in this study, the average age of the older adults with diabetes was 71.36 and 80.31 years at baseline and follow-up –, and the presence of multimorbidity, which directly reflects the greater demand for health services[7,20,23].

Self-rated health (SRH) is an important indicator to identify people at higher risk of adverse events, such as mortality and functional disability. A study that used the EuroQol (VAS EQ) to investigate SRH as an independent predictor of vascular events and complications in individuals with type 2 diabetes determined, after controlling for clinical risk factors, that a higher self-rated health score (VAS EQ) >10 points) was associated with 6% and 22% lower risks of vascular events and diabetes complications, respectively[24]. SRH is characterized as a comprehensive health status screening tool and provides important information regarding the magnitude of the disease's effects on the individual[25]. In this study, worse SRH was associated with diabetes at baseline, but not at follow-up. It is important to consider that the increase in chronological age at follow-up (at baseline, the older adults were already 65 years old) may produce overestimated positive evaluations as a result of psychological adaptation, resulting from downward social comparison processes, that is, older adults may feel higher satisfaction than their contemporaries when they perceive themselves as having better health status, even with chronic conditions like diabetes[26].

In this study, overweight status was associated with diabetes at baseline and follow-up. The literature shows a relation between being overweight and diabetes regardless of the indicator used[12,13,23,27]. In older adults, in addition to obesity, aging itself is associated with greater infiltration of fatty tissue in the muscles and liver, which is related to insulin resistance and glucose intolerance[28]. Several anthropometric indices are used to diagnose being overweight[29,30]. It is important to highlight that the waist-to-height ratio, the indicator used in this study to determine overweight status, is recognized as the best anthropometric marker in relation to other indices (body mass index, waist circumference, and waist-to-hip ratio)[29], because in addition to showing better prediction of cardiometabolic risk factors, the adjustment for height enables the definition of a single threshold applicable to the general population, regardless of age, sex or ethnicity[30].

Among the diseases considered by the FIBRA study, both arterial hypertension and heart disease have risk factors in common, particularly being overweight or obese, which are associated with other chronic non-communicable diseases, including diabetes[9]. Furthermore, in this study, about 85% of the older adults with diabetes presented arterial hypertension, which is a morbidity and, at the same time, a risk factor for other diseases[9,14]. It is important to consider that at follow-up, the mean age of the older adults evaluated was 80.62 years old, increasing the risk of the incidence of chronic diseases and multimorbidity, which was also associated with a higher occurrence of diabetes.

In this research, the prevalence of diabetes was twice as high in older adults who consumed a greater number of snacks per day (3 to 5 *vs* 0 to 1). According to the Brazilian Society of Diabetes, food plans for people with diabetes should consider the consumption of five to six meals a day, the three main ones (breakfast, lunch and dinner) and another two or three consisting of snacks, aimed at promoting satiety[4]. However, the quality of food consumed in snacks is essential to prevent body weight gain and maintain glycemic control.

The *Protocolo de Uso do Guia Alimentar para a População Brasileira* [Protocol for Using the Food Guide for the Brazilian Population] for older adults recommends the consumption of *in natura* or minimally processed foods, including fresh or dried fruits, oilseeds, tapioca, milk and natural yogurt, and that the consumption of ultra-processed foods, such as cookies/biscuits, packaged breads, sausages, juice boxes/soft drinks, including those with nutritional claims of "high in fiber", diet or light, should be avoided[31]. An intervention study identified that more frequent food consumption (6 *vs* 3 meals/day), in

smaller amounts, improved glucose concentrations, glycemic control, reduced the sensation of hunger and the desire to eat in obese individuals, and promoted body weight stability[32]. The results obtained in this study suggest that FIBRA participants prioritized the consumption of ultra-processed foods as snacks, and indicated the need for actions to promote healthy eating practices.

Diabetes mellitus remains asymptomatic for many years, resulting in delayed diagnosis and sometimes accompanied by micro and macrovascular systemic complications (cardiovascular diseases, peripheral neuropathy, retinopathy and nephropathy). For this reason, primary care plays an important role in the control of risk factors (unhealthy eating habits, sedentary lifestyle, and obesity), health education, screening and early diagnosis, monitoring, glycemic control, and adequate treatment. From this perspective, disease- and age-specific management, knowledge concerning the risks inherent to poor adherence to treatment and encouragement of self-care are tools that contribute to better control of diabetes and to a reduction in the use of health services[4,33].

This study provides data on the occurrence of self-reported diabetes in older adults – 70 and 80-year-olds – residing in the community. Participants in the FIBRA study are a sample of older adults without cognitive impairment, with better physical, emotional and cognitive status, who attended public spaces for data collection[15], which may have introduced a selection bias that reflects in the underestimation of the condition studied. With regard to the occurrence of diabetes, both the best conditions at baseline and the length of follow-up (around 9 years) may have influenced the magnitude of risk (incidence) over this period. Particularly in relation to the variable use of alcohol, there was a loss of information during follow-up (which could be different if related to exposure), making it impossible to assess the differences between the prevalences. In relation to the variable the practice of leisure-time physical activity, the measurements were not comparable at baseline and follow-up.

Regarding the care of older adults with diabetes, qualified listening, expanded clinical care – understanding the importance of nutritional guidance that considers socioeconomic conditions and living arrangements, in addition to drug treatment – and the recognition of older adults as the main agent in the health-disease-care process, and their autonomy in relation to its treatment, according to Baade and Bueno, constitute:

> powerful strategies to understand living and dealing with diabetes as a unique shared process between patients and health professionals, where the disease is a part of life and not life a part of the disease[34].

CONCLUSION

The results obtained in the study showed an increase in the prevalence of diabetes among older adults and the importance of being overweight in determining the disease, in both periods. The presence of two or more chronic diseases and higher consumption of snacks were also related to diabetes. The findings indicate that older adults with diabetes require specific care management, which includes the provision of educational interventions by health professionals, in addition to expanding care coverage, with greater frequency of care and multidisciplinary assessment, and one that considers comorbidities and other health problems, the social insertion and living arrangements of the older adult, and their support network.

In the context of public policies, in addition to investments aimed at drug treatment and adequate care for patients, governmental programs and campaigns are also essential in order to encourage behavioral changes – the consumption of healthy foods and physical activity, among others –, that favor a reduction in the incidence of diabetes mellitus and its most frequent complications.

Follow-up studies with larger samples, which include others groups older adults residing in the community (the bedridden and those presenting cognitive impairment) and which consider other predictive variables, could contribute to more comprehensive estimates of the incidence of the disease in this age subgroup.

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Frailty, depression and mortality in a cohort of community-dwelling older adults

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Abstract

Objective: To estimate the risk represented by the combined conditions of frailty and depression in relation to mortality in a cohort of older adults in a prospective measure. *Method:* Prospective cohort study derived from baseline (2008/2009) and follow-up (2016/2017) measurements of the FIBRA Study - Polo Unicamp. Data from 739 older adults (67,2% female; 73,1+5.87 years) living in two urban centers in the state of São Paulo (Brazil) were analyzed to examine survival curves and to estimate mortality risk. The analyzes included four conditions resulting from the combination of depression (presence x absence of symptoms) and frailty (frail x robust) and the covariates sex, age, education, cognitive performance and comorbidities. *Results:* The percentage of deaths was 25.7%. There were significant differences between the survival curves regarding the combinations between frailty and depression. Male sex, age over 75 years, low education, low cognitive performance and the combinations "depression-robust", "depression-frail" and "no depression-frail" presented independent risks for mortality. In the multivariate model, the highest risks were given, respectively, by older ages, the combinations "depression-robust", "depression-frail", "no depression-frail", male sex and lower cognitive performance. *Conclusion:* Combinations between frailty and depression can result in differences in survival and mortality among older adults. In the nine-year period, depression proved to be the ordering variable of the groups in relation to risk estimates, even in the presence of important covariates. Investments in the prevention of both syndromes and their associations may result in a decrease in mortality in older people from general causes.

Keywords: Frailty. Depression. Mortality. Survival Analysis. Older adults.

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INTRODUCTION

Since the proposition of a characteristic phenotype of frailty in older adults[1], it has been recognized that associations between this syndrome and the presence of depressive symptoms have important effects on clinical management and lead to different impacts on quality of life and on the risk of morbidity and mortality in older adults[2,3]. There is evidence that both conditions are associated with greater functional dependence, cognitive impairment, greater use of health services and risk of institutionalization[2,4-6]. However, a smaller number of investigations have been devoted to the effects resulting from the associations between different combinations of frailty and depression on the mortality of older adults in prospective surveys[7].

Meta-analysis strategies applied to recent studies have suggested that there is a prevalence of 38.6% of depression among frail older adults and a 40.4% prevalence of frailty in depressive older adults[8]. The possibility of shared pathophysiological factors, such as inflammatory markers, and antecedent conditions of a psychosocial nature, are considered in the production of common manifestations between the syndromes[9]. Older adults with depressive symptoms present complaints that, in addition to changes in mood, physical and cognitive disposition and social withdrawal, coincide with the criteria for identifying frailty associated with reports of fatigue, unintentional loss of body mass, and low physical activity levels, gait speed and handgrip strength[8-10].

Both frailty and depression represent risks for mortality, according to evidence generated by examining each of these conditions separately or by statistically controlling for the presence of the other[11]. A meta-analysis study showed an increase in all-cause mortality, attributed to frailty, a higher risk among frail older adults than among pre-frail and robust older adults, and greater risks for males[12]. These results were interpreted as indicators of the progression of the syndrome and its reflexes on the reduced availability of resources to maintain the integrity of the organism, culminating in death[13].

The increased risk of mortality attributed to depression in the general population reveals more heterogeneous evidence resulting from the variety of measurements and criteria used and from the peculiarities of the presentation of this condition at different stages of life[6]. Differences in age, sex, health behaviors, comorbidities, functional and cognitive impairments, and intensity and duration of depressive symptoms can act as potential moderators of the outcome of death[14]. However, in a review and meta-analysis of prospective cohort studies with older adult samples, Wei et al.[15] estimated that depression increases the risk of all-cause mortality by 34% and of specific mortality from cardiovascular diseases by 31%.

Chang et al[6] reported results from the combination of frailty (measured as accumulation of functional deficits) and depression over time (18 years). Frail and depressed older adults showed a lower chance for the remission of depressive symptoms. This profile also presented a higher probability of mortality when compared with frail, non-depressed older adults. Ruiz-Grao et al.[7] compared the proportional hazards represented by six different combinations of presence or absence of depression and frailty at baseline to mortality recorded over a subsequent 10-year period. After adjusting for sociodemographic variables, institutionalization, comorbidities and polypharmacy, only the combination of depression and pre-frailty represented a risk of death in the period under study.

In order to obtain and explore evidence from a sample of Brazilian older adults, this study sought to estimate the risk for mortality represented by different combinations of depression and frailty in a cohort of older adults. The covariation of these combinations with sociodemographic characteristics, cognitive performance, and number of diseases at baseline in relation to the outcome of death recorded at follow-up was considered.

METHODS

A prospective cohort study developed from data derived from baseline (2008/2009) and follow-up (2016/2017) surveys from the Frailty Profile of Elderly Brazilians (FIBRA UNICAMP) study. This is a multicenter study, with a baseline sample

composed of older adults living in seven Brazilian cities[17], which prospectively followed cohorts from two of these locations (Campinas and the subdistrict of Ermelino Matarazzo, São Paulo, Brazil) in a follow-up survey. At the time of the first data collection, Campinas (SP; human development index HDI= 0.852) had a general population of 1,083,113 inhabitants, 11.5% of which were people aged 65 years old and over. The sub-district of Ermelino Matarazzo (HDI= 0.730), located in the east of the city of São Paulo (SP), had 207,509 inhabitants, 10.8% of which were people aged 60 years old and over. Based on standardized protocols, the study aimed to investigate the frailty conditions of urban older adults residing in the community (not institutionalized). and the relationships between this condition and sociodemographic, psychosocial, health, and functionality variables. The study also obtained and recorded information concerning deaths that occurred between baseline and follow-up.

Baseline data were collected in 2008/2009, by recruiting older adult females and males, 65 years old or over, with different sociodemographic conditions, who resided in randomly selected census tracts. The older adults were invited to attend community service locations (primary health care units, community centers, parish halls and clubs) to be evaluated by trained interviewers. At the time, those who presented severe cognitive or physical deficits that made their participation unfeasible or difficult were not included in the study.

A total of 1,284 older adults living in the city of Campinas (n=900) and in the sub-district of Ermelino Matarazzo (n=384), in the city of São Paulo participated in the baseline study. The samples were selected by means of a simple drawing of urban census sectors in the two locations (90 in Campinas and 62 in Ermelino Matarazzo), for which quotas of men and women aged 65 to 69, 70 to 74, 75 to 79 and 80 years old or over, representative of the older adult population, in 2007, plus 25% to cover possible losses.

In the follow-up survey, conducted in 2016/2017, trained researchers returned to the households registered in the database at baseline. All the older adults who consented to participate responded to the Mini Mental State Examination (MMSE) cognitive screening test, adopting the criteria by Brucki et al.[18] to define the cut-off scores. Older adults who scored below the criterion for their level of education responded only to the cognitive assessment, physical assessment and frailty items. Questions concerning health, functionality and psychosocial variables were answered by a family member. In the case of death of the older adult, a family member was invited to answer a questionnaire about signs and symptoms, and chronic non-communicable diseases in the last year of life and about the circumstances of their death.

In the follow-up study, 549 older adults were located and interviewed at home, among which 130 were helped by a family member, given the fact that they scored below the MMSE cut-off score. Another 192 had died and 543 were not located, refused to participate, abandoned the interview, were excluded by research criteria or were not interviewed because their place of residence posed risks to the interviewers' safety (Figure 1).

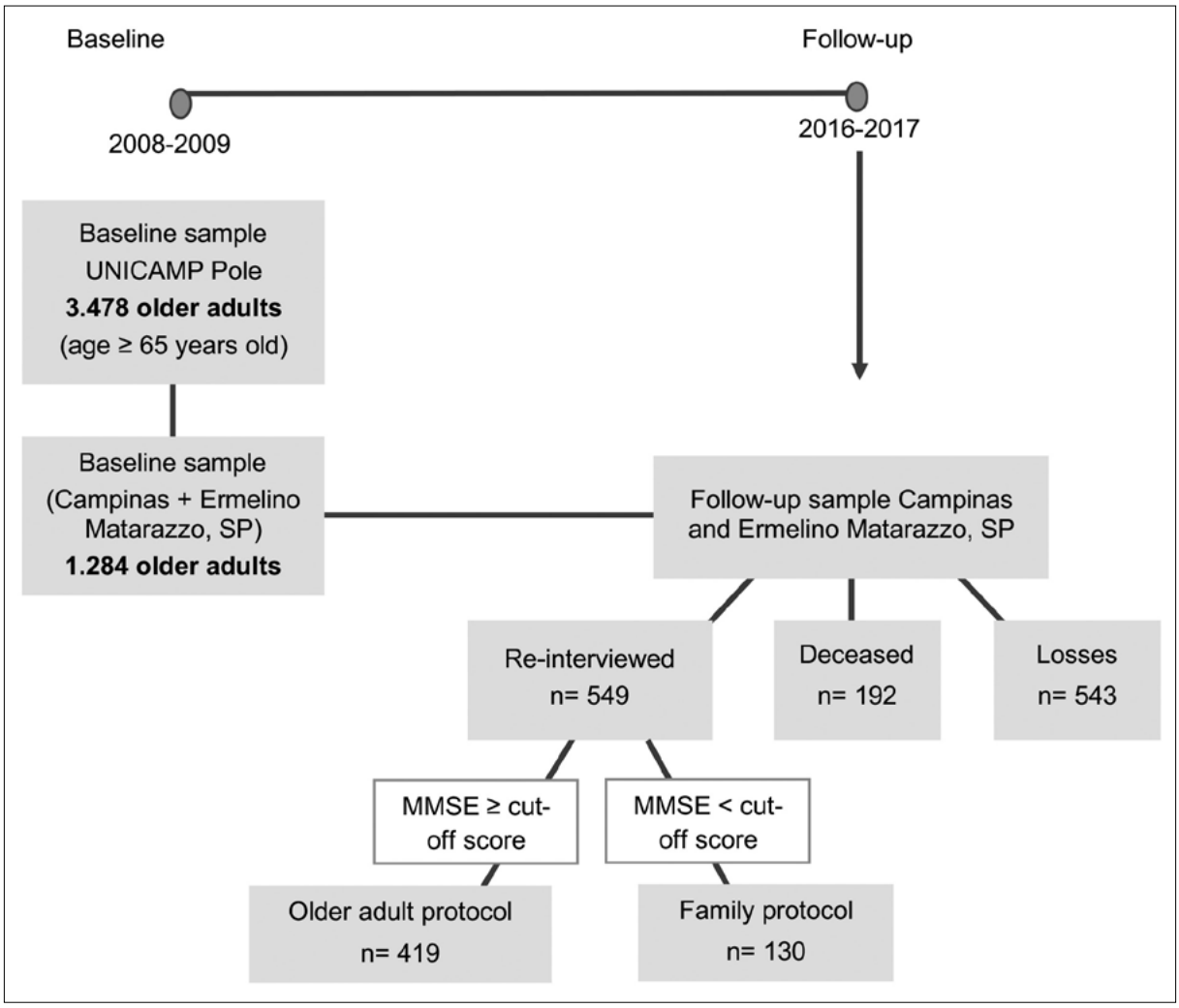

Figure 1. Flowchart of the composition of the FIBRA Study sample at baseline and follow-up survey. FIBRA Study, Older adults, Campinas and Ermelino Matarazzo, SP, Brazil, 2008/2009 and 2016/2017.

As shown in Figure 1, the 1,284 participants in the baseline measurements of the FIBRA Campinas and Ermelino Matarazzo Study, both located in the State of São Paulo, were considered eligible for this study. Of this total, data were collected and analyzed from 549 older adults located at their former addresses, and from 192 deceased older adults whose data concerning their last year of life and the circumstances of their death were informed by a family member. These data were verified and confirmed by the death certificate of each deceased older adult and by consulting the *Sistema de Informação sobre Mortalidade* (SIM) [Mortality Information System] of the municipality of Campinas. It was not possible to access SIM data for the subdistrict of Ermelino Matarazzo.

Variables and measurements

The outcome of interest in this study was the occurrence of death from all causes, for the period between the baseline and follow-up surveys. The date of death was recorded to calculate survival during the period.

The presence of depression in the cohort was identified by applying the Geriatric Depression Scale-15 (GDS-15)[19], determined as obtaining any score below 6 (>5 points) at baseline.

Frailty was identified by measurements of the five frailty phenotype criteria, as described by Fried et al.[1]. According to the authors, individuals who meet

one or two of the following criteria are considered pre-frail and those who meet three or more criteria are considered frail. Individuals that do not meet any of these criteria are considered robust:

1) Unintentional weight loss equal to or greater than 4.5 kg or 5% of body weight in the previous year, considering the sex of the older adult;

2) Fatigue, assessed by two items that correspond to this complaint on the CES-D (Center for Epidemiological Studies-Depression) screening scale. The criteria for frailty are the answers "always" or "most of the time" as the frequency of occurrence of fatigue to any of the two items[20];

3) Low hand grip strength, in kilogram-force, measured with a portable hydraulic dynamometer in the dominant hand[21] (Jamar® - Lafayette Instruments, Lafayette, Indiana, United States), over three attempts, with means adjusted for sex and body mass index (BMI). Older adults with a mean below the 1st quintile of the distribution score for frailty;

4) Physical activity level, assessed by self-reporting of physical exercise and housework performed in the preceding seven days, according to the items in the Minnesota Leisure Time Activities Questionnaire[22] with means adjusted for sex. Older adults with a mean below the 1st quintile of the distribution score for frailty;

5) Slow gait speed indicated by the average time taken to walk a distance of 4 m three times, on a level floor, at their normal pace, with means adjusted according to sex and height[23]. Older adults with a mean above the 80th percentile of the sample score for frailty.

As covariates of the relationships between frailty, depression and mortality, the following information derived from baseline measures were selected:

a) Sociodemographic variables: sex, male or female; age, <75 years old, 75-79 years old, ≥80 years old; and education, number of years of formal education: 0, 1 to 4, 5 to 8, 9 or more;

b) Chronic diseases: identified by the number of self-reported diseases based on an inventory of nine dichotomous items composed of the most prevalent chronic non-communicable diseases in the older adult population;

c) Cognitive performance: estimated by the total score on the MMSE[18,24] with scores ranging from 0 to 30 points and a specific cut-off point for number of years of education completed.

To describe the sample under study alone, certain indicators of functional capacity were included, in this case, the performance of instrumental activities of daily living (IADLs) in the baseline survey. The inventory and criteria described by Lawton & Brody[25] were used, which involve a list of seven activities of practical life used to identify independence or total or partial dependence in their performance.

The FIBRA study baseline and follow-up surveys were approved by the Research Ethics Committee of the State University of Campinas (UNICAMP) under report no. 208/2007, on May 22, 2007, and report no. 1,332,651, on November 23, 2015. A term of free, informed consent was signed by all participants in both surveys. The use of data to conduct this study was also approved by the aforementioned committee, under report no. 3,097,048, on December 20, 2018.

The variables of interest were described according to their percentage distribution and position measurements (mean and standard deviation). Data from living and deceased older adults were compared using the Mann-Whitney and Fisher's exact tests, due to the absence of normal data distribution. From the data on depression and frailty, four categories of association were generated, derived from the combinations between absence or presence of depression and frailty status (robust or frail): 1) no depression and robust; 2) no depression and frail; 3) with depression and robust; 4) with depression and frail. Kaplan-Maier survival curves were determined and nonparametric log-rank, Gehan-Breslow, and Tarone-Ware tests were performed to identify differences between the combined conditions of depression and frailty. To estimate the mortality risk for the groups of associations between depression and

frailty, crude and adjusted Cox proportional hazards models were used, considering their covariation with sociodemographic variables (sex, age and education), cognitive performance and comorbidities. The significance level for the tests was 95% or p<0.05.

RESULTS

The sample was characterized by a higher percentage of female participants (67.2%), aged between 65 and 74 years (64%) with four years of education or less. The average cognitive performance on the MMSE was 23.8+4.14 points. There was also a higher percentage of older adults reporting at least one chronic disease, but a high degree of the preservation of functional independence when performing IADLs in baseline measurements (70.5%).

Considering only the current sample, in the follow-up survey, 190 deaths (25.7%) were recorded. The subsample of deceased older adults differed from the subsample of living participants in terms of distribution in all the variables of interest, with the exception of the number of self-reported diseases. Male sex, aged 80 years old and over, lack of formal education, greater functional disability, depression and frailty were present to a greater extent in the subsample of deceased than in the subsample of living participants. Compared with participating older adults, deceased older adults also showed lower mean scores on cognitive performance and a higher percentage of older adults who exhibited more unfavorable combinations of depression and frailty (Table 1).

Figure 2 shows the survival curves (Kaplan-Maier) corresponding to the combinations of frailty and depression conditions. The log-rank test (X^2=17.79; gl=3; p<0.001) resulted in significant differences between them. Measured in months, the mean survival of the robust and non-depressed older adults was 116.7+1 months (95%CI =114.8–1118.5); those without depression and frail was 112.8+0.9 months (95%CI =111.1–114.5); those with depression and robust was 106.7+3.9 months (95%CI=98.5–113.8); and those with depression and frail was 110.7+1.3 months (95%CI =108.1–113.3). The Gehan-Breslow (X^2=13.83; gl=3; p=0.003) and Tarone-Wade (X^2=14.74; gl=3; p=0.002) tests also showed differences between the combined conditions of frailty and depression. Graphic signs along the curves refer to the occurrence of assessments.

Table 1. Characterization of the baseline sample and subsamples of participating and deceased older adults according to sociodemographic variables, number of diseases and functional disabilities, cognition and isolated and combined conditions of depression and frailty. FIBRA Study, Older adults, Campinas and Ermelino Matarazzo, SP, Brazil, 2008/2009 and 2016/2017.

Sample characteristics	Baseline	Follow-up		
	(N=739)	Participants (n=549)	Deceased (n=190)	p-valor
	n(%)	n(%)	n(%)	
Sex				
Female	497 (67.2)	384 (**70.0**)	113 (59.5)	p=0.008*
Male	242 (32.8)	165 (30.0)	77 (**40.5**)	
Age (M±DP)	73.1 (±5.9)	72.3 (±5.3)	75.6 (±6.8)	p<0.001**
65-74 years old	473 (64.0)	384 (**70.0**)	89 (46.8)	p<0.001*
75-79 years old	161 (21.8)	112 (20.4)	49 (25.8)	
≥ 80 years old	105 (14.2)	53 (9.7)	52 (**27.4**)	
Education (M±DP)	3.9 (±3.6)	4.3 (±3.8)	3.1 (±3.0)	p<0.001**
0 years	140 (19.0)	88 (16.1)	52 (**27.4**)	p<0.001*
1-4 years	428 (58.0)	325 (59.3)	103 (54.2)	
5-8 years	103 (14.0)	76 (13.9)	27 (14.2)	
≥ 9 years	67 (9.0)	59 (**10.8**)	8 (4.2)	

to be continued

Continuation of Table 1

Sample characteristics	Baseline	Follow-up		
	(N=739)	Participants (n=549)	Deceased (n=190)	p-valor
	n(%)	n(%)	n(%)	
MMSE (M±DP)	23.8 (±4.2)	24.5 (±3.6)	22.0 (±5.0)	p<0.001**
No. of diseases (M±DP)	2.1 (±1.3)	2.1 (±1.4)	2.1 (±1.3)	p=0.999**
0	57 (9.7)	45 (10.0)	12 (9.1)	p=0.846*
1-2	328 (56.2)	251 (55.5)	77 (58.3)	
≥ 3	199 (34.1)	156 (34.5)	43 (32.6)	
No. of incapacities (M±DP)	0.6 (±1.1)	0.5 (±1.0)	1.0 (±1.5)	p<0.001**
0	409 (70.5)	334 (**74.5**)	75 (56.8)	p<0.001*
1-2	121 (20.9)	86 (19.2)	35 (**26.5**)	
≥ 3	50 (8.6)	28 (6.3)	22 (**16.7**)	
Depression (M±DP)	3.5 (±2.8)	3.4 (±2.7)	4.2 (±3.1)	p=0.011**
Yes	121 (20.9)	85 (19.0)	36 (**27.7**)	p=0.032*
No	457 (79.1)	363 (**81.0**)	94 (72.3)	
Frailty status				
Pre-frail & Frail	516 (69.8)	365 (66.5)	151 (**79.5**)	p<0.001*
Robust	223 (30.2)	184 (**33.5**)	39 (20.5)	
Combined conditions				
No depression-Robust	175 (30.3)	150 (**33.5**)	25 (19.2)	p=0.007*
No depression-Frail	282 (48.8)	213 (47.5)	69 (**53.1**)	
With depression-Robust	18 (3.1)	11 (2.5)	7 (5.4)	
With depression-Frail	103 (17.8)	74 (16.5)	29 (22.3)	

* p-value for the Mann-Whitney test comparing values between two groups; ** p-value for comparing means. In bold, significant percentage differences between subsamples are specified.

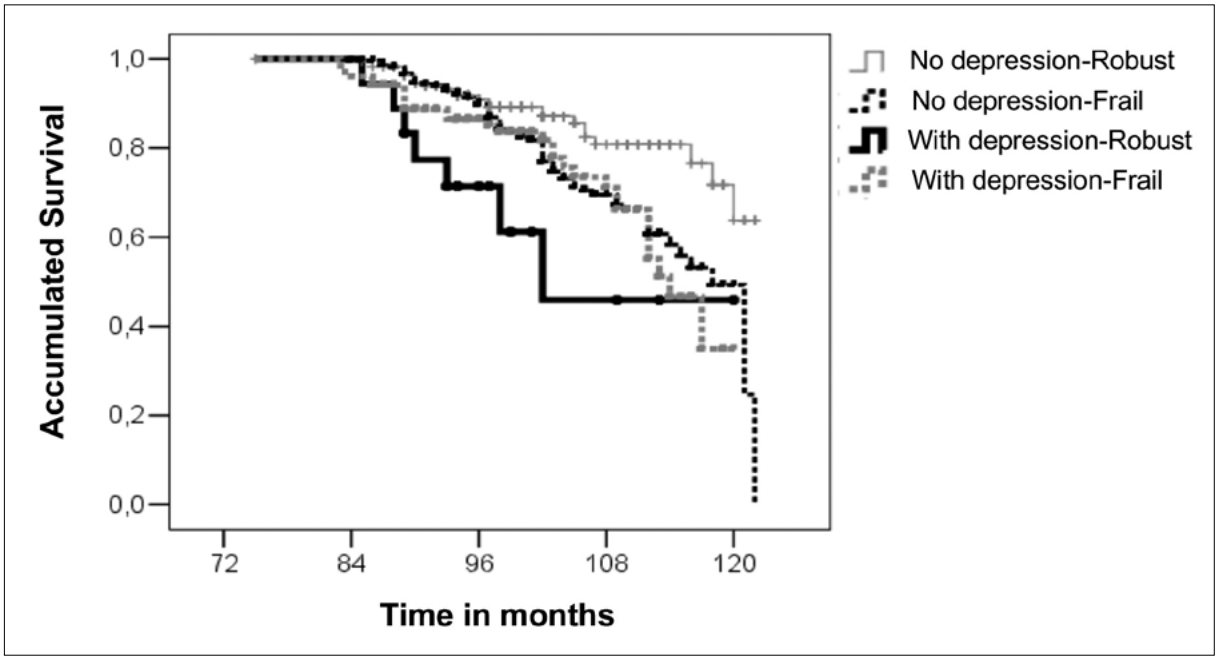

Figure 2. Survival curves according to combined conditions of depression and frailty. FIBRA Study, Older adults, Campinas and Ermelino Matarazzo, SP, Brazil, 2008/2009 and 2016/2017.

In Table 2, the crude and adjusted risk ratios (HR) are described for the variables sex, age, education, cognitive performance, number of diseases, and combined conditions of frailty and depression.

In the crude analysis, the highest risk ratio for mortality over time was determined for category age, with the oldest age group (>80 years) showing the highest rate compared with the age group 65 to 74 years old. The absence of formal education showed a risk ratio of 3.59 (95%CI = 1.70–7.56) compared with older adults with more years of education (>9 years); men showed a risk 33% higher than women. Compared with the condition "no depression and robust," all other combinations represented a significant risk, the highest was that obtained for the condition "with depression and robust," followed by "with depression and frail," and "no depression and frail." Regarding performance on the MMSE, the increase in total score by one point represented a reduction in the risk of death, or increase in survival, of 11.6%.

The results of the adjusted analysis revealed that education lost statistical significance. Higher indices were associated with the age groups >80 years old and 75 to 79 years old, for the condition "with depression and robust," followed by "with depression and frail," and "no depression and frail," and by total score on the MMSE, in which one point represented a reduction in the risk of death, or an increase in survival, of 8%.

Table 2. Crude and adjusted Cox regression for overall survival (N=733). FIBRA Study, Older adults, Campinas and Ermelino Matarazzo, SP, Brazil, 2008/2009 and 2016/2017.

Sample characteristics	Crude analysis		Adjusted analysis	
	HR	95%CI	HR	95%CI
Sex				
Female (ref.)	1.00	-	1.00	-
Male	1.33	1.01 – 1.78	1.62	1.13 – 2.32
Age				
65-74 years old (ref.)	1.00	-	1.00	-
75-79 years old	5.53	3.71 – 8.23	6.43	3.99 – 10.36
≥ 80 years old	9.96	6.69 – 14.81	8.18	4.82 – 13.88
Education				
≥ 9 years (ref.)	1.00	-	-	-
5-8 years	1.86	0.84 – 4.09	-	-
1-4 years	1.96	0.96 – 4.03	-	-
0 years	3.59	1.70 – 7.56	-	-
MMSE score	0.884	0.858 – 0.910	0.920	0.870 – 0.974
Number of diseases				
0 (ref.)	1.00	-	-	-
1-2	1.21	-0.66 – 2.23	-	-
≥ 3	1.04	0.55 – 1.98	-	-
Combined conditions				
No depression-Robust (ref.)	1.00	-	1.00	-
No depression-Frail	1.91	1.21 – 3.00	1.64	1.02 – 2.63
With depression-Robust	4.00	1.72 – 9.28	3.19	1.37 – 7.43
With depression-Frail	2.27	1.32 – 3.90	1.98	1.14 – 3.44

HR, risk ratio for death; Crude analysis: n=543 assessments and n=190 deaths; Adjusted analysis: n=442 assessments and n=128 deaths; 95%CI, 95% confidence interval for hazard ratio; (ref.), reference category.

DISCUSSION

The results support the hypothesis that different combinations of frailty and depression in older adults have different probabilities of mortality over time. Here, sociodemographic conditions and cognitive performance contributed to the differentiation in risk indices.

In Brazil, the prevalence of depression in older adults, estimated by the application of screening scales, is 21.0% (95%CI: 18.0–25.0)[26], a value similar to that found in the baseline survey of this study. The identification of frailty by the phenotype described by Fried et al.[1] requires the fulfilment of specific criteria. The presence of three or more criteria estimated for Brazil is 16%, and based on data from the FIBRA Study in the UNICAMP Pole, 9.1% of frail and 51.8% of pre-frail older adults were observed[27]. The combination of pre-frailty and frailty in this study showed a high percentage of older adults who meet some of the frailty criteria (69.8%). This percentage was similar to that reported by Ruiz-Grão et al.[15] in Spain (75.6%), though their sample also included institutionalized older adults.

Frailty and depression screening measurements in the older adult population are used to determine different aspects of health, but have the potential to generate specific association subgroups[7]. The results suggested the importance of verifying this potential based on three forms of analyzing mortality: percentage distribution based on dichotomous outcomes, survival curves, and calculating risk ratios.

Concerning the dichotomous outcome, the subsample of deceased older adults differed from that of participating older adults, in terms of the percentage of deaths that occurred for the condition "no depression and frail", that is, isolated frailty was present more often among older adults who died than among participating older adults.

However, when considering the time of occurrence of these deaths, the combinations of conditions revealed different survival trajectories. Regarding accumulated survival, the condition "with depression and robust" stood out from the first months of recorded deaths onwards, and was only surpassed by the condition "with depression and frail," and later by "no depression and frail," by the end of the last third of the period under study. Different non-parametric tests for comparing trajectories were used to capture possible biases in the distribution of deaths over time, given the long interval between the surveys. The log-rank test assigns the same weight to associations over time. In turn, the Gerhan-Breslow test is influenced by the initial portion and the Tarone-Ware test by the intermediate portion. All of them confirmed the differences in the curves of the groups.

To calculate the risk ratios, the condition "no depression and robust" was used as the reference for comparisons. The remaining conditions all presented significant risks independently or adjusted for covariates. The independent risks identified for the covariates were advanced age, male sex, and lack of formal education. An increase in the score for cognitive performance was associated with a reduced risk of death. Advanced age, male sex and cognitive performance significantly and jointly affected the risk-adjusted calculation represented by the different combinations.

As expected, advanced age is an independent indicator of mortality. However, age also acts as a source of variation for the relationship between depression and frailty. A study by Ji et al.[28] showed that the associations between frailty and depression and their effects on mortality became weaker with advancing age. The authors suggested that the performance of adaptive mechanisms of emotional regulation were more active in older adults, even in the presence of frailty criteria.

In studies on mortality in older adults with depression and studies on frailty, there is evidence of a higher risk for men[7,29], possibly mediated by cardiovascular causes, in the context of depression and frailty[30]. Although there is a higher percentage of frail women than frail men, in the presence of depression, this condition represents an increased risk of death for men[28,30]. In a prospective study, depressive symptoms at baseline represented a risk of mortality in men, with or without adjustment for frailty[29]. One of the explanatory hypotheses lies in shared vascular risk, which is associated both with

mortality from general and specific causes in men and with depression, which manifests itself later in life[14].

Cho et al.[31] observed associations between low socioeconomic status and frailty and risk of mortality, even after adjusting for covariates of health and functionality. In this study, the absence of formal education was associated with an independent risk of mortality. In the adjusted analyses, it is possible that it lost explanatory power when aligned with performance in the MMSE, a test that is highly sensitive to education level[8].

The greatest difficulties and sources of criticism of mortality studies come from controlling confounding variables[32]. In this study, we opted to control the number of self-reported diseases (those which did not show independent or joint effects), but not to control the presence of disabilities in performing instrumental activities of daily living (IADLs)[4]. This choice was motivated by criticism directed at the study by Ruiz-Grao et al.[7] for saturating the regression model with variables of great influence on mortality, such as IADLs, weighted comorbidities and health behaviors, and for including older adults institutionalized in the sample. Their critics[33] considered that the explanatory power of frailty was reduced, given that the only significant combination between depression and frailty in relation to the risk of mortality was "pre-frailty and depression."

In the short term, the presence of functional disabilities is perhaps one of the most common consequences of the combination of depression and frailty[4,7,8]. The purpose of this study was to draw attention to groups of association based on mortality estimates, with adjustments only for less specific sociodemographic and health variables.

The available data set and our analytical choices could be considered methodological limitations. Frail older adults may not have been sufficiently included in the baseline survey. Baseline frailty results of older adults lost to the follow-up survey or the incidence of other chronic diseases during the period were not analyzed. These data may have biases from several sources, and these possibilities were not considered.

Similarly, due to the size of the sample and its distribution in subgroups, separating the status of pre-frailty and frailty was not considered in the best interests of the study. Thus, more than combinations of depression and frailty, the study analyzed the relationship between the presence of depressive symptoms in a significant number and some of the frailty criteria. We believe this strategy is justified, since the distinctive feature of the frailty phenotype lies in its continuous nature, in which the criteria have been useful to explain the mortality and morbidity of older adults from different cultural contexts[2].

Whether the risks represented by the different combinations of frailty and their criteria are additive or synergistic falls outside the scope of this study, more so when considering that there is simply insufficient data for such a task. Park et al.[34] suggested that there is a synergistic effect between depression and handgrip strength, especially among older adult males. Ward and Bhat[33] affirmed that statements regarding interactions between risks is premature, given the lack of consensus on shared causal mechanisms.

In this study, it seems reasonable to affirm that depression was the ordering variable of the risks, since its presence in isolation, and again in combination with frailty, represented higher risks than the condition of frailty alone[35]. In future research on the subject, analyzes of all-cause mortality should aim to compare the effects represented by the associations of depression with the levels of frailty, with each of its criteria and with pre-frailty, with adjustments for specific diseases, for example, cardiovascular diseases[30].

CONCLUSION

Screening measurements for frailty and depressive symptoms taken in community-dwelling older adults can help to compose specific risk stratification criteria, since different combinations of conditions manifest in different aging trajectories and, in particular, different mortality risks. The greatest risks were identified in the presence of the combinations

"with depression and robust", "with depression and frail", and "no depression and frail", respectively.

The presence of depressive symptoms may be the ordering factor of the combinations on mortality within a period of approximately a decade of life, especially when the older adults are men, 75 years old and over, who present lower cognitive performance.

Depression in old age is an identifiable and treatable condition, and evidence and effective interventions in the management of the frailty syndrome are growing. Investment in the prevention of and interventions in these conditions can minimize indicators of excess mortality from general causes.

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Stability and change in prospective measures of life satisfaction in older adults: Fibra Study

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Abstract

Objective: The purpose of this study was to identify the incidence and variables associated with stability and change in life satisfaction (LS) between baseline and 9-year follow-up, in community-dwelling-older adults. *Method:* A prospective longitudinal study of baseline (BL; 2008-2009) and follow-up (FW; 2016-2017) data from the Frailty in Elderly Brazilians Study involving 360 individuals aged 71.7±5.0 years at BL, 68.9% women, was conducted. Associations of sociodemographic and psychosocial variables, and objective and subjective health indicators measured at BL with the incidence of stability and change in LS between BL and FW were investigated. *Results:* Nine years after the BL collection, the following results were observed: higher incidence of stability (61.1%) than of worsening (26.4%) or improvement (12.5%) in LS; lower incidence of worsening of LS in the ≥80 age group than in the 70-79 years group; higher incidence of change than stability of LS among the participants with multimorbidities and scores > 6 for depressive symptoms; higher incidence of LS worsening among participants with low self-rated health (relative risk; RR=2.26) and low satisfaction with memory (RR=2.33). *Conclusions:* The incidence of stability in LS was more frequent than that of worsening or improvement. Subjective indicators of physical health and satisfaction with memory may serve as indicators of deterioration in wellbeing over time and the presence of depressive symptoms may suggest instability in self-assessments, possibly accompanying a reduction or increase in LS over time. There was considerable heterogeneity in the manifestations of LS among the older adults assessed.

Keywords: Aged. Personal Satisfaction. Memory. Depression. Longitudinal Studies.

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INTRODUCTION

Life satisfaction (LS) is defined as the evaluative-cognitive aspect of subject wellbeing. This reflects the individual´s perception on the degree to which life as a whole meets their expectations based on internal and external standards[1]. The measure can encompass specific domains, such as physical and mental health, functional ability, family relations and social support, which are relatively independent from one another and from the global construct[1]. Life satisfaction and satisfaction for domains changes over the life span, becoming weaker or stronger over chronological time of cohorts and over biological time of adults and older people[2].

Surveys carried out in over 160 countries show that LS is high early in adult life, declines towards the end of this phase, stabilizes and increases from 55-60 years[1], and to decline again from 75 years and older. Life satisfaction is influenced by age-related changes in health status and functional ability[3-5], rather than by the elapsing of time. Data from the 3 waves of the Health and Retirement Study[6] (2006, 2010-2012, 2014-2016) involving 12,998 North-Americans aged 50 years and older showed that individuals with higher LS scores had lower risk for pain, less limitation in physical functioning and fewer chronic diseases. This high LS group also showed high scores for self-rated health, health behaviors and psychosocial indicators. These individuals had low risk for depression, hopelessness, negative affects, perception that social opportunities are restricted, and loneliness. A study with a similar design, but involving Chinese oldest-old (aged ≥80 years)[7] showed more robust positive associations between LS, self-rated health and cognitive status. Stronger negative correlations were observed between satisfaction and self-rated health and instrumental activities of daily living (IADLs), and between satisfaction and self-rated health and depression. Strong positive associations were found between LS and gender, education, place of residence and other economic indicators.

The field of research on LS is rich in data, but a large proportion is derived from cross-sectional studies, whose validity can be compromised by the fact that they draw on comparisons between groups of successive ages tested at the same historical point of life of the society they belong to. Although less common, longitudinal studies with repeat measures and a mix of longitudinal and cross-sectional sequences which allow historical and biological time to be compared, yield more meaningful data on the heterogeneity of the trajectories of satisfaction.

Research results which exemplify this quality were provided by the study of Headey and Muffels[8]. Trajectories of life satisfaction trajectories of 2,473 German adults and older individuals were examined in the form of responses given over 25 consecutive years (1990-2014) to the German Socio-Economic Panel. Long-term stable trajectories were exhibited by 64% of the sample and worse or better trajectories were observed in 24% of participants. The remainder had a pattern of instability over the long term. The authors proposed that changes in values, priorities and behavioral choice less seldom occur and explain long-lasting changes in life satisfaction. However, transient instabilities can result from the influence of everyday life events and of feedback from occurrences in the life course. In other words, LS is essentially stable throughout the life span and heavily influenced by personality, emotions and attitudes. Satisfaction with life varies in response to unexpected, temporary events such as diseases and accidents, but when the impact of these events has been absorbed by the individual, satisfaction returns to basal levels[1].

There is considerable heterogeneity in trajectories of LS in aging, as reported by Korean researchers, who identified 5 different trajectories over an 8-year period of a longitudinal study[9]. Four trajectories were characterized by instability (high, medium-high, medium, low-medium) and 1 by improvement (medium-to-high). The trajectories of stability predominated in individuals who were older, higher educated and more financially secure. Medium

stability trajectories were more prevalent in older individuals who had poorer health status, lived alone and experienced financial stress. The individuals who showed improvement were younger and had worse mental health at baseline than those who had a rising trajectory.

To the best of our knowledge, there are no Brazilian studies investigating stability and change in LS in aging associated with satisfaction for specific aspects of life, such as health, memory, sociability and emotional wellbeing, which contribute to global satisfaction. Studies of oldest-old (age ≥80 years) are rare, despite this representing the fastest growing age strata in the older population[10], associated with a large burden of unmet economic, health and educational needs. Greater knowledge on these assessments and identifying variables associated with them paves the way for devising effective procedures for promoting health and behavioral changes that are important for the global wellbeing of older adults.

The objective of this study was to investigate the incidence of stability and change in life satisfaction based on measurements collected 9 years apart, evaluating physical and mental health conditions, social engagement, self-rated health and satisfaction with memory domains and support at baseline.

METHODS

A prospective longitudinal study drawing on data derived from the Estudo da Fragilidade em Idosos Brasileiros (Fibra Study) was conducted. The Fibra is multi-center, multi-disciplinary, population-based survey of 6762 Brazilian community-dwelling older adults performed in 2008-2009. A total of 17 cities located in Brazil´s 5 geographic regions with different human development indexes were chosen based on convenience criteria[11]. From each city, individuals aged 65 or older were selected using probabilistic sampling by sex, age, population density of older adults, based on the 2000 Brazilian Demographic Census[10]. Four public universities were involved in training interviewers, together with data collection and storage[11].

This survey had additional stages, such as the second wave of measures or follow-up of the baseline study, conducted by research centers within the 4 universities, according to the availability of teams and financial resources. For example, in the city of Campinas, São Paulo state, and in Ermelino Matarazzo, a subdistrict of São Paulo city, a follow-up study was conducted in 2016-2017 involving survivors from the baseline study.

At baseline (BL), a total of 1,284 older adults comprised the sample selected by simple random sampling of urban census sectors of the 2 locations (90 in Campinas and 62 in Ermelino Matarazzo). For the 2007 survey of these locations, quotas were estimated of men and women aged 65-69, 70-74, 75-79 and ≥80 years, representative of the older population, with a further 25% for possible sample losses. Participants were recruited at households and in areas with a high flow of older adults. Inclusion criteria were: aged ≥65, residing permanently at the household located in the city and census sector, and being able to understand and follow the instructions. The exclusion criteria were: severe visual/hearing or cognitive deficits; neurological and motor complications due to stroke; severe stage or unstable Parkinson´s disease; being bedridden; wheelchair user; cancer; undergoing chemotherapy treatment and harboring terminal stage disease[11].

At BL, the older adults participated in a single data collection session carried out at community centers, schools, churches and primary health centers, at times and dates pre-established during recruitment. Graduate and undergraduate students and community health workers, as pairs, were trained to perform recruitment and data collection. Measurements were made for sociodemographic, anthropometric, clinical (blood pressure and oral health) variables, frailty phenotype and mental health. Mental health served as a selection criterion for the second stage of data collection, which included variables of interest for the current study. Older adults who scored above the cut-off, after adjusting for years of education, less 1 standard deviation, relative to the mean for their group[12,13], were selected, while those scoring below the cut-off were rejected. Cut-off scores adopted were 17 for illiterate individuals and those with no formal schooling, 22 for individuals with 1-4 years of education, 24 for 5-8 years and 26 points for those with ≥9 years of formal education[14].

For the follow-up (FW), data collection was carried out at households. The scales measuring sociodemographic, clinical, anthropometric and frailty used at BL were reapplied, and all respondents scoring below the cut-off score on the mini-mental state exam (MMSE) were again excluded.

In 2015, the database containing the records of the older adults surveyed at BL were used to compile the list of recruitable subjects or the FW. The addresses were checked by trained personnel, who made 3 attempts to locate the individual. Participants found at the addresses were invited to take part in the FW study (n= 549); 192 had died and 543 were lost to follow-up. Thus, the data for this study were derived from the BL database (2008-2009) and FW database (2016-2017) of the Campinas and Ermelino Matarazzo Fibra Study. Of the 549 interviewed at FW, 130 were excluded for scoring below the cut-off on the cognitive screening exam. Of the remaining 419, a further 59 were excluded for not having records of MMSE application at BL and/or because they held no records for satisfaction or the other variables of interest in the FW. Thus, the final sample comprised 360 older adults with data on the same variables at BL and FW.

The dependent variable was stability or change in life satisfaction, assessed by the question "How satisfied are you with your life?" (not very satisfied x moderately x very satisfied). To measure the change between BL and FW, negative, null or positive differences between them were calculated (deltas) corresponding to worsening x unchanged x improved (life satisfaction).

The independent variables whose association with stability and change in LS over 9 years was assessed were: (a) objective health: number of non-communicable chronic diseases/multimorbidities, depressive symptoms and partial or total dependence for performing Instrumental Activities of Daily Living (IADLs); (b) subjective health: response to single item for self-rated health; (c) social engagement in Advanced (or complex) Activities of Daily Living (AADLs); (d) satisfaction for memory and social support, instrumental and affective domains; and (e) sociodemographic variables.

The number of non-communicable chronic diseases was obtained by tallying the diagnosed medical conditions from a list of nine (coronary heart diseases, hypertension, arthritis/arthrosis/rheumatism, stroke, osteoporosis, diabetes mellitus, depression, lung diseases, and cancer)[14], answered with a yes or a no. Respondents who answered with a yes for 2 or more diseases scored for multimorbidities[15]. Depressive symptoms were selected from the 15 yes/no items of the Geriatric Depression Scale[16], indicating the presence or absence of dysphoric moods: 6 or more responses confirming these items scored for depression. Partial or total dependence for IADLs was assessed by applying the Instrumental Activities of Daily Living Inventory[17], containing 7 descriptive items of activities of daily living. Older adults who reported needing total or partial assistance to carry out one or more IADL scored for dependence.

Self-rated health was measured by an item scored on scale which asked the subject to rate their own health by assigning one of the following categories: very good, good, regular, poor and very poor, subsequently reduced to two: very good x regular. poor or very poor. The level of social engagement was represented by involvement in AADLs[18] contained in a 14-item inventory, ranging from the simplest to most complex, relative to managing social life, with response "never done" x "stopped doing" x "still do". Older individuals who responded with "still do" to a total of AADLs that exceeded the median value were scored as having high social engagement[11].

The measure of satisfaction for domains included a dichotomous satisfaction item on memory and 3 others on satisfaction with support received (of instrumental nature, when ill, of social nature when needing company, and affective nature when needing emotional support and comfort). Sociodemographic variables included gender (male and female), age (65-69, 70-79 and ≥80 years), education (none, 1-4 and ≥5 years of formal studies), living alone (yes and no) and marital status (with or without partner), with information collected by self-report.

With the aim of assessing selection bias in the subsamples of older individuals found and reinterviewed, deceased or lost, comparisons among them were made using Pearson´s chi-square test. Those with a value of p >0.05 were deemed statistically similar.

Descriptive analyses of the variables at BL and FW were then performed. Subsequently, cumulative incidence (%) of changes in LS (worsening and improvement x stability) was calculated between BL and FW for the independent values. Associations were checked using Pearson´s chi-square test, with a $p < 0.05$ adopted as statistically significant. Lastly, analysis of multinomial logistical regression was performed to estimate the relative risks (RR) and respective 95% confidence intervals (CI) for effects of improvement or worsening of independent conditions on LS. On the multiple model, independent variables exhibiting $p<0.20$ were included in the bivariate analysis. In the final regression, variables with value of $p<0.05$ were retained. Age was maintained to adjust the model, irrespective of level of significance obtained on the bivariate analysis. Data analysis was performed using the Stata statistical software package version 15.1 (StataCorp, College Station, USA).

The baseline project was approved by the Research Ethics Committee of the State University of Campinas on 22/05/200710 under permit 208/2007, and on 15/12/2014 under permit 907.575. The follow-up project was approved on 23/11/2015 under permit 1.332.651. All participants were informed about the study goals and procedures and regarding their rights and obligations, and signed the Free and Informed Consent Form.

RESULTS

The comparative analysis of the subsamples of older individuals reinterviewed, deceased and lost, revealed similarities and differences in the distribution of the sample losses, which were more numerous among younger elderly and in those living alone ($p<0.05$). The results on the chi-square test proved similar ($p>0.05$) for all the other comparisons (data not shown in Table).

A total of 360 older adults aged ≥65 years at BL were analyzed, all of whom answered the scale assessing LS at both BL (2008-2009) and FW (2016-2017). The sample at BL comprised predominantly women (68.9%), individuals age ≥60 years (62.2%), with no formal study or 1-4 years of education (74.4%), living alone (84.7%) and who were married (55.4%). Mean age was 71.7±5.0 years at BL and 80.3±4.6 years at follow-up. Most respondents were clinically diagnosed with 2 or more chronic diseases (62.5%) and rated their health as regular or poor (57.5%). Approximately 70% performed ≥5 AADLs, 77% were totally independent for carrying out IADLs, and 17.8% scored above the cut-off for depressive symptoms. Over half of the participants were satisfied with their memory (57.2%) and with the instrumental support received from friends and relatives when sick (59.4%), needing company (57.1%), and emotional comfort (69.9%) (Tables 1 and 2).

The incidence of stability of satisfaction between BL and FW was proportionally greater than worsening or improvement. The incidence of worsening LS was lower in individuals aged ≥80 years than in the other two age groups, while lower incidence of improvement was found in the 70-79 years group (Table 1).

The incidence of change in LS was greater than that of stability in individuals with multimorbidities and among those scoring >6 for depressive symptoms. Participants who self-rated their health as regular/poor and those reporting low satisfaction with memory had a higher incidence of worsening LS and lower incidence of stability. No significant association with the LS measure was found for the other variables (Table 2).

At BL, 64.7% of the older adults were satisfied with life, 28.0% moderately satisfied and 7.3% dissatisfied. At FW, 79.4% were satisfied, 16.7% moderately satisfied and 3.9% dissatisfied with life. Most of the participants (61.1%) showed stable satisfaction between BL and FW. Negative change was found in 26.4% of respondents and positive change in 12.5% (Figure 1).

The results of multinomial logistic regression analysis showed that depression was the variable most strongly associated with change in LS: respondents who scored above the cut-off on the scale screening for depressive symptoms had a 3.77 times greater relative risk of improved LS ($p=0.001$) and 2.74 times greater relative risk of worsened LS ($p=0.002$). Low self-rated health (RR=2.26; $p=0.004$) and low satisfaction with memory (RR=2.33; $p=0.001$) were also significantly associated with a worsening in LS (Table 3).

Table 1. Incidence of changes in global life satisfaction over 9 years, according to sociodemographic variables. FIBRA study, older adults, Campinas and Ermelino Matarazzo, São Paulo state, Brazil, 2008-2009 and 2016-2017.

Variables	n (%)	Global satisfaction with life (%)			*p*-value*
		Worsening n= 95	Stability n= 220	Improvement n= 45	
Sex					
Male	112 (31.1)	26.8	60.7	12.5	0.993
Female	248 (68.9)	26.2	61.3	12.5	
Total	360	26.4	61.1	12.5	
Age group (years)					
65-69	136 (37.8)	24.3	57.3	18.4	**0.009****
70-79	196 (54.4)	30.1	62.2	7.7	
≥80	28 (7.8)	10.7	71.4	17.9	
Education (years)					
0	54 (15.0)	24.0	59.3	16.7	0.493
1-4	214 (59.4)	27.1	59.3	13.5	
≥5	92 (25.6)	26.1	66.3	7.6	
Living alone					
No	305 (84.7)	26.2	62.0	11.8	0.596
Yes	55 (15.3)	27.3	56.4	16.3	
Marital status					
With partner	199 (55.4)	25.6	62.3	12.1	0.851
Without partner	160 (44.6)	27.5	59.4	13.1	

*p-value of Pearson´s chi-squared test. ** p-value of Fisher´s Test.

Table 2. Incidence of changes in global life satisfaction according to objective and subjective health conditions, social engagement and satisfaction for memory and perceived social support domains. FIBRA study, older adults, Campinas and Ermelino Matarazzo, São Paulo state, Brazil, 2008-2009 and 2016-2017.

Variables	n (%)	Global satisfaction with life (%)			*p**
		Worsening n= 95	Stability n= 220	Improvement n= 45	
Objective health status					
Multimorbidity					
None (0 or 1 disease)	135 (37.5)	20.7	69.7	9.6	**0.037**
Present (≥2 diseases)	225 (62.5)	29.8	56.0	14.2	
Depressive Symptoms					
Without symptoms (score< 6)	296 (82.2)	23.0	66.5	10.5	**<0.001**
With symptoms (score ≥ 6)	64 (17.8)	42.2	35.9	21.9	
Performance of IADLs					
Total independence	276 (76.7)	26.8	61.2	12.0	0.834
Partial/total dependence	84 (23.3)	25.0	60.7	14.3	
Subjective health status					
Self-rated health					
Very good/good	152 (42.5)	16.5	71.7	11.8	**0.001**
Regular/poor/very poor	206 (57.5)	33.5	53.4	13.1	

continua

Continuation of Table 2

Variables	n (%)	Global satisfaction with life (%)			*p**
		Worsening n= 95	Stability n= 220	Improvement n= 45	
Social engagement					
AADLs performed (<5)	117 (32.8)	33.3	53.0	13.7	0.072
AADLs performed (≥5)	240 (67.2)	22.9	65.0	12.1	
Satisfaction with domains					
Memory					
High	206 (57.2)	18.0	67.5	14.5	**<0.001**
Moderate/low	154 (42.8)	37.7	52.6	9.7	
Support received					
Instrumental					
High	211 (59.4)	24.2	64.4	11.4	0.297
Moderate/low	144 (40.6)	29.9	56.2	13.9	
Social					
High	241 (67.1)	26.1	62.7	11.2	0.532
Moderate/low	118 (32.9)	26.3	58.5	15.2	
Emotional					
High	251 (69.9)	26.3	61.4	12.3	0.992
Moderate/low	108 (30.1)	26.9	61.1	12.0	

*p-value of Pearson´s chi-squared test; IADLs: Instrumental Activities of Daily Living; AADLs: Advanced Activities of Daily Living.

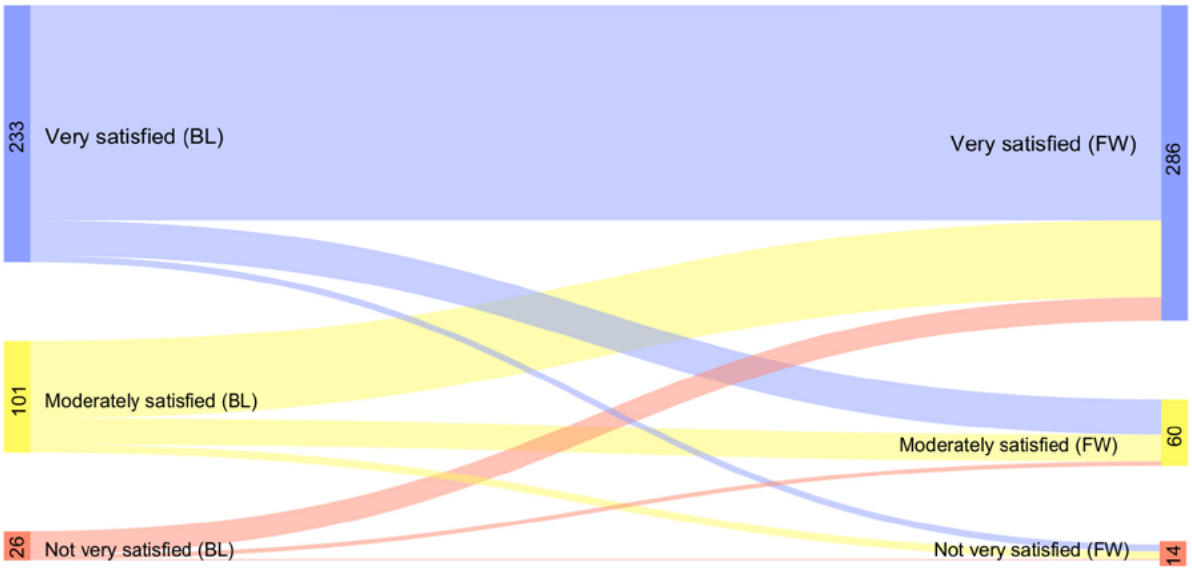

Figure 1. Changes in life satisfaction between baseline (BL) and follow-up (FW) after 9-year interval. FIBRA study, older adults, Campinas and Ermelino Matarazzo, São Paulo state, Brazil, 2008-2009 and 2016-2017.

Table 3. Relative risks and factors associated with changes in life satisfaction in older adults, at 9 years, estimated using a multinomial logistics regression multiple model. FIBRA study, older adults, Campinas and Ermelino Matarazzo, São Paulo state, Brazil, 2008-2009 and 2016-2017.

Variables	Global Satisfaction with Life					
	Worsening			Improvement		
	RR*	95%CI**	*p***	RR*	95%CI**	p***
Self-rated health						
Very good/good	1				1	
Regular/poor/very poor	2.26	1.30-3.93	0.004	1.23	0.62-2.44	0.543
Depressive symptoms						
Without	1			1		
With	2.74	1.44-5.21	0.002	3.77	1.73-8.23	0.001
Satisfaction with memory						
High	1					
Moderate/low	2.33	1.40-3.90	0.001	0.76	0.38-1.53	0.451

*Relative risk;**CI: Confidence Interval; ****p*-value of Wald test if >0.05.

DISCUSSION

The objective of the present study was to identify factors associated with stability and changes in a prospective measure of life satisfaction in community-dwelling older adults. Nine years after baseline measurements, the following was observed: there was a greater incidence of stability of LS than worsening. A lower incidence of worsening was found in the ≥80 years age group than in the 70-79 years group. A higher incidence of change than instability of LS was observed in individuals with multimorbidities and higher scores for depressive symptoms. Lastly, a higher incidence of worsening of LS was found in respondents reporting low self-rated health and low satisfaction with memory.

These findings corroborate the results in the related literature on the subject. For example, the study of Witley et al.[19] investigating associations between objective dimensions of successful aging (absence of disease and disability, good physical/cognitive functioning and good interpersonal/productive social engagement)[20] and aspects of subjective health, satisfaction with health and satisfaction with health for age. All positive dimensions of successful aging were found to be associated with better self-rated health and satisfaction, irrespective of age, gender, manual or nonmanual occupations, and personality. The authors concluded that self-rated health was strongly associated with LS due to mediation by objective health conditions[21]. These data are consistent with those of the Health and Retirement Study[6] and of the Chinese Longitudinal Health Longevity Survey[7]. This latter survey in particular, highlights the primacy of subjective assessments over objective ones and of stability over change, which greatly favors older individuals.

Stability or improvement of LS and its domains, even in the presence of disease and disability, is a phenomenon widely recognized by researchers, and denoted the "age and subjective wellbeing paradox" [21,22]. There are 4 theories explaining this form of adaptation, which was also evident in the present study. The first theory points to emotional-cognitive resources, such as accommodative coping strategies, resistance to frustration based on past experience of deprivation or suffering, or minimization of cognitive dissonance through social and temporal comparison strategies. For the second explanation, LS is stable for age and declines caused by major events are transient, where older adults quickly adapt with satisfaction returning to basal levels[9]. A third theory regards this information as a result typical of cross-sectional type observation[1]. The

fourth explanation is that the reduced perspective of future time which accompanies aging confers older adults with higher levels of self-regulation and socioemotional selectivity[23] which, in turn, are protective and help them attain better LS.

In the present study, changes characterized as worsening or improvement of LS proved highly heterogeneous in nature, i.e. there were differences in distribution of the trajectories of worsening, stability and improvement in LS and in memory across age groups. Depressive symptoms were associated with both worsening and improvement of LS, suggesting instability of assessment over time. The effect of stability and change was not uniform for all domains of LS[24]. These findings are similar to those of the study by Hansen and Slavsgod[23] involving 3,750 Norwegians aged 40-85 years. These authors showed that overall LS did not translate to equal satisfaction for all domains. Older individuals may be dissatisfied with their own health, yet satisfied with their family relationships. Negative affects changed during the course of aging, whereas positive affects and depression worsened in older age. Loss of health and partner were the main causes of decline in subjective wellbeing in older age, whereas spirit of partnership and intimacy were the main contributors to satisfaction in the younger old[25].

Despite being a group more exposed to declines in objective life conditions, in the present study, the 80 years age group had lower incidence of worsening and higher incidence of stability in assessments of satisfaction at 9 years, than the younger age group. This result suggests accommodative and compensatory strategies were adopted by the oldest-old when comparing desired health with actual health conditions. However, there was a higher incidence of change to a worse state in respondents with 2 or more diseases and with scores >6 for depressive symptoms. This result technically and intuitively supports the notion of a correlation between LS and negative objective conditions of physical and mental health. The incidence of worsening LS was higher on the assessment of subjective health, possibly influenced by associations with objective conditions of worsened mood[25-27]. The lower incidence of worsening or instability found on the assessment of memory and depression was probably due, in part, to the "it could be worse" attitude.

This study has some limitations. Firstly, individuals presenting cognitive impairment were excluded, a procedure which on the one hand ensured data reliability, but on the other may have contributed to selection bias. Secondly, although studies with long intervals between two observations are not uncommon, those applying more repeated measures spaced closer together tend to produce more robust results. Lastly, although similarities in the composition of the subsamples were observed, fewer losses to follow-up would have been more favorable. Strengths of the study include the sample of older adults which contained a large subsample of octogenarians, and also the analysis of changes in life satisfaction associated with the variables objective and subjective health, satisfaction for domains, and sociodemographics, based on measurements made after a 9-year follow-up period.

CONCLUSIONS

The subjective conditions had primacy over objective conditions and stability predominated over change, particularly among the oldest-old, a group which showed less worsening of LS. A large contingent of the respondents reported being satisfied with life, despite disease and losses in aging. The trajectories of stability and change in LS proved heterogeneous across age groups. The associations between depressive symptoms and both worsening and improvement of satisfaction suggest the assessments have some degree of instability.

The results of this study are novel in Brazil, as is the methodology employed. Professionals working with older individuals and engaged in research can benefit from deeper knowledge on the components and correlates of subjective wellbeing and on the benefits of subjective assessment, as well as by recognizing that both older age and aging represent heterogeneous phenomena.

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Urinary incontinence, sense of control/autonomy and social participation in community-dwelling older adults

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Abstract

Objective: Identify the presence of urinary incontinence (UI) symptoms and test a model of direct and indirect associations with the psychosocial variables sense of control/autonomy and social participation in community-dwelling older adults. *Method:* Cross-sectional study conducted with 419 adults aged 72 years or over (70.2% female) participating in the follow-up survey of the FIBRA Study - Polo Unicamp. Age, sex and educational level were the sociodemographic variables selected as antecedents of the relationship between UI and social participation. A sense of control/autonomy was tested as a mediator of these relationships in a path analysis through structural equation modelling. *Results:* UI was reported by 38% of the sample, with significant differences according to sex (41% female versus 31.3% male). Three levels of social participation were proposed, based on the degree of interaction between the individual and society. The model of relationships explained 15% of the variance in social participation. Direct effects were observed between control/autonomy and social participation; indirect effects between education and participation, mediated by the presence of UI. *Conclusion:* UI contributed to restrictions in social participation at all levels. Control/autonomy, although related, did not prove to be a psychological mediator for the relationship between UI and participation. The presence of UI potentialized the disadvantageous relationships between education and social participation. As modifiable factors, the treatment and management of UI through clinical and psychosocial initiatives can act to reduce negative psychological effects and reduce socioeconomic inequalities in social participation.

Keywords: Urinary Incontinence. Health of the Elderly. Social Participation. Quality of life.

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INTRODUCTION

In the list of signs and symptoms used in epidemiological health surveys, the report of "involuntary loss of urine in the last year" is a simple and useful strategy to operationalize and estimate the presence of urinary incontinence (UI) in community-dwelling older adults[1]. An affirmative answer to the question is an important marker of health morbidity and worse physical and cognitive functionality, with negative repercussions on quality of life and sleep quality and an aggravating factor for conditions like frailty, falls, hospitalization, institutionalization and death[2-4].

Regardless of clinical classification, it is estimated that 50% of women will experience UI symptoms throughout their lives, and the prevalence of UI is higher among women than among men (60% to 30%)[1,2,5]. Based on a systematic review and meta-analysis, a prevalence of UI of 37.1% in older adult women is estimated, with rates varying between 29.6 and 45.4%[1]. Older adult women are about twice as susceptible to UI as older men[2,6].

As indicated by data from clinical research literature, older adults with UI are more likely to be restricted in the performance of daily self-care and social participation activities, experience increased feelings of loneliness and social isolation, and present increased risk for depression and anxiety[7-10]. The negative effects of UI on social participation constitute a potential barrier to public and clinical goals of promoting involvement and maintenance of social participation in old age. Defined as "involvement in activities that provide interactions with other people in the community"[11], social participation is a highly valued concept in gerontology, considered one of the pillars of the promotion of active aging and the Decade of Healthy Aging (2021-2030)[12]. Older adults with UI are less likely to engage in social activities outside the home, such as going shopping or attending church or religious services[13,14], as evidenced by samples with different sociodemographics[3] and cultural conditions[15].

Psychological repercussions derived from social constraints and psychological hypervigilance in the face of episodes of urinary leakage can contribute to reducing the probability of involvement in social leisure activities, physical exercise, festivities and volunteer work[16]. The presence of UI in old age is associated with personal experiences and social attitudes that involve a sense of loss of control and autonomy over persons´s own life, dependence, frailty and social isolation[17,18].

As an indicator of human agency, a positive sense of control and autonomy is an important prerequisite for participation in society[19]. Psychological measures operationalize a sense of control and autonomy from the agreement or disagreement of individuals with items that express the exercise of free choice and the overcoming of limitations or social, economic and health barriers, in order to achieve the expected results[20].

Associations between positive indicators of control and autonomy and involvement and maintaining participation in social activities are reported in studies with large population samples[20-22]. Evidence suggests that, if the measurements of these constructs are affected by the presence of UI, they also have the potential to affect the social participation of older adults, acting either as a risk factor, or as a protective factor or personal resource for resilience against restriction in social activities[23-25].

Although the gerontological and geriatric literature evidence the psychosocial repercussions of UI, there is relatively little investment in the investigation of the psychological older adults in social activities[18,26-27]. The interrelationships between conditions of sex, age and education, which differently expose older adults to opportunities and choices for involvement in social activities, can influence the magnitude of these relationships. They can be mediated by psychological factors that promote or decrease the probability of social participation in old age[27]. A sense of control over life and personal autonomy can be affected by UI and can affect the participation of older adults in social activities[28]. Identifying the magnitude of these relationships enables the exploration of pathways for clinical and psychosocial interventions.

Therefore, this study sought to identify the presence of urinary incontinence (UI) symptoms and to test a model of direct and indirect associations between psychosocial variables, the sense of control/autonomy and social participation in community-dwelling older adults.

METHODS

This is a cross-sectional, population-based study, based on follow-up data from a cohort of older adults conducted by the FIBRA Study – Frailty Profile of Elderly Brazilians[29]. In 2016-2017, older adults living in Campinas and Ermelino Matarazzo, a sub-district of the City of São Paulo (SP), Brazil, were contacted again for data collection and longitudinal analyzes based on the follow-up of this cohort. Household address lists recorded in the 2008-2009 baseline databases were used to recruit older adults for follow-up measures. Trained recruiters actively searched for these older adults on up to three occasions at the registered addresses. Informants or family members found at the time of recruitment were contacted, to be present with older adult at the time of the interview or to offer information about older adults who had cognitive impairments, identified by applying the Mini-Mental State Examination (MMSE)[30].

Figure 1 presents the flowchart of the composition of the follow-up sample of the FIBRA Study. Excluding sample losses, responses provided by the informants or family members, and deaths, 419 older adults responded fully to the research protocol.

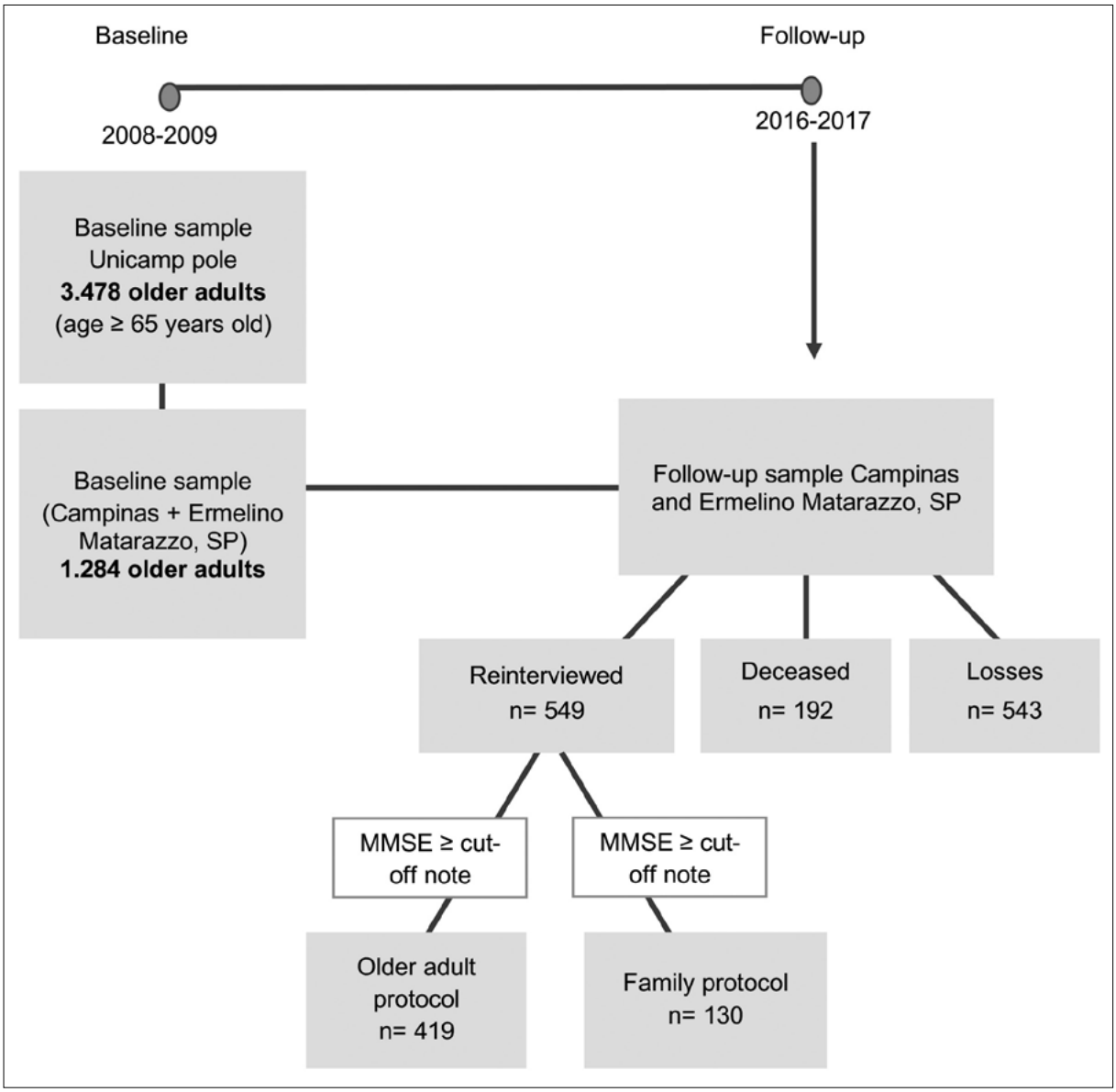

Figure 1. Flowchart of the FIBRA Study sample composition for the baseline and follow-up survey. FIBRA Study, Older adults, Campinas and Ermelino Matarazzo, SP, Brazil, 2016/2017.

For this study, selected information on 419 older adults who participated in the follow-up survey was used. The following inclusion criteria were applied: participation in data collection at baseline (2008-2009); clarification and agreeing to participate in a further data collection; and screening that required scoring above the cut-off for cognitive decline on the MMSE[30], adjusted for education level: 17 points (illiterate); 22 points (1-4 years of education); 24 points (5-8 years of education) and 26 (9 or more years of education).

To identify the presence of UI in the sample, one of the items from the questionnaire on health signs and symptoms was used: "In the last 12 months, have you had involuntary loss of urine?" Affirmative answers determined the presence of UI and negative answers, the absence of UI.

To identify social participation, responses to the Advanced Activities of Daily Living (AADL) scale were used. This scale was developed for the study based on Reuben et al.[31] and Baltes et al.[32], to identify the involvement of the older adults in a set of leisure and social activities, performed in their free time and independent of paid work; volunteering, educational activities and social participation in the community. It consists of 26 items, each with three response options: 1, "I have never done it"; 2, "I stopped doing it"; 3, "I still do it".

Of the 26 activities in the scale, 10 were classified by us as corresponding to the concept of participation and the taxonomy of social activities proposed by Levasseur et al[11]. They conceptualize participation as the involvement in activities that provide interactions with other people in the community, activities that can be organized by levels of complexity. These levels reflect the needs, proximity or repercussions of the individual, groups and society[11].

In light of the taxonomy of Levasseur et al[11], 10 items from the AADL scale referring to social participation, including the activities "visit others at their homes" and "entertain at home", were classified as proximal social activities, since they are less complex, require less displacement or physical effort and because they are initiated and maintained by the individual themselves. The activities "keeping in touch by letter or phone with friends and family" and "using e-mail or social networks to communicate with friends and family" were also classified as proximal activities, however, mediated by some technology. The activities "going to church for religious rituals or social activities linked to religion", "attending meetings, parties or dances", "meeting with people in public places, restaurants, cinemas, theaters, concerts, clubs, etc." and "participating in a university open to older adults, community centers or refresher courses" were classified as intermediary social activities, which can require more functionality resources and greater geographical displacement, can involve interaction between people and can be mediated by social institutions. Distal activities were classified as those that presuppose exchanges or the offer of social capital, greater functional demands and broader social interactions between the individual and society; these were: "doing voluntary work" and "taking part in boards, councils of associations or clubs, schools, unions, cooperatives, social centers, or political activities". A total score for each level of participation was identified from the choice of responses, "I have never done it", "I stopped doing it" and "I still do it", issued for each item.

A sense of control and autonomy was identified from the responses of the older adults to six items from the Brazilian Portuguese version of the CASP-19 scale (Factor 2)[20-21]. Originally developed in the United Kingdom, the scale measures quality of life in old age from a theoretical model of psychological needs satisfaction (control, autonomy, self-fulfillment and pleasure, the initials of which produce the acronym CASP-19), expressed in 19 items with four intensities each (0 to 3). The score on the whole scale ranges from 0 to 57. In the Brazilian version of the scale, the six items corresponding to the control and autonomy factor (Factor 2) score from 0 to 18 points (items 1, 2, 4, 6, 8, and 9) as follows: 0, never; 1, occasionally; 2, almost always; and 3, always. These items achieved Cronbach's $\alpha = 0.67$, an indication of moderate internal consistency[21]. The sociodemographic variables age, sex and education were selected to describe the sample and identify antecedent conditions in the analysis of relationships with the remainder.

Descriptive analyzes of the variables of interest were performed with absolute and relative frequencies for the categorical data and measures of position and dispersion for the quantitative data. Percentage distributions and respective 95% confidence intervals were estimated.

Spearman's nonparametric rank correlation test was used to estimate the magnitude and statistical significance of bivariate associations. From the analysis of the correlation matrix, we were able to generate an understanding of the behavior of the data, before moving on to more advanced analyses. The significance level adopted for the tests was 95% or $p<0.05$.

Path analysis via the structural equation method was used to test the direct and indirect relationships between selected observable variables. Recursive and latent variables were not used[33]. A hypothetical model of relationships was formulated, with the following ordering: a) age, sex and education indicators were considered antecedents to all the variables under study; b) the presence of UI was considered antecedent to the sense of control/autonomy and the indicators of social participation; c) a sense of control/autonomy was proposed as a variable associated with participation, as well as a variable that mediates the indirect relationships between UI and social participation.

To analyze the goodness of fit of the data to the proposed model, significance tests were performed for the path coefficients (expressed as betas; $t>1.96$). The parameters adopted to accept the model were: chi-square test >0.05; chi-square ratio (X2/GL) <2; SRMR (standardized root mean square residual) <0.10; RMSEA (root mean square error of approximation) <0.08; CFI (comparative fit index) >0.90; and TLI (Tucker-Lewis index) >0.9033.

This study was approved by the Human Research Ethics Committee of the State University of Campinas (UNICAMP), on December 15 2014, report no. 907.575, CAAE 39547014.0.1001.5404, report no. 1,332,651 of November 23 2015, CAAE 49987615.3.0000.5404 and report no. 3,502,189, CAAE 16559119.7.0000.5404. All participants signed a term of free, informed consent in which the objectives of the study, the content of the interviews and the ethical commitments of the researchers to the participants were explained.

RESULTS

Regarding all the participants (N=419), the majority were female (69.9%), aged 80 years or older (55.9%), with between 1 and 4 years of education (58.2%). Our analysis showed that 37.9% of the older adults presented urinary incontinence, while 59.1% presented control/autonomy above the median of 14 points. Regarding the maintenance of social participation, most of the sample reported being involved in at least one activity, as well as in social activities mediated by technology (75.4%). Engagement in intermediary social activities showed greater variation, with the highest percentages of older adults participating in one to three activities; 72.9% reported no involvement in distal social activities (Table 1).

In comparative analyzes (Pearson's chi-square test), the presence of UI was significantly different between the sexes (41% female versus 31.3% male; $p=0.036$) regarding specific participation in intermediary social activity "participating in meetings, parties or dances" (33.3% of older adults with UI participated, 43% did not; $p=0.01$), such that in all individual items that measured control/autonomy there was a lower frequency of scores that express better control/autonomy ($p<0.05$).

Table 2 describes the magnitude of the correlations between the variables. Negative correlations between age x sex and education x control/autonomy were significant, but of low magnitude. UI was negatively correlated with control/autonomy and with participation in technology-mediated social and proximal activities. Greater control/autonomy correlated with participation in proximal social activities. Participation in technology-mediated proximal social activities showed the highest number of negative correlations with age, education, control/autonomy and proximal social activities, togethere with a positive correlation with sex (female).

Table 1. Sample characterization according to sociodemographic variables, presence of UI, control/autonomy and social participation. FIBRA Study, Older adults, Campinas and Ermelino Matarazzo, SP, Brazil, 2016/2017.

Variable	N (%)	95%CI
Sex		
Female	293 (69.9)	65.3 - 74.1
Male	126 (30.1)	25.8 - 34.6
Age (M=72.6±5.9)		
65-79 years old	185 (44.1)	39.4 - 48.9
≥ 80 years old	234 (55.9)	51.3 - 60.5
Education (years)		
No formal education	57 (13.6)	10.6 - 17.0
1-4	244 (58.2)	53.4 - 62.9
≥5	118 (28.2)	24.4 - 32.7
Urinary Incontinence		
No	260 (62.1)	23.7 - 66.5
Yes	159 (37.9)	33.4 - 42.8
Control/Autonomy		
Below the median (<14 points)	153 (40.9)	33.4 - 42.8
Above the median (≥14 points)	221 (59.1)	57.1 – 66.5
Social Participation		
Proximal Level		
None	44 (10.6)	7.9 - 13.9
1 activity	313 (75.4)	71.3 - 79.3
2 activities	58 (14.0)	10.9 - 17.6
Proximal Level mediated by technology		
None	44 (10.6)	7.9 - 13.9
1 activity	313 (75.4)	71.3 - 79.3
2 activities	58 (14.0)	10.9 - 17.6
Intermediary Level		
None	44 (10.6)	7.9 - 13.8
1 activity	122 (29.2)	25.7 - 33.8
2 activities	127 (30.5)	26.2 - 35.6
3 activities	109 (26.1)	22.1 - 30.5
4 activities	15 (3.6)	2.1 - 5.8
Distal Level		
None	304 (72.9)	68.4 - 76.9
1 activity	90 (21.6)	17.8 - 25.8
2 activities	23 (5.5)	3.6 – 8.1

Table 2. Matrix of correlations between sociodemographic variables, UI, control/autonomy (C/A) and levels of social participation. FIBRA Study, Older adults, Campinas and Ermelino Matarazzo, SP, Brazil, 2016/2017.

Variables	1	2	3	4	5	6	7	8	9
1. Age	1								
2. Sex	-0.10*	1							
3. Education	0.07	0.07	1						
4. UI	0.00	0.04	0.06	1					
5. C/A	0.04	0.02	0.14**	-0.21**	1				
6. Proximal	0.00	0.07	0.02	-0.11*	0.17**	1			
7. Mediated	-0.13**	0.12*	0.24**	-0.11*	0.18**	0.22**	1		
8. Intermediary	-0.08	0.16*	0.13*	-0.08	0.22**	0.35**	0.25**	1	
9. Distal	-0.10*	0.02	0.09	-0.03	0.15**	0.18**	0.06	0.33**	1

*p<0.05;**p<0.01.

Sex, age, and education level were tested as covariates in the path analysis between UI, control/autonomy, and social participation. After the second review and the removal of non-significant paths between the variables, acceptable values were obtained for all the adjustment criteria of the proposed model. Figure 2 shows the paths tested that remained in the final relationship model (R^2 =0.16). The values for the tests were: chi-square =0.14; chi-square ratio (X^2/GL) =0.00; SRMR (standardized root mean square residual) =0.03; RMSEA (root mean square error of approximation) =0.03; CFI (comparative fit index) =0.97; and TLI (Tucker-Lewis index) =0.94.

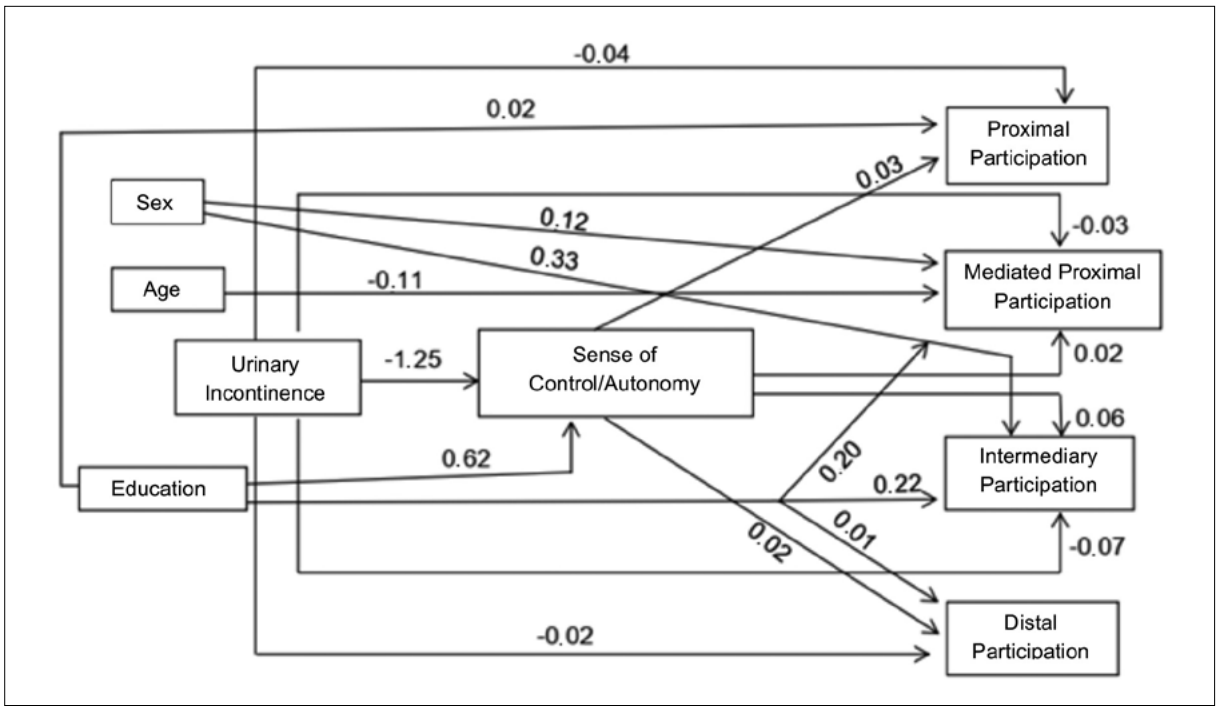

Figure 2. Diagram representing the significant associations between the variables tested via path analysis. FIBRA Study, Older adults, Campinas and Ermelino Matarazzo, SP, Brazil, 2016/2017.

In tests of direct effects, the sense of control/autonomy was affected by UI (β =-0.17; p <0.01), it affected all levels of social participation (p<0.01) and showed no indirect effect that suggested it was a mediator of indirect relationships between these variables. The tests of indirect effects between the variables determined that UI acted as a mediator variable of the indirect relationships between education and all levels of social participation (Figure 3).

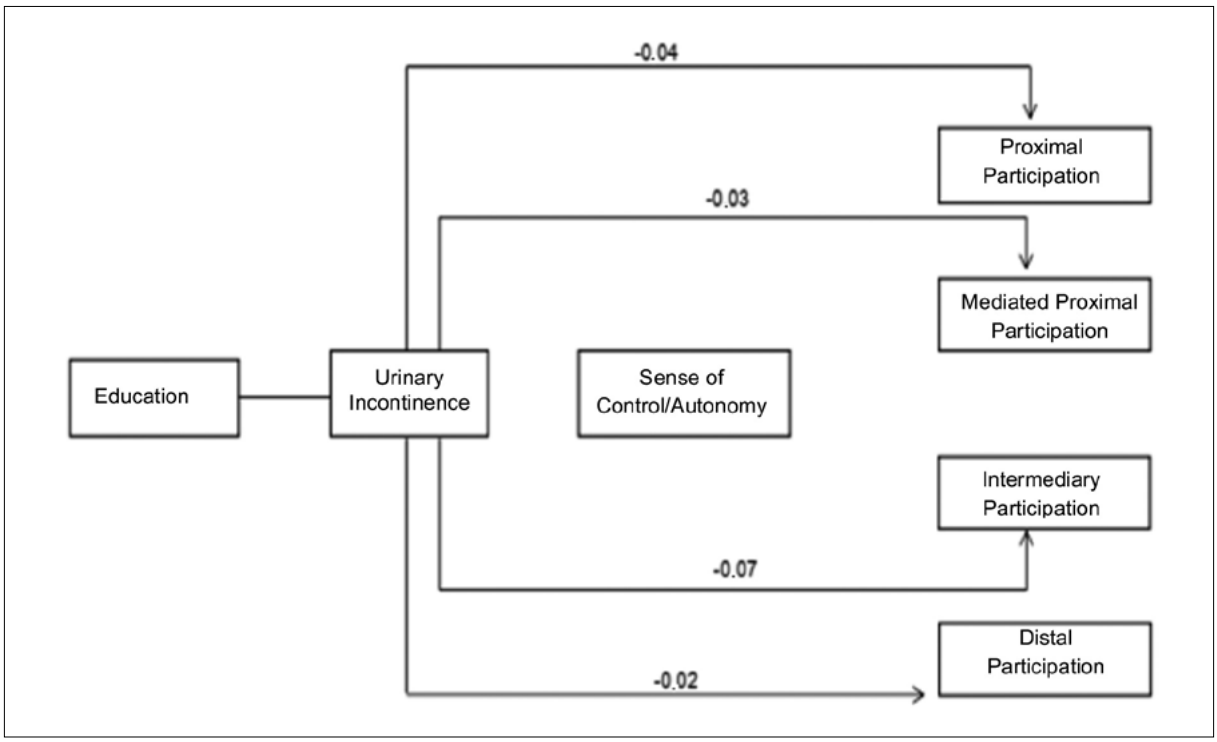

Figure 3. Diagram representing the indirect effects between the variables under study. FIBRA Study, Older adults, Campinas and Ermelino Matarazzo, SP, Brazil, 2016/2017.

DISCUSSION

With a percentage similar to that reported in review studies[1-6], UI was shown to be quite frequent among community-dwelling older adults, with evidence of repercussions on social participation.

Using a single item survey of signs and symptoms in the population, 38% of the sample reported the occurrence of involuntary loss of urine in the last 12 months. This percentage is within the range of 29.6% to 45.4% estimated by a meta-analysis study on the prevalence of UI in older adult women. There were differences in the prevalence of UI between the sexes (41% female versus 31% male). However, despite being significant, it did not present the same magnitude observed in studies that showed that UI prevalence among men is about half that among women[1-4]. Considering the sample composition regarding the variable sex, the fact that the men were older than the women may have contributed to the high prevalence of UI among men in this study.

The prevalence of UI in men tends to be higher with advancing age. In a study by Kessler et al.[34] involving Brazilian older adults, they reported that men over 75 years of age have a UI prevalence of 17.9% and an odds ratio of 4.61 (1.97-10.79) compared with men aged between 60 and 64 years old. Women aged 75 years and over had a prevalence of 33.8% and an odds ratio of 1.69 (1.26-2.27) compared with women aged 60 to 64 years old.

Other interesting characteristics of the sample were revealed by examining the correlations performed. An increase in age was associated with a reduction in participation in technology-mediated proximal activities and distal activities. These two types of participation involve activities that demand greater physical and cognitive functionality. With regard to technology-mediated activities, less inclusion, fewer cognitive resources and less developed digital skills are common among older cohorts, reducing the chances of maintaining social participation through mobile devices or personal computers[10,16]. Greater demand for attention, memory and speed in processing information can reduce involvement with technologies, even in cognitively healthy cohorts[19]. Distal activities generally involve offering and exchanging social capital, that is, knowledge, skills, socio-emotional and physical resources, greater use of time and more geographical displacements[10,11,16,23,24].

Female sex and a higher level of education were associated with continued participation in technology-mediated activities and intermediary level activities. Older adult women tend to report greater participation in activities outside the home, which involve leisure and socialization, such as those that take place at parties, clubs, churches or social centers[11,12].

Higher education level among the older adults also revealed a correlation with a greater sense of control/autonomy. Education increases access to information, opportunities and income to maintain social activities carried out outside the home or mediated by technology, as well as benefiting levels of confidence in the individual's own abilities. Control/autonomy measurements were correlated with the maintenance of social participation at all levels, corroborating the literature that argues that this is an important resource in promoting social functioning[23]. The presence of UI was correlated with a decrease in this resource and a reduction in participation in proximal and mediated proximal activities. Since this usually involves the most intimate circle of social relationships, this level of participation is highly affected by psychological factors of a motivational and emotional nature, and has been shown to decrease in cases of depression and loneliness[16,26-28].

The proposition of a model of associations between the variables under study enabled us to specify a logic of action and influence between the variables, while also revealing the influence of variables that are not correlated in analyzes of this nature.

Based on the initial hypothetical model, all variables of interest remained present in the model, with the variables age and sex showing the lowest number of associations with the remainder. Among the sociodemographic variables, education was associated with a greater number of variables. Controlled for the remaining variables, education positively affected all levels of social participation. Education was associated with a sense of control/autonomy (β=0.62) at a greater magnitude, suggesting that it is an important life course variable for maintaining this psychological resource, when facing of the challenges of old age.

Educational level is considered as one of the components of personal and social development and, as such, plays a central role in inequalities and inequities in health and quality of life[28]. In the review study by Batmani et al.[1], high education levels were relevant in reducing the incidence of UI in four studies reviewed. It is interesting to note, however, that although education was not associated with the presence of UI in the multiple relationships, in the analysis of indirect effects, the effects of education on levels of social participation were mediated by the presence of UI. These results suggest that educational inequalities in social participation can be amplified by the presence of UI[28].

In the model tested, all levels of participation were affected by UI, although the associations were of weak magnitude. This suggests the role of other variables in determining social participation. Clinical and epidemiological literature reports that UI usually manifests in the context of other chronic diseases and changes in physical and cognitive functionality[1,4].

The magnitude of the influence of UI on the sense of control/autonomy confirms its potential to act negatively on assessments individuals make concerning themselves and their competences in the exercise of personal agency[4]. Curtis, Huxhod and Windsor[23] identified robust longitudinal associations

between a sense of control and social participation in a study conducted with 114,126 middle-aged and older German adults (40-78 years old). The results supported evidence of causality for perceived sense of control in analyzes based on data collected on three occasions. According to the authors, perceived control can promote participation among older adults, since it affects their sense of confidence in their ability to achieve results, a greater propensity to choose more complex activities, greater persistence and the use of strategies to overcome challenges.

Although it revealed important associations with both phenomena, in this study, analysis of the indirect effects between the variables did not support the hypothesis of control/autonomy acting as a psychological mediator between UI and social participation. It is possible that other subjective aspects, such as self-factors for such mediation[34]. Despite this, the potential of proposing and testing association models in the study of the repercussions of UI was evident. Social participation in old age is a complex, multi-determined phenomenon. Despite this, the model explained 15% of the data variability. The paths that remained significant, together with the identification of indirect effects, suggest applications within the scope of decisions and practices of care for older adults and the promotion of active aging.

Based on the modifiable factors present in the model, social participation can be stimulated, considering contextual, life course, health and psychological factors. Strategies that aim to increase current knowledge concerning older adults and UI as a treatable and/or manageable condition and access to pharmacological and non-pharmacological strategies can have a positive impact on the assessments that older adults make concerning themselves, their own aging, and their opportunities for remaining socially active[4,35].

There is evidence of efficacy and positive clinical responses regarding the use of isolated or combined non-pharmacological strategies to manage UI in older adults[5]. These involve support in behavioral changes and hygiene routines, strengthening of the pelvic floor muscles in the context of educational guidance, the reorganization of routines, use of support devices and psychological encouragement[35]. Psychosocial strategies that involve opportunities to restructure beliefs and attitudes about the self can have repercussions on an individual's level of social participation.

Considerations should be made in view of the potential methodological limitations of the study. Although the use of path analysis specifies relationships and demonstrates advantages, its application on data collected in a cross-sectional design means we cannot make claims regarding causality. Another critical observation is that the sample was composed solely of older adults with no cognitive deficit suggestive of dementia, a condition strongly associated with UI and with important implications in understanding social participation. We recommend that future studies invest in longitudinal data and the inclusion of other relevant variables, like cognitive deficits, to increase the explanatory and predictive power of the model.

CONCLUSION

This test of an association model shows that the presence of UI contributes to restrictions in social participation. Assessments that older adults make regarding the degree to which they perceive themselves to exert control and autonomy over their life were also negatively influenced by the presence of UI. The presence of UI potentiated the disadvantageous relationships between educational level and social participation. Although associated with both phenomena, measurements of control/autonomy were not shown to be a mediating variable in the relationship between UI and social participation.

The theoretical investment in strengthening multidimensional models to explain the psychosocial repercussions of UI in older adults could produce pathways for interventions in the modifiable factors of this condition.

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Accuracy of the life-space mobility measure for discriminating frailty and sarcopenia in older people

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Abstract

Objective: To identify the profile of a sample of older people recruited at home based on a measure of life-space mobility and to establish the accuracy of the cut-off points of this instrument for discriminating between levels of frailty, frailty in walking speed and risk of sarcopenia. *Method:* An observational methodological study of 391 participants aged ≥72 (80.4±4.6) years, who answered the Life-Space Assessment (LSA) and underwent frailty and risk of sarcopenia screening using the frailty phenotype and SARC-F measures, respectively, was performed. The cut-off points for frailty and risk of sarcopenia were determined using ROC (Receiver Operating Characteristic) curves and their respective 95% confidence intervals. *Results:* Mean total LSA score was 53.6±21.8. The cut-off points with the best diagnostic accuracy for total LSA were ≤54 points for frailty in walking speed (AUC=0.645 95%; $p<0.001$) and ≤60 points for risk of sarcopenia (AUC=0.651 95%; $p<0.001$). *Conclusion:* The ability of older people to move around life-space levels, as assessed by the LSA, proved a promising tool to screen for frailty in walking speed and risk of sarcopenia, thus contributing to the prevention of adverse outcomes.

Keywords: Aging. Older people. Frailty. Sarcopenia. Mobility Limitation.

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INTRODUCTION

Mobility can be defined as intentional activity of a person moving oneself from one place to another. This movement is undertaken within the internal and external environments and for specific purposes, such as walking around the house, visiting friends and family, taking part in religious or cultural events and visiting health services[1,2]. Independence for mobility is recognized as a key marker of functioning and healthy aging[1,3]. Studies have found mobility to be associated with physical and psychological wellbeing in older people[1-3]. Moreover, social engagement of older adults is strongly associated with mobility outside the home, into the neighborhood or journeys to places within and beyond the city[2].

For research purposes, mobility within and beyond one's home has been measured in terms of life-space[4-6]. To this end, Webber et al.[6] devised a life-space framework which includes concentric areas of expanding locations from home with increasing requirements for independent mobility. These mobility zones include the room where one sleeps, the home, the outdoor area surrounding the home, the neighborhood, the service community (e.g., shops, banks, health care facilities), the town, the surrounding area (e.g., within the state and country) and the world[6]. Under this model, life-space is measured by an instrument called the Life Space Assessment (LSA)[5] which estimates the magnitude or extent of travel within environments that expand from one´s home into the wider environment beyond, regardless of how one gets there, albeit independently or by using assistive devices or transportation[5].

The LSA was validated in a random sample of 306 older adults aged 65 years and older. The test-retest reliability at 2-week follow-up was 0.96 (95% CI=0.95–0.97)[1]. The LSA has been translated into several languages (German, Chinese, Danish, Spanish, Finnish, French-Canadian, Japanese and Portuguese)[1]. The Brazilian version of the LSA has met content validity criteria in community-dwelling older adults. The instrument had a Cronbach alpha of 0.92 and intraclass correlation coefficient of 0.97 (95% CI=0.95-0.98)[7].

The life-space is a good construct and valid criterion for assessing mobility limitations[1,4,5,6]. In older adults, mobility restriction in life spaces is associated with adverse health events, such as falling, fractures, sarcopenia, cognitive decline, frailty and institutionalization and even death[1,7-12]. Conversely, the maintenance of mobility in life spaces is associated with good functional capacity and sense of autonomy, resulting in the desire to participate in social activities and in good levels of perceived quality of life[1,5,8,9,13-16]. Impaired mobility stems not only from the cumulative effect of comorbidities on physiological systems, but also from the interaction of biological, behavioral, social, economic and environmental factors[1,2,15,16].

Life-space mobility is a multidimensional concept able to identify negative health and functioning outcomes in older adults, including sarcopenia and frailty[1,12-17]. Assessing life-space mobility is straightforward and low-cost and has great potential for monitoring older individuals treated under the primary care system[1], but is a tool little used in Brazil for this purpose. Although distinct concepts, the coexistence of sarcopenia, frailty and mobility restriction is common with aging.

The objective of the present study was to identify the profile of life-space mobility in community-dwelling adults and to determine the accuracy of the cut-off points of the instrument for discriminating frailty levels, frailty in walking speed and risk of sarcopenia.

METHODS

A cross-sectional, descriptive, observational, methodological study was carried out based on data from the Fibra (Frailty in Brazilian Older Adults) study. The Fibra is a multicenter, population-based study with measurements collected during 2 waves (2008-2009 and 2016-17) at cities selected according to convenience in the 5 geographic macro regions of Brazil. In the first wave of measurements, a simple randomization of a predefined number of census sectors was performed, with sectors grouped by geographic criteria for the purposes of recruitment and data collection. At baseline, quotas of men and

women aged 65-69, 70-74, 75-79 and ≥80 years were recruited, with quotas estimated according to size of the respective segments of the general population, with the addition of a further 25% to replace possible losses.

This stage also entailed the application of eligibility and exclusion criteria at the time of recruitment, performed at households and points of flow of older adults. The eligibility criteria were: age, being a permanent resident of the city and within the census sector, comprehension of instructions, and acceptance of the invitation to take part in a study on demographic, socioeconomic, health and psychosocial factors associated with frailty in older adults. The exclusion criteria comprised: severe sensory deficits, stroke complications such as aphasia, immobility and local loss of strength, dementia, advanced-stage Parkinson´s Disease, being bedridden or constrained to a wheelchair, impaired comprehension and expression, cancer, undergoing chemotherapy treatment, and terminal illness. Data collection took place through a single session lasting 40-90 mins held at public venues on dates and times previously scheduled with the participant (see Neri et al.[18] for further details on methodology).

In 2015, the second wave of measurement collection was conducted involving the samples of Campinas city and Ermelino Matarazzo (subdistrict of São Paulo city). In the second wave, 549 (42.8%) out of the baseline sample of 1,284 participants from the first wave were recruited and reinterviewed at households. Between the two waves, a total of 192 respondents (14.9%) had died and 543 (42.3%) were considered sample losses (due to refusal, not found, exclusion, drop-out or safety risk to interviewers). Of the 549 participants reinterviewed, 130 were subsequently excluded for scoring below the education-adjusted cut-off points on the Mini-Mental State Exam (MMSE)[19-21], namely: 17 for illiterate individuals and those with no formal schooling; 22 for individuals with 1-4 years; 24 for 5-8 years, and 26 for ≥9 years of education[19,20]. Out of the 419 who scored above the MMSE cut-off, a further 28 individuals were excluded, giving a final sample for the present study of 391 older adults aged ≥72 years in 2016-2017.

The variables investigated were sociodemographics, sex (derived from yes/no responses to male/female options), age (derived by subtracting date of birth from data of follow-up interview), marital status [married or living with partner, single, divorced, widowed] and full years of education (0,1-4, 5-8 or ≥9).

Life-space mobility was measured using the LSA questionnaire[6], translated and transculturally adapted to Brazilian Portuguese[22] and submitted to psychometric studies for validity, reliability and interpretability[7]. As an indicator of internal consistency, the scale had a Cronbach alpha of 0.92, intraclass correlation coefficient of 0.97 (95% CI 0.95-0.98), and standard error of measurement of 4.12[7]. The LSA consists of questions on the 5 life-space levels frequented by the respondent, with or without assistance, in the 4 weeks leading up to the assessment: 1) other rooms of the home besides the room where they sleep; 2) an area immediately outside the home; 3) places in neighborhood; 4) places outside neighborhood; and 5) places outside town. The frequency per week is recorded (<1 time, 1-3 times, 4-6 times or daily), along with degree of independence (without assistive devices or personal assistance, and with assistive devices or personal assistance), with which each older adult frequents and uses these spaces.

Overall score on the scale ranges from 0-120 points and is calculated by tallying the scores for each life-space level. Higher overall score indicates greater life-space mobility[6]. Simões et al.[7] analyzed the validity, reliability and interpretability of the LSA for Brazilian community-dwelling adults. The LSA met the criteria for content validity.

Frailty was assessed based on the phenotype model, operationalized by Fried[23], involving 5 components: 1) Unintentional weight loss in the 12 months prior to interview of 4.5kg or 5% of body weight[23]; 2) Fatigue/exhaustion as indicated by always and almost always responses to either of 2 items on strength and vitality for carrying out activities of daily living (ADLs), in the past 7 days[23,24]; 3) Low hand-grip strength measured by hand-held dynamometer[23], as defined as a force value below the 1st quintile of the distribution of

means of the sample for 3 consecutive attempts, adjusted by sex and body mass index - BMI (men: BMI ≤23kg/m^2, cut-off: ≤24.67kgf; BMI>23kg and <28kg/m^2, cut-off: ≤23.33kgf; BMI≥28 and <30kg/m^2, cut-off: ≤45.90kgf; BMI≥30kg/m^2, cut-off: ≤21,33kgf. Women: BMI≤23kg/m^2, cut-off: ≤10.67kgf; BMI>23kg and <28kg/m^2, cut-off: ≤13.33kgf; BMI≥28 and <30kg/m^2, cut-off: ≤13.67kgf; and BMI≥30kg/m^2, cut-off: ≤13.33kgf); 4) Slow walking speed as indicated by mean time in seconds, for 3 attempts, taken to walk 4.6m in a straight line with usual gait, yielding values above the 80th percentile of the distribution, adjusted for height and weight (men: height ≤166cm, cut-off: ≥7.60; height >166cm, cut-off:≥7.10. Women: height ≤152cm, cut-off:≥8.54; height>152cm, cut-off:≥8.62)[25]; and 5) Low physical activity level indicated by weekly energy expenditure in METs (Metabolic Equivalent of Task) adjusted for gender, spent on moderate or vigorous intensity physical exercise in leisure or active sports situations, as per responses on selected items from the Minnesota Leisure Time Activities Questionnaire[25]. Individuals scoring within the lowest 20% of values for the distribution were classified as frail.

Risk of sarcopenia was screened using the 5-item SARC-F[26,] questionnaire validated for the Brazilian population[26]. In 4 of the items, participants were probed whether they experienced difficulty performing the following activities: 1) lifting and carrying 5kg; 2) walking across a room; 3) rising from a chair or bed; and 4) climbing a flight of 10 stairs. Each item response was scored on a 3-level scale: 0= none; 1= some; and 2= a lot or unable without assistance. The fifth item asks how many times the respondent has fallen in the past year[25]. Total score on the SARC-F ranges from 0 to 10 points, with 0-4 points indicating absence of signs suggesting risk of sarcopenia, while 5-10 points suggests presence of risk of sarcopenia[27].

This study is part of the follow-up study of the Campinas and Ermelino Matarazzo cohorts of the Fibra Study: predictors and outcomes of frailty in older adults in Brazil. The present investigation complied with Resolution nos. 466/2012 and 510/2016 and was approved by CEP UNICAMP permit nos. 1.332.651 of 23/1/2015 and by CEP Unicamp permit no 2.847.829, of 27/08/2018. All participants were informed about the study goals and procedures and regarding their rights and obligations, and signed the Free and Informed Consent Form.

The sample profile was described by building frequency tables containing the categorical variables, expressed as absolute frequency (n) and percentage (%), and descriptive statistics for numeric variables. Cronbach's alpha coefficient was employed to analyze internal consistency. Alpha values ≥0.70 were taken to indicate high consistency. The Mann-Whitney test was used to compare numeric variables between the two groups, whereas the Kruskal-Wallis test was used for comparison of three or more groups, given the absence of normal distribution of variables. Spearman´s correlation coefficient was employed to determine correlation of the variables frailty, frailty in walking and risk of sarcopenia with LSA score. The level of significance adopted for the statistical tests was 5% ($p<0.05$).

Receiver Operating Characteristic (ROC) curves were plotted to identify the optimal cut-off point for the LSA as best predictors of frailty and risk of sarcopenia, maximizing the sensitivity and specificity of these measures. The area under the curve, and respective 95% CI, were also determined for this measure.

RESULTS

Of the total sample (n=391), 273 (69.8%) participants were female and mean age was 84.3 (±4.6) years. Regarding marital status of participants, 181 (46.6%) were widowed and 117 (45.6%) married or living with a partner. For education, 231 respondents (59.0%) had 1-4 years of education. In terms of frailty status, 248 participants (63.4%) were classified as pre-frail and 64 (16.3%) as frail. Of the sample, 76 (20.0%) scored for frailty in walking. Regarding sarcopenia, 296 (76.6%) had no signs suggesting risk of sarcopenia (Table 1).

Table 1. Characteristics of sample (N=391) for sociodemographic data, frailty, and sarcopenia risk. FIBRA study, participants from Campinas and Ermelino Matarazzo, São Paulo state, Brazil, 2016-2017.

Variables	n (%)
Sex	
Female	273 (69.8)
Male	118 (30.1)
Age (years)	
72-79	161 (41.1)
≥ 80	230 (58.8)
Marital status	
Married or living with partner	117 (45.6)
Single	18 (4.6)
Divorced	12 (3.0)
Widow(er)	181 (46.6)
Educational level (years)	
0	55 (14.0)
1-4	231 (59.0)
5-8	61 (15.6)
≥ 9	44 (11.2)
Frailty level	
Non-frail	79 (20.2)
Pre-frail	248 (63.4)
Frail	64 (16.3)
Sarcopenia risk*	
Absence of signs suggesting sarcopenia risk	296 (76.6)
Presence of signs suggesting sarcopenia risk	90 (23.3)

*Frequency missing = 05.

The LSA showed moderate internal consistency, with a Cronbach alpha coefficient of 0.613. Mean total score was 53.6±21.8 points and median 52.5 points. With regard to mobility of participants at each LSA level, 385 (98.7%) reported frequenting level 1 daily. As the life-space extended, there was a reduction in mobility reported within the environments each participant used and in the frequency of access. At level 4 for instance, 142 (44.7%) reported accessing this space less than once a week, while 201 (53.3%) did not access level 5 at all. In terms of independence in life spaces, 352 (90.5%) were independent for level 1 and 138 (75.8%) for level 5. However, an increased need of personal assistance for life-space mobility was evident from level 4 and above (Table 2).

Regarding the relationship between total LSA scores and sociodemographic variables, frailty, frailty in walking speed and risk of sarcopenia, participants who scored for frailty, frailty in walking or attained >4 points on the SARC-F had lower total scores on the LSA (Table 3).

There was no significant correlation between the variable age and total LSA score. Conversely, the variables frailty, frailty in walking speed and risk of sarcopenia correlated significantly with total LSA score (Table 4).

Using ROC curves, the optimal cut-off scores on the LSA for predicting frailty levels (non-frail, pre-frail and frail), frailty in walking speed and risk of sarcopenia were determined. Areas under the curve (AUC) were significant for frailty in walking speed and for risk of sarcopenia at total LSA scores of ≤54 and ≤60 points, respectively (Figure 1).

Table 2. Description of LSA (Life Space Assessment) according to the 5 life-space levels accessed by participants, with or without assistance, in the 4 weeks leading up to assessment. FIBRA study, participants from Campinas and Ermelino Matarazzo, São Paulo state, Brazil, 2016-2017.

Life-space level	n	Weekly frequency	n (%)	Independence	n (%)
Level 1	390	< 1 time	2 (0.5)	personal assistance	7(1.8)
		4-6 times	3 (0.7)	devices	30 (7.7)
		daily	385 (98.7)	none	352 (90.4)
Level 2	389	< 1 time	3 (0.7)	personal assistance	11 (2.8)
		1-3 times	14 (3.6)	devices	34 (8.7)
		4-6 times	11 (2.8)	none	343 (88.4)
		daily	359 (92.7)		
Level 3	341	< 1 time	53 (15.5)	personal assistance	22 (6.3)
		1-3 times	96 (28.0)	devices	31 (8.9)
		4-6 times	33 (9.6)	none	292 (84.6)
		daily	160 (46.7)		
Level 4	317	< 1 time	142 (44.7)	personal assistance	45 (14.0)
		1-3 times	104 (32.8)	devices	19 (5.9)
		4-6 times	17 (5.3)	none	256 (80.0)
		daily	54 (17.0)		
Level 5	176	< 1 time	164 (91.6)	personal assistance	36 (19.7)
		1-3 times	8 (4.4)	devices	8 (4.4)
		daily	7 (3.9)	none	138 (75.8)

Level 1- other rooms of the home besides the room where participant sleeps; Level 2- an area immediately outside the home area, e.g. porch, patio, garage, or hallway of an apartment; Level 3- places in neighborhood, beyond own property or building; Level 4- places outside neighborhood, but within the town; and Level 5- places outside town.

Table 3. Comparative analysis of total scores on LSA, according to sociodemographic variables, frailty, frailty in walking speed, and risk of sarcopenia. FIBRA study, participants from Campinas and Ermelino Matarazzo, São Paulo state, Brazil, 2016-2017.

Variables	Total score on LSA	*p-valor*
Sex		p=0.139*
Female (n=273)	56	
Male (n=118)	52	
Age		p= 0.749*
72-79 years (n=161)	52	
≥ 80 years (n=230)	54	
Education		p=0.228**
0 years (n=55)	45	
1-4 years (n=231)	54	
5-8 years (n= 61)	52	
≥ 9 years (n=44)	55	
Frailty		**p= 0.001****
Non-frail (n=79)	62	
Pre-frail (n=248)	52	
Frail (n=64)	38.5	

to be continued

Continuation of Table 3

Variables	Total score on LSA	*p-valor*
Frailty in walking speed		***p*<0.001***
Yes (n=76)	35.2	
No (n=306)	56	
Risk of sarcopenia		***p*<0.001***
Presence of signs suggesting risk of sarcopenia (n=90)	39	
Absence of signs suggesting risk of sarcopenia (n=296)	56	

Total score on LSA ranges from 0 to 120 points. Higher overall score indicates greater life-space mobility. *p*-value of Mann-Whitney test for comparison of variables between 2 groups; **p-value of Kruskal-Wallis test for comparison of variables among 3 or more groups.

Table 4. Correlation of LSA with age, frailty criteria score, walking speed and risk of sarcopenia assessments. FIBRA study, participants from Campinas and Ermelino Matarazzo, São Paulo state, Brazil, 2016-2017.

LSA scores	Age	Frailty	Frailty in walking speed	Sarcopenia risk
Total	*r*= -0.0628	*r*= -0.3389	*r*= -0.4440	*r*= -0.4205
	p= 0.2234	***p*=<0.0001**	***p*<0.0001**	***p*<0.0001**

r= Spearman's correlation coefficient.

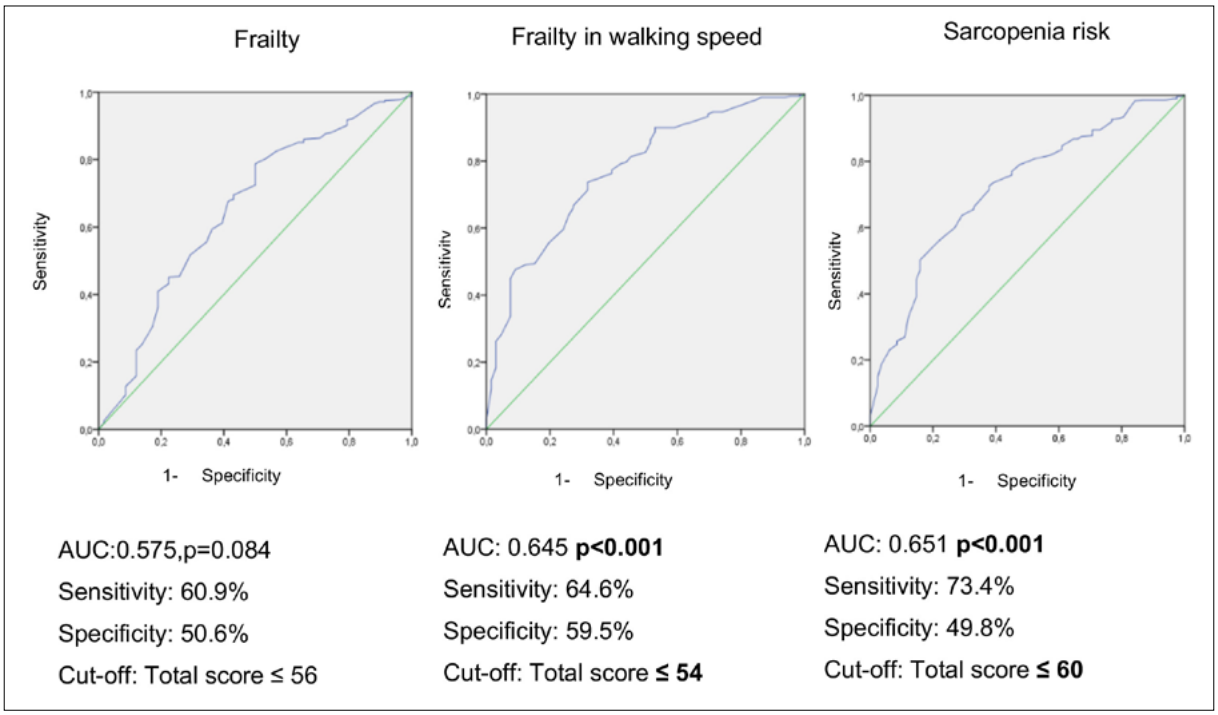

Figure 1. ROC curve demonstrating sensitivity and specificity of optimal cut-off points for total LSA score as predictors of frailty in walking and risk of sarcopenia. FIBRA study, participants from Campinas and Ermelino Matarazzo, São Paulo state, Brazil, 2016-2017.

DISCUSSION

This study found that LSA scores were correlated with scores for frailty in walking speed and risk of sarcopenia. The optimal cut-offs of total LSA score for best diagnostic accuracy were ≤54 for frailty in walking speed and ≤60 points for risk of sarcopenia.

The maintenance of mobility is believed to be fundamental to healthy active aging[1,3]. Conversely, loss of mobility can adversely affect physical and mental health, limiting social participation in the community and negatively impacting quality of life[1,3,8,9,11-16]. The study of Rantakokko et al.[9] investigating changes in life-space mobility and quality of life among community-dwelling older people found a mean LSA score of 63.9 in their sample with a mean age of 80,6 years.

By comparison, overall score on the LSA averaged 53.6 for the present study sample with a mean age of 84.3 years. No national studies of individuals aged 80 or older are currently available. However, a study of older adults from the Brazilian city of Natal city (n=150)[22] reported a mean LSA score of 59.6 in a sample with a mean age of 69.6 years. In the study by Simões et al.[7] exploring the properties of the LSA measure in Brazilian community-dwelling Brazilian adults with a mean age of 70 years, found a mean LSA score of 52.8 points[7].

According to Tsai et al.[28], scores above 60 have been considered to indicate impaired space-life mobility, suggesting the individual is no longer able to travel beyond their surrounding area, where this restriction correlates with low levels of social participation and increased risk for mortality.

Cross-sectional studies analyzing sociodemographic variables and LSA scores have shown advanced age[5,29,30], female gender[5,29-31], lower socioeconomic level[29,30,32] to be associated with reduced LSA scores. According to Webber et al.[6] and Choi et al.[8], impaired mobility has been shown to be an early predictor of physical disability and restriction in functional performance. In the present study, as life-space expanded, a growing proportion of participants required more personal help to travel in spaces associated with greater physical and cognitive demand (6.3% at level 3, 14.0% level 4 and 19.5% for level 5). Commensurately, the number of times a week that each life-space level was accessed fell with increasing distance and demands. From level 3 and above, there was a steady decline in the weekly frequency of movement.

According to studies by Rantakokko et al.[9,31], the most common restrictions in participation of older people involve environmental barriers. Increased social and emotional support and sense of security to go outside the home and travel to places outside the immediate neighborhood, as well as inside and outside town, can contribute to functioning and activities of older adults[9,31].

In clinical practice, particularly primary health, measures that are straight-forward, rapid, low-cost and offering good predictive power are needed to screen for mobility restriction[33].

LSA scores were negatively correlated with frailty, frailty in walking speed and risk of sarcopenia, where higher scores on the scale were associated with fewer frailty criteria, faster walking time and lower sarcopenia screening score. The optimal cut-offs of total LSA score for best diagnostic accuracy were ≤54 for frailty in walking speed and ≤60 points for risk of sarcopenia. Portegijs et al.[12] identified older adults with risk of reduced mobility in activities of daily living using the LSA. The study found a cut-off of 52.3 for a mean age of 80.4 years, 86% sensitivity and 74% specificity. In the present study, the results of analysis of the ROC curve analysis and of diagnostic accuracy measurements revealed ideal cut-offs for total LSA score of ≤54 as a predictor of frailty in walking speed (64.6% sensitivity and 59.5% specificity) and of ≤60 as a predictor of risk of sarcopenia (73.4% sensitivity and 49.8% specificity).

Ullrich et al[34]. estimated the cut-off for the LSA in 118 older persons with cognitive impairment and comorbidities. The authors found the ideal cut-off on the LSA to differentiate between individuals with reduced life-space (confined to home) and extended life-space (out of home and active) was <26.75 (range 0-90 points), with sensitivity of 78% and specificity 84%, and moderately accurate diagnostic validity of 0.8.

The present study sample had singular characteristics, calling for caution in generalization of results[16]. The participants were older survivors of a previous study investigating the frailty profile in older Brazilian adults. It is possible that the more robust participants with better health status survived, a factor which may have affected the results. In general, older participants in the FIBRA study have demonstrated better health status compared to those of other studies[16,18]. Approximately 63% of participants were classified as pre-frail and 76% exhibited no signs of risk of sarcopenia. The study participants were survivors of a baseline sample assessed in 2008-2009 which originally had a robust, pro-active profile[18].

Because collection for this study was carried out at households, it was not possible to fully follow the Find cases-Assess-Confirm-Severity (F - A - C - S) path as recommended by the European Working Group on Sarcopenia in Older People (EWGSOP) consensus[35]. Risk of sarcopenia was screened using the SARC-F alone, corresponding to the Find cases step. The subsequent steps, comprising the assessment and confirmation of sarcopenia using the handgrip strength measure, and detection of low muscle mass and quality using imaging techniques, such as Dual-energy X-ray absorptiometry (DEXA), could not be performed[35].

Strengths of the study include its novel contribution in Brazil regarding screening frailty and risk of sarcopenia using the life-space mobility assessment (LSA) scale. Given its low-cost and ease-of-use, the tool holds promise for use in clinical and primary health settings. Further studies investigating the utility and impact of life-space mobility in monitoring older adults treated in primary care are warranted.

CONCLUSION

The ability of older adults to move through different levels of life space, as measured by the Life Space Assessment (LSA) scale, proved a useful tool to help screen for frailty in walking speed and risk of sarcopenia in the older population. The use of the LSA in different lines of gerontological health care, together with accurate cut-offs, can help health professionals employ preventive approaches to slow functional decline and maintain social participation.

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Follow-up evaluation of the Fibra Study: sociodemographic, cognitive, and frailty characterization of older adults in Campinas and Ermelino Matarazzo, SP

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Abstract

Objective: To investigate and compare the sociodemographic, cognitive and frailty profile of participants from the Frailty in Brazilian Older Adults (Fibra) study regarding follow-up (FW) and baseline (BL) measurements carried out in 2016-2017 and 2008-2009, respectively. *Methods:* A total of 1,284 older adults living in Campinas and Ermelino Matarazzo (SP), Brazil, participated in the BL, comprising a pooled sample. At FW, 549 older adults (42.7%) were interviewed again; 192 had died (14.9%) and 543 were lost to follow-up (42.4%). Sex, age, education, marital status, family income, housing arrangement, cognitive status (Mini-Mental State Examination) and frailty phenotype (score ≥3 out of 5) were evaluated at both timepoints. Intergroup and intragroup differences were verified by Pearson's chi-square and McNemar's tests. Statistical significant level was set at $p<0.05$. *Results:* The survivors were younger (72.2±5.3 years) than the deceased (75.5±6.8 years) and individuals included in the FW were mostly married, higher educated, cognitively unimpaired and pre-frail. Between BL and FW there was an increase in the number of participants who lived alone (17.1% vs. 22.0%), had no partner (46.4% vs. 55.4%), a family income <3 minimum wages (52.2% vs. 62.2%), cognitive impairment (17.7% vs. 23.5%) and frailty (9.8% vs. 24.5%). *Conclusion:* Between BL and FW there was an increase in the physical, cognitive and social vulnerability of the older adults. These results reinforce the importance of public policies that favor the quality of life of older people and a reduction in health inequities throughout life.

Keywords: Aged. Aged, 80 and Over. Frailty. Mental Status and Dementia Tests. Phenotype. Longitudinal Studies.

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INTRODUCTION

Frailty is a complex clinical condition associated with aging that is characterized by a decline in functional reserve of different bodily systems and by greater individual susceptibility to negative outcomes in response to internal, environmental, and life-style event stressors[1]. A body of evidence gathered over the last few decades supports the association between frailty and increased risk of physical limitations, disabilities, falls, hospitalization, institutionalization, and death in older people[2,3]. The prevalence of frailty increases with advancing age[4,5] and is influenced by sex[5], assessment methods[5,6] and participant origin[6]. Meta-analysis studies estimate that the prevalence of frailty among non-institutionalized older adults is higher in low-to-middle income countries than in high-income nations[5,6].

In Brazil, the prevalence of frailty in older adults is estimated at 24%[6] and varies according to the assessment methodology used and recruitment site of participants[4,6]. Additionally, an estimated 53% of Brazilian adults are pre-frail[6], a statistic which reinforces the importance of preventive strategies, given there is a greater chance of pre-frailty being reversed compared to frailty[7]. According to data from The Brazilian Longitudinal Study of Aging (ELSI-Brasil), frailty is associated with advanced age, low education, single status, poor/very poor self-rated health, multimorbidity and limitations for performing activities of daily living[4]. Publications derived from the first wave of the Frailty in Brazilian Older Adults Study (Fibra Study; 2008-2009) showed that frailty was associated with multimorbidity, polypharmacy, cognitive impairment suggestive of dementia, depressive symptoms, dependence for activities of daily living, falls, hospitalization and mortality[8-10].

Akin to frailty, a decline and deficit in cognitive functions are conditions which directly impact the health of older people, increase the risk of disabilities and dependence, impair quality of life and contribute to other adverse outcomes[11]. Cognitive decline is a gradual ongoing and highly variable process, characterized by normal and abnormal changes in information processing speed, thinking, memory, reasoning and planning. Differences in the timing of onset, speed of progression and trajectories of age-related cognitive decline can be explained by the interaction of individual, environmental and lifestyle factors[12,13].

The marked disparities between Brazil and high-income countries[1,13-15] in terms of the social determinants of health that can influence the establishment and progression of cognitive decline and frailty, underscores the importance of conducting longitudinal studies to better understand the factors which worsen these conditions in older adults. Longitudinal studies can yield valuable information for the development of public policies aimed at identifying older adults at risk of developing frailty, and to help manage their symptoms in primary healthcare services for adults and older adults.

Therefore, the objective of the present study was to investigate the sociodemographic, cognitive and frailty profile of the participants of the Fibra Study from Campinas city, São Paulo state and from Ermelino Matarazzo, a subdistrict of São Paulo city, based on follow-up measurements made in 2016-2017 compared with baseline values collected in 2008-2009.

METHOD

The Fibra Study is a multi-center, multi-discipline, population-based study carried out in 17 Brazilian cities located in five major geographical regions of the country chosen by convenience. In 2008 and 2009, four large Brazilian public universities oversaw the process of recruitment and data collection for the study which had both a protocol common to the sites and protocols specific to each. The objective was to investigate associations between frailty and demographic, socioeconomic, health and psychosocial variables in Brazilian older adults aged ≥65 years. The city of Campinas and Ermelino Matarazzo (subdistrict of São Paulo city), both in São Paulo state, Brazil, were part of the group of sites belonging to the center coordinated by the State University of Campinas (Unicamp, São Paulo state).

At the Unicamp center, a total of 1,284 community-dwelling older adults (≥65 years) took part in the first wave of measurements of the Fibra Study. The

participants resided in family households located in randomly selected census sectors in Campinas and the Ermelino Matarazzo subdistrict. Households and points of flow of older adults from randomly selected areas of Campinas (90 census sectors) and Ermelino Matarazzo (62 census sectors) were visited by pairs of trained recruiters (Graduate students and Community Health Workers). The older adults identified who met the eligibility criteria were invited by the recruiters to attend a session entailing an interview and health measurements, lasting 60-90 mins, held at community centers, schools, clubs and churches on pre-defined dates and times. Additional quotas of 25% of the estimated samples for the two sites were invited as a strategy to cover any losses.

Eligibility criteria were being aged ≥65 years and having permanent residence in the city and household. Individuals presenting with memory problems suggesting dementia, severe complications of stroke, severe or unstable Parkinson´s disease, or visual/hearing deficits, were not included in the sample. Individuals who were bedridden, in a terminal state, had cancer or were undergoing chemotherapy treatment, were also excluded (details available in previous publication[16]).

Data collection was split into two blocks: in the first block, involving 1,284 participants, data for identification, sociodemographic, anthropometric and clinical (oral health and blood pressure) variables were collected, along with frailty and cognitive status. In the second part, which included only respondents who scored above the cut-off score on the cognitive screening test (Mini-Mental State Exam – MMSE) applied at the end of the first phase (n=991), comprised the variables self-reported physical and mental health, functional capacity, psychosocial aspects and stressful life events. The cut-off scores on the MMSE were 17 for illiterate individuals and those who had never attended school, 22 for individuals with 1-3 years of education, 24 for 5-8 years, and 26 for ≥9 years of formal schooling[17].

In 2016 and 2017, an average of nine years after the first wave of measurement collection or baseline, the second, follow-up wave was carried out. Recruitment of the participants was done at households based on addresses registered on the database at baseline. A total of three attempts were made to contact each participant. The individuals located were invited to take part in a follow-up assessment from Fibra 2008-2009 via a single session lasting around 80 mins conducted by previously trained researchers (graduate and undergraduate students). The same eligibility and exclusion criteria used in the previous wave were applied. In the event of difficulties answering items on health and functioning, the presence of another family member or proxy was requested to mediate the interaction between the interviewer and the respondent. For respondents who scored below the cut-off on the MMSE, the interview was performed with a family member or other proxy.

The following variables were selected for study: sex (options male or female); age (derived from question on date of birth); living alone (single question with yes/no answer); marital status (with alternatives spouse/partner, single, divorced or widowed); literate (yes or no); education with options never attended school, 1-4 years, 5-8 years, and ≥9 years of formal study); head of household (yes or no) and family income (<1.0, 1.1-3.0, 3.1-5.0 or >5.1 minimum wages).

The presence of cognitive deficit suggestive of dementia was reassessed using the MMSE, with cut-off scores adjusted for years of education, as established in a population-based study of Brazilian older adults[17].

Frailty was assessed based on the phenotype model, operationalized by Fried et al.[18], involving five components: unintentional weight loss in the 12 months prior to interview of 4.5kg or 5% of body weight; exhaustion/fatigue as indicated by always and almost always responses to the scaled items on fatigue taken from the Center for Epidemiologic Studies Depression (CES-D) scale; low hand-grip strength defined as a value in kg force below the 1st quintile of the distribution of means of the sample as measured by three consecutive attempts using a hand-held dynamometer (model Jamar) adjusted by sex and body mass index (BMI); slow walking speed as indicated by mean time in seconds taken to walk 4.6m in a straight line with usual gait, with values above the 80th percentile of the distribution for the sample, adjusted for sex and weight; and

low physical activity indicated by weekly energy expenditure below the value of the 1st quintile of the distribution of metabolic units spent by the individual over the past week in the cumulative performance of domestic chores and mild, moderate or vigorous intensity physical exercise, as per responses on selected items from the Minnesota Leisure Time Activities Questionnaire[19]. Individuals whose calculation of metabolic equivalents (METs) was below the 1st quintile for the sample, adjusted for gender, were classified as having low physical activity. The procedures, criteria and cut-off scores and adjustment variables adopted were those described by Fried et al.[18]

For participants who scored below the cut-off on the MMSE, frailty phenotype was determined using a validated scale[20] based on the model of Fried et al.[18], containing 6 items answered by proxies. Participants who scored for one or two criteria were classified as pre-frail; those scoring for ≥ three as frail, and those scoring on zero as non-frail or robust.

This study complied with the ethical principles provided for under National Board of Health Resolution no. 466/2012. All participants signed the Free and Informed Consent Form at both baseline and follow-up. The 2008-2009 study project was approved by the Research Ethics Committee of the States University of Campinas under permit nos. 208/2007 and 907.575, while the follow-up project was approved under permits no.1.332.651 and no. 2.952.507.

The relative frequencies of sociodemographic variables, cognitive status, and frailty status were calculated and are expressed according to participant status at baseline and follow-up (reinterviewed, deceased or lost to follow-up). The statistical significance of differences between quantities of participants found in the intergroup analyses was analyzed using Pearson´s chi-square test, where differences in results at baseline versus follow-up were assessed using McNemar´s test. The same sociodemographic variables of interest in the study were explored in both analyses. The level of significance adopted for both statistical tests was $p<0.05$.

RESULTS

The number of participants at baseline according to their distribution in the follow-up subsamples is given in Table 1. There was a similar percentage of participants from baseline in the three follow-up subsamples (reinterviewed, deceased, lost), but the Campinas site located and reinterviewed a greater number of individuals, had fewer respondents categorized as deceased and lower sample losses compared to the Ermelino Matarazzo site. Regarding the total sample, 549 participants (42.7%) were reinterviewed at follow-up, 192 (14.9%) had deceased since baseline, and 543 (42.4%) were deemed sample losses for different reasons (Table 1).

The main reason for sample loss was failure to locate the addresses or participants. Ermelino Matarazzo had the highest number of participants not found for lack of information on current address or due to errors in the address records retrieved from the baseline date. The proportion of baseline participants not included in follow-up, having been excluded by the study exclusion criteria (due to data collection session unconcluded or interviewers feeling unsafe at residence) proved similar for the two study sites (Table 2). The breakdown of these losses was: 57,9% not found at address; 34.5% refusal to participate; 5.5% dropout or withdrawal before end of interview; 1.6% met exclusion criteria; and 0.5% were not interviewed because interviewers deemed the area in the vicinity of the household unsafe (Table 2).

Table 1. Distribution of participants from baseline in follow-up subsamples. Fibra Study, Brazil. Older Adults, 2008-2009 and 2016-2017.

Subsamples	Campinas	Ermelino Matarazzo	Total
	n (%)	n (%)	N (%)
Reinterviewed	394 (43.8)	155 (40.3)	549 (42.7)
Deceased	129 (14.3)	63 (16.4)	192 (14.9)
Losses	377 (41.9)	166 (43.3)	543 (42.4)
Total	900 (100.0)	384 (100.00)	1284 (100.0)

Table 2. Frequency of sample losses according to reason for non-inclusion of baseline participants in follow-up sample. Fibra Study, Brazil. Older Adults, 2008-2009 and 2016-2017.

Subsamples	Campinas	Ermelino Matarazzo	Total Losses
	n (%)	n (%)	n (%)
Refusal	120 (31.8)	67 (40.4)	187 (34.5)
Not found	227 (60.2)	87 (52.4)	314 (57.9)
Exclusion criteria	20 (5.3)	10 (6.0)	30 (5.5)
Interruption/dropout	7 (1.8)	2 (1.2)	9 (1.6)
Risk to interviewers	3 (0.9)	0 (0.0)	3 (0.5)
Total	377 (100.0)	166 (100.0)	543 (100.0)

The baseline sample comprised predominantly individuals who were female (68.7%), aged 70-79 years (51.2%; M_{age} =72.6±5.8 years), lived alone (83.8%), and had a spouse or partner (50.9%). Most of the participants reported they were literate (78.1%) and had 1-4 years of education (56.4%); 43.9% had a monthly family income of 1.1-3.0 minimum wages and 58.2% reported being the breadwinner. Cognitive deficit and frailty were present in 22.8% and 11.6% of participants interviewed at baseline, with higher rates among deceased than those lost to follow-up. Statistically significant differences in age, literacy, education, cognitive performance and frailty level were evident between reinterviewed and deceased subsamples: the number of deceased individuals was proportionally greater among those who were male, aged ≥80 years, illiterate or never attended school, cognitively impaired and frail (Table 3).

With regard to frequency of deceased and losses, there were statistically significant differences for the variables sex, age, living arrangement, literacy, education and cognitive deficit. In the individuals lost to follow-up, the percentage of deceased was higher in the those who were male, aged ≥80 years, not living alone, illiterate or had never frequented school, and cognitively impaired. Comparison of the reinterviewed and lost to follow-up subsamples showed that only the variables living alone (14.8% of reinterviewed vs. 19.4% of losses) and cognitive deficit (17.7% of reinterviewed vs. 25.4% of losses) differed statistically (Table 3).

Between baseline and follow-up, there was a statistically significant increase in the percentage of respondents who lived alone (17.1% to 22.0%), had no partner (46.4% to 55.4%), a family income of ≤ three minimum wages (52.2% to 62,2%), cognitive deficit (17.7% to 23.5%) and frailty (9.8% to 24.5%). Conversely, there was a decrease in the number of respondents considered robust after the nine-year follow-up (from 33.6% to 18.6%) (Table 4).

Table 3. Comparison of percentage of participants at baseline and follow-up for sociodemographic variables, cognitive status, and frailty**.** Fibra Study, Brazil. Older Adults, 2008-2009 and 2016-2017.

	Baseline	Follow-up			
	Total N=1284	Reinterviewed n=549	Deceased n=192	Losses n=543	*p**
Variable	n (%)	n (%)	n (%)	n (%)	
Sex					
Male	402 (31.3)	165 (30.0)	77 (40.1)	160 (29.5)	0.017
Female	882 (68.7)	394 (70.0)	115 (59.9)	383 (70.5)	
Age					
65-69 years	455 (35.4)	195 (35.5)	46 (24.0)	214 (39.4)	<0.001
70-79 years	657 (51.2)	301 (54.8)	94 (48.9)	262 (48.3)	
≥80 years	172 (13.4)	53 (9.7)	52 (27.1)	67 (12.3)	
Living alone					
Yes	207 (16.2)	81 (14.8)	21 (11.0)	105 (19.4)	0.013
No	1073 (83.8)	467 (85.2)	170 (89.0)	436 (80.6)	
Marital status					
With partner	651 (50.9)	292 (53.4)	89 (46.6)	270 (49.8)	0.255
Single	85 (6.6)	33 (6.0)	13 (6.8)	39 (7.2)	
Divorced	93 (7.3)	31 (5.7)	13 (6.8)	49 (9.0)	
Widow(er)	451 (35.2)	191 (34.9)	76 (39.8)	184 (34.0)	
Literate					
Yes	997 (78.1)	444 (81.2)	128 (67.4)	425 (78.7)	<0.001
No	280 (21.9)	103 (18.8)	62 (32.6)	115 (21.3)	
Education (years)					
Never attended school	233 (18.2)	88 (16.0)	52 (27.1)	93 (17.2)	<0.001
1-4	723 (56.4)	325 (59.3)	105 (54.7)	293 (54.2)	
5-8	175 (13.7)	76 (13.9)	27 (14.0)	72 (13.3)	
≥9	150 (11.7)	59 (10.8)	8 (4.2)	83 (15.3)	
Head of household					
Yes	745 (58.2)	311 (57.0)	113 (58.9)	321 (59.2)	0.736
No	535 (41.8)	235 (43.0)	79 (41.1)	221 (40.8)	
Family Income (MW**)					
0-1	102 (9.2)	54 (9.9)	21 (11.1)	43 (7.9)	0.126
1.1-3.0	484 (43.9)	227 (41.3)	93 (48.4)	245 (45.1)	
3.1-5.0	282 (25.6)	146 (26.6)	53 (27.4)	130 (23.9)	
> 5.1	235 (21.3)	122 (22.2)	25 (13.1)	125 (23.1)	
Cognitive deficit					
Yes	292 (22.8)	97 (17.7)	57 (29.7)	138 (25.4)	<0.001
No	991 (77.2)	451 (82.3)	135 (70.3)	405 (74.6)	
Frailty					
Non-frail	386 (30.1)	184 (33.5)	39 (20.3)	163 (30.0)	0.002
Pre-frail	749 (58.3)	310 (56.5)	119 (62.0)	320 (58.9)	
Frail	149 (11.6)	55 (10.0)	34 (17.7)	60 (11.1)	

*statistically significant differences when p-value < 0.05; *P*earson´s chi-squared test; **MW: Number of minimum wages at time of registering data.

Table 4. Sociodemographic variables, cognitive deficit and frailty at baseline and follow-up. Fibra Study, Brazil. Older Adults, 2008-2009 and 2016-2017.

Variables	Baseline n (%)	Follow-up n (%)	*p**
Living alone			
Yes	74 (17.1)	95 (22.0)	0.018
No	358 (82.9)	337 (78.0)	
Marital status			
With partner	291 (53.6)	242 (44.6)	<0.001
Without partner	252 (46.4)	301 (55.4)	
Literate			
Yes	438 (81.3)	434 (80.5)	0.720
No	101 (18.7)	105 (19.5)	
Head of household			
Yes	303 (57.3)	299 (56.5)	0.815
No	226 (42.7)	230 (43.5)	
Family Income (MW**)			
1-3	224 (52.2)	267 (62.2)	<0.001
>3.0	205 (47.8)	162 (37.8)	
Cognitive deficit			
Yes	97 (17.7)	129 (23.5)	0.007
No	451 (82.3)	419 (76.5)	
Frailty			
Non-frail	184 (33.6)	102 (18.6)	<0.001
Pre-frail	310 (56.6)	312 (56.9)	
Frail	54 (9.8)	134 (24.5)	

*McNemar Test; **MW: Number of minimum wages at time of data collection.

DISCUSSION

The present cohort study analyzed the profile of variables at baseline (2008-2009) versus follow-up (2016-2017) in a sample of urban older adults recruited at households aged ≥65 years at baseline and ≥74 years at follow-up. Regarding attrition between waves, a total of 42.7% of participants were located and reinterviewed nine years after baseline measurements. This rate is similar to those found by other longitudinal studies investigating frailty in older people. For example, in a study involving Mexican Americans, Ottenbacher et al.[21] reassessed 38% of the original sample after 10 years. In another two studies[22,23], albeit with shorter intervals between first and second waves (seven and six years, respectively), 46% and 63% of participants were available for reinterview. In the three studies cited[21-23], the proportion of participants who either died or were lost between baseline and follow-up ranged from 20% to 44% and 18% to 24%, respectively. These rates differ somewhat to the rates found in the present study of 14.9% deceased and 42.3% lost to follow-up. While it was not possible to ascertain all cases of death among the losses registered, the interviews conducted at the households, together with the input of proxies, likely reduced the prevalence and incidence of losses due to physical limitations and/or cognitive impairment.

Losses over time are inevitable in cohort studies involving older populations. This lack of retention can be explained, in part, by the variables mortality and morbidity[24]. Level of sample attrition due

to uncontrollable losses of participants tends to increase with longer interval between first and last assessments. In addition, attrition also tends to be greater in older cohorts than younger samples[24-26]. In cohort studies involving the older population, poorer health and socioeconomic status are factors associated with loss of control over the sample conditions as a whole and, thus, also associated with attrition. Participants requiring more care have a greater likelihood of not being included in the follow-up assessment[26,27]. As a result, the data on the remaining participants may become biased in that they more strongly reflect the characteristics of those individuals whose health status allowed continuation in the study than the characteristics of the overall sample. A similar phenomenon gives rise to a 'healthy survivor effect', often evident in older cohorts[27]. Despite the knowledge that the representativeness of follow-up samples tends to deteriorate over time, deaths are expected and thus tend to introduce less bias than attrition due to other factors[28].

In the present study, participants who died before the follow-up were older and had lower educational level than survivors reinterviewed at follow-up. The rates of cognitive impairment and frailty at baseline were also significantly higher in the deceased group than the reinterviewed group. These data are consistent with results of studies which found differences for sociodemographic variables, cognitive state and health conditions between individuals not reinterviewed due to death or other reasons, and those interviewed again at follow-up[25,26].

In a 10-year longitudinal study, Cacioppo and Cacioppo[25] reported that all-cause attrition was associated with age, education, family income and retirement. Conversely, participant retention in the sample was associated with better cognitive function and more social relationships. In another investigation[26], also with a 10-year follow-up, being older, male, socially isolated, physically inactive and presenting cognitive impairment at baseline predicted loss in subsequent waves. For every additional year of age at follow-up, there was a 2.8% greater risk of attrition, while for each extra point on the MMSE at baseline, this risk was reduced by 6.0%[26].

Besides mortality, cognitive impairment also numbers among the common causes of attrition in longitudinal studies involving older adults. According to Chatfield et al.[29], who conducted a systematic review of factors associated with attrition in cohort studies involving older adults and greater cognitive impairment were independent determinants of sample dropout at follow-up, excluding attrition due to participant death. The authors found high dropout rates among participants that had cognitive deficit, lived alone and were single.

In the present study, no statistically significant differences were evident for age, sex, education, family income and frailty at baseline between the reinterviewed group and the group lost to follow-up. In a follow-up of a subsample of the Fibra network of Juiz de Fora (MG), Barbosa et al.[30] also found no introduction of significant bias in the sample studied, except for a higher proportion of individuals who lived alone at baseline among the sample losses at five-six-year follow-up, a result partially in line with the findings of the present study. It is important to note that methodological differences in data collection at follow-up between the study by Barbosa et al.[30] compared with the present investigation, namely, a shorter time interval between assessments, exclusion of cognitively impaired subjects and interviews conducted by telephone, may have contributed to the disparities in results.

Comparing baseline with follow-up, there was a statistically significant increase in the number of respondents who lived alone, had no partner, a low family income, and cognitive deficit. In addition, there was a decrease in the proportion of non-frail individuals and an increase in frail participants. A five-year evaluation of a cohort of oldest old individuals by Rhor et al.[31] reported that a third of participants were socially isolated at follow-up. This group was older and had lower MMSE scores, where most had no partner and lived alone. Data from the ELSA (English Longitudinal Study of Ageing)[32] showed that eight-year mortality risk was higher in older adults who had started living alone during the follow-up, whether because of divorce or widowhood, and also in participants that had depression, loneliness

and reduced mobility. In situations of widowhood, irrespective of changes in income, older adults can subsequently start living with their adult children and grandchildren, a shift which can often negatively impact their own well-being[33].

Of the changes observed after nine years, cognitive performance merits attention because it has a negative impact on health, increases risk of disability, reduced quality of life and contributes to other adverse outcomes[11]. Aging-related cognitive decline varies among individuals, where some people maintain relatively high levels of cognitive function in late life, while others experience rapid decline[16,35]. According to the review by Wu et al.[34], different trajectories in cognition can take place. Social determinants of health commonly associated with more favorable trajectories include high educational level, social engagement and physical activity, whereas depressive symptoms, physical limitations, diabetes and smoking number among the risk factors[34].

In international studies involving follow-ups of six to 10 years[21,22], changes in frailty status were found to follow the same pattern identified in the present study, i.e. a decrease in the proportion of non-frail, accompanied by an increase in frail individuals. To the best of our knowledge, few studies in Brazil have tracked changes in life and health conditions in older adults for longer periods[21,22]. Fhon et al.[35], observed a rise in frailty after six years, and estimated an increase in mean frailty score of 0.5% for each additional year of age and of 8.4% for living without a partner or spouse. Akin to the pattern seen in the present study, the authors observed an increase in the number of participants classified as frail (17.6% vs. 50.4%) and a decrease in the number of non-frail (59.5% vs. 28.6%) individuals, between baseline and follow-up[35]. Worsening frailty appeared to be associated with different factors, predominantly older age, female gender, presence of neurodegenerative diseases, cognitive impairment and unfavorable socioeconomic conditions. By contrast, other factors (male gender, education, social support, cultural engagement and physical activity) had potential protective effects[14].

The present study has several limitations, such as the high dropout between baseline and follow-up. Given that part of this attrition occurred due to unavoidable events typically expected in aged cohorts, including death and cognitive decline, we believe no bias was introduced to the sample and thus the older adults reinterviewed were representative of Brazilian oldest-old. Another limitation inherent to the study was the long interval between baseline and follow-up measurements, or the absence of additional collection interim timepoints. Future longitudinal studies should address this shortcoming, thereby improving the likelihood of identifying direct and indirect determinants of negative outcomes, such as cognitive deficits, frailty, disability and multimorbidity.

The high financial costs, most of which enjoy no immediate return, the lack of permanent well-prepared teams for planning and executing longitudinal research projects, along with a shortage and discontinuity of physical and human resources are factors underlying the low number of longitudinal studies in Brazil. However, further longitudinal studies are pivotal to elucidate the repercussions of aging on the health and well-being of this population.

The second wave of the Fibra study included a sample of oldest-old recruited within family households, a segment of the population that has been poorly investigated to date. Estimates for the coming decades project a rise in the number of poor oldest-old with low educational level and poor state of health[15]. This study reflects a concerted effort to gain a clearer picture of this group and plan more effective interventions to improve their lives, negatively impacted by adversities both old and new.

CONCLUSION

After the nine-year follow-up period, an increase in physical, cognitive and social vulnerability of the participants was evident. Furthermore, those who died during the period differed at baseline for age, education, cognitive status and frailty status compared with survivors. These data highlight the need for public policies that favor not only the quality

of life of oldest-old, but which also reduce health inequalities over the lifespan. Thus, by identifying changes in the profile of the older population over time, individual and collective preventive strategies can be better planned and implemented. Such strategies should be aimed not only at the wellbeing of older individuals and their families, but also seek to attenuate the burden of Brazilian population aging on the national health and social service systems. Therefore, longitudinal cohort studies involving representative samples of the population with more regular measurements over time are needed to help inform public policies aimed at older adults, both preventive and for long-term care.

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Purpose in life and performance of advanced activities of daily living among the oldest old

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Abstract

Objective: To verify the association between purpose in life (PL) and the performance in advanced (AADL) and instrumental (IADL) activities of daily living. *Methods:* Cross-sectional community-based study which analyzed data from the follow-up assessment of the FIBRA Study (Frailty in Elderly Brazilians) in the cities of Campinas and Ermelino Matarazzo (SP), Brazil, in 2016 and 2017. Participants were 187 community dwelling persons aged 80 years and older. The protocol included the application of a cognitive deficit screening test suggestive of dementia, an inventory assessing AADL, the Lawton and Brody scale (IADL), the Geriatric Depression Scale and the Ryff and Keyes' (1995) Purpose in Life Scale. *Results:* Participants had an average of 83.81 (±3.60) years, 4.38 (± 3.76) years of schooling, 3.49 minimum wages (±2.61) of income, 125 (66.8%) being women. Hierarchical linear regression analyzes showed that PV and depressive symptoms were significantly associated with a higher number of AADL (p=0.003) and no significant association with IADL scores (0.580), in a model adjusted for sociodemographic variables, self-rated health, cognitive performance and depression. *Conclusions:* The results suggest that older adults with higher PL and lower number of depression symptoms are more likely to perform a higher number of AADL. This association was not observed for IADL, which were associated with age, sex, depression and cognitive performance. PL may have an impact on complex levels of functional status in the elderly, thus contributing to healthy aging.

Keywords: Longevity. Aging. Personal satisfaction. Activities of Daily Living.

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INTRODUCTION

Functional capacity can be defined as the ability to perform activities that enable the person to take care of themselves and live independently. It can be evaluated by questionnaires that investigate the ability to perform basic (BADL), instrumental (IADL) and advanced activities of daily living (AADL)[1]. BADL are activities related to self-care and survival, including bathing, and eating, while IADL are activities of practical life, more complex in terms of cognitive requirements than BADL, and include handling medication, controlling finances, and using means of transport, which can be influenced by social, motivational, and contextual factors[2]. AADL refer to activities commonly performed outside the home, associated to community and social participation, including paid and voluntary work, attending to church services, and taking courses[3].

An increasing number of studies suggest that psychological factors like eudaimonic or psychological well-being may moderate the impact of age on functional status[4]. According to Ryff and Keyes[5], there are six dimensions of psychological or eudaimonic well-being: autonomy (independence and capacity for self-determination); mastery of the environment (the ability to manage the world around you); personal growth (being open to new experiences); positive relationships with others; self-acceptance (a positive attitude towards yourself); and purpose in life (PIL). PIL refers to the sense that life has meaning and direction, and guides behavior in pursuit of goals and objectives. PIL is related to a positive outlook on life, including feeling motivated to live life to the fullest[6]. It is described by Ryff et al.[4] as one of the main domains of psychological well-being, associated with a greater probability of engaging in healthy behaviors and favorable outcomes in aging. PIL is a construct increasingly explored in contemporary research due to its potential to stimulate resilience in the face of adversity and stressors[4]. It acts as a buffer for the effects of risk factors on physical and mental health and can be the focus of interventions aimed at improving these conditions[7]. It is of great importance in advanced age, when the potential for loss of physical and cognitive abilities and the occurrence of uncontrollable events increase. The management of these events is benefited by a positive outlook on life and the motivation to live life.

Higher scores in PIL are related to the use of preventive health services[8]; higher frequency of physical activity[9,10]; improved sleep quality[11]; less cognitive impairment[12]; lower risk of hospitalization[13]; lower risk of Alzheimer's disease[14]; and lower mortality rates[15]. Boyle et al.[6] demonstrated that a higher PIL score was associated with a lower risk of developing disabilities in BADL and IADL and with fewer mobility limitations after 4 years, controlling for sociodemographic variables, frailty, cardiovascular risk, vascular diseases, depression, neuroticism, and social network size. In a follow-up study[16]hey observed that a higher PIL score was a protective factor against the development of disabilities in IADL, even after adjusting for sociodemographic, physical, and psychiatric risk factors. Possible explanations for these findings could be related to the fact that people with a high level of PIL tend to be more proactive in terms of self-care in health and involvement in healthy activities, with improved global functionality[17].

Given the increase in life expectancy around the world, there is a growing need to identify factors that can prolong the period of independence in advanced age[18]. The objective of this research was to determine the association between PIL and performance in AADL and IADL, sociodemographic variables, subjective health assessment, cognitive performance, and depressive symptoms, in Brazilian adults aged 80 years old and over. This research made use of follow-up data from the FIBRA study (Frailty in Elderly Brazilians).

We chose to investigate the relationship between PIL and AADL in persons aged 80 years or older because functional limitations are more frequent in advanced age and PIL could moderate the effect of such limitations on the adaptation of advanced age adults. The underlying hypothesis is that advanced age adults with higher PIL scores perform better in AADL and IADL than those with lower scores. We conjectured that higher PIL likely provides greater motivation to perform activities and greater engagement in healthy behaviors.

METHODS

This is a cross-sectional study, with a sample of 187 older adults recruited from family homes, members of a cohort of adults born from January 1, 1911 onwards (persons aged 80 years or over) who participated in the follow-up FIBRA Study (Frailty in Elderly Brazilians) conducted in Campinas and Ermelino Matarazzo, São Paulo, Brazil, in 2016 and 2017, in which a PIL scale was included.

The baseline records of the FIBRA Study (2008-2009; N=1,284) supported the identification of older adults who were then invited to participate in the follow-up study. Recruitment and data collection were performed by trained students at the participants' homes and lasted approximately 90 minutes. The inclusion criteria were: being aged 80 years or over; participation in the baseline FIBRA study Campinas; permanent residence at home; understanding the instructions; and agreeing to participate. The exclusion criteria were: presence of cognitive deficits suggestive of dementia; permanent or temporary inability to walk, even using a cane or walker; localized loss of strength and aphasia resulting from stroke; severe impairment of motor and speech skills associated with Parkinson's disease; severe sensory deficits; and being in the terminal stage[19].

Participants initially selected to the baseline survey totaled 1,284 individuals, 900 from Campinas and 384 from Ermelino Matarazzo. Of these, in the follow-up 543 were considered losses due to non-location, refusal, exclusion, and dropout. A further 192 older adults were deceased, thus only 549 were interviewed again. Among these, 419 scored above the cutoff on the cognitive screening test. In this group, 234 were 80 years old or over, from which 47 were excluded because they did not fully respond to all the items of interest to this study. Thus, the sample consisted of 187 persons aged 80 years old and over, without cognitive impairment suggestive of dementia, and who responded to the PIL, IADL, AADL, subjective health, cognitive performance, depressive symptoms, and sociodemographic instruments in the follow-up of the study FIBRA Campinas and Ermelino Matarazzo (2016 and 2017).

PIL was assessed using the 10-item version of the Ryff and Keyes scale[5], translated and validated for use in Brazil[20]. Participants were asked to rate their degree of agreement with each statement on a five-point Likert scale: *não concordo de jeito nenhum* [I do not agree at all] (1); *concordo pouco* [I agree a little] (2), *concordância moderada* [I somewhat agree] (3); *concordo muito* [I agree a lot] (4); and *concordo muitíssimo* [I very much agree] (5). Item scores 2, 3, 5, 6, and 10 were inverted for analysis. The final score is the result of the average of the answers to the 10 questions (sum/10), ranging from 1 to 5. Higher scores reflect higher levels of PIL[14]. Examples of two scale questions: "I live life one day at a time and don't really think about the future" and "I have a sense of direction and purpose in life".

Cognitive performance was measured by the Mini Mental State Examination (MMSE). For each participant, the total score varies from 0 to 30 points, corresponding to the sum of the scores of the right responses. To determine inclusion in this analysis, the following cut-off scores were considered, based on averages determined by Brucki et al.[21] for each range of education level minus one standard deviation: 17 for illiterate older adults; 22 for older adults with one to four years of education; 24 for older adults with five to eight years of education; and 26 for older adults with nine or more years of education.

AADL were assessed using a questionnaire containing 17 self-report items: visiting other people's homes; receiving guests; going to church; going to social meetings and cultural events; driving a car; making short and/or long trips; doing paid and/or voluntary work; keeping in touch with friends and family by phone, letter, email or social media; using the internet to obtain information, making purchases or operating a bank account; taking courses and attending groups for older adults. For each of the items, there were three alternative responses: *nunca fiz* [I've never done it], *parei de fazer* [I stopped doing it] and *ainda faço* [I still do it]. The number of responses indicating "*ainda faço*" was computed, ranging from 0 to 17 points[19].

IADL were assessed using the Lawton and Brody Scale[22], with seven items: ability to use the

telephone, use of transportation, ability to shop, prepare meals, household chores, use medication and manage money; and three possible responses: fully independent (3 points), in need of some help (2 points), and in need of full help (1 point). In the analyses, the sum of activities carried out with full independence was used.

Participants answered a question about general health assessment, with scores ranging from 1 (very bad) to 5 (very good). In the analyses, the general health assessment scores were divided into four categories (poor/very poor, fair, good and very good). Depressive symptoms were assessed using the Geriatric Depression Scale (GDS), with 15 items[23,24].

The project was approved by the Research Ethics Committee of the State University of Campinas on Nov. 23, 2015, report no. 1,332,651, and registered on the Brazilian Ministry of Health Platform under the C.A.A.E. 49987615.30000.5404 and report 2,847,829, of Aug. 27, 2018, CAAE 92684517.5.1001.5404. All participants signed a term of free and informed consent before data was collected.

Descriptive analyzes were performed for the variables that characterize the sample. Data are presented for the total sample, and men and women separately. The study of the relationship between PIL and the AADL and IADL variables was performed using simple and multiple linear regression analysis, with a hierarchical method in three models. The first model analyzed the association between PIL and AADL. The second model included the variables sex, age, and education, while in the third model, the MMSE, EDG and subjective health assessment scores were inserted. In the regression analyzes (simple and hierarchical), the numerical variables were transformed into ranks due to the absence of normal distribution.

RESULTS

The sample consisted of 187 adults of advanced age, 125 (66.8%) of whom were women. Participant age ranged between 80 and 98 years old, with a mean of 83.8 (±3.6). The mean number of years of education was 4.4 (±3.8), ranging from 0 to 9 years; 13.9% of the sample had no formal education. The average income was 3.5 MW (minimum wages) (±2.6), and 47.5% had an income of 1 to 3 MW. The mean for the MMSE was 25.0 (±2.8). For the GDS, the mean was 3.5 (±2.8) ranging from 0 to 12 points. Table 1 presents the sociodemographic and clinical characterization and the PIL scores in the total sample and in the sample subdivided according to sex. A statistically significant difference was observed between the number of IADL performed independently by men, who were more independent than women.

Table 2 shows there were significant associations between higher AADL scores and more years of education, higher MMSE scores, lower number of depressive symptoms, higher PIL scores and health perceived as good and very good.

In the hierarchical linear regression analysis (Table 3), model 2 indicated a positive association between AADL and PIL and years of education. In model 3, the association between AADL and PIL remained significant even in the presence of subjective health assessment, MMSE and depressive symptoms, which was negatively associated with AADL.

Table 4 presents the results of simple linear regression analyzes between the number of IADL performed independently and the independent variables. There was a significant positive association between independence in IADL and being male, years of education, MMSE score, PIL, subjective health assessment and a negative association with GDS scores.

The hierarchical linear regression analysis for IADL with independence (Table 5) indicates that PIL showed a significant association with IADL in models 1 and 2, both alone and in the presence of sociodemographic variables. However, in the most complete model, which included the variables subjective health assessment, MMSE and GDS, PIL was not associated with IADL; however, it maintained a significant association with sex, age, MMSE and GDS.

Table 1. Sociodemographic and clinical characteristics and PIL scores for the total sample and for women and men, considering performance in IADL and AADL and subjective health assessment. FIBRA 80+ Study, Campinas, SP, 2016-2017.

Variable	Full sample (N=187)	Women (n=125)	Men (n=62)	*p* value*
Age	83.8 (3.6)	83.6 (3.76)	84.1 (3.2)	0.139
Education	4.3 (3.7)	4.4 (3.71)	4.3 (3.9)	0.775
Family income	3.5 (2.6)	3.5 (2.78)	3.4 (2.2)	0.342
MMSE	25.0 (2.8)	24.8 (3.01)	25.3 (2.5)	0.438
GDS	3.5 (2.8)	3.7 (2.90)	3.7 (2.9)	0.214
Number of IADL performed independently	5.6 (1.8)	5.3 (1.87)	6.0 (1.6)	**0.003***
Number of AADL still performing	6.9 (2.6)	6.9 (2.74)	6.8 (2.5)	0.515
Purpose in Life score (PIL)	3.5 (0.6)	3.5 (0.68)	3.5 (0.6)	0.781
Subjective health assessment				
Very good	28 (14.9)	22 (17.6)	6 (9.7)	0.084**
Good	70 (37.4)	40 (32.0)	30 (48.4)	
Regular	76 (40.6)	51 (40.8)	25 (40.3)	
Poor	10 (5.3)	9 (7.20)	1 (1.6)	

Family income in minimum wages; MMSE, Mini Mental State Examination; GDS, Geriatric Depression Scale; IADL, instrumental activities of daily living; AADL, advanced activities of daily living; *p-value in Mann-Whitney test, ** Fisher's exact test.

Table 2. Simple linear regression analysis of the associations between the number of AADL performed, sociodemographic variables, MMSE, GDS, PIL and subjective health assessment scores (N=187). FIBRA 80+ Study, Campinas, SP, 2016-2017.

Variable	Beta (EP)	*p* value	R^2
Sex			
Female (ref.)	---		
Male	-5.43 (8.36)	0.517	0.0023
Age (years)	-0.09 (0.07)	0.217	0.0082
Education (years)	0.30 (0.08)	**<0.001**	0.0771
MMSE	0.28 (0.07)	**<0.001**	0.0785
GDS	-0.36 (0.07)	**<0.001**	0.1285
Purpose in Life (PIL)	0.30 (0.07)	**<0.001**	0.0896
Subjective health assessment			0.0778
Very poor/Poor (ref)	---		
Regular	6.92 (15.61)	0.658	
Good	31.90 (15.71)	**0.044**	
Very good	42.24 (17.46)	**0.017**	

Beta refers to the value of the estimate or angular coefficient (slope) on the regression line; EP, beta standard error. R^2, coefficient of determination (% variability of the response variable explained by the independent variable); $p \leq 0.001$.

Table 3. Hierarchical linear regression analysis between higher AADL and PIL scores, sociodemographic variables, MMSE and GDS scores, and subjective health assessment (N=187). FIBRA 80+ Study, Campinas, SP, 2016-2017.

Variable	Model 1		Model 2		Model 3	
	Beta (*p* value)	Partial R^2	Beta (*p* value)	Partial R^2	Beta (*p* value)	Partial R^2
Purpose in Life (PIL)	0.33 **(<0.001)**	0.113	0.31 **(<0.001)**	0.113	0.23 **(0.003)**	0.113
Sex			-4.59 (0.562)	0.002	-9.90 (0.215)	0.002
Age (years)			-0.01 (0.838)	< 0.001	0.03 (0.671)	< 0.001
Education (years)			0.26 (**<0.001**)	< 0.061	0.15 (0.092)	< 0.061
MMSE					0.12 (0.172)	< 0.017
GDS					-0.20 **(0.011)**	< 0.044
Subjective health assessment						< 0.011
Very poor/Poor (ref)					-----	
Regular					3.29 (0.823)	
Good					16.24 (0.298)	
Very good					7.90 (0.648)	

Beta refers to the value of the estimate or angular coefficient (slope) on the regression line; EP, beta standard error. R^2, coefficient of determination (% variability of the response variable explained by the independent variable); Model 3: Total R^2= 0.2476. Intercept (EP): 59.94 (22.45); p=0.008. Variables without normal distribution were transformed into ranks.

Table 4. Simple linear regression analysis for greater independence in IADL (N=187). FIBRA 80+ Study, Campinas, SP, 2016-2017.

Variable	Beta (EP)	*p* value	R^2
Sex			
Female (ref.)	---		
Male	23.54 (7.76)	0.003	0.0473
Age (years)	-0.19 (0.07)	0.006	0.0396
Education (years)	0.18 (0.07)	0.015	0.0328
MMSE	0.29 (0.07)	<0.001	0.0956
GDS	-0.34 (0.07)	<0.001	0.1241
Purpose in Life (PIL)	0.20 (0.07)	0.003	0.0461
Subjective health assessment			
Very poor/Poor (ref)	---		0.0278
Regular	18.05 (15.24)	0.238	
Good	27.39 (15.33)	0.076	
Very good	34.07 (17.04)	0.047	

Beta refers to the value of the estimate or angular coefficient (slope) on the regression line; EP, beta standard error. R^2, coefficient of determination (% variability of the response variable explained by the independent variable); $p \leq 0.001$.

Table 5. Hierarchical linear regression analysis between the highest number of IADL performed independently and the PIL, MMSE and GDS scores, sociodemographic variables and subjective health assessment (N=187). FIBRA 80+ Study, Campinas, SP, 2016-2017.

Variable	Model 1		Model 2		Model 3	
	Beta (*p* value)	Partial R^2	Beta (*p* value)	Partial R^2	Beta (*p* value)	Partial R^2
Purpose in Life (PIL)	0.21 **(0.003)**	R^2= 0.050	0.15 **(0.026)**	R^2=0.050	0.04 (0.580)	R^2 =0.050
Sex			24.12 (**0.002**)	R^2=0.038	21.68 **(0.005)**	R^2 =0.038
Age (years)			- 0.18 **(0.010)**	R^2 < 0.032	-0.15 **(0.030)**	R^2 =0.032
Education (years)			0.17 **(0.017)**	R^2 < 0.028	0.06 (0.503)	R^2 =0.028
MMSE					0.17 **(0.041)**	R^2 =0.030
GDS					-0.24 **(0.002)**	R^2 =0.047
Subjective health assessment						R^2=0.002
Very poor/Poor (ref)					----	
Regular					2.55 (0.858)	
Good					-2.29 (0.879)	
Very good					3.70 (0.825)	

Beta refers to the value of the estimate or angular coefficient (slope) on the regression line; EP, beta standard error. R^2, coefficient of determination (% variability of the response variable explained by the independent variable); Model 3: Total R^2= 0.2291. Intercept (EP): 98.94 (21.67); p=0.008. Variables without normal distribution were transformed into ranks.

DISCUSSION

This research aimed to verify the association between PIL and the performance of AADL and IADL, depressive symptoms, self-rated health, and sociodemographic variables, in adults aged 80 years and over. The results indicated that the number of AADL performed showed a significant positive association with PIL and a negative association with depressive symptoms. However, independence in IADL was negatively associated with age, depressive symptoms, and positively associated with sex and cognitive performance, but not with PIL. In this study, men were better at performing IADL independently compared with women. This is because they presented a greater number of chronic and limiting diseases that cause pain and difficulties in carrying out daily activities, thus compromising functionality[25].

The results of this study emphasize the importance of high PIL for performing AADL, more complex activities, which require greater daily competence and motivation[17,26]. People with high PIL seem more likely to engage in more elaborate activities that require multiple skills and different environmental demands. The presence of high PIL may constitute motivation for active involvement in the execution of these activities, which are usually carried out in the community[27,28]. To our knowledge, there are no prior studies that examine the relationship between PIL and AADL performance.

The results showed the important influence of education on PIL and AADL. According to Ryff et al.[4], psychological well-being and education are strongly linked, especially by the domains of personal growth and PIL. According to the authors, opportunities for self-actualization are not evenly distributed, they occur mainly for those who make the most of their talents and abilities. It is assumed, therefore, that more educated individuals are more likely to put their skills into practice, engage in more complex activities, such as AADL, increasing self-realization, psychological well-being, reflecting favorably on PIL scores[20]. However, further analysis using more complex models that included the variables MMSE, GDS and subjective health assessment, indicated that education was not associated with AADL or IADL.

The findings regarding IADL showed that these activities were not associated with PIL in the most complete model. Divergent results were reported by Tomioka et al.[17], who investigated the relationship between the maintenance of hobbies and PIL with

mortality and decline in independence. In the 3-year follow-up period, 248 older adults died, 119 showed declined in BADL and 178 in IADL. Having no pleasurable hobbies and lower PIL were associated with increased risk of mortality odds ratio (OR= 2.08; 95%CI, 1.47-2.94), decline in BADL (OR= 2.74; 95%CI, 1.44-5.21) and decline in IADL (OR=1.89; 95%CI, 1.01-3.55). The study by Tomioka et al.[17] was based on longitudinal data that involved a younger sample than this study, therefore, more in-depth comparisons are limited by methodological differences.

Boyle et al.[6] and Mota et al.[16] also demonstrated that a higher PIL score was associated with a lower risk of developing disabilities in IADL in longitudinal studies over 4.7 and 2 years, respectively. High PIL is associated with healthier behaviors and may represent a protective factor against diseases. Thus, it is plausible to assume that this variable, when high, can contribute to the functional capacity of older adults[7,29]. In our analysis, PIL was significantly associated in models 1 and 2, in the presence of sociodemographic variables. Its significance was lost when additional variables were considered. This finding may indicate that, among the advanced age adults, IADL are more influenced by cognitive performance, mood, and health status than by psychological well-being. In contrast, performance in AADL can be driven by a sense of purpose.

The results obtained here showed that depressive symptoms were associated with IADL and AADL in the most complete regression model, indicating that psychosocial factors, particularly depression, seem to be associated with the risk of physical and functional disability in daily activities by persons of advanced age[30]. This is not fully in agreement with other studies that suggest depression is the result of increased functional disability, and not a predictor variable of changes in functional status[31]. This association can be explained by the fact that depression is a condition related to low levels of activity and reduced motivational status, leading to a deficit in mobility, physical performance and active lifestyle[31]. The findings on depressive symptoms and PIL are in agreement with other cross-sectional studies. Hedberg et al.[32], for example, included 189 participants (120 women and 69 men) aged 85 to 103 years, living in northern Sweden. They observed that 40 participants (21.2%) were depressed and that these were the individuals with the lowest PIL scores.

The findings of this study suggest that a higher PIL may be associated with greater involvement with complex activities carried out in the community. Additionally, studies have shown that PIL can be increased through psychosocial interventions.

A school protocol designed to teach children and adolescents about the importance of well-being showed an increase in psychological well-being in a non-clinical sample[33]. In this investigation, a combination of cognitive behavioral therapy techniques was followed by specific strategies to adapt the dimensions of psychological well-being. Based on this school intervention, Friedman et al.[34] created the Lighten UP! Program to promote psychological well-being in community-dwelling older adults. The program lasted eight weeks and was aimed to teach participants (103 men and women aged 60 and over) to identify positive experiences in various domains of psychological well-being. After the intervention, participants reported significant increases in psychological well-being (including PIL), life satisfaction, social well-being, and lower levels of depression. This pilot investigation suggests that these interventions can increase psychological well-being and enable positive changes for older adults.

This study presents limitations. First, the research was cross-sectional, which hinders us from establishing cause and effect relationships between PIL and functional status. Additionally, possible sample selection bias in longitudinal studies should be considered, when the most vulnerable participants are excluded. Thus, it is possible that people with lower PIL and greater dependence in the activities of daily life have been screened from the sample in greater proportion, either due to death or because they need to live with their children or long-term institutions for older adults[35].

CONCLUSIONS

The results suggest that there is a significant relationship between purpose in life and maintaining AADL among adults aged 80 years old and over. Regarding independence in IADL, there was

a negative association with age, sex, depressive symptoms, and a positive association with cognitive performance, but not with PIL.

Dissemination of the study data in academic, lay and professional circles is important, in order to encourage the involvement of society in actions to improve the motivation for life among older adults and to provide favorable outcomes in aging.

This work highlights the need for further research to investigate the effectiveness of interventions that can raise levels of purpose in life and facilitate engagement in meaningful social activities. Such initiatives constitute important new directions for research in the field of gerontology, specifically on the theme of purpose in life.

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Masticatory function loss and frailty risk in community-dwelling older people in the State of São Paulo

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Abstract

Objective: To verify if the loss of masticatory function increases the risk of frailty in community-dwelling older people in the state of São Paulo. *Methods:* A prospective cohort design was adopted based on the FIBRA study database (Fragility in Brazilian Elderly), with a baseline performed in 2008-2009 and follow-up in 2016-2018, elapsed on average 100.2 ± 9.2 months. The outcome variable was the incidence of frailty. The exposure variable was masticatory function according to edentulism and self-reported chewing difficulty. Adjustment variables were sociodemographic, behavioral, and general health conditions. A Poisson regression model with robust variance was used to estimate the relative risk. *Results:* the cumulative incidence of frailty over eight years was 30 cases per 100 edentulous participants with chewing difficulties, who had a higher risk of developing frailty (RR: 1.75 95% CI 1.09-2.81) than the dentate elderly without chewing difficulties, regardless of smoking (RR: 1.71 95% CI 1.07-2.73) and socioeconomic status (RR: 1.72 95% CI 1.13-2.62). *Conclusion:* Loss of masticatory function increases the risk of frailty in older people. Future research should study whether the rehabilitation of oral function reduces this risk.

Keywords: Oral health. Frail elderly. Longitudinal studies.

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INTRODUCTION

Frailty is recognized as one of the main health problems associated with aging[1-3]. It can be defined as a geriatric syndrome which develops as a consequence of a progressive decline in multiple physiological systems, impairing an individual´s capacity to cope with stressors and rendering them vulnerable to adverse outcomes such as hospitalization, dependency, disability and death[4]. Progression of the condition spans 3 possibilities along a spectrum of frailty: robust or non-frail; pre-frail (or at high risk of developing frailty); and frail[4]. Frailty can be reversed, and therefore efforts to provide early detection and treatment of symptoms are need to restore robustness[5].

A relationship between oral health problems and frailty has been established[6]. A potential mechanism underlying this link lies in the association between poor oral status and disability, muscle weakness, lower intake of nutrients and weight loss, factors related with the pathogenesis of frailty[6]. Cross-sectional studies have shown an association between frailty and number of teeth, denture use, negative self-rating of oral health and low use of dental services[7, 8]. A systematic review of longitudinal studies with 3-5 year follow-ups found that poor oral health status was a strong predictor of frailty[9, 10]. Conversely, retaining a higher number of teeth[11] and the presence functional dentition[12] were associated with a lower risk of developing frailty.

Although not universal in aging, deterioration of oral health and frailty are chronic, progressive and cumulative conditions which promote morbidity, disability, pain, discomfort and impairment in social life and overall quality of life[10].Therefore, it is crucial that primary care services adopt early regular diagnostic and treatment measures throughout adult life and into old age, particularly more advanced age.

If deterioration in oral health can serve as a valid marker of the onset of frailty, and given that 50% of community-dwelling older adults are at risk of developing frailty [13], then it is important to explore this relationship because oral status can be used to allow timely identification of individuals at risk. Additionally, the prevalence of both frailty and oral health problems are higher in low-to-middle income countries[13, 14], as is the case in Brazil.Therefore, the objective of this study was to determine whether loss of masticatory function increases the risk of frailty in community-dwelling older people from São Paulo state.

METHODS

A prospective cohort study drawing on data from the Frailty in Brazilian Adults (FIBRA) study was conducted. The FIBRA study is a population-based survey carried out in 2008-2009 to investigate associations between frailty syndrome and sociodemographic, health, functionality and psychosocial variables[15]. Although the original FIBRA study was cross-sectional in design and covered 7 Brazilian cities, each with a different Human Development Index (HDI), the present study involved a sample of 1284 older adults aged ≥65 years, comprising 900 participants from Campinas and 384 from Ermelino Matarazzo, a subdistrict of São Paulo city, Brazil.These are the only cities for which baseline data was collected on oral health of participants and where a complete follow-up of all variables was performed between 2016 and 2018.

For this study, a non-probabilistic consecutive sample was created, where the baseline sample involved simple random sampling of urban census sectors, according to the calculation of the target number of older adults recruited and number of urban census sectors. As a result, 90 census sectors were surveyed by recruiters in Campinas, and 62 in Ermelino Matarazzo. Quotas of men and women were estimated observing the proportions of the distribution of the older population according to different age groups: 65-69, 70-74, 75-79 and ≥80 years.The minimum sample size was estimated at 601 older adults for Campinas with a total population of over 1 million people, allowing for a sampling error of 4%. For Ermelino Matarazzo, with a total population of under 1 million people, a minimum sample of 384 older adults was estimated, allowing for a sampling error of 5%.

During recruitment, a sequence was marked out on a map used by pairs of trained interviewers to cover

the streets. The interviewers visited all households, checking door-to-door for the presence of older adults who met the selection criteria. Inclusion criteria were the older adult agreeing to take part in the study, understanding the instructions, being aged ≥65 years, and a being permanent resident at the address and within the census sector. Older adults who presented problems suggestive of cognitive impairment or advanced Parkinson´s disease, severe hearing or vision loss, stroke complications, permanent or temporary walking disability (except for use of walking aids) and individuals at terminal stage of illness were excluded.

In the 2016-2018 follow-up, conducted at a mean time elapsed since baseline of 100.2 ± 9.2 months, a second wave of data collection was carried out via home visits, during which participants were invited to take part again. After agreeing to participate, respondents were interviewed by pairs of researchers who collected information on the same variables using the same instruments.As a strategy to reduce losses, when the older adult exhibited cognitive impairment, as confirmed by the Mini-Mental State Examination (MMSE), validated for use in Brazil [16], a family member or otreliable informant was asked to answer the self-report questionnaire on their behalf.

For this study, older adults who were frail at baseline and remained frail at the follow-up were excluded. Likewise, individuals who did not participate in the follow-up, whether due to death, not found, refusal, exclusion, drop out, perceived risk to interviewers in vicinity of residence, or missing data for the variables of interest, were also excluded.

The dependent variable was frailty incidence. Frailty was rated using Fried´s phenotype model[4] derived from data from 2 population-based studies: the Cardiovascular Health Study and the Women and Health Study. According to these studies, frailty increases the risk for morbidity, disabilities, falls, hospitalization, institutionalization and death within 2-3 years[4]. The components indicating frailty are as follows:(1) unintentional weight loss in the past year of ≥4.5kg or 5% of body weight; (2) low physical activity level (as indicated by energy expenditure on the Minnesota Leisure Time Activities Questionnaire[17], adjusted for gender; (3) Fatigue/exhaustion (response to statements "strength and vitality for carrying out activities of daily living" and/or "I could not get going"; 4) Low hand-grip strength measured in Kgf by hand-held Jamar type dynamometer, for 3 consecutive attempts, adjusted by sex and Body Mass Index (BMI); and (5) slow walking speed as indicated by mean time in seconds taken to walk 4.6m with usual gait 3 consecutive times, adjusted for sex and weight. Scores below the 20th percentile of the sample for hand-grip strength and physical activity; and above the 80th percentile for gait speed, indicated frailty. Details on the cut-off points used for each criterion have been published elsewhere[18]. Briefly, cut-off scores for physical inactivity (sedentarism) were weekly expenditure < 383kcal for men and expenditure < 270kcal for women; for hand-grip strength, men were defined as frail at strength values < 29 kgf (BMI < 24), < 30 kgf (BMI 24.1–28) and < 32 kgf (BMI > 28), while women were deemed frail at values < 17 kgf (BMI < 23), < 17.3 kgf (BMI 23.1–26), < 18 kgf (BMI 26.1–29) and < 21 kgf (BMI >29); while for gait speed,men were defined as frail for time taken >7 seconds (< 173cm) or 6 seconds (< 173cm), while women were deemed frail for time >7 seconds (< 159cm) or 6 seconds (>160cm). Individuals scoring for ≥3 criteria were classified as "frail"; 1-2 criteria as "pre-frail"; and with no score for all 5 criteria as "robust". Individual frailty incidence was determined over a mean period of 8 years, according to the transition from robust to frail status or from pre-frail to frail status, between baseline and follow-up. Individuals who were frail at baseline and remained so at follow-up were excluded from the sample (n=20).

The exposure of interest was oral health status. Edentulism (defined as total absence of teeth) status and perceived difficulty chewing were determined by self-report. On the basis of this data, the variable "masticatory function" was created, categorized into 4 levels: dentate without chewing difficulty, dentate with chewing difficulty, edentulous without chewing difficulty, and edentulous with chewing difficulty. Also, respondents were probed about their perceived oral health, with responses dichotomized into positive (excellent/good) and negative (fair/poor).

Using baseline data, the following sociodemographic information was analyzed: age, sex, education (years), marital status, family income, living arrangement and homeowner status. Education was stratified into ≤4 years and ≥5 years. Marital status was dichotomized into single/widowed/separated/without partner and married/with partner. Family income was measured according to number of minimum wages (MWs) in 2008 (R$415/US$231) at baseline and in 2017 (R$937/US$288) at follow-up, dichotomized into 0-3 MWs and ≥4 MWs.The variable living arrangement was dichotomized into "alone" and "with others". Results of measures of behavioral variables were also collected, namely: frequency of alcohol consumption (0 and ≥1 times per month), smoking (yes or no) and use of dental services in the past year (yes or no).

With regard to general health variables, BMI was calculated as a proxy of nutritional status and used to classify participants as obese (≥ 30 kg/m^2), overweight (28-29.9 kg/m^2), normal weight (23-27.9 kg/m^2) or underweight (17-22.9 kg/m^2). Multimorbidity was defined as yes (presence of ≥2 disease) or no (≤1 disease), including conditions such as cardiovascular diseases (angina and myocardial infraction), hypertension, stroke, diabetes mellitus, cancer, arthritis, respiratory disorders (bronchitis and emphysema), depression and osteoporosis.

All participants signed an Free and Informed Consent Form, and all procedures were previously approved by the local Research Ethics Committee (CEP) of UNICAMP under permit no. N° 4541075, on 15/02/2021.

The characteristics of participants were treated using descriptive statistics. Pearson´s chi-square test was used, adopting a p-value <0.05 as statistically significant. The strength of associations between oral status (baseline data) and frailty incidence as the outcome (baseline and follow-up data) was estimated by calculating relative risks (RRs) using the Poisson regression model with robust variance. The model was controlled for the covariates outlined previously (obtained from baseline data), considered confounding factors.A bivariate analysis was first performed in which variables with p<0.20, or those documented as important in relation to frailty, were entered in the multivariate analysis.The final model yielded RRs with their respective 95% confidence intervals (CI), adopting a value of p<0.05 to indicate statistical significance.

RESULTS

Of the 1284 original participants in the 2008-2009 wave of the FIBRA study, 549 (42.8%) remained in the 2016-2018 follow-up, with full data available for 428 subjects.In the second wave assessment, participants had a mean age of 80±4 (range 72-102) years, and were predominantly female (69%) and homeowners (85%).The overall incidence of frailty was 21.7% (n=103) (Table 1).

With regard to the reasons for losses to follow-up, 192 (14.9%) participants died and 543 (42.3%) were lost due to not being found, refusal, exclusion, drop-out or risk to interviewers.

The cumulative frailty incidence of participants by masticatory function category is depicted in Figure 1. There were 30 cases of frailty per 100 edentulous participants with chewing difficulty after an average 8 year follow-up period.

The variables associated in the bivariate analysis and final model are shown in Table 2. Individuals who were edentulous with chewing difficulties had a 1.75 times higher risk of developing frailty (RR:1.75 95%CI 1.09-2.81) compared to those who were dentate without chewing difficulties, irrespective of smoking effect (RR:1.71 95%CI 1.07-2.73) and socioeconomic position (RR:1.72 95%CI 1.13-2.62).

Table 1. Characteristics of participants at baseline and at follow-up. *FIBRA Study, Older adults, Campinas and Ermelino Matarazzo, São Paulo state, Brazil, 2008-2009 and 2016-2018.*

Variables	Participants n (%)*	
	2008-2009	2016-2017
Sociodemographic		
Gender		
Male	147 (31)	147 (31)
Female	327 (69)	327 (69)
Education		
0-4 years	363 (76.7)	354 (74.7)
≥ 5 years	110 (23.3)	120 (25.3)
Family income		
0-3 minimum wages	208 (49.6)	270 (63.4)
≥ 4 minimum wages	211 (50.4)	156 (36.6)
Marital status		
single/widowed/separated/without partner	218 (46.2)	259 (55)
married/with partner	254 (53.8)	212 (45)
Living arrangement (alone)		
Yes	69 (14.6)	83 (22.1)
No	404 (85.4)	293 (77.9)
Homeowner		
Yes	398 (84.1)	385 (83.3)
No	75 (15.9)	77 (16.7)
Behavioral variables		
Smoking		
Yes	39 (9)	11 (3.2)
No	395 (91)	334 (96.8)
Alcohol use		
Yes	144 (33.5)	125 (35.3)
No	286 (66.5)	229 (64.7)
Dental visit in past year		
Yes	205 (48)	163 (46.4)
No	222 (52)	188 (53.6)
General health variables		
BMI		
Underweight	66 (14)	93 (19.7)
Normal weight	204 (43.3)	205 (43.5)
Overweight	76 (16.1)	53 (11.3)
Obese	125 (26.6)	120 (25.5)
Multimorbidity		
Yes	297 (68.6)	311 (68.2)
No	136 (31.4)	145 (31.8)

to be continued

Continuation of Table 1

Variables	Participants n (%)*	
	2008-2009	2016-2017
Frailty		
Non-frail	169 (35.7)	98 (20.7)
Pre-frail	277 (58.4)	273 (57.6)
Frail	28 (5.9)	103 (21.7)
Oral health status		
Perceived oral health		
Positive (excellent/good)	66 (15.5)	230 (65.3)
Negative (fair/poor)	359 (84.5)	122 (34.7)
Swallowing difficulties		
Yes	146 (33.9)	147 (37.5)
No	285 (66.1)	245 (62.5)
Edentulous		
Yes	209 (48.6)	187 (54.4)
No	221 (51.4)	157 (45.6)
Masticatory function		
Dentate with chewing difficulty	63 (14.7)	47 (13.7)
Edentulous with chewing difficulty	83 (19.3)	79 (23.1)
Edentulous without chewing difficulty	126 (29.4)	108 (31.6)
Dentate without chewing difficulty	157 (36.6)	108 (31.6)

BMI:body mass index

*20 individuals were frail at baseline and remained so at follow-up and therefore excluded from the sample.

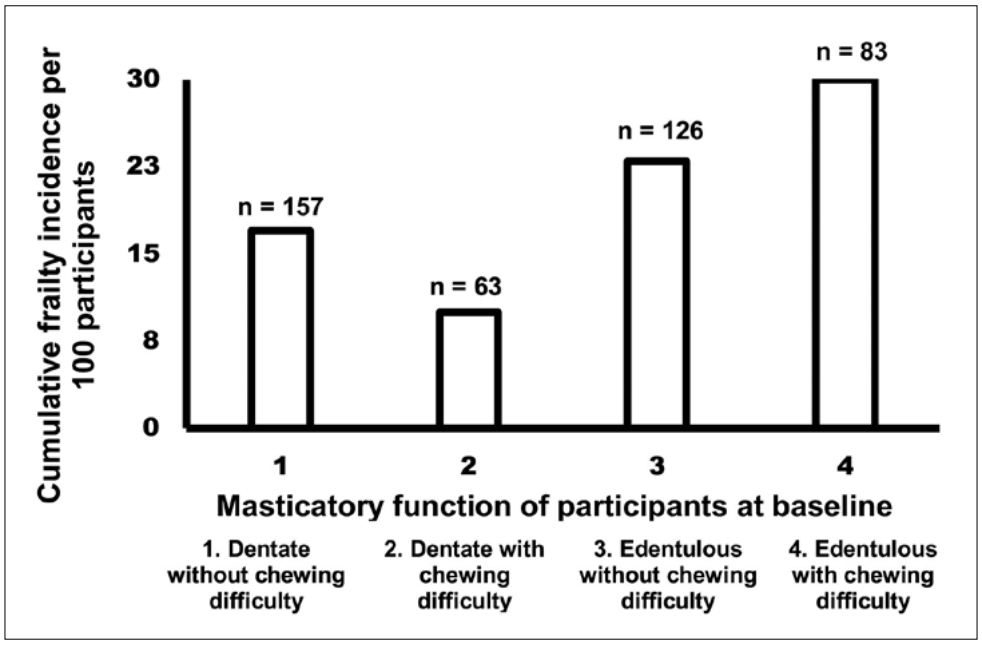

Figure 1. Cumulative frailty incidence according to masticatory function over mean period of 8 years FIBRA Study, Older adults, Campinas and Ermelino Matarazzo, São Paulo state, Brazil, 2008-2009 and 2016-2018.

Table 2. Association of loss of masticatory function with frailty incidence over mean period of 8 years. *FIBRA Study, Older adults, Campinas and Ermelino Matarazzo, São Paulo state, Brazil, 2008-2009 and 2016-2018.*

Variable (baseline)	Frailty incidence	
	Category	Crude RR (95%CI)
Sociodemographic		
Living arrangement	Alone	1.50 (1.0 -2.25)
	With others	1
Education	0-4 years	1.43 (0.90-2.27)
	≥5 years	1
Homeowner	No	1.61 (1.10-2.37)**
	Yes	1
Family income	0-3 MWs	1.60 (1.08-2.36)
	≥ 4 MWs	1
Marital status	Single	1.44 (1.02-2.04)
	married/with partner	1
Behavioral		
Dental visit	No	1.75 (1.16-2.63)*
	Yes	1
Monthly frequency of alcohol use	≥1	0.68 (0.44-1.06)
	0	1
Smoking	Yes	1.80 (1.10-2.94)*
	No	1
General health		
BMI	Obese	1.15 (0.73-1.80)
	Overweight	1.52 (0.96-2.43)
	Normal weight	1
	Underweight	1.59 (0.98-2.56)
Multimorbidity	Yes	1.39 (0.91-2.12)*
	No	1
Oral health status		
Perceived oral health	Negative	0.84 (0.53-1.32)
	Positive	1
Masticatory function	Dentate with chewing difficulty	0.57 (0.25-1.33)
	Edentulous with chewing difficulty	1.82 (1.12-2.94)*
	Edentulous without chewing difficulty	1.39 (0.86-2.23)
	Dentate without chewing difficulty	1

*p-value <0.20. **p-value <0.05. RR:relative risk; CI:confidence interval; MW:minimum wage;BMI (body mass index).

Table 3. Final regression model for variables associated with frailty incidence over mean period of 8 years (n=428). *FIBRA Study, Older adults, Campinas and Ermelino Matarazzo, São Paulo state, Brazil, 2008-2009 and 2016-2018.*

Variable	Category	Frailty incidence RR (95%CI)
Homeowner	No	1.72 (1.13-2.62)*
	Yes	1
Smoking	Yes	1.71 (1.07-2.73)*
	No	1
Masticatory function	Dentate with chewing difficulty	0.62 (0.27-1.42)
	Edentulous with chewing difficulty	1.75 (1.09-2.81)*
	Edentulous without chewing difficulty	1.36 (0.84-2.18)
	Dentate without chewing difficulty	1

*p-value <0.05. RR:relative risk; CI:confidence interval

DISCUSSION

In this study, loss of masticatory function was found to increase the risk of frailty. Masticatory function loss can lead to malnutrition and, in turn, to frailty[19]. This relationship is also consistent with other evidence in the literature, even when different approaches were used to measure loss of masticatory function. A previous longitudinal study estimated this parameter, defining functional mastication as the presence of 20 or more teeth in the oral cavity, and confirmed this marker as a protective factor for frailty[12]. Based on the same rationale, another study with a 3-year follow-up, found that, for each additional tooth present in the oral cavity, there was a 5% lower risk of frailty[11]. However, measuring masticatory function goes beyond counting the teeth present. It is also important to take account of the number of pairs of teeth in occlusion and, in cases of dental losses, to perform prosthetic rehabilitation which restores the function of lost teeth[20].

In the present study, masticatory function loss was determined according to edentulism, together with self-reported chewing difficulty.Using this approach, edentulous individuals without masticatory difficulty were shown to be at no higher risk of frailty. This finding suggests two possible explanations: the simplest may be that older individuals adapted to loss of masticatory function based on the belief that tooth loss is a normal part of aging[21] and modified their diet reducing intake of fiber and protein by overcooking foods or cutting out fresh products from the diet to avoid chewing problems[20]. Indeed, if nutrition had been affected, an effect on frailty would have been evident. Another possible explanation is that these individuals used some kind of denture.The literature suggests that, irrespective of number of remaining teeth, if functional dentures are used, frailty risk does not increase[22]. However, older women living in the community that used dentures, but had chewing or swallowing difficulties, effectively had greater malnutrition, frailty and mortality risk[23]. Congruent with the present study results, these data support the relationship between masticatory dysfunction and frailty. The present study highlights the importance and validity of examining this relationship, investigating older men and women using two separate measures over an average follow-up of 8 years.

The functions of the masticatory system have two distinct aspects: physical function observed clinically; and masticatory function reported by the patient. Although physical functioning can be measured objectively by masticatory efficiency, older individuals do not always perceive its negative impact[24]. This makes subject assessment of masticatory capacity vital. A longitudinal study found that both impaired ability to form food bolus and subjective mastication capacity were associated with progression to frailty[25]. Thus, it is plausible that, in the present study, an association with frailty also occurred, even though masticatory function was measured by self-report.

The mechanisms through which poor oral health can lead to frailty include deteriorating nutritional status due to the inability to consume an adequate diet[26,27], psychosocial effects, such as lack of self-esteem, isolation, reduced quality of life and the chronic inflammation typical of oral diseases, which alters the metabolism of other key organs[28]. These mechanisms are, in turn, associated with socioeconomic position[29] and smoking[30], factors which this study found to contribute to higher risk of frailty. Nevertheless, despite the confounding effect which socioeconomic and smoking status may have had on the relationship studied, an effect on increased incidence of frailty was found among participants with loss of masticatory function.

Regarding the limitations of this study, the difference in proportion of older adults estimated and effectively observed may constitute one such limitation. These disparities may have influenced by the results obtained.Future studies should be conducted to confirm the proportion of older adults who refused to the participate, perhaps because they had deteriorated oral health status, given that the current findings may have been underestimated, albeit without affecting the power of the relationship found.

Although the data collected on masticatory function did not include factors such as partial edentulism, its extent , and use of dentures or otherwise, the lack of this data is unlikely to have made a meaningful difference to the results obtained. The majority of the participants reported using dentures, and most individuals (66%) reported no chewing difficulty.

The use of assessments of oral health status by self-report is advantageous in situations where clinical evaluation is not cost-effective. A previous study involving participants of the FIBRA study Campinas, in the same group of older adults, showed high sensitivity and specificity for self-reported edentulism and use of removable dentures[31]. Both the clinical and subjective assessment of masticatory function proved sensitive for showing that both indicators were associated with frailty[25]. Another strength of the present study is the long follow-up period, being the first study of oral health and frailty to have been conducted after an average period of 8 years from baseline assessment, especially for developing countries such as Brazil.The study findings are particularly timely because projections of edentulism in Brazil indicate the condition is increasing and set to continue rising among older people up until 2040[32].

CONCLUSION

The relevance of this study to the geriatric and gerontology area lies in the finding that loss of masticatory function increased the incidence of frailty over an average period of 8 years. Masticatory function should be incorporated into frailty assessments because edentulism and chewing difficulties can lead to a greater risk of the condition. Future studies investigating whether rehabilitation of masticatory function helps reduce this risk are warranted.

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Prevalence and incidence of cognitive impairment in older adults: associations with physical activity at leisure

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Abstract

Objective: Describing the prevalence and incidence of cognitive impairment in older adults, considering the isolated and combined presence of leisure-time physical activities, hypertension, and obesity. *Methods:* An observational, analytical, cohort study was conducted based on the data records of baseline (2008-2009) and follow-up (2016-2017) from the Campinas FIBRA Study. Screening for dementia and self-report measures concerning the number of weekly hours of low and moderate levels of leisure-time physical activities, hypertension, and nutritional status based on the body mass index (BMI) were applied. *Results:* There were 394 aged participants; 71.8% were female and 74.4% had less than four years of formal education. The mean age at the baseline was 72.8±5.3 years old, and at follow-up was 81.4±4.8. At baseline, the most prevalent concurrent conditions were physical inactivity and hypertension (21.5%), and the least prevalent were physical inactivity, obesity, hypertension and cognitive deficit (0.6%). Associations were observed between physical inactivity at follow-up, or for both measurement periods, and cognitive impairment at follow-up. Inactive participants at the baseline showed a higher incidence ratio of cognitive impairment at follow-up, adjusted for sex, age, education, nutritional status and hypertension (RI=2.27; 95%CI: 1.49-3.45; p<0.001). *Conclusion:* Prevalence and incidence of cognitive deficit mostly reflected the influence of low levels of leisure-time physical activity at baseline and follow-up.

Keywords: Cognition. Exercise. Nutritional Status. Hypertension. Older Adults.

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INTRODUCTION

Changes in cognitive status are more likely in those aged 70 and 80 years old, when functional capacity tends to decline, cognitive losses become more likely, the manifestation of chronic degenerative diseases are more evident, and interindividual differences more noticeable than in early old age[1].

Changes in cognitive status in old age result from a multifactorial process, in which non-modifiable determinants, such as age and genetics, act together with risk factors arising from the way people live their lives and the choices they make, depending on their beliefs, possibilities, social arrangements and education[2,3]. Diabetes mellitus, obesity, systemic arterial hypertension and depression; smoking and physical inactivity, and a lower education level, increase the risk of cognitive decline in old age[4]. About one third of cases of dementia can be avoided with proper management of determinants that include physical activity and diet management, among other modifiable factors, through healthy habits and self-care[2].

The term physical activity refers to a wide class of voluntary actions performed by the skeletal muscles, generating higher caloric expenditure than that observed when the body is at rest[5]. Within the scope of epidemiological research in geriatrics, measures of physical activity are established through surveys of the engagement of older adults in actions that occur in different spaces and at different times, following different logics and intentions. Among them are utilitarian physical activities, subordinated to specific objectives, such as those performed in work situations, while commuting and during domestic hygiene. There are non-utilitarian physical activities, but subordinated to a purpose, which are carried out in leisure situations. Among these are physical exercises and sports, the former characterized by planning, structuring and systematization associated with the purpose of maintaining or improving physical condition. Sports respond to pre-established, common sense rules, and their main objective is participation, but they can also be aimed at physical conditioning[6].

There is great interest in creating indicators of people's involvement in practices that require body movement and physical effort and are carried out in free or leisure time. They are associated with different values and meanings, mainly related to health, socialization and the improvement of physical conditioning[5,6]. There is evidence of a positive association between high levels of leisure-time physical activity and a decrease in the risk of cognitive decline in old age[7-10], supporting the notion that the regular practice of these activities is a relevant modifiable risk factor for maintaining cognitive status.

Unfortunately, the engagement of older adults in leisure-time physical activities tends to decline[5,11,12], together with functionality[12] and living space[11,12]. Likewise, systemic arterial hypertension (SAH) and obesity can act as barriers to engaging in leisure-time physical activities[13] and cognitive health[14,15]. The impact of these changes is felt in the physical[3,11], cognitive[14,15] and psychosocial[3] spheres, affecting the quality of life of older adults[17] and interfering in health system costs and impacting the economy of families[11,14].

Brazilian literature on the effects of the isolated or combined presence of leisure-time physical activity levels, hypertension and obesity on the cognitive status of older adults is scarce. The theme is important considering that the three conditions act in determining the cognitive status in adult life and in old age and their control integrates an arsenal of resources for dementia prevention. This study aimed to describe the prevalence and incidence of cognitive impairment in older adults, considering the isolated or concurrent presence of leisure-time physical activities, SAH and obesity, while also analyzing the isolated and concurrent presence of physical inactivity, obesity, hypertension and cognitive impairment in two measurement times.

METHODS

The research adopted an observational, analytical, cohort design, based on baseline and follow-up records from the electronic database of the Frailty in Brazilian Elderly Study (FIBRA Campinas). Its participants were part of the sample of a multicenter, population-based study on frailty in older adults,

with baseline and follow-up measurements taken in 2008 and 2009 and 2016 and 2017, respectively.

At baseline, the sample consisted of 900 individuals aged 65 and over, recruited by trained personnel, in family households and in points of flow of older adults located in 90 census tracts drawn at random, from all census units in the urban area from the municipality of Campinas, SP, Brazil. Quotas of men and women aged 65 to 69, 70 to 74, 75 to 79 and 80 and over, to be recruited to represent the older adult population were estimated, with a 4% margin of error. The follow-up sample comprised 394 older adults aged 72 years or over, recruited from addresses collected at baseline and interviewed in 2016 and 2017. Among these, 129 (14.3%) had died and 377 (42.9%) were considered as sample losses, because they could not be located (60.2%) or because the area in which they lived offered risk to the interviewers (0.9%), refusal to participate (31.8%) or withdrawal (1.8%), and exclusion due to the research criteria (5.3%).

The eligibility criteria for the baseline sample were 65 years of age or over and permanently residing in the census tract and household. Older adults who presented the following were excluded: severe sensory and communication problems; motor and language sequelae resulting from stroke; restricted to bed or a wheelchair; advanced-stage Parkinson's disease; cognitive impairment suggestive of dementia; cancer and undergoing chemotherapy treatment. In the follow-up, older adults who declared not knowing or not wanting to respond to items of the instruments used to measure the variables of interest were excluded.

The older adults were invited to participate in a single data collection session at previously scheduled dates and times: at baseline in community centers, clubs, churches, schools and basic health units; and during follow-up, at home. Details on the composition of the sample for the two phases, on recruitment and on data collection have been described in previous publications[16,17].

Verbal, clinical, and performance measurements were part of the research protocol at baseline and follow-up. Measurements of leisure-time physical activity was derived from the investigation of daily and weekly time spent practicing moderate and vigorous physical exercise, using 11 dichotomous items selected from the Minnesota Leisure Activity Questionnaire[18], which uses the level of caloric expenditure evaluated in metabolic equivalent of task (MET, where 1 MET =1 kcal/kg/h) as a criterion[6]. Activities considered as moderate, 3 to 6 METs, were: walking, cycling, ballroom dancing, gymnastics at home, hydrogymnastics, bodybuilding, and adapted volleyball. Activities considered as vigorous, more than 6 MET, were: gymnastics at a gym or club, light running, vigorous running, and swimming. For each activity performed in the last week, data on the frequency of practice and minutes per day were collected. Based on the WHO (2020) criteria, older adults who practiced 150 minutes of moderate activity or 75 minutes of vigorous activity at baseline and/or follow-up[19] were considered active. Based on these indicators, the older adults were classified into four groups: active at baseline and at follow-up (Active/Active); inactive at baseline and follow-up (Inactive/Inactive); active at baseline and inactive at follow-up (Active/Inactive); and inactive at baseline and active at follow-up (Inactive/Active).

SAH was assessed through three consecutive blood pressure measurements performed in the sitting and standing positions[20]. Older adults with systolic pressure ≥140 mmHg and/or diastolic pressure ≥90 mmHg[21] were considered hypertensive. Obesity assessment was based on anthropometric measurements of weight and height, which were converted into body mass indexes [BMI = weight (kg)/height (m^2)] and compared with indicators of nutritional status: underweight (BMI ≤23.0 kg/m^2); normal weight (BMI >23.0 and <28.0 kg/m^2); overweight (BMI ≥28.0 and <30.0 kg/m^2) and obesity (BMI ≥30.0 kg/m^2) established by the World Health Organization[22]. Based on these values, the older adults were classified as obese (BMI ≥30.0 kg/m^2) and non-obese (other BMI values).

Cognitive status was indicated by the median scores obtained by older adults in the Mini Mental State Examination (MMSE)[23], adjusted for years of education, minus one standard deviation (17 for those who never attended school, 22 for those with 1 to 4 years of education, 24 for those with 5 to 8 years, 26 for those with 9 or more years)[24]. Thus, participants were classified with or without cognitive impairment.

At the two measurement periods, the variables submitted to statistical analysis were cognitive impairment (dependent variable) and leisure-time physical activity x inactivity, sex, age, education, SAH and nutritional status (independent variables). Comparisons were made between prevalences using the McNemar test. The observed prevalences were used to construct two Venn diagrams: one for baseline and the other for follow-up. Chi-square tests were performed to verify the variables statistically associated with physical activity x inactivity for these two periods. Poisson regression analysis was performed at follow-up to estimate the incidence ratio of cognitive impairment, with the respective 95%CI confidence intervals. All variables were incorporated into this adjusted analysis. The results were referenced at a significance level of 5% ($p<0.05$).

Before the interview, all participants signed a term of free, informed consent regarding the objectives and procedures of the research, and the ethical commitments of the researchers. The research projects and the pertinent documentation were previously approved by the Research Ethics Committee of the State University of Campinas by reports 907.575 (baseline), 1.332.651 (follow-up) and 3.281.728 (this study).

RESULTS

At baseline, the participant mean age was 72.8±5.3 years old and at follow-up, it was 81.4±4.8 years old. The majority were women (71.8%) and had between 0 and 4 years of education (74.4%). Table 1 presents the baseline and follow-up percentages of older adults who were classified as: physically active or inactive; with or without SAH; eutrophic, underweight, overweight or obese; and with or without cognitive impairment suggestive of dementia. At follow-up, a significantly higher number of inactive older adults and older adults with hypertension were observed than at baseline.

Table 1. Older adults who assessed themselves as physically active or inactive during leisure time, and presented with or without cognitive impairment, hypertension, and obesity, at baseline and at follow-up. FIBRA Study, Older adults, Campinas, SP, Brazil, 2008-2009 and 2016-2017.

Variable	Baseline	Follow-up	*p* value*
	n (%)	n (%)	
Leisure-time physical activity			
Active	219 (55.6)	75 (19.0)	<0.001
Inactive	175 (44.4)	319 (81.0)	
Systemic arterial hypertension			
No	184 (46.7)	144 (36.5)	<0.001
Yes	210 (53.3)	250 (63.5)	
Nutritional status**			
Eutrophic	169 (43.0)	169 (43.0)	
Underweight	55 (14.0)	75 (19.1)	0.999
Overweight	112 (28.5)	104 (26.5)	
Obese	57 (14.5)	46 (11.4)	
Cognitive deficit			
No	319 (81.0)	310 (78.7)	0.370
Yes	75 (19.0)	84 (21.3)	

*McNemar test; **Determined by body mass index (BMI).

In Figure 1, the Venn diagram presents the isolated and concurrent prevalence of hypertension, obesity, leisure-time physical inactivity and cognitive impairment at baseline. Among the older adults, 23.0% presented hypertension, 19.1% were inactive, 7.0% showed cognitive impairment, and 3.7% were obese; 21.5% were both inactive and hypertensive, 7.0% were hypertensive and showed cognitive impairment, 4.3% were obese and hypertensive, 3.0% were obese and inactive, 2.4% were inactive and showed cognitive impairment, and 0.6% were obese and showed cognitive impairment.

The same relationships observed at baseline were present at follow-up: 35.6% of the participants were inactive and hypertensive, 20.4% were inactive and 11.4% were hypertensive, inactive and presented cognitive impairment (Figure 2).

To calculate of the incidence of cognitive deficit in the follow-up, the active older adults were excluded from the baseline sample (n=75), since the aim was to observe which variables were associated with a change in status, considering sex, age, education, SAH, obesity and leisure-time physical activity. Associations were observed between physical inactivity at follow-up, or for both measurement periods, and cognitive impairment at follow-up (Table 2).

According to the result of the Poisson regression model test, adjusted for the variables sex, age, level of education, nutritional status and SAH, older adults who were inactive at follow-up showed a higher incidence ratio for cognitive impairment at follow-up (Table 3).

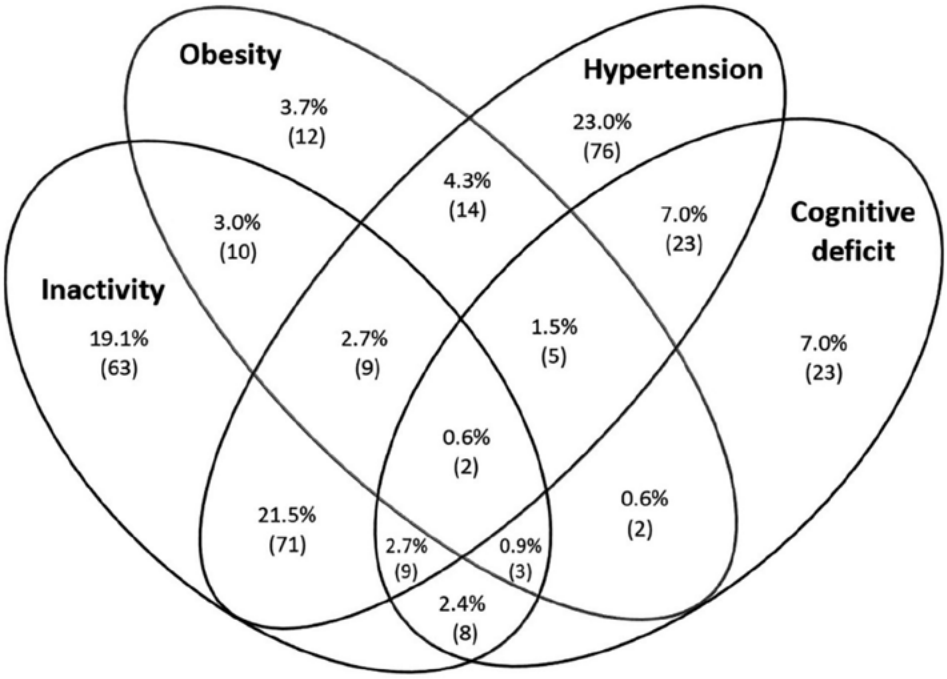

Figure 1. Venn diagram on the isolated and concurrent presence of physical inactivity, obesity, hypertension and cognitive impairment at baseline (n=330). FIBRA Study, Older adults, Campinas, SP, Brazil, 2008-2009 and 2016-2017.

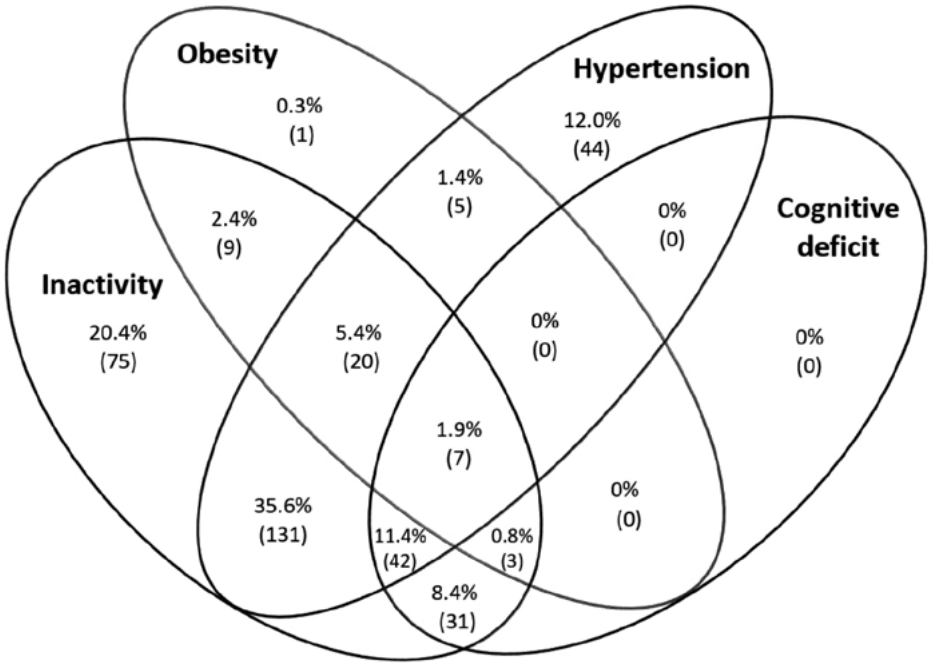

Figure 2. Venn diagram on the isolated and concurrent presence of physical inactivity, obesity, hypertension and cognitive impairment at follow-up (n=368). FIBRA Study, Older adults, Campinas, SP, Brazil, 2008-2009 and 2016-2017.

Table 2. Incidence of cognitive impairment at follow-up, considering sociodemographic variables, SAH, nutritional status and leisure-time physical activity. FIBRA Study, Older adults, Campinas, SP, Brazil, 2008-2009 and 2016-2017.

Variable	With Cognitive Impairment 264 (82.8%) n (%)	Without Cognitive Impairment 55 (17.2%) n (%)	*p* value*
Sex			
Male (95)	76 (80.0)	19 (20.0)	0.396
Female (224)	188 (84.0)	36 (16.0)	
Age			
65-69 years old (104)	86 (82.7)	18 (17.3)	
70-79 years old (183)	155 (84.7)	28 (15.3)	0.208
80 years old or over (32)	23 (71.9)	9 (28.1)	
Education			
Never attended to school (53)	40 (75.5)	13 (24.5)	
1-4 years of schooling (182)	149 (81.9)	33 (18.1)	0.101
5 or more years of schooling (84)	75 (89.3)	9 (10.7)	
Obesity			
Non-obese (273)	226 (82.8)	47 (17.2)	0.926
Obese (45)	37 (82.3)	8 (17.7)	
Leisure-time physical activity			
Active/Active or Inactive/Active (218)	190 (87.2)	28 (12.8)	**0.002**
Active/Inactive or Inactive/Inactive (101)	74 (73.3)	27 (26.7)	

*Chi-square test; statistically significant difference p<0.05

Table 3. Poisson regression model of cognitive impairment in the elderly over nine years, on average, considering leisure-time physical activity, sociodemographic variables, SAH and nutritional status. FIBRA Study, Older adults, Campinas, SP, Brazil, 2008-2009 and 2016-2017.

Variable	Cognitive impairment IR** (95%CI)	*p* value*
Leisure-time physical activity		
Active/Active and Inactive/Active (ref)	1.00	-----
Active/Inactive and Inactive/Inactive	2.04 (1.20-3.50)	**<0.001**
Sex		
Male (ref)	1.00	----
Female	0.83 (0.47-1.48)	0.545
Education		
Never attended to school (ref)	1.00	----
1-4 years of schooling	0.69 (0.35-1.35)	0.285
5 years or more of schooling	0.45 (0.19-1.07)	0.073
Age		
65-69 years old (ref)	1.00	----
70-79 years old	0.89 (0.49-1.64)	0.728
80 years old or over	1.44 (0.63-3.28)	0.375
SAH***		
Non-hypertensive (ref)	1.00	----
Hypertensive	1.14 (0.65-2.00)	0.951
Nutritional status, determined by BMI****		
Non-obese (ref)	1.00	----
Obese	0.23 (0.59-0.96)	0.045

* Poisson regression; ** Incidence ratio; *** SAH, systemic arterial hypertension; **** BMI, body mass index.

DISCUSSION

At baseline and follow-up, low leisure-time physical activity and SAH were the most prevalent conditions, while obesity and cognitive impairment were the least prevalent. The incidence of cognitive impairment at follow-up was higher among physically inactive older adults than among those who were physically active. The prevalence of obesity did not increase during follow-up, in contrast to that observed for low weight, possibly due to the presence of older adults in the sample. However, a significant association was determined between obesity and cognitive impairment.

From baseline to follow-up, a significant increase was observed for physically inactive older adults in leisure situations. A literature review which analyzed data from several countries showed that the inactivity rate increases among adults over 70 years old, affecting between 35% and 80% of the population[26]. In this study, the number of inactive older adults varied in a similar manner, increasing from 44.4% to 81%. The larger number of inactive people was probably motivated by the loss of functional and cognitive abilities and the emergence of limitations associated with these. Fear of falls and injuries and a lack of motivation and family support, together with the scarcity of information on exercises separate older adults from the practice and make them more vulnerable to chronic diseases, disability and inactivity[3,27].

Data from this study indicate that SAH showed an increased prevalence at follow-up, when 64.4% of older adults were hypertensive. These data are comparable with other similar national population studies[28,29], and in the international scenario, similar data were obtained for the population over 70 years of age[26,30]. The practice of physical exercises and the

presence of SAH has a reverse causality relation, as regularly active individuals show lower rates of cardiovascular diseases, while non-practitioners are more likely to present these types of disease[30,31]. The practice of physical activity is closely linked to good cardiovascular health and lower rates of disease. In this research, the concurrent prevalence of SAH and physical inactivity increased during follow-up. In contrast, the implementation of an active routine helps control blood pressure, improves cardiovascular function and protects cognitive function[1,30].

The increase in the concomitant occurrence of the conditions studied at follow-up, compared with baseline, can be associated with the decrease in functional reserves resulting from aging, in combination with lifestyle[13]. One Brazilian study that analyzed the patterns of multimorbidity in individuals aged 50 years old or over, associated the occurrence of two or more diseases with age, a risk factor for the coexistence of several chronic health conditions[29]. The same result was obtained in a clinical[1] and an epidemiological study[28], in which 80% of adults over 70 years old presented at least two chronic conditions. The coexistence of these factors can influence other systems, trigger comorbidities, increase systemic inflammation, and impair physical and cognitive health[26,30]. Physical and cognitive losses are often associated with multimorbidities, disabilities and inactivity[27].

Cognitive decline was mainly influenced by the condition of physical inactivity: older adults who were physically inactive at baseline and at follow-up were 2.27 times more likely to present cognitive impairment than those who exercised at some point. The literature indicates that physical inactivity is associated with worse cognitive health and a greater probability of developing dementia and Alzheimer's disease[14]. Inactive older adults have a 20 to 30% greater risk of developing cognitive losses than those who exercise[32]. In contrast, physical activity can help improve cognitive function and, consequently, delay the progression of cognitive impairment, even in older adults who practice activities below recommended levels[33].

Participants active at baseline and inactive at follow-up were more likely to score for cognitive impairment at follow-up. There is evidence that discontinuing exercise in a group of older adults for just 10 days resulted in reduced hippocampal blood flow, a predictor of cognitive impairment in the long-term[34]. From such findings, we can infer the importance of regular and uninterrupted practice of exercises to maintain good cognitive health.

A study involving 3,752 adults and older adults, using a methodology similar to that developed by this research, tracked the participants' physical activity for 12 years and classified the individuals into four groups: active in the pre- and post-test periods; inactive in both these periods; active in the pre-test period, and inactive in the post-test period; and inactive in the pre-test period and active in the post-test period[31]. They observed that the groups formed by older adults who were inactive in the pre- and post-test periods, and those who were active in the pre-test and inactive in the post-test period, were more likely to present chronic diseases and had worse general health status, which were significantly associated with cognitive impairment. These results suggest that long-term physical inactivity can harm physical health, functionality and cognition.

The difficulty in implementing an exercise routine, in combination with symptoms of illness, disability and use of medication[3,26] increases inactivity and exposes older adults to the risks of developing cognitive impairment and comorbidities[32]. Even though they do not present a consensus regarding the ideal quality and quantity of ideal exercises for the older adult population, such studies converge in their appraisal of this practice, as a great ally in the fight against cognitive decline and physical inactivity[31]. The practice of physical exercises is inherent to good cognitive health, prevents chronic diseases and contributes to a process of successful aging. Despite presenting practical limitations, it is still a simple, effective, lower cost action for older adults and the health system than the use of medication. Over the years, readjusting and planning activities to maintain the ideal level of demand is important to avoid discouragement and discontinuation.

At follow-up, obesity was shown to be a protective factor for cognition among the oldest participants, a finding also observed in the systematic review by Dall

and Hassing[35]. Although this cannot be considered indicative of a cause and effect relationship, this data suggests the presence of greater cognitive reserve and more robust health status in the obese older adults than in those who scored for frailty, sarcopenia, low weight and associated morbidities, most of whom died earlier.

One limitation of this study is that the records obtained at two time periods separated by a relatively long interval fail to inform us about how continuous or intermittent the practice of exercises was over the years, because intermediate measures are unavailable. Another limitation stems from the fact that data on leisure-time physical activities were self-reported and were not supplemented by objective measures. The strengths of the study result from the prospective design and the fact that the follow-up sample is composed of long-lived people from a sample that was originally population and census based.

CONCLUSION

Physical inactivity represented a risk factor for cognitive decline in the sample studied. In contrast, the continuous practice of physical exercises is a tool for promoting successful aging, healthy cognition, and the prevention of chronic diseases and their consequences. More data are required to elucidate mechanisms that explain how physical exercises can facilitate improvements in these conditions in the long-term.

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Neuroticism and satisfaction with relationships and with life in old age

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Abstract

Objectives: To investigate the association between neuroticism and life satisfaction and social support in married older people; in addition to verifying whether satisfaction with marriage and with family and friendship relationships are mediators of these associations. *Method:* A cross-sectional was study carried out with data from the Fragility in Older Adult Brazilians (FIBRA) study. A total of 194 older people recruited from residential households participated in the survey. Instruments used included a sociodemographic questionnaire; the NEO-PI-R-Neuroticism scale from the Big Five Personality Inventory; five items semantically adapted from the ISEL (Interpersonal Support Evaluation List) and single items rated on scales (five points each) for the variables satisfaction with marital, family, and friendship relationships and for satisfaction with life. Structural equation modelling via path analysis was performed. *Results:* The sample comprised individuals who were predominantly men (54.6%), and that reported being satisfied or highly satisfied with life, marriage, friendships, and family relationships. Participants with lower neuroticism scores had higher satisfaction with life, marriage, friendships, and family relationships. Greater satisfaction with marriage and friendships was directly associated with better social support. Satisfaction with family members and friends were variables mediating the association between neuroticism and life satisfaction. *Conclusion:* Individuals with higher levels of neuroticism are less satisfied with their relationships and with life. Longitudinal research is needed to explain the relationships observed.

Keywords: Older adults. Neuroticism. Marriage. Friends. Social support. Family Relations.

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INTRODUCTION

Social relationship networks and social support are a focus of investigation in various different areas. In the field of gerontology, these social aspects are studied predominantly for their role in health and psychological wellbeing of older adults[1]. According to the convoy model of social relationships, individuals are surrounded by significant people, more commonly family and friends, who accompany and support them throughout the life course. The strength of these relationships varies according to closeness (e.g. geographical, contact frequency), quality (e.g. positive, negative), function (e.g. help, affect, information sharing) and structure of social networks (e.g. number of components in group) [2].

The theory of selectivity holds that perceived passage of time and chronological age play a central role in prioritizing activities and in choosing social partners. In later life, individuals actively change their social networks, selecting emotionally positive relationships as an adaptation mechanism which favors well-being[3]. In this context, couples that stay together in late life tend to be inclined to experience the positive aspects of the relationship and enjoy greater marital satisfaction. These individuals tend to have greater control over their emotions when interacting with one another, seeking to experience the present, appreciate the good, while forgetting concerns and prioritizing meaningful experiences[4].

Social support denotes the support given and/or received, encompassing instrumental, emotional or affective aspects and affirmation or confirmation of values or beliefs of an individual. Satisfaction with support can be defined as the assessment people make of the support received[1]; the manner in which they perceive this may favor or otherwise coping with the stressors associated with aging[5]. Previous studies[6,7] have shown that older people who have greater perceived social support tend to be more satisfied with life.

Satisfaction with life is influenced by marital, family and friendship relationships[8,9]. The quality of close personal relationships can have direct effects on physical and mental health outcomes, and also exert a indirect impact on health through social support received[10]. Satisfaction with life and with relationships are influenced by personality traits, including neuroticism[11]. This personality factor is defined operationally by items related to anxiety, hostility, depression, excessive self-consciousness, impulsiveness and vulnerability, intercorrelated on factor analyses[12].

On the five-factor model of personality (Big Five) described by Costa and McCrae[12], neuroticism was consistently identified as having a greater effect on relationships than the other four factors (extroversion, openness to experience, agreeableness and conscientiousness). Individuals with a high level of neuroticism tend to focus on negative aspects of themselves, of others and of social, family and marital relationships. These individuals often experience negative affect and have limited capacity to deal with stress adaptively[13,14].

According to the integrated Vulnerability-Stress-Adaptation model[14], marriages in which couples have high neuroticism scores are more susceptible to stress, vulnerability and to less resilient adaptive processes. Studies involving married people of different age groups[15,16], including older couples[17], have shown neuroticism to be a negative predictor of marital satisfaction. Individuals with high neuroticism scores display greater insecurity in relationships, are more critical of their partner, disdainful and defensive[15]. They also show less tolerance and empathy, act more negatively in marital relationships, and divorce more than individuals with low levels of neuroticism[18]. With aging, personality traits tend to have a significantly greater influence on marital satisfaction of men than of women[17].

There is a dearth of Brazilian studies investigating the influence of neuroticism on marital relationships of older adults, and also a lack of psychometric studies of instruments involving these variables. Such studies are important, not least because close personal relationships are considered central aspects in the life course, and marital life constitutes one of its most complex experiences. Thus, the objectives of the present study were to investigate the associations among neuroticism, life satisfaction and social support in married individuals, and to determine whether the variables satisfaction with married life,

family relationships and friendship relations are mediators of these associations.

METHOD

A population-based cross-sectional study was conducted of follow-up data from a cohort of older participants of the FIBRA (Fragility in Older Adult Brazilians) study for the 2008-2009, 2016-2017 waves in Campinas city and subdistrict of Ermelino Matarazzo, São Paulo state, Brazil[19]. Details on the sampling, variables and measurements at study baseline (2008-2009) and follow-up (2016-2017) can be found in Neri et al.[19,20].

Inclusion criteria were: agreeing to take part in the follow-up (2016-2017) of the FIBRA study; being married, having records available of responses about marital satisfaction; and score above cut-off for dementia screening on the Mini-Mental State Exam (MMSE)[21], adjusted for years of education (17 points for illiterate subjects, 22 for 4 years of formal education, 24 for 5-8 years, and 26 points for ≥9 years of education).

Recruitment of participants for the follow-up of the FIBRA study (2016-2017) was performed using the lists of household addresses held on the baseline database (2008-2009; N=1,284). Trained recruiters carried out an active search of these individuals with a maximum of 3 tries at the available addresses to invite them to join the follow-up sample. At this stage, of the 1,284 respondents at baseline, 549 (42.7%) were located and fully re-interviewed; 192 (14.9%) had died and 543 (42.4%) were lost to follow-up: 59,9% not found, 34.5% refusals; 5.5% FIBRA exclusion criteria; 1.6% halted session; and 0.5% interviewer safety risk.

Of the 549 participants interviewed, only 194 were included in the present sample. Individuals who were not married at the time of follow-up interview (n=301) and couples with no responses available for the item on marital satisfaction (n=54) were excluded.

Sociodemographic variables included sex, age, years of education and marital status and were assessed based on self-report items. The Neuroticism trait was measured using the NEO Personality Inventory-Revised (NEO PI-R) – Neuroticism scale[11], semantically validated for Portuguese by Flores-Mendoza[22], comprising 12 items scored on a Likert-type scale (totally agree to totally disagree). Given the absence of parameters obtained by psychometric studies for Brazilian older adults, responses were categorized into ranges for scores attained by the respondents. Scores in the 30-48 range were taken to indicate a high level of neuroticism; 24-29 as intermediate level; and 11-23 as low level.

Perceived social support was assessed using 5 questions selected and semantically adapted from the ISEL (Interpersonal Support Evaluation List), addressing instrumental, material, informative, social and emotional support[23], namely: *"When you feel lonely, are there several people you can talk to?"; "Do you meet or talk with friends and family?; "If you were sick, would you easily find someone to help you with your daily chores?"; "When you need suggestions on how to deal with a problem, do you know someone you can turn to?"; "is there at least one person you know whose advice you really trust?"*. The following scores were attributed to the responses: 1 - "never", 2 - "sometimes", 3 - "most of the time"; and 4 - "always". The mean of scores on the scale was calculated.

Marital satisfaction was assessed using the item "*how satisfied are you with your marriage?"* (responses from 1- 5, where 1 - "not at all", 2 - "somewhat", 3 - "fairly", 4 - "very"; and 5 - "completely"), as proposed by Umberson et al.[24] Mean scores on the scale were determined.

Satisfaction with family and friendship relationships was assessed by applying the 2 items (*How satisfied are you with your friendship relationships? How satisfied are you with your family relationships?* with responses 1-5 (1-"highly dissatisfied", 2-"dissatisfied"; 3-"neither satisfied nor dissatisfied", 4–satisfied", or 5-"highly satisfied"), as proposed by Ferring et al.[25]. The mean of scores on the scale was calculated.

Satisfaction with life was measured using the question *"How satisfied are you with your life?"*, as devised by Neri[26]. Responses were 1-"highly dissatisfied", 2-"dissatisfied"; 3-"neither satisfied nor dissatisfied", 4–"satisfied", or 5-"highly satisfied". The mean of scores on the scale was calculated.

The present study was approved by the Research Ethics Committee of the Universidade Estadual de Campinas on 23/11/2015 (permit no. 1.332.651), and on 17/09/2018 (permit no. 2.899.393), for the Campinas and Ermelino Matarazzo follow-ups, respectively. All participants signed the Free and Informed Consent Form prior to interview.

The sample was characterized by a descriptive analysis, with categorical variable expressed as absolute and relative frequency, and quantitative variables as mean and standard deviations. Percentage distributions and respective 95% confidence intervals were estimated.

Structural equations modeling (path analysis) was used to determine the relationship among the variables of interest according to the theoretical model outlined (Figure 1). This type of analysis serves as an extension of the regression model and is employed to explore multiple relationships among variables. The approach allows the identification of direct or indirect associations among independent and dependent variables. After adjusting for indicators and applying tests of significance, the final paths analysis model is produced, retaining or removing associations from the previous theoretical model.

Tests of significance for path coefficients, expressed as betas, were performed to analyze the goodness-of--fit of the data to the proposed model. Absolute values of $t>1.96$ show the path has a statistically significant coefficient. The level of significance adopted for the tests was 5% or $p<0.05$. The parameters adopted for acceptance of the model were: chi-square test for goodness-of-fit >0.05; chi-square ratio (X^2/DF) <2; SRMR (Standardized Root Mean Square Residual) ≤0.10; RMSEA (Root Mean Square Error of Approximation) ≤0.08; CFI (Comparative Fit Index) ≥0.90; and TLI (Tucker-Lewis Index) ≥0.90.

RESULTS

For the overall sample (n=194), participants were predominantly men (54.6%) and had 1-4 years of education (57.2%). Participants had mean age of 79.3±4.09. Neuroticism score was in the 12-49 range and had a mean of 25.9±7.38, while perceived social support was in the 5-25 range with a mean of 18.0±4.76. The majority of respondents reported being satisfied or highly satisfied with life, marriage, friendships and family relationships. More detailed information is given in Table 1.

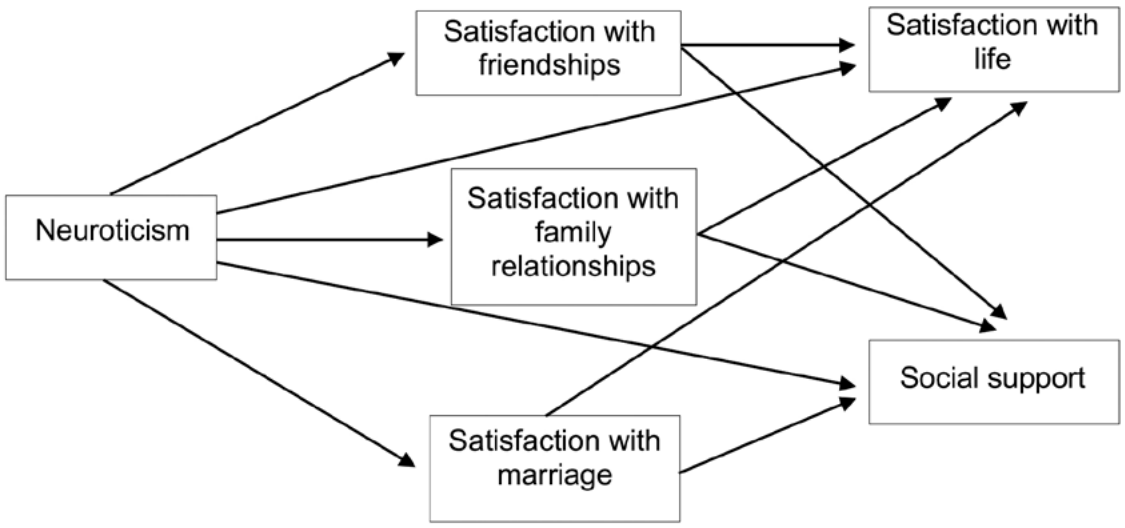

Figure 1. Hypothetical model of associations of neuroticism with life satisfaction and with social support. Fibra Study, Older Adults, Campinas and Ermelino Matarazzo, São Paulo state, Brazil, 2016-2017.

Table 1. Characteristics of participants. Fibra Study. Older adults, Campinas, São Paulo state, 2016-2018.

Variables	n (%) or Mean ± SD
Age, Mean ± SD [n=194]	79.3 (± 4.1)
Sex	
Female	88 (45.4%)
Male	106 (54.6%)
Education (years) [n=194]	
Illiterate	32 (19.5%)
1-4	111 (57.22%)
5-8	33 (17.0%)
≥9	18 (9.3%)
Neuroticism, Mean ± SD [n=194]	25.9 (± 7.4)
Satisfaction with friendships [n=172]	
Highly dissatisfied	2 (1.2%)
Dissatisfied	7 (4.1%)
Neither satisfied nor dissatisfied	14 (8.1%)
Satisfied	101 (58.7%)
Highly satisfied	48 (27.9%)
Satisfaction with family [n=172]	
Highly dissatisfied	2 (1.2%)
Dissatisfied	4 (2.3%)
Neither satisfied nor dissatisfied	17 (9.8%)
Satisfied	88 (51.1%)
Highly satisfied	61 (35.5%)
Satisfaction with marriage [n=194]	
Not at all	4 (2.0%)
Somewhat satisfied	10 (5.1%)
Fairly satisfied	29 (14.9%)
Very satisfied	67 (34.5%)
Completely satisfied	84 (43.3%)
Satisfaction with life [n=172]	
Highly dissatisfied	2 (1.1%)
Dissatisfied	2 (1.1%)
Neither satisfied nor dissatisfied	24 (13.9%)
Satisfied	84 (48.8%)
Highly satisfied	60 (34.8%)
Social support [n=144]	18.0 (±4.7)

The first revision included covariation between the variables satisfaction with friendships and with family relationships. In the second revision of the paths, significant acceptable values were obtained for all goodness-of-fit criteria (p<0.05) (Table 2). The changes made to the final model removed the direct associations between neuroticism and perceived social support; satisfaction with family relationships and perceived social support; satisfaction with marriage and satisfaction with life.

Table 2. Measures of goodness-of-fit for variables investigated in paths analysis. Fibra Study, Older Adults, Campinas and Ermelino Matarazzo, São Paulo state, Brazil, 2016-2017.

Goodness-of-fit criteria	Initial model	After 1st revision	After 2nd revision
Chi-square test for goodness-of-fit	<0.001	<0.001	0.418
Chi-square ratio (c2/GL)	<0.001	<0.001	<0.001
TLI (Tucker-Lewis Index)	-0.035	0.395	0.999
CFI (Comparative Fit Index)	0.724	0.718	1.000
SRMR (Standardized Root Mean Square Residual)	0.111	0.119	0.049
RMSEA (Root Mean Square Error of Approximation)	0.249	0.191	0.008

The outcome of the paths analysis is depicted in Figure 2. The main findings of the analysis were: lower neuroticism scores were associated with higher levels of satisfaction with life, marriage, friendships and family relationships; higher levels of satisfaction with friendships and with family relationships were associated with greater levels of life satisfaction; and higher levels of satisfaction with marriage and with friendships were directly correlated with better perceived social support.

On the final paths analysis model, satisfaction with friendships and with family relationships were variables partially mediating the association between neuroticism and satisfaction with life. The relationship between neuroticism and perceived social support was mediated by the variables satisfaction with marriage and satisfaction with friendships (Figure 2).

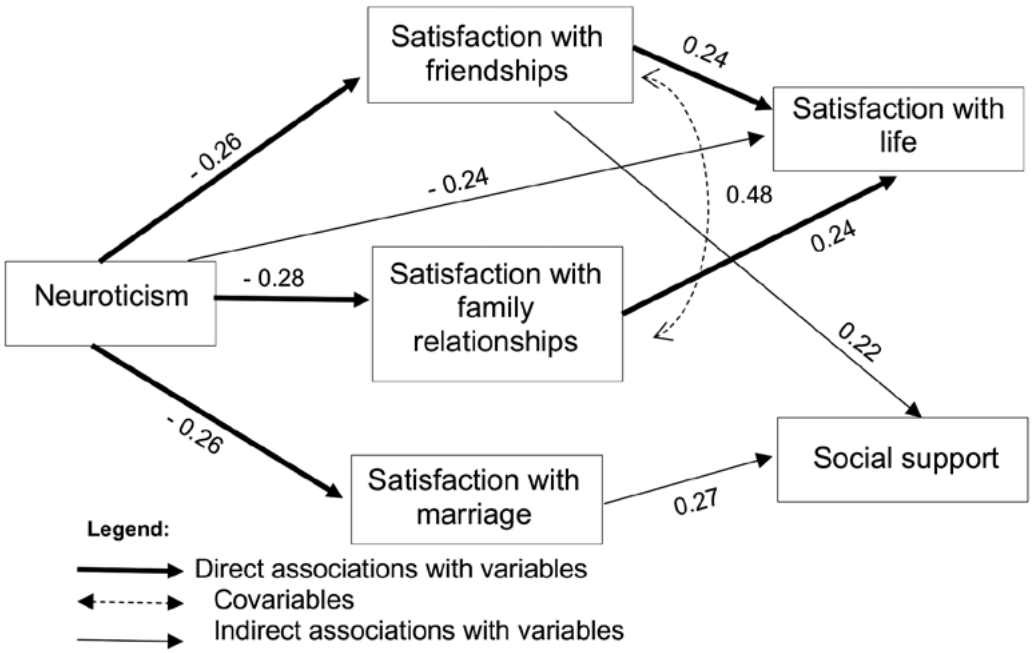

Figure 2. Final model of associations of neuroticism with life satisfaction and with social support according to path analysis. Fibra Study, Older Adults, Campinas and Ermelino Matarazzo, São Paulo state, Brazil, 2016-2017.

DISCUSSION

For the sample studied, participants were predominantly male, aged ≥ 70 years, and had education of 1-4 years. Overall, participants reported being satisfied or highly satisfied with life, marriage, friendships and family relationships. A previous study[27] revealed that married older adults reported greater satisfaction with life than individuals who were divorced or had lost their partner, especially those who benefited from group activities and emotional support. In the present study, no statistically significant association between marital satisfaction and satisfaction with life was found.

According to the integrated vulnerability-stress-adaptation model of Karney and Bradbury[14], personality traits influence marital functioning and satisfaction over time, acting as a vulnerability factor or protective factor for the relationship and well-being. In the present study, participants with lower neuroticism scores reported higher satisfaction with marriage, mirroring the results of previous studies[16-18].

High neuroticism score is associated with negative cognitive, behavioral and emotional aspects for marital relationships[15]. By contrast, individuals with low neuroticism are more likely to forgive their partner´s faults, interact more positively with them, have higher levels of sexual satisfaction and be more satisfied with marital relations[17]. In the present study, lower neuroticism scores were associated with greater satisfaction with life, friendships and family relationships. Greater satisfaction with friendships and with family relationships were associated with greater satisfaction with life. These results are consistent with the principles of the convoy model of social relationships. In later life, social convoys involving good quality relationships and providing support when needed favor satisfaction with life[1].

Satisfaction with family relationships and friendships were found to mediate the association between neuroticism and satisfaction with life, in congruence with the theoretical model proposed. Greater satisfaction with marriage and with friendships was directly associated with better perceived social support, echoing the findings of Sullivan et al.[28]. Satisfaction with family relationships showed no direct association with social support, and the association between neuroticism and social support was mediated by the variables satisfaction with marriage and with friends, but not by satisfaction with family relationships.

The literature emphasizes the importance of differentiating satisfaction with family relationships from satisfaction with friendships. The effects of these relationships on perceived social support and satisfaction with life differ in as far as family relationships are obligatory, whereas those with friends are based on freely chosen criteria, being potentially more positive than relationships maintained by obligation[1,28,29].

The family is often elected as the source of social support, but has more potentially for causing stress than relationships with friends. The companionship, reciprocity and social support of friends, often understood as "chosen parents" (e.g. brotherly friends), can serve as socioemotional resources that can cushion the negative effects of conflicting family interactions on the psychological wellbeing of older individuals[30,31]. These results can be interpreted in the context of the theory of socioemotional selectivity[2,3], according to which, as individuals age, they tend to prefer social relationships that provide more satisfactory and high affective quality social interactions over interactions to acquire knowledge or social status.

The results help promote reflection on the dynamic of interpersonal relationships that include neuroticism and contribute toward furthering understanding of the psychological mechanisms underlying the interaction between personality in later life and satisfaction with close personal relationships. Given that personality traits are relatively stable over the lifespan, they can be used to predict behaviors of an individual in different life situations, including marital, family and friendship relationships.

Assessing the personality traits of older married couples can yield knowledge on low marital satisfaction, which can increase the risk of "gray divorce" (divorces in couples aged ≥ 50 years) and of worse health status in late life. These findings can aid professionals in the areas of Geriatrics, Gerontology

and Psychology to develop health promotion strategies, besides social and clinical interventions which can strengthen affective bonds of older individuals with their partners, family members and friends. This study has some limitations, most notably the small sample size and high attrition of participants between baseline and follow-up.

CONCLUSION

The present study revealed the mediating influence of satisfaction with family and with friends on the associations between neuroticism and satisfaction with life; and of satisfaction with marriage and friends on the associations between neuroticism and social support in married community-dwelling older adults. The majority of respondents reported being highly satisfied with life, marriage, friendships and family relationships, particularly those with lower neuroticism scores. Moreover, respondents with higher levels of satisfaction with marriage and friendships had better perceived social support. Longitudinal studies are needed to elucidate the associations found. Mediation of these associations by protective factors promoted by education on aging and psychoeducation for couples and families are areas warranting further research, together with investment in public policies and health promotion actions during the life course.

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Changes in anthropometric indicators and gait speed in older adults: cohort study

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Abstract

Objective: To characterize changes in anthropometric indicators in older adults and investigate whether being overweight was associated with lower gait speed (GS), based on measurements taken at an interval of nine years. *Methods:* Cohort study with older adults (≥65 years), conducted in 2008-2009 (baseline) and 2016-2017 (follow-up) in the city of Campinas/SP and in Ermelino Matarazzo/SP, Brazil. Body weight, height, waist circumference (WC) and hip (HC) measurements were taken and used to determine the following indicators: body mass index (BMI), waist-to-height ratio (WHtR), waist-to-hip ratio (WHR) and conicity index (C index). The T and Wilcoxon tests for paired samples were used to estimate the differences. *Results:* Information from 537 older adults (70.0% women) with a mean age of 72.2 years at baseline and 80.7 years at follow-up were analyzed. After nine years, the men showed significant decreases in weight, height and BMI, and an increase in the C index. In women, decreases in weight, height and BMI, and increases in WC, HC, WHtR, WHR and C index were observed. The percentage variations observed were: -3.89% (weight), -0.36% (height), -4.18% (BMI) and +2.27% (C index) among men; -2.95% (weight), -0.65% (height), -0.73% (BMI), +3.33% (WC), +1.59% (HC), +3.45% (WHtR), +2.27% (WHR) and +4.76% (C-Index) among women. Being overweight was associated with greater odds ratio of stability and new cases of lower GS at follow-up. *Conclusion:* Changes were identified in weight, height, BMI, and indicators of abdominal obesity, especially in women, together with an association between being overweight and lower GS.

Key words: Aged. Anthropometry. Body Composition. Gait. Obesity, Abdominal. Longitudinal Studies.

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INTRODUCTION

The aging process, or senescence, is associated with changes in body composition that include a reduction in muscle and bone tissue, and an increase in and redistribution of adipose tissue[1,2]. The loss of muscle tissue causes a decrease in the basal metabolic rate, predisposing older adults to weight gain[1,2], together with higher incidence of chronic non-communicable diseases (CNCDs), regardless of age, sex and body composition[3].

Loss of muscle mass loss and increased fat mass heighten the risk of mortality[4-6] and produce negative effects on health and quality of life, including a decline in gait speed[7,8] and functional capacity[6,9-11], higher occurrence of falls[6,11], frailty[11-13] and CNCDs[6]. A follow-up study involving North American older adults showed a higher incidence of mobility limitation (difficulty walking or climbing stairs) among overweight or obese men and women at 25, 50 and 70 to 79 years of age, compared with those who maintained a healthy weight[9]. A meta-analysis with data from two cohorts conducted on older adults in Spain detected a higher risk of frailty among obese individuals, higher scores in the fatigue criteria, low levels of physical activity and low handgrip strength[13].

Excess visceral adipose tissue and ectopic fat deposits (liver, pancreas, heart, musculoskeletal system, and bone marrow) increase the production of inflammatory cytokines and reduce the production of adiponectin, a protein that has an anti-inflammatory, antidiabetic and antiatherogenic role[14]. In old age, the activation of the innate immune system triggers a low-grade chronic inflammatory process called inflammaging, which accelerates the development of chronic diseases and loss of muscle mass[14,15].

There are several anthropometric indicators considered practical, inexpensive and that show good reliability in the assessment of body composition, such as body mass index (BMI), waist circumference (WC) and waist-to-hip ratio (WHR) that are widely used, in addition to others like the waist-to-height ratio (WHtR) and the conicity index (C index), which are rarely used in clinical practice and in population studies. Since it adjusts for height, WHtR is better than WC at detecting cardiovascular diseases, diabetes, arterial hypertension and dyslipidemia in men and women[16]. The C index comes from measurements of weight, height and WC, and is based on changes in body design – from the shape of a cylinder to a double cone (two cones with a common base) – due to the concentration of fat in the abdomen[17]. With aging, the redistribution of adipose tissue and its accumulation in the abdominal region affect the ability of these indicators to classify older adults with excess adiposity[6,15]. BMI does not assess the distribution of body fat, especially that deposited in the visceral region, which makes it less accurate for detecting increased cardiometabolic risk than the other indicators mentioned[18,19].

The Frailty Profile of Elderly Brazilians (FIBRA Study) is a multicenter, population-based survey that was developed in 2008-2009 in 17 cities located in all five geographic regions of Brazil, selected by criteria of convenience. It aimed to characterize frailty profiles in adults aged 65 years old and over, considering a profusion of instruments and variables. One of the consequences of this research was a follow-up study, in 2016-2017, involving older adults from the initial study who were still alive and residing in Campinas/SP and Ermelino Matarazzo/SP. In the follow-up survey, the sociodemographic, anthropometric, frailty phenotype and mental status variables collected in the initial survey were repeated.

The literature provides accumulated evidence on the nutritional status of older adult populations and associated factors. In contrast, there are few national studies that analyze changes in body composition and associations with adverse health outcomes, particularly in a sample with a considerable portion of adults aged 80 years old and over.

The aim of this study was to characterize changes in anthropometric indicators in older adults and to investigate whether being overweight is associated with lower gait speed, based on measurements taken at an interval of nine years.

METHODS

This is a multicenter, populational cohort study conducted using data from the FIBRA Study. Data collection originally took place in 2008-2009, in

cities chosen for convenience in the five Brazilian geographic regions, which were gathered in poles coordinated by four public universities, including the State University of Campinas and its survey of seven cities. In each one, a representative sample of the urban population of older adults aged 65 years and over[20] was selected. In 2016-2017, Campinas/SP and Ermelino Matarazzo, a district of the city of São Paulo, conducted a cohort study involving older adult who had participated in the initial study and who still resided there, and the data obtained were analyzed in this research.

In 2008-2009 (baseline), 90 urban census sectors were randomly selected in Campinas and 62 in Ermelino Matarazzo. All households in the selected sectors were visited to identify the presence of older adults who met the inclusion criteria: 65 years of age or older, agreeing to participate in the research, residing in the household, and presenting sufficient independence and autonomy, and sensory, psychomotor, language, and comprehension abilities. The study excluded older adults who were bedridden, those with terminal disease or neoplasia (except for the skin), severe sensory or cognitive problems, aphasia or neurological diseases with signs of aggravation[20].

Recruited from households and flow points, the older adults were invited to attend public places, in easily accessible areas, for a data collection session. Recruitment at flow points, places of confluence for older adults located in the selected census sectors, was the except and was used when households were difficult to access. Recruitment was carried out until the quotas of men and women by age group (65 to 69, 70 to 74, 75 to 79 and ≥80 years old) were completed in proportions compatible with the census distribution of the same in the selected sectors, having anticipated possible losses or refusals[20].

In 2016-2017, a follow-up study was conducted involving the older adult participants at baseline. The addresses registered in the Campinas and Ermelino Matarazzo databases served as a basis for locating these older adults. Recruitment and data collection were carried out at home by graduate students in gerontology and undergraduate students in medicine, organized in pairs. Up to three attempts were made to find each older adult.

For both time points of the study, body weight, height, and waist (WC) and hip (HC) circumference were measured. Weight was measured with a portable electronic scale, with the older adult standing erect on the equipment platform, facing the scale, with their eyes fixed forward, feet parallel and barefoot, while wearing light-weight clothes. For height, a portable stadiometer was used and the older adults stood upright, with their backs to the scale, barefoot and feet together, with their heads positioned in the Frankfurt Plane. WC was verified at the midpoint between the lower edge of the last rib and the iliac crest, with the individual standing and the waist region naked. HC was measured in the area with the greatest volume of the buttocks, with the older adult standing and wearing clothes below the buttocks[21,22].

The following anthropometric indicators were calculated:

- Body Mass Index (BMI): [weight (kg)/height (m^2)].
- Waist-to-height ratio (WHtR): [waist circumference (cm)/height (cm)].
- Waist-to-hip ratio (WHR): [waist circumference (cm)/hip circumference (cm)].
- Conicity Index (C Index):

$$\frac{\text{waist circumference (m)}}{0.109\sqrt{\frac{\text{body weight (kg)}}{\text{height (m)}}}}$$

The anthropometric variables and indicators were presented according to sex and age group at baseline (65-69, 70-74 and 75 years old or over) and at follow-up (72-79, 80-84 and 85 years old or over).

The usual gait speed (GS) was evaluated by the time in seconds it took the older adult to walk a distance of 4 meters on a flat floor. Three attempts were made, allowing the use of a walking stick or walker. The average travel time was calculated. The cut-off point ≤0.8 m/s was used to identify older adults who presented slow gait[23]. Next, a dichotomous variable was created that reflects stability or change in GS from baseline to follow-up, composed of: older adults with higher GS (>0.8m/s) at baseline and follow-up or who began to present higher GS at

follow-up; lower GS (≤0.8m/s) at the two time periods or who began to present lower GS at follow-up.

Being overweight was identified from the anthropometric variables and respective cut-off points:

- WC: ≥96.0 cm for men and ≥88.7 cm for women[24].
- WHtR: ≥0.58 for both sexes[24].
- BMI: ≥27 kg/m^2 [21].
- WHR: >1.0 for men and >0.85 for women[25].
- C index: ≥1.25 for men and ≥1.18 for women[26].

The cut-off points used for WC, WHtR and BMI were defined for older adults, while cut-off points for WHR were defined for adults and for the C index were defined for adults aged 30 to 74 years.

Data analysis used descriptive statistics (mean, standard deviation, median and interquartile distance) for the variables considered at baseline and at follow-up, according to sex. To assess the differences between the measurements studied during the period, the normality of the distribution of variables was initially verified using the Shapiro-Wilk statistical test. Thus, the appropriate statistical tests were used – Student's t test for paired samples, and the non-parametric Wilcoxon test – considering a significance level lower than 5%. The percentage changes in measurements and anthropometric indicators in older adults were also calculated between baseline and follow-up for both sexes.

Next, the incidences (%) of lower GS according to being overweight at baseline were estimated, and the associations were verified using Pearson's chi-square test ($p<0.05$). Logistic regression adjusted for sex and age was used to obtain the odds ratios (OR) and respective 95% confidence intervals (95%CI) of slow gait, and associations with being overweight were determined by the Wald test, $p<0.05$.

The FIBRA Study projects were approved by the Ethics Committees of the Campinas State University (report 1,332,651, CAAE 49987615.3.0000.5404) and the University of São Paulo (report 2,952,507, CAAE 92684517.5.3001.5390). All participants signed a term of free, informed consent.

RESULTS

At baseline, 1,284 older adults composed the sample, 900 in Campinas and 384 in Ermelino Matarazzo. At follow-up, only 549 older adult participants remained, 192 were deceased and 543 could not be located. Regarding the baseline samples, the losses (older adults not located or who refused to participate) represented 41.9% in Campinas and 43.2% in Ermelino Matarazzo.

Among the 549 older adults interviewed at baseline and at follow-up, 12 were excluded due to the lack of complete data on anthropometric measurements in both periods. Thus, data from 537 older adults were analyzed in this study (Figure 1).

Data were analyzed from 537 older adults whose weight, height, WC and HC were measured in 2008-2009 and 2016-2017. Women represented 70.0% of the sample evaluated in both survey time periods, and the mean age was 72.2 years (±5.2) at baseline and 80.7 years (±4.8) at follow-up. Mean GS was 0.43 m/s (±0.49) for the group of older adults at baseline, and 0.81 m/s (±0.39) at follow-up.

For men, weight and height were normally distributed ($p>0.05$). All other variables for both men and women did not show normal distribution. Between baseline and follow-up, among men, decreases in the average weight and height, in the median BMI, and an increase in the median C index were observed (Table 1).

For women, decreases in the median weight, height and BMI, and increases in the median WC, HC, WHtR, WHR and C index were observed (Table 2).

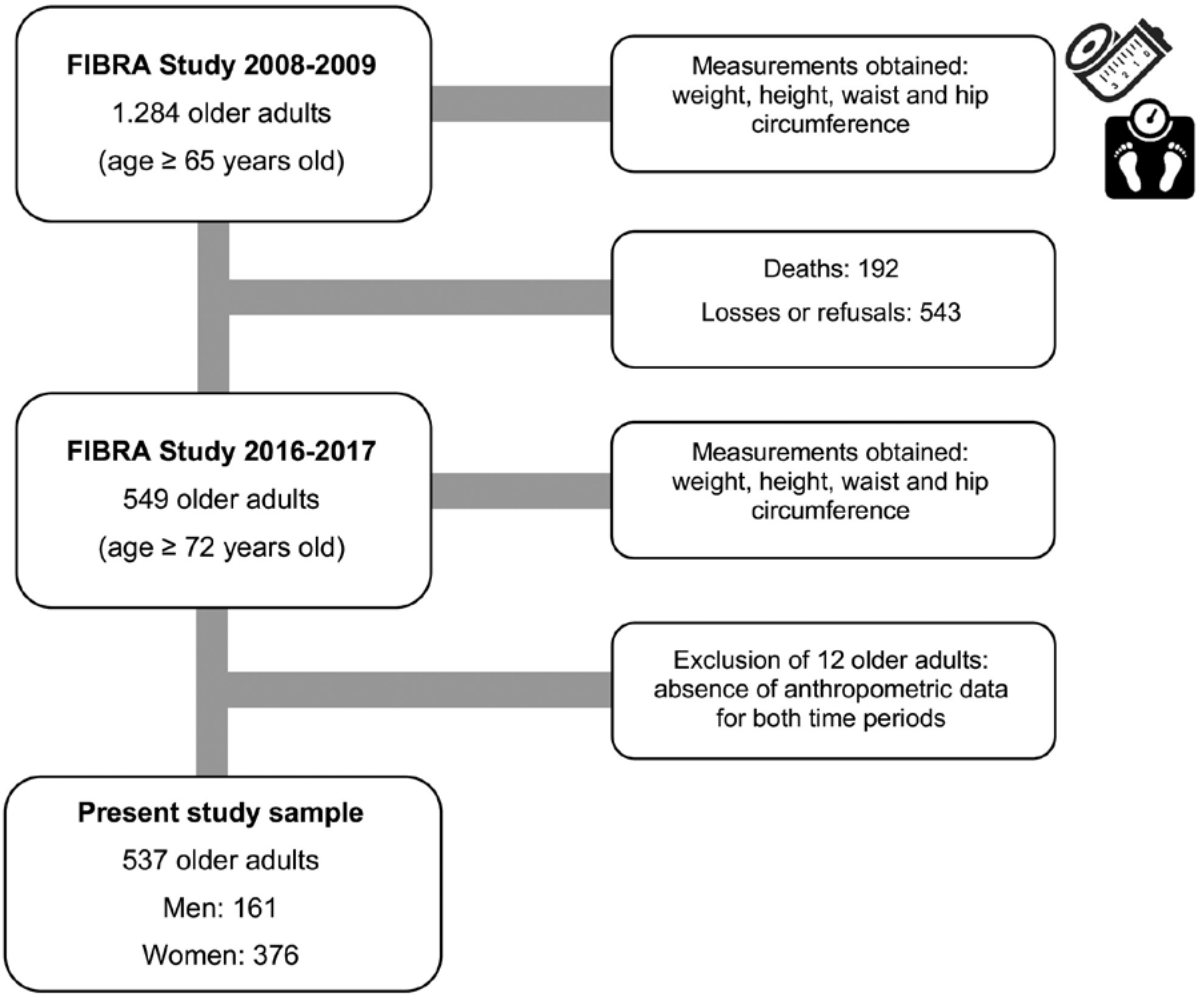

Figure 1. Flowchart of the sample used in this research. FIBRA study, Older adults, Campinas and Ermelino Matarazzo, SP, Brazil.

Table 1. Means and medians of anthropometric variables in older adult males, according to age (n=161). FIBRA Study, Older adults, Campinas and Ermelino Matarazzo, SP, Brazil, 2008-2009 and 2016-2017.

Variables by age group	n (%)	Mean (standard deviation)	Median (interquartile distance)
Weight (kg) – baseline			
65-69	48 (29.8)	77.8 ± 14.2	76.7 (16.4)
70-74	68 (42.3)	73.9 ± 11.2	74.2 (13.5)
≥ 75	45 (27.9)	72.1 ± 10.2	72.7 (11.6)
Total	161	74.6 ± 12.1	75.0 (13.5)
Weight (kg) – follow-up			
72-79	57 (35.4)	74.0 ± 15.2	75.8 (20.1)
80-84	70 (43.5)	72.5 ± 13.2	72.3 (18.9)
≥ 85	34 (21.1)	66.0 ± 8.8	65.1 (10.4)
Total	161	71.7 ± 13.4	71.1 (18.4)

to be continued

Continuation of Table 1

Variables by age group	n (%)	Mean (standard deviation)	Median (interquartile distance)
p value (difference: baseline – follow-up)			**<0.001**[a]
Height (cm) – baseline			
65-69	48	168.1 ± 6.9	168.0 (11.5)
70-74	68	167.3 ± 6.0	167.5 (9.5)
≥ 75	45	165.9 ± 5.2	166.0 (7.0)
Total	161	167.1 ± 6.1	167.0 (9.0)
Height (cm) – follow-up			
72-79	57	167.8 ± 7.1	168.0 (10.0)
80-84	70	165.5 ± 6.3	165.7 (9.0)
≥ 85	34	166.2 ± 6.0	166.5 (7.0)
Total	161	166.5 ± 6.6	166.0 (8.0)
p value (difference: baseline – follow-up)			**0.038**[a]
Waist circumference (cm) – baseline			
65-69	48	96.6 ± 12.8	96.0 (16.7)
70-74	68	95.9 ± 9.9	95.5 (11.7)
≥ 75	45	93.7 ± 11.3	94.0 (15.0)
Total	161	95.5 ± 11.2	95.0 (16.0)
Waist circumference (cm) – follow-up			
72-79	57	97.3 ± 12.3	97.0 (14.0)
80-84	70	96.0 ± 13.3	94.5 (19.0)
≥ 85	34	92.3 ± 8.0	94.0 (11.0)
Total	161	95.7 ± 12.1	96.0 (15.5)
p value (difference: baseline – follow-up)			0.402[b]
Hip circumference (cm) – baseline			
65-69	48	98.1 ± 9.5	98.5 (12.2)
70-74	68	98.5 ± 7.6	97.5 (9.7)
≥ 75	45	97.4 ± 8.0	98.0 (11.0)
Total	161	98.1 ± 8.3	98.0 (10.5)
Hip circumference (cm) – follow-up			
72-79	57	99.4 ± 10.0	99.0 (13.0)
80-84	70	99.3 ± 7.9	98.0 (9.0)
≥ 85	34	97.3 ± 5.7	98.5 (8.0)
Total	161	98.9 ± 8.3	98.0 (9.0)
p value (difference: baseline to follow-up)			0.121[b]
Body mass index (kg/m^2) – baseline			
65-69	48	27.5 ± 4.9	27.2 (5.8)
70-74	68	26.4 ± 3.7	26.2 (5.4)
≥ 75	45	26.2 ± 3.7	26.0 (4.4)
Total	161	26.7 ± 4.1	26.3 (5.4)
Body mass index (kg/m^2) – follow-up			
72-79	57	26.2 ± 5.2	25.8 (6.2)
80-84	70	26.4 ± 4.4	25.9 (6.7)
≥ 85	34	23.9 ± 3.4	23.6 (4.3)
Total	161	25.8 ± 4.6	25.2 (6.2)

to be continued

Continuation of Table 1

Variables by age group	n (%)	Mean (standard deviation)	Median (interquartile distance)
p value (difference: baseline – follow-up)			**<0.001**[b]
Waist-to-height ratio – baseline			
65-69	48	0.57 ± 0.08	0.57 (0.10)
70-74	68	0.57 ± 0.06	0.57 (0.09)
≥ 75	45	0.56 ± 0.07	0.55 (0.10)
Total	161	0.57 ± 0.07	0.57 (0.09)
Waist-to-height ratio – follow-up			
72-79	57	0.58 ± 0.08	0.57 (0.09)
80-84	70	0.58 ± 0.08	0.57 (0.10)
≥ 85	34	0.56 ± 0.05	0.55 (0.07)
Total	161	0.57 ± 0.07	0.57 (0.09)
p value (difference: baseline – follow-up)			0.180[b]
Waist-to-hip ratio – baseline			
65-69	48	0.98 ± 0.07	1.00 (0.11)
70-74	68	0.97 ± 0.06	0.97 (0.09)
≥ 75	45	0.96 ± 0.08	0.96 (0.11)
Total	161	0.97 ± 0.07	0.98 (0.10)
Waist-to-hip ratio – follow-up			
72-79	57	0.98 ± 0.06	0.98 (0.07)
80-84	70	0.96 ± 0.08	0.97 (0.09)
≥ 85	34	0.95 ± 0.06	0.95 (0.07)
Total	161	0.96 ± 0.07	0.97 (0.08)
p value (difference: baseline – follow-up)			0.349[b]
Conicity index – baseline			
65-69	48	1.30 ± 0.07	1.31 (0.10)
70-74	68	1.33 ± 0.06	1.32 (0.07)
≥ 75	45	1.30 ± 0.10	1.30 (0.13)
Total	161	1.31 ± 0.08	1.32 (0.10)
Conicity index – follow-up			
72-79	57	1.35 ± 0.09	1.35 (0.09)
80-84	70	1.33 ± 0.10	1.34 (0.11)
≥ 85	34	1.35 ± 0.07	1.35 (0.08)
Total	161	1.34 ± 0.09	1.35 (0.10)
p value (difference: baseline – follow-up)			**<0.001**[b]

[a] p-value, paired T test; [b] p-value, paired Wilcoxon test.

Table 2. Means and medians of anthropometric variables in older adult females, according to age (n=376). FIBRA Study, Older adults, Campinas and Ermelino Matarazzo, SP, Brazil, 2008-2009 and 2016-2017.

Variables by age group	n (%)	Mean (standard deviation)	Median (interquartile distance)
Weight (kg) – baseline			
65-69	143 (38.0)	67.6 ± 11.0	66.1 (13.4)
70-74	117 (31.1)	66.4 ± 12.2	65.1 (15.1)
≥ 75	116 (30.9)	63.5 ± 12.2	62.1 (15.7)
Total	376	65.9 ± 11.9	64.4 (14.9)
Weight (kg) – follow-up			
72-79	164 (43.6)	66.7 ± 11.0	66.9 (12.9)
80-84	135 (35.9)	64.0 ± 14.1	61.7 (17.3)
≥ 85	77 (20.5)	58.5 ± 10.0	57.5 (13.6)
Total	376	64.1 ± 12.4	62.5 (15.4)
p value (difference: baseline – follow-up)			**<0.001**[a]
Height (cm) – baseline			
65-69	143	155.1 ± 6.8	155.0 (10.0)
70-74	117	154.0 ± 6.1	154.0 (8.0)
≥ 75	116	152.6 ± 6.7	153.0 (7.7)
Total	376	154.0 ± 6.6	154.0 (8.0)
Height (cm) – follow-up			
72-79	164	153.8 ± 6.5	154.0 (9.0)
80-84	135	152.5 ± 6.5	153.0 (9.0)
≥ 85	77	149.7 ± 7.7	151.0 (8.0)
Total	376	152.5 ± 6.9	153.0 (9.0)
p value (difference: baseline – follow-up)			**<0.001**[a]
Waist circumference (cm) – baseline			
65-69	143	90.4 ± 11.1	90.0 (13.5)
70-74	117	89.9 ± 11.3	89.0 14.5)
≥ 75	116	87.9 ± 12.9	88.5 (16.2)
Total	376	89.5 ± 11.7	90.0 (14.5)
Waist circumference (cm) – follow-up			
72-79	164	94.7 ± 11.4	93.2 (14.0)
80-84	135	93.7 ± 15.0	93.0 (19.0)
≥ 85	77	88.5 ± 11.4	90.0 (18.0)
Total	376	93.1 ± 13.0	93.0 (16.7)
p value (difference: baseline – follow-up)			**<0.001**[a]
Hip circumference (cm) – baseline			
65-69	143	101.9 ± 9.3	100.0 (12.0)
70-74	117	102.0 ± 9.7	101.0 (11.5)
≥ 75	116	101.1 ± 9.7	100.7 (11.4)
Total	376	101.7 ± 9.5	100.4 (11.0)
Hip circumference (cm) – follow-up			
72-79	164	103.9 ± 11.7	103.0 (13.5)
80-84	135	103.4 ± 12.3	101.5 (15.0)
≥ 85	77	98.1 ± 9.2	98.0 (13.0)
Total	376	102.5 ± 11.7	102.0 (13.7)

to be continued

Continuation of Table 2

Variables by age group	n (%)	Mean (standard deviation)	Median (interquartile distance)
p value (difference: baseline to follow-up)			**0.036**[a]
Body mass index (kg/m^2) – baseline			
65-69	143	28.1 ± 4.5	27.2 (6.0)
70-74	117	27.9 ± 4.5	27.8 (5.5)
≥ 75	116	27.2 ± 4.8	27.1 (6.8)
Total	376	27.8 ± 4.6	27.3 (5.9)
Body mass index (kg/m^2) – follow-up			
72-79	164	28.3 ± 4.7	27.6 (5.9)
80-84	135	27.5 ± 5.5	27.2 (6.9)
≥ 85	77	26.3 ± 5.3	25.6 (6.4)
Total	376	27.6 ± 5.2	27.1 (6.5)
p value (difference: baseline – follow-up)			0.041[a]
Waist-to-height ratio – baseline			
65-69	143	0.58 ± 0.08	0.58 (0.08)
70-74	117	0.58 ± 0.07	0.58 (0.10)
≥ 75	116	0.58 ± 0.09	0.58 (0.11)
Total	376	0.58 ± 0.08	0.58 (0.10)
Waist-to-height ratio – follow-up			
72-79	164	0.62 ± 0.08	0.60 (0.10)
80-84	135	0.61 ± 0.10	0.62 (0.12)
≥ 85	77	0.59 ± 0.09	0.59 (0.12)
Total	376	0.61 ± 0.09	0.60 (0.11)
p value (difference: baseline – follow-up)			**<0.001**[a]
Waist-to-hip ratio – baseline			
65-69	143	0.89 ± 0.07	0.89 (0.10)
70-74	117	0.88 ± 0.08	0.87 (0.10)
≥ 75	116	0.87 ± 0.08	0.87 (0.10)
Total	376	0.88 ± 0.08	0.88 (0.10)
Waist-to-hip ratio – follow-up			
72-79	164	0.91 ± 0.10	0.91 (0.11)
80-84	135	0.90 ± 0.10	0.90 (0.11)
≥ 85	77	0.90 ± 0.08	0.90 (0.11)
Total	376	0.91 ± 0.10	0.90 (0.11)
p value (difference: baseline – follow-up)			**<0.001**[a]
Conicity index – baseline			
65-69	143	1.26 ± 0.09	1.26 (0.11)
70-74	117	1.26 ± 0.10	1.27 (0.13)
≥ 75	116	1.25 ± 0.11	1.26 (0.13)
Total	376	1.26 ± 0.10	1.26 (0.12)
Conicity index – follow-up			
72-79	164	1.32 ± 0.09	1.32 (0.12)
80-84	135	1.33 ± 0.13	1.32 (0.13)
≥ 85	77	1.30 ± 0.11	1.30 (0.16)
Total	376	1.32 ± 0.11	1.32 (0.14)
p value (difference: baseline – follow-up)			<0.001[a]

[a] p-value, paired Wilcoxon test.

Figure 2 shows the percentage change in anthropometric measurements after nine years, according to sex. Among men, decreases in weight (-3.89%), height (-0.36%) and BMI (-4.18%) were observed. Only the C index showed a positive change (+2.27%). Among women, decreases in weight (-2.95%), height (-0.65%) and BMI (-0.73%) were observed, while the remaining measurements and indicators showed increases: WC (+3.33%), HC (+1.59%), WHtR (+3.45%), WHR (+2.27%) and C index (+4.76%).

There were no significant differences between the sexes in the incidence of gait stability or occurrence of slower gait between baseline and follow-up. In contrast, among adults aged 75 years old and over, the incidence of slower gait was 2.6 times higher compared with those 60 to 69 years old. As determined by the anthropometric measurements WC, BMI, WHtR and WHR, being overweight increased the chances of older adults presenting gait stability or a slower gait after nine years (Table 3).

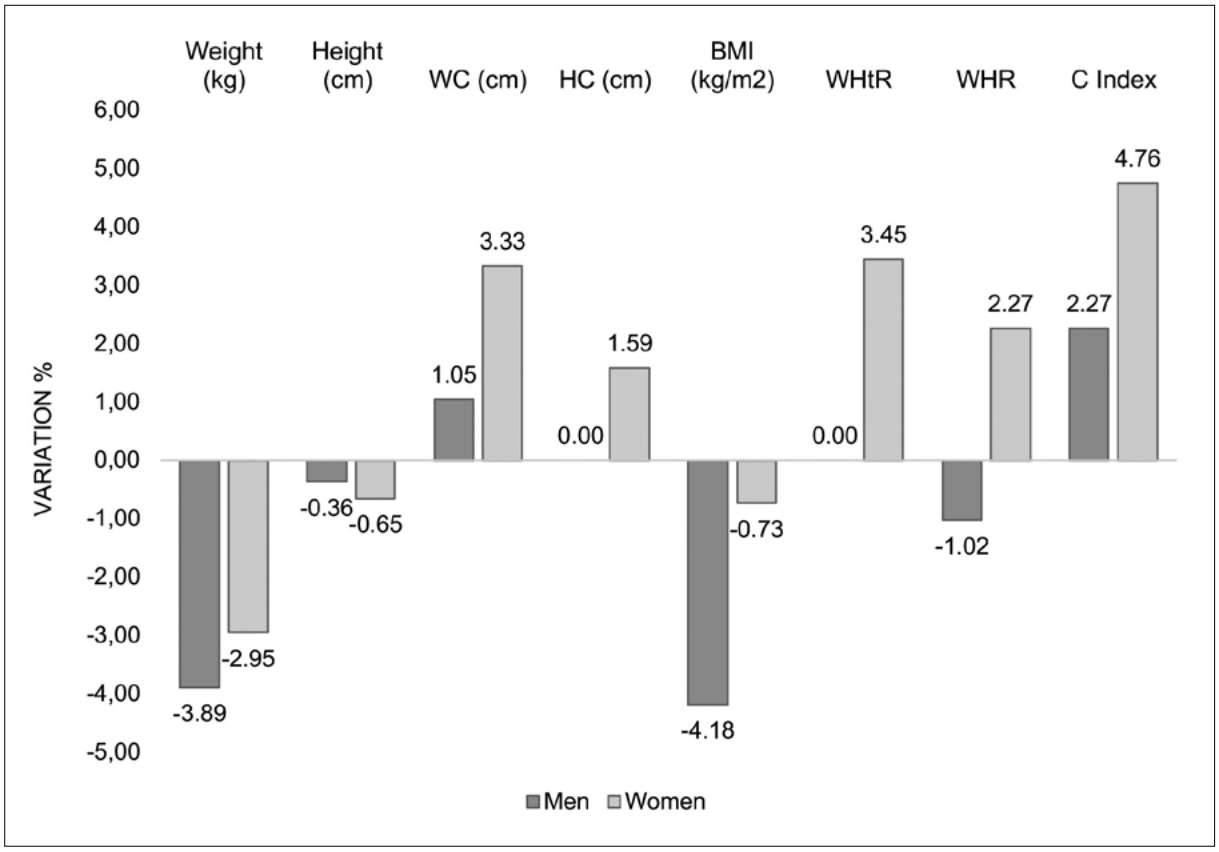

Figure 2. Percentage variation in measurements and anthropometric indicators in older adults, between baseline and follow-up. FIBRA study, Older adults, Campinas and Ermelino Matarazzo, SP, Brazil.

Table 3. Incidence of lower gait speed in older adults, according to sex, age and overweight. FIBRA study, Older adults, Campinas e Ermelino Matarazzo, SP, Brazil, 2008-2009 and 2016-2017.

Variable	Incidence %	Adjusted OR [b] (IC95%)	p value [c]
Sex	p= 0.139 [a]		
Male	77.2	1.00	
Female	82.7	1.51 (0.95 - 2.41)	0.082
Age (in years)	p= 0.004		
60 to 69	77.0	1.00	
70 to 74	77.8	1.09 (0.66 - 1.79)	0.733
≥ 75	89.7	2.66 (1.43 - 4.92)	**0.002**
Waist circumference	p= 0.017		
Not overweight	76.8	1.00	
Overweight	85.0	1.80 (1.14 - 2.83)	**0.011**
Body mass index	p= 0.009		
Underweight	81.2	1.38 (0.62 - 3.08)	0.428
Eutrophy	75.0	1.00	
Overweight	86.1	2.11 (1.31 - 3.39)	**0.002**
Waist-to-height ratio	p= 0.001		
Not overweight	75.6	1.00	
Overweight	86.9	2.08 (1.31 - 3.31)	**0.002**
Waist-to-hip ratio	p= 0.009		
Not overweight	75.8	1.00	
Overweight	84.9	1.87 (1.17 - 2.99)	**0.009**
Conicity index	p= 0.128		
Not overweight	76.1	1.00	
Overweight	82.4	1.60 (0.96 - 2.68)	0.069

[a] p value, Pearson's chi-square test; [b] OR: adjusted odds ratio: sex adjusted for age, age adjusted for sex, and overweight adjusted for sex and age; 95%CI: 95% confidence interval; [c] p value, Wald test.

DISCUSSION

This research assessed changes in the anthropometric profile of the older adults recruited in households and at flow points, during the period between the baseline (2008-2009) and follow-up (2016-2017) surveys of the FIBRA Study. Among the eight measures and indicators selected, men showed alterations in four: decreases in weight, height and BMI, and an increase in C index; while women showed alterations in all of them: decreases in weight, height and BMI, and increases in measurements and indicators of central adiposity – WC, HC, WHtR, WHR and C index. Significant associations were observed between being overweight and gait stability or new cases of slower gait. Being overweight/obese impacts the health and quality of life of older adults, resulting from the increased risks of morbidity and mortality, complications and disabilities, while also impacting health care systems through the increase in costs and demand for health services[4-7,10].

Other studies report the same findings regarding the reduction in weight[5,27,28] and height[27-29] observed in this research. Santanasto et al.[5] analyzed data from the Health, Aging and Body Composition (Health ABC) cohort of Pittsburgh, PA, and Memphis, TN, in the United States, and observed a reduction in body weight in men (81.6 kg at baseline; -1.5 kg/-1.7%)

and women (70.1 kg at baseline; -1.4 kg/-1.8%) after five years. In Norway, a follow-up study, detected decreases in the height of older adults aged between 60 and 69, 70 and 79 and ≥ 80 years at baseline: -1.3 cm, -1.9 cm, -2.4 cm in males and -1.9 cm, -2.3 cm, -2.3 cm in females, 11 years later. Regarding body weight, reductions were observed from the age of 70: -1.3 kg and -2.4 kg in men and -2.4 kg and -5.6 kg in women[27]. In contrast to the results of this study, Almeida et al.[30] observed no significant changes in the weight and height of older adults (≥60 years) included in the SABE Study (Health, Well-being and Aging), between 2000 and 2006, probably due to the younger sample and shorter follow-up time.

Based on data from a cohort of Swedish older adults, Gavriilidou et al.[28] observed decreases in height of around 6 cm for men and 8 cm for women, between the ages of 60 to 64 and 85 years or older. The authors also investigated anthropometric classification errors caused by the imprecision of measured height in older adults. To achieve this, they calculated the BMI using the measured height and that estimated by knee height. The results revealed that the use of measured height to calculate the BMI underestimated the prevalence of low weight and overestimated the prevalence of obesity, in both sexes and more intensely in older adults aged ≥80 years, in relation to the estimated measure[28]. A study conducted in an outpatient clinic identified that frail older adults presented greater differences between the measured and estimated height compared with their robust peers, and recommended the use of the estimated measure, particularly for frail older adults[31].

The trajectory of human aging involves changes in body composition that include a decrease in height, loss of muscle and bone tissue, and an increase in and redistribution of adipose tissue[1,2,6]. The progressive decrease in height results from compression of the intervertebral discs, flattening of the vertebrae, changes in body posture, decreased bone mineral density (osteopenia/osteoporosis) and flattening of the plantar arch[1,2,32]. Body weight reduction is observed from the age of 70 and over[6,27] and results from the loss of muscle mass, body water and bone mass[1,2,32]. BMI decreases with advancing age due to loss of muscle mass[27,33]. Results from the English Longitudinal Study of Ageing (ELSA) show an increase in BMI in the early years of old age, followed by a significant decline from the age of 71 onwards[33].

In this study, women showed an increase in the medians of anthropometric measurements that evaluated the distribution of body fat (WC, HC, WHtR and WHR). Over the course of eight years, the ELSA data revealed an increase in waist circumference up to the age of 80 (0.18 cm/year) and a downward trend from that age onwards, for both sexes[33]. In the United States, a five-year prospective study involving older adults aged 70 to 79 years at baseline, identified a reduction in subcutaneous and visceral abdominal fat in women using computed tomography[5]. Adipose tissue increases with advancing age and tends to accumulate in the abdominal region, increasing chronic low-grade inflammation and the risk of cardiometabolic diseases[2,6,15]. After menopause, with the decline in estrogen levels, the fat deposited in the gluteofemoral region is redistributed to the visceral deposit[15]. The findings of this research show that the process of fat mass redistribution in women continued during follow-up, different from that observed in men.

Although there were increases in the medians of the C index in both sexes, it was more intense among women. In a study conducted with older adults assisted by the *Estratégia Saúde da Família* [Family Health Strategy] in Viçosa, MG, the mean value of the C index for women was also higher than for men ($p<0.01$)[34]. In older adults (≥60 years) from Salvador, BA, the accuracy of the C index for classifying visceral obesity was 0.97 and 0.66, respectively for males and females[35]. Proposed by Valdez[17] in the 1990s, as an indicator of central obesity, the C index is considered a good predictor of diabetes mellitus, hypertension and cardiovascular diseases[19].

A cross-sectional study involving Portuguese older adults (≥65 years) observed greater chances of slower gait (≤0.8 m/s) among overweight (OR= 2.42, 95%CI: 1.13-5.18) and obese women (3.97, 95%CI: 1.63-9.67) than among eutrophic women. Among men, these associations were similar, but the OR estimates fell by half (p value for trend = 0.001)[7]. Data from the SABE Colombia survey showed an

inverse association between BMI and gait speed in women and older adults in general[8]. The mechanical overload that being overweight/obese exerts on body joints, such as the knees and hips, and the low-grade inflammation triggered by excess adipose mass are indicated in the literature as causes of slower gait[7,8], highlighting the importance of strategies to prevent weight gain.

Appraisal of the results of this research should consider certain limitations. At baseline, the FIBRA Study selected a sample of older adults with no apparent cognitive deficit and with adequate physical and health status to attend the data collection sites, which may have introduced some bias in the selection of individuals who presented better anthropometric and nutritional profiles. In turn, the survival bias that may have influenced the data could be due to the lower risk of premature death among non-obese older adults with a greater reserve of lean mass. Despite these potential limitations, the possibility of evaluating changes in the anthropometric indicators of older adults nine years later is a major strength of this study.

CONCLUSION

The results of this study revealed changes in the anthropometric profile resulting from aging. In both sexes, we observed decreases in body weight, height and BMI. Women showed increases in all the indicators of abdominal obesity, while men only showed an increase in the C index. Being overweight was associated with a greater chance of gait stability and new cases of slower gait, nine years after the first survey of measurements.

This study provides information from a cohort of older adults, a considerable portion of whom were aged 80 years old or over, on changes in various anthropometric indicators and in gait speed. Clinical or public health professionals dedicated to the care of older adults and research will benefit from the results, in order to identify, for example, the most sensitive indicators for discerning excess weight during aging, in order to develop interventions that promote healthy aging.

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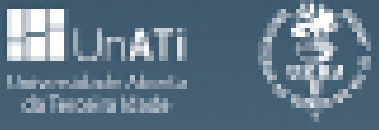
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