

## ORIGINAL ARTICLE

## BIOLOGY

# Prevalence of and factors associated with successful aging in Brazilian older adults: Frailty in Brazilian older people Study (FIBRA RJ)

Ana C Canêdo,<sup>1</sup>  Claudia S Lopes<sup>2</sup> and Roberto A Lourenço<sup>3</sup>

<sup>1</sup>Division of Geriatric Medicine, Pedro Ernesto University Hospital, Rio de Janeiro State University (UERJ), Rio de Janeiro, Brazil

<sup>2</sup>Department of Epidemiology, Institute of Social Medicine, Rio de Janeiro State University (UERJ), Rio de Janeiro, Brazil

<sup>3</sup>Department of Internal Medicine, Faculty of Medical Sciences, Rio de Janeiro State University (UERJ), Rio de Janeiro, Brazil

## Correspondence

Ana Cristina Canêdo MD, Pedro Ernesto University Hospital, Rio de Janeiro State University (UERJ), São Francisco Xavier St, 524, Bloco F, 10147 Pavilhão João Lyra Filho 20550-900 - Rio de Janeiro, RJ, Brazil.  
Email: anacristinacanedo@gmail.com

Received: 10 July 2017

Revised: 22 February 2018

Accepted: 16 March 2018

**Aim:** We aimed to estimate the factors associated with the biomedical dimension of successful aging (SA) and its prevalence in older Brazilian individuals. The conceptual framework for this approach relies on the considerable variation in the biophysiological effects of aging and the need to understand the factors that influence this process.

**Methods:** Data from a total of 845 older adults were analyzed. SA operationalization included the following criteria: good physical and cognitive performance, absence of disabilities, and good health conditions. Descriptive analyses were used to estimate the prevalence of SA, and the factors associated with SA were assessed using multivariate logistic regressions.

**Results:** The overall prevalence of SA was 25%, and the associated factors were the absence of (OR 10.5, 95% CI 5.2–21.1) or fewer than two physical morbidities (OR 3.5, 95% CI 2.1–5.9), body mass index in the overweight range (OR 1.8, 95% CI 1.02–3.3), absence of depression (OR 2.1, 95% CI 1.07–4.1), high levels of physical activity (OR 1.88, 95% CI 1.14–3.2), high levels of social participation (OR 2.07, 95% CI 1.16–3.4) and younger age (65–74 years, OR 4.27, 95% CI 1.79–10.1; 75–84 years, OR 2.7, 95% CI 1.18–6.41).

**Conclusions:** A small proportion of older adults met the criteria defining successful aging. Despite the great impact of biological determinants, modifiable social and lifestyle factors predicted successful aging in this population, suggesting that health promotion targeting behavioral changes might lead to tangible benefits for health and well-being in old age. *Geriatr Gerontol Int* 2018; ●●: ●●–●●.

**Keywords:** healthy aging, prevalence, successful aging.

## Introduction

There is no universally accepted definition for healthy or successful aging. However, Rowe and Kahn's concept of "successful aging" has played a major role in moving the scientific discourse forward and has been cited in many scientific articles. These authors proposed the following objective criteria for successful aging: free of disease and disability; high levels of physical and cognitive functioning; and social engagement. However, SA has been studied over the past few decades from different perspectives (biomedical, social, and psychological) that have contributed to multiple different definitions published in the literature.<sup>1</sup> The current trend is to consider SA in a multidimensional manner that encompasses objective biomedical, psychological and social assessments, as well as subjective criteria examining the older individual's quality of life.<sup>2</sup>

From a biomedical perspective, successful aging tends to emphasize physical health, assessed through factors such as physical and cognitive function, the absence of diseases and disabilities, and longevity.<sup>2</sup> The focus of this approach is the study of interindividual variability in biophysiological parameters related to aging, with the aim of quantifying biological age in contrast to chronological age. The study of SA from this perspective, in contrast to

aging associated with functional decline, frailty and disease, is necessary for understanding the variables that might influence the biological aging process. Furthermore, a better definition of the factors that promote SA is essential for planning effective health promotion strategies.

In Brazil, as in other Latin American countries, the population has aged at an accelerated pace amidst extremely fragile institutional, economic and health access contexts that create challenges in responding to aging-related demands. Strategies for promoting healthy life expectancy are key to making this demographic phenomenon more sustainable.

The objective of the present study was to evaluate the prevalence of older individuals with good levels of health associated with the preservation of physical and cognitive functioning, as well as to determine the factors associated with this phenotype.

## Methods

### Context and study population

This is a cross-sectional study with a population selected from the database of the research network Frailty in Brazilian older people Study, specifically the Rio de Janeiro section (FIBRA-RJ). The

study population consisted of clients of a healthcare provider, reaching approximately 102 000 older adults.

To select the study population, the following inclusion criteria were used: having been a client of the healthcare provider for at least 12 months, age  $\geq 65$  years and living in the North Zone of the city of Rio de Janeiro. Exclusion criteria were the following: acute neuropsychiatric conditions, Mini-Mental State Examination score less  $< 14$ , and severe auditory and visual limitations that prevented responding to the questionnaire.

The sampling plan was stratified according to sex and age group, which were provided by the healthcare provider's registry. An inverse sampling strategy was applied to reach the representative sample size for each stratum, making it unnecessary to increase the sample size calculated to compensate for the non-response rate. The complete methodology for all phases of the FIBRA study is published elsewhere.<sup>3</sup>

A total of 847 individuals composed the study's baseline. Two individuals were excluded due to acute pathology or recent surgery. In the present study, 845 individuals' data were analyzed, representing an expanded sample of 9175 individuals.

### Measures

A questionnaire was administered from January 2009 to January 2010 through face-to-face interviews lasting approximately 60 min.

### Successful aging

The SA construct used in the present study was adapted from the Rowe and Kahn model, and was operationalized according to the following criteria: good health conditions, absence of disabilities, good physical performance and good cognitive performance.<sup>4</sup> It is important to note that we eliminated Rowe and Kahn's active engagement criterion from our definition to restrict our analysis to strictly biomedical criteria. Participants who met all the criteria above were classified as successful agers. The evaluations of the questionnaire for each one of these criterion are described below.

The criterion of good health was determined by self-perceived health classified as good or very good. The absence of disabilities was determined by complete independence for activities of daily living (ADL), assessed using the Katz Index.<sup>5</sup>

The good cognitive performance was met by those with a Mini-Mental State Examination score  $> 18$  (illiterate) or  $> 24$  ( $\geq 1$  year of education), and the criterion for good physical performance was attributed to participants who presented palmar grip strength and gait velocity values above the first quintile of the sample, considering that lower results are associated with the frailty syndrome.<sup>6</sup> Grip strength was measured in the dominant upper limb using a manual dynamometer (JAMAR Model J00105; Sammons Preston, Bolingbrook, Illinois) by requesting each participant to apply the highest force possible in three attempts. The values were adjusted for sex and body mass index (I). Gait speed was measured using a chronometer to clock the time spent to walk a 4.6-m long circuit, and the values were adjusted for height and sex.

### Socioeconomic and demographic variables

The variables evaluated were sex, age, marital status, personal income, schooling and race.

### Clinical and behavioral variables

The clinical variables evaluated were the number of reported physical morbidities (0; 1–2; 3–4;  $\geq 5$ ), visual impairment (no/yes), hearing impairment (no/yes) and BMI (reference  $\leq 22$ ; 22–27; 27–29.9;  $> 30$ ).<sup>7</sup>

The behavioral variables included the following: previous and active smoking, frequency of alcohol consumption (never, daily, weekly and monthly) and level of physical activity. The level of

physical activity was assessed using the Minnesota Leisure Physical Activity instrument based on the energy expenditure during the 2 weeks before the interview. On the Minnesota Leisure Physical Activity, activities are grouped into nine categories. Based on the participant's answers, a kilocalorie score per week (kcal/week) was calculated to estimate the caloric expenditure, and the tertiles of caloric expenditure were evaluated.

### Psychosocial variables

Among the psychosocial variables were "self-reported depression" (diagnosis established by a doctor in the last year) and advanced ADL (AADL). The AADL were evaluated through a group of 12 questions from the research questionnaire, adapted from Baltes *et al.*<sup>8</sup> and Reuben *et al.*<sup>9</sup> These questions were related to social, productive and leisure activities, and were categorized into three groups according to the number of AADL carried out (0–4, 5–6,  $> 6$ ). The greater the number of activities carried out, the greater the level of social participation.<sup>10</sup>

### Statistical analysis

Descriptive analyses of all study variables were carried out. Bivariate analysis was carried out, and absolute (*n*) and relative (%) frequencies of successful aging were calculated in relation to socioeconomic, demographic, clinical, psychosocial and behavioral characteristics. To assess the association between these variables and the SA, Pearson's  $\chi^2$ -test was used. Subsequently, multivariate analyses were carried out using a logistic regression model, and crude and adjusted odds ratios (OR) were adjusted to their respective 95% confidence intervals (95% CI). As a criterion for the inclusion of variables in the multivariate models, we selected the variables that presented values of  $P < 0.20$  in the bivariate analysis and tested them in the sequential multivariate model, so that they were evaluated in blocks according to the

**Table 1** Sociodemographic characteristics of residents of neighborhoods in the north of Rio de Janeiro aged  $\geq 65$  years participating in the Frailty in Brazilian Elderly Study

Sociodemographic data	<i>n</i> (%)
<b>Age groups (years)</b>	
65–74	327 (38.7)
75–84	359 (42.5)
85–94	126 (14.9)
$\geq 95$	33 (3.9)
<b>Sex</b>	
Male	242 (28.6)
Female	603 (71.4)
<b>Race/ethnicity</b>	
White	531 (62.8)
Non-white	316 (35.2)
<b>Marital status</b>	
Married/living with partner*	328 (42.9)
Widowed	292 (38.2)
Never married	85 (11.1)
Separated/divorced	59 (7.7)
<b>Schooling (years)</b>	
Illiterate	35 (4.2)
1–4	152 (18.1)
5–8	175 (20.9)
9–12	255 (30.4)
$\geq 13$	222 (26.5)
<b>Personal income (\$US monthly)</b>	
0–404	149 (18.5)
$> 404$ –1010	283 (35.2)
$> 1010$ –1415	136 (16.9)
$> 1415$	237 (29.4)

Total *n* = 895.

**Table 2** Expanded prevalence of successful aging and its individual criteria in residents of neighborhoods in the north of Rio de Janeiro aged ≥65 years participating in the Frailty in Brazilian Elderly Study

Criteria	n	%
Self-perceived health good or very good	425	56.1
Independence for ADL	608	79.7
Good physical performance	468	63.3
Good cognitive performance	637	75.3
Successful aging	211	25.0

ADL, activities of daily living.

dimensions presented in the theoretical model. In addition, we maintained those variables for which the association with SA is already established consistently in the literature. For the statistical analysis, the *SPSS* for Windows version 19 package (*SPSS*, Chicago, IL, USA) was used, considering the sample weights and study design.

The FIBRA-RJ study was submitted to the Research Ethics Committee of the Pedro Ernesto University Hospital after approval to carry it out was obtained. All participating individuals signed the informed consent form.

## Results

Table 1 shows the sociodemographic characteristics of the sample. The mean age was 76.6 years, while the mean schooling level and per capita monthly income were 10.02 years and \$US1240.00, respectively. There was a predominance of individuals who were younger than 85 years (80%), female (71.4%), had >9 years of education (57%) and had a monthly income above \$US1010.00 (47%). The proportion of illiteracy was 4.2%.

### Prevalence of successful aging

The overall prevalence of SA was 25% (211 participants), which was higher in men (36.1%) than in women (20.4%). Table 2 presents the calculated prevalence for each component of the SA construct used in this study.

Table 3 shows the prevalence of SA according to sociodemographic, clinical, psychosocial and behavioral characteristics. The proportion of successful agers was inversely proportional to age. In the 65–74-year age group, the prevalence was 39.2%, whereas in those aged ≥85 years, it was just 9.2%. There was a higher proportion of SA among married men, as well as those with >13 years of schooling, personal monthly income above \$US1400.00, fewer than three morbidities, an absence of auditory and visual deficits, BMI within the normal and overweight ranges, levels of physical activity in the upper tertile, regular alcohol consumption, high levels of participation in advanced activities (>6), paid or voluntary work, and an absence of depression.

### Factors associated with successful aging

The factors associated with SA in the final model (Table 4) were the absence of morbidities (OR 10.5, 95% CI 5.2–21.1) or fewer than two physical morbidities (OR 3.5, 95% CI 2.1–5.9), BMI in the overweight range (OR 1.8, 95% CI 1.02–3.3), carrying out more than six advanced activities of daily living (AADLs) (OR 2.07, 95% CI 1.16–3.4), the absence of depression (OR 2.1, 95% CI 1.07), high levels of physical activity (caloric expenditure in the upper tertile; OR 1.88, 95% CI 1.14–3.2) and age. The absence of visual impairment (OR 1.5, 95% CI 1.01–2.4) showed a borderline association. In relation to age, when compared with the very old (>85 years), those aged between 65 and 74 years presented a fourfold higher chance of SA (OR 4.27, 95% CI 1.79–10.1), whereas those aged 75–84 years presented a 2.7-fold greater chance (OR 2.7, 95% CI 1.18–6.41).

**Table 3** Characteristics and expanded prevalence of successful aging according to socioeconomic and demographic, clinical, lifestyle and psychosocial variables of residents of neighborhoods in the north of Rio de Janeiro aged ≥65 years participating in the Frailty in Brazilian Elderly Study

Variables	n (%)	Prevalence of successful aging, n (%)	P
<b>Sex</b>			
Female	603 (71.4)	126 (20.4)	<0.001
Male	242 (21.6)	85 (36.1)	–
<b>Age groups (years)</b>			
65–74	327 (38.7)	125 (39.2)	<0.001
75–84	359 (42.5)	78 (21.8)	–
≥85	159 (18.8)	8 (9.2)	–
<b>Schooling (years)</b>			
0–4	187 (22.3)	20 (10.7)	<0.001
5–8	175 (20.9)	27 (15.4)	–
9–12	255 (30.4)	73 (29.2)	–
≥13	222 (26.5)	91 (41.1)	–
<b>Personal income (US monthly)</b>			
0–404	149 (18.5)	18 (12.5)	<0.001
>404–1010	283 (35.2)	69 (24.5)	–
>1010	373 (46.3)	118 (31.6)	–
<b>Marital status</b>			
Married	328 (42.9)	113 (34.8)	<0.001
Not married	436 (57.1)	98 (22.7)	–
<b>BMI</b>			
<22	104 (14.1)	21 (20.8)	0.01
22–27	292 (39.7)	94 (32.6)	–
27–29	164 (22.3)	56 (34.0)	–
>30	176 (23.9)	37 (21.0)	–
<b>Physical morbidities (n)</b>			
0	99 (11.8)	52 (52.5)	<0.001
1–2	448 (53.2)	132 (62.6)	–
≥3	295 (35.0)	27 (9.2)	–
<b>Hearing impairment</b>			
Yes	234 (27.8)	34 (14.5)	<0.001
No	608 (72.2)	177 (29.1)	–
<b>Visual impairment</b>			
Yes	295 (35)	45 (15.3)	<0.001
No	597 (65)	166 (30.3)	–
<b>Smoking</b>			
Current	33 (4.3)	8 (24.2)	0.604
Never	476 (62.3)	127 (26.7)	–
Past	255 (33.4)	76 (29.8)	–
<b>Alcohol consumption</b>			
Never	379 (49.6)	85 (22.4)	0.01
Monthly	298 (39.0)	94 (31.5)	–
Weekly	52 (6.8)	18 (34.6)	–
Daily	35 (4.6)	14 (40.0)	–
<b>Physical activity (kcal/week)</b>			
0–471	249 (33.2)	44 (17.0)	0.01
472–1742	247 (32.9)	61 (24.7)	–
1743–26 372	255 (34.0)	105 (41.2)	–
<b>No. AADL</b>			
0–4	334 (39.5)	39 (11.7)	<0.001
5–6	214 (25.3)	50 (23.4)	–
>6	297 (35.1)	122 (41.1)	–
<b>Work</b>			
Yes	199 (23.6)	84 (42.2)	<0.001
No	644 (76.4)	127 (19.7)	–
<b>Depression</b>			
Yes	134 (15.9)	16 (11.9)	<0.001
No	711 (84.1)	195 (27.4)	–

P-value was obtained by comparison between participants with successful aging and participants without successful aging, according to socioeconomic and demographic, clinical, lifestyle, and psychosocial variables. Total n = 895.

**Table 4** Unadjusted and adjusted odds ratios of the association between sociodemographic, clinical, psychosocial, behavioral variables and successful aging in the Frailty in Brazilian Elderly Study, specifically the Rio de Janeiro section

Variables	OR unadjusted (95% CI)	OR adjusted (95% CI) Model 1	OR adjusted (95% CI) Model 2	OR adjusted (95% CI) Model 3	OR adjusted (95% CI) Model 4	OR adjusted (95% CI) Model 5
<b>Age groups (years)</b>						
>84	1	1	–	–	–	–
75–84	5.23 (2.4–11.1)	2.91 (1.32–6.42)	–	–	–	1
65–74	11.6 (5.5–24.6)	5.58 (2.52–12.3)	–	–	–	2.75 (1.18–6.41)
<b>Sex</b>						
Male	1	1	–	–	–	1
Female	0.48 (0.35–0.68)	0.65 (0.43–0.98)	–	–	–	0.80 (0.47–1.39)
<b>Education (years)</b>						
0–4	1	1	–	–	–	1
5–8	1.52 (0.82–2.82)	1.07 (0.52–2.06)	–	–	–	0.84 (0.41–1.75)
9–12	3.34 (1.95–5.72)	1.81 (0.98–3.26)	–	–	–	1.13 (0.58–2.24)
≥13	5.80 (3.32–9.90)	2.86 (1.48–5.52)	–	–	–	1.56 (0.75–3.28)
<b>Marital status</b>						
Not married	1	1	–	–	–	1
Married	1.81 (1.31–2.49)	1.22 (0.82–1.82)	–	–	–	1.19 (0.76–1.87)
<b>Personal income (\$US monthly)</b>						
0–404	1	1	–	–	–	1
>404–1.010	2.3 (1.33–4.14)	1.34 (0.74–2.48)	–	–	–	1.51 (0.75–3.17)
>1010	3.3 (1.91–5.75)	1.32 (0.64–2.25)	–	–	–	1.53 (0.71–3.55)
<b>BMI</b>						
≥30	1	1	1	–	–	1
<22	0.95 (0.52–1.73)	0.95 (0.48–1.8)	0.86 (0.42–1.76)	–	–	0.9 (0.4–1.9)
22–27	1.78 (1.15–2.76)	1.56 (0.97–2.5)	1.44 (0.86–2.40)	–	–	1.4 (0.8–2.5)
27–29.9	1.94 (1.19–3.16)	1.63 (0.96–2.7)	1.89 (1.07–3.31)	–	–	1.8 (1.02–3.3)
<b>Hearing impairment</b>						
No	2.41 (1.61–3.6)	1.63 (1.04–2.57)	1.56 (0.93–2.42)	–	–	1.59 (0.94–2.5)
<b>Visual impairment</b>						
No	2.42 (1.66–3.48)	1.98 (1.32–2.97)	1.63 (1.06–2.49)	–	–	1.5 (0.98–2.4)
<b>Physical morbidities</b>						
≥3	1	1	1	–	–	1
1–2	4.1 (2.6–6.4)	3.7 (2.3–6.1)	3.77 (2.2–6.1)	–	–	3.55 (2.11–5.9)
No	10.9 (6.2–19.2)	10.7 (5.6–20.2)	11.2 (5.8–21.9)	–	–	10.5 (5.2–21.1)
<b>Work</b>						
Yes	2.97 (2.21–4.18)	1.80 (1.24–6.37)	–	1.27 (0.83–1.95)	–	1.19 (0.74–2.2)
<b>No. AADL</b>						
0–4	1	1	–	1	–	1
5–6	2.30 (1.45–3.65)	1.73 (1.04–2.86)	–	1.59 (0.95–2.43)	–	1.29 (0.72–2.2)
>6	5.27 (3.54–7.91)	2.76 (1.74–4.38)	–	2.23 (1.34–3.70)	–	2.07 (1.16–3.4)
<b>Depression</b>						
No	2.78 (1.6–4.8)	2.58 (1.42–4.69)	–	2.18 (1.18–4.0)	–	2.1 (1.07–4.1)
<b>Smoking</b>						
Current	1	1	–	–	1	1
Never	1.3 (0.53–3.04)	1.31 (0.53–3.22)	–	–	1.39 (0.55–3.5)	1.44 (0.52–3.9)
Past	1.1 (0.51–2.61)	1.53 (0.64–3.67)	–	–	1.69 (0.68–4.1)	1.50 (0.55–4.0)
<b>Alcohol consumption</b>						
Never	1	1	–	–	1	1
Daily	2.3 (1.1–4.7)	1.6 (0.7–3.8)	–	–	1.4 (0.6–3.3)	1.5 (0.62–3.9)
Weekly	1.8 (0.98–3.4)	1.3 (0.6–2.5)	–	–	1.1 (0.5–2.2)	0.79 (0.3–1.6)
Monthly	1.5 (1.1–2.2)	1.1 (0.4–1.0)	–	–	1.2 (0.8–1.7)	1.13 (0.7–1.7)
<b>Physical activity (Kcal per week)</b>						
0–471	1	1	–	–	1	1
472–1742	1.52 (0.98–2.3)	1.20 (0.75–1.91)	–	–	1.16 (0.87–1.8)	1.12 (0.65–1.8)
1743–26 372	3.27 (2.17–4.87)	2.34 (1.50–3.65)	–	–	2.25 (1.43–3.5)	1.88 (1.14–3.2)

Model 1 – Adjustment of each variable by sociodemographic variables. Model 2 – Clinical variables adjusted by the others of the block + sociodemographic variables. Model 3 – Psychosocial variables adjusted by the others of the block + sociodemographic variables. Model 4 – Behavioral variables adjusted by the others of the block + sociodemographic variables. Model 5 – Clinical + psychosocial + behavioral + sociodemographic variables (final model).

AADL, advanced activities of daily living.

## Discussion

The present study explored the biological dimension of successful aging by using modified Rowe and Kahn criteria, and analyzed the

roles of sociodemographic, clinical, psychological and lifestyle factors. While in developed countries, the literature on the subject is vast, in developing countries, these findings are rare; more specifically, in Brazil, this is the first study about prevalence. In Latin

America, we found only Mexican studies of SA prevalence, in which the complete Rowe and Kahn criteria were used.<sup>11</sup>

The prevalence of SA in the present study was 25%. Other studies that emphasized the biomedical dimension have found similar average prevalences (20.4%).<sup>1</sup> This result was also comparable with a recent study that adapted the Rowe and Kahn criteria similarly to our study by removing the social engagement component and using a less restrictive criterion for disease assessment, and that found a prevalence of 19.7%.<sup>12</sup>

The low prevalence found in the present study shows how difficult the concomitant preservation of all the criteria evaluated in old age can be: physical performance, cognition, functionality and good health. In addition, we found that the proportion of older adults who can reach this phenotype is drastically reduced every decade after age 60 years.

In the present study, the prevalence of SA varied by a range of factors. Those who were younger, white, men, married, regular drinkers, not depressed, with high levels of schooling and income, few morbidities, an absence of sensorial deficits, a BMI within the normal and overweight ranges, and high levels of physical activity and social participation were more likely to be successful agers.

The factors associated with SA shown in the present study were age, few physical morbidities, absence of depression, BMI in the overweight range, carrying out more than six AADL and high levels of physical activity.

Among the clinical variables, we found a directly proportional association with the number of physical morbidities. Those who reported the absence or less than two morbidities showed a higher probability of SA. We observed that among the successful agers, just 24.6% reported a complete absence of morbidities, whereas 62.1% reported one or two chronic diseases. Therefore, despite our statistical confirmation of the impact of chronic morbidity on the probability of remaining successful, we also observed that for some older people, the preservation of the functionality associated with good self-perception of health is possible in the presence of comorbidities. Evidence suggests that the functional consequences of chronic diseases are not inevitable, and can be significantly and positively influenced by several potentially modifiable factors, such as physical activity, social support, self-efficacy and psychological profile.<sup>13</sup>

Regarding BMI, overweight was positively associated with SA in relation to obesity. There are few studies evaluating the relationship between BMI and SA in elderly cohorts as the present study did. Despite the association of overweight with a discrete increase in incapacities among older adults when compared with the normal weight group,<sup>14,15</sup> some studies point to a possible inverse or null relationship between overweight and mortality in older adults.<sup>2,3</sup>

Between psychosocial variables, being engaged in multiple social or productive activities was positively associated with SA. Several studies have shown that a high level of participation in productive and social activities has both subjective impacts related to life satisfaction and objective effects on functional and cognitive status, physical health, and mortality.<sup>16</sup> In addition, we found a positive association between SA and the absence of depression. Evidence has shown that even mild and sub-syndromic depression is associated with declining overall functioning and disability.<sup>17</sup>

Regarding lifestyle factors, high levels of physical activity were associated with SA in the present study. This finding is consistent with different studies,<sup>18,19</sup> however, there is no consensus regarding what level of energy expenditure in physical activity is sufficient for the maintenance of health between these studies.<sup>20</sup>

The absence of an association between income and schooling and SA in the present results suggests that socioeconomic status did not have a major impact on the aging process in this sample. This result is similar to the literature from developed countries,<sup>1</sup> but not with another Brazilian study,<sup>21</sup> which might be influenced by the fact that this study population has greater access to healthcare and less income inequalities compared with the general

Brazilian population. The average monthly income of the Brazilian population is \$US724.56, the average schooling is 4.8 years (IBGE, 2014) and the access to supplementary health care currently covers 12.5% of the elderly population (ANS, 2016). The subgroup analyzed represents predominantly middle-class older adults with access to supplementary healthcare, as well as schooling (10.02 years) and monthly income levels (\$US1240.00) above the average population.

Despite studies showing the negative impact of smoking and alcohol abuse on healthy aging, we did not find statistically significant associations between these factors and SA.<sup>22</sup> The absence of an association with smoking is probably due to a mortality bias, as smokers have shorter survival times. Regarding the consumption of alcoholic beverages, we found a positive statistical association for alcohol abstainers in the crude analysis, but there was no association in the final model. The literature is quite inconsistent regarding this evidence. While some studies have shown benefits of moderate alcohol consumption compared with abstaining for healthy aging,<sup>23,24</sup> others have shown no association<sup>25</sup> or contradictory results.<sup>26</sup>

The strengths of the study include its contribution of information regarding the older population of a middle-income Latin American country. Focusing on healthy life expectancy, we emphasized the biomedical dimension of SA rather than its multidimensional construct to clarify the factors associated with this dimension.

The present study encourages some interesting interpretations. Contrary to previous Brazilian study findings,<sup>21</sup> we found a strong impact of biological determinants, such as age and disease, and a lack of association with socioeconomic status.

In addition to age, physical morbidity and depression, the other variables associated with SA were essentially modifiable factors: social engagement, BMI and physical activity. Thus, we conclude that disease control and prevention are central to SA, but are only part of the equation.

These findings highlight the importance of considering these modifiable behavioral factors when planning effective strategies for health promotion and disability prevention in the older population. A future challenge will be finding better ways to apply this evidence to encourage the older population to adopt and maintain healthy and active lifestyles.

Among the limitations of the study was the fact that it was transversal and did not allow the establishment of predictors. In addition, the study population is specific, because it represents a sample of supplementary healthcare clients, and thus, it is not representative of the Brazilian older population in general.

## Acknowledgements

This study was supported by the National Research Council – Brazil (Conselho Nacional de Pesquisa - CNPq), grant No 555087/2006-9 and Carlos Chagas Filho Foundation for Research Support of the state of Rio de Janeiro – Brazil (Fundação Carlos Chagas de apoio à pesquisa), grant No. E-6/171 469/2006 and E-26/110 294/2007.

## Disclosure statement

The authors declare no conflict of interest.

## References

- 1 Depp CA, Jeste DV. Definitions and predictors of successful aging: a comprehensive review of larger quantitative studies. *Am J Geriatr Psychiatry* 2006; **14**: 6–20.
- 2 Bowling A, Iliffe S. Which model of successful ageing should be used? Baseline findings from a British longitudinal survey of ageing. *Age Ageing* 2006; **35**: 607–614.

- 3 Lourenço RA, Sanchez MA, Moreira VG *et al.* Frailty in older Brazilians – FIBRA-RJ: research methodology on frailty, cognitive disorders and sarcopenia. *Rev Hosp Univ Pedro Ernesto* 2015; **14**: 11–21.
- 4 Rowe JW, Kahn RL. Successful aging. *Aging (Milano)* 1998; **10**: 142–144.
- 5 Lino VT, Pereira RS, Camacho LA *et al.* Cross-cultural adaptation of the independence in activities of daily living index (Katz Index). *Cad Saude Publica* 2008; **24**: 103–112.
- 6 Fried LP, Tangen CM, Walston J *et al.* Frailty in older adults: evidence for a phenotype. *J Gerontol A Biol Sci Med Sci* 2001; **56**: M146–M157.
- 7 Nutrition Screening Initiative. *Nutrition Interventions Manual for Professionals Caring for Older Americans*. Washington, DC: Nutrition Screening Initiative, 1992.
- 8 Baltes MM, Mayr U, Borchelt M, Maas I, Wilms HU. Everyday competence in old and very old age: an interdisciplinary perspective. *Ageing Soc* 1993; **13**: 657–680.
- 9 Reuben DB, Laliberti L, Hiris J, Mor V. A hierarchical exercise scale to measure function at the Advanced Activities of Daily Living (AADL) level. *J Am Geriatr Soc* 1990; **38**: 855–861.
- 10 Oliveira EM, Silva HS, Lopes A *et al.* Atividades Avançadas de Vida Diária (AAVD) e desempenho cognitivo entre idosos. *Psico-USF, Bragança Paulista* 2005; **20**: 109–120.
- 11 Arias-Merino E, Mendoza-Ruvalcaba N. Prevalence of successful aging in the elderly in western Mexico. *Curr Gerontol Geriatr Res* 2012; **2012**: 1–6.
- 12 McLaughlin S, Jette A, Connell C. An examination of healthy aging across a conceptual continuum: prevalence estimates, demographic patterns, and validity. *J Gerontol A Biol Sci Med Sci* 2012; **67**: 783–789.
- 13 Seeman TE, Chen X. Risk and protective factors for functioning in older adults with and without chronic conditions: MacArthur Studies of Successful Aging. *J Gerontol B Psychol Sci Soc Sci* 2002; **57**: 135–144.
- 14 Leveille S, Guralnik J, Ferrucci L. Aging successfully until death in old age: opportunities for increasing active life expectancy. *Am J Epidemiol* 1999; **149**: 654–664.
- 15 Janssen I. Morbidity and mortality risk associated with overweight BMI in older men and women. *Obesity* 2007; **15**: 1827–1840.
- 16 Menec V. The relation between everyday activities and successful aging: a 6-year longitudinal study. *J Gerontol B Psychol Sci Soc Sci* 2003; **58**: 74–82.
- 17 Lyness J, Heo M. Outcomes of minor subsyndromal depression among elderly patients in primary care settings. *Ann Intern Med* 2006; **144**: 496–504.
- 18 Manini T, Everhart JE, Patel KV *et al.* Daily activity energy expenditure and mortality among older adults. *JAMA* 2006; **296**: 171–179.
- 19 Hirsch C, Diehr P, Newman A *et al.* Physical activity and years of healthy life in older adults: results from the cardiovascular health study. *J Aging Phys Act* 2010; **18**: 313–334.
- 20 Vaillant GE, Mukamal K. Successful aging. *Am J Psychiatry* 2001; **158**: 839–847.
- 21 Chaves ML, Camozzato AL, Eizirik CL, Kaye J. Predictors of normal and successful aging among urban-dwelling elderly Brazilians. *J Gerontol B Psychol Sci Soc Sci* 2009; **64**: 597–602.
- 22 Peel NM, McClure RM, Bartlett HP. Behavioral determinants of healthy aging. *Am J Prev Med* 2005; **28**: 298–304.
- 23 Guralnik JM, Kaplan GA. Predictors of healthy aging: prospective evidence from the Alameda County study. *Am J Public Health* 1989; **79**: 703–708.
- 24 Meng X, D’Arcy C. Successful aging in Canada: prevalence and predictors from a population-based sample of older adults. *Gerontology* 2014; **60**: 65–72.
- 25 Strawbridge W, Cohen RD, Shema SJ, Kaplan GA. Successful aging: predictors and activities association. *Am J Epidemiol* 1996; **144**: 135–141.
- 26 Pruchno RA, Wilson-Genderson M. A Longitudinal Examination of the Effects of Early Influences and Midlife Characteristics on Successful Aging. *J Gerontol B Psychol Sci Soc Sci* 2015; **70**: 850–859.
- 27 Instituto Brasileiro de Geografia e Estatística (IBGE). Pesquisa Nacional por Amostra de Domicílios. Instituto Brasileiro de Geografia e Estatística, 2014.
- 28 Agência Nacional de Saúde Suplementar (ANS). Idosos na Saúde Suplementar, 2016.

**How to cite this article:** Canêdo AC, Lopes CS, Lourenço RA. Prevalence of and factors associated with successful aging in Brazilian older adults: Frailty in Brazilian older people Study (FIBRA RJ). *Geriatr. Gerontol. Int.* 2018;1–6. <https://doi.org/10.1111/ggi.13334>