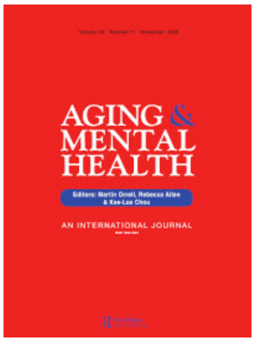

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Cognitive function of Brazilian elderly persons: longitudinal study with non-clinical community sample

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ABSTRACT

Several biopsychosocial changes in individuals' life might happen, resulting in a decline of long-term cognitive abilities. In this way, the aim of this study was to compare cognition in non-clinical older adults in Brazil during a four-year period, as well as to examine which variables may explain cognitive function variations identified during this time. For this purpose, a longitudinal study was developed including 108 older Brazilians in phase I and 64 in phase II, from 2013 to 2017. Socio-demographic variables were assessed and the following instruments were administered: the Mini-Mental State Examination (MMSE), the Wechsler Adult Intelligence Scale (WAIS) - 3rd Edition - Digital Symbol-Coding subtests, the Verbal Fluency Test (animal category), the Rey Auditory-Verbal Learning Test, the Beck Anxiety Inventory (BAI), and the Geriatric Depression Scale 15-item version (GDS-15). In order to compare cognitive variables, the Wilcoxon signed-rank test for repeated measures was used. Temporal comparisons of nominal variables were carried out using McNemar's chi-square tests for matched pairs. Finally, multiple linear regression and correlation analyses were applied, using the participants' cognitive performance variation scores (Δ) as dependent variables. Global cognitive function delayed verbal episodic memory, and processing speed experienced a significant decline in four years. Symptoms of anxiety were the main predictor of cognitive performance variations in this sample.

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Older adults; cognition; normal aging; longitudinal

Introduction

The aging process is associated with several normative changes in people's biological, psychic and social conditions, being age-related cognitive decline one of the most frequent causes of disability in older adults (Courtney-Long et al., 2015). These changes may lead, not only to a decline in people's cognitive performance but it also can decrease the ability of learning and processing new information. Furthermore, changes may occur in the performance of memory, attention, reasoning, language, and executive functions (Tsai et al., 2016), even in normal aging processes (Moret-Tatay et al., 2017).

Regarding cognitive functions, the older adult's memory commitment level may be related to education level, attention level, emotions experienced during life as well as individual attributes (Kuns, Paulino, & Aprile, 2015). Moreover, literature indicates that having a more active lifestyle also leads to improved cognitive function in this population (Murphy, Spillane, Cully, Navarro-Pardo, & Moret-Tatay, 2016; Stern, 2017).

Physical exercise and intellectual activities have been associated with improved performance in activities that measure the processing speed, working memory and executive function (Carral, Curras, Pérez, & Suárez, 2017; Murphy & Cunningham, 2012; Murphy, O'sullivan, & Kelleher, 2014), contributing to an upgrading in processing speed levels and reasoning skills in this population (Engeroff, Ingmann, & Banzer, 2018; Sanchez-Lopez et al., 2018; Pedroso et al., 2018). That is, an active routine may benefit mental and cognitive health, as well as longevity (Araujo, 2017). Considering the occurrence of changes in normal aging processes – which take place not only due to biological and genetic aspects, but also because of individual lifestyle choices (Fechine & Trompieri, 2015) – it is important to identify the variations in older adults' cognitive function throughout the years.

According to Baudouin, Isingrini and Vanneste (2018), one variable of interest is the information processing speed, which is a crucial ability in life-spam, since it enables the efficient operation of higher order cognitive functions (such as reasoning, implicated in multiple cognitive decline models). Two of the most widespread theories in this field are the executive dysfunction and cognitive slowing down. The first one establishes that the decline in cognition is mainly due to decreased executive functioning, which has been supported by studies involving results in the frontal lobe (a brain area especially sensitive to aging).

On the other hand, it is considered that speed processing drops in older adults, and as a result, time to perform operations is reduced, leading to less efficiency in this cognitive processing. Lastly, one latent variable of cognition, that might cause variability and deficient performance, is the older person anxiety level. More precisely, the

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Table 1. Baseline socio-demographic and cognitive variables (n = 108).

Socio-demographic variables	*McNemar's Chi-square (2)*	Wilcoxon (z)	*p*
Marital Status	2,581		0,461
Reading	0,099		0,753
Crossword Puzzles	1,660		0,198
Use of computer	1,498		0,221
Learning another language	0,053		0,818
Physical activity	0,067		0,795
Cognitive variables			
Global cognitive function (MMSE)		−2,536	0,011
Immediate verbal episodic memory (RAVLT A1)		−1,557	0,119
Delayed verbal episodic memory (RAVLT A7)		−1,455	0,146
Processing Speed (Coding)		−1,239	0,216
Attention and immediate/working memory (Digital Symbols)		−0,235	0,814
Verbal fluency and word generation (Fluency - Animals)		−0,702	0,483

bidirectional nature of this association has been reported in the literature, and the presence of this symptomatology has been linked to a poorer cognitive performance in the older people (Beaudreau & O'Hara, 2008).

Research in the field has been focused on the comparison between older adults cognitively impaired and those intact (Hwang, Masterman, Ortiz, Fairbanks, & Cummings, 2004; Wolitzky-Taylor, Castriotta, Lenze, Stanley, & Craske, 2010). However, a limitation of these studies seems to be the use of personality measures rather than anxiety measures (Beaudreau & O'hara, 2009). Furthermore, anxiety might be interesting for visible cognitive process such as memory. Several authors (Evans, Charness, Dijkstra, Fitzgibbons, & Yoon, 2018; Moon, Yang, & Jeong, 2015) pointed out that anxiety disorders might be related to a reduction of verbal episodic memory. Thus, a better understanding of the relationship between anxiety and speed processing in the older adults may clarify some aspects of the aging process.

This research aims to investigate which variables may be associated with cognitive performance in older adults. Studies including this population are important and even recommended by the literature. However, there are few longitudinal studies developed with Brazilian samples, especially non-clinical studies. Studies which intend to assess the cognitive performance of the aged individuals during a given period of time are required and must be highlighted (Farina, 2015; Lopes, 2014).

Therefore, the main objective was to evaluate the cognitive performance of aged people during a four-year period. Furthermore, the study aims to verify if age, education level, intellectual activities, physical exercise, symptoms of depression and anxiety may explain variations the cognitive performance of older adults during this time. Finally, the role of speed processing and anxiety are inspected in terms of current models in cognition. In a theoretical level, results might help to implement current models of cognition in the field. In an applied level, results are of interest for a particular population such as the Brazilian one.

Method

Outline

This is a longitudinal study, which estimated the temporal effects of different variables, refining the inference level about the influence of such variables. The assessments were carried out on two occasions, four years apart from each other, in 2013 and in 2017.

Participants

In stage I, in 2013, 108 older adults were assessed. In stage II, in 2017, 64 older individuals were assessed. Initially, all participants were contacted by telephone. The reasons for non-participation in stage II were the following: the phone number information given was out-of-date or disconnected ($n = 20$), the individual did not want to participate in stage II ($n = 13$), the participant started to show symptoms of dementia, according to family members ($n = 4$), the individual moved to another city ($n = 4$) or was traveling during the collection period ($n = 3$); in total, 44 participants did not take part in stage II.

Regarding the sociodemographic characteristics of the 44 participants in phase I, in 2013, the following results were observed: the mean age was 68.75 years (SD = 7.37), education level was 11.93 years (SD = 4.80) and the majority of participants 59.1% (n = 26) was married. Regarding the practice of cognitively stimulating activities, 25% (n = 11) had knowledge of a second language, 81.8% (n = 36) practiced reading activities, 47.7% (n = 21), 50% (n = 22) used to handle electronic devices and 22.7% (n = 10) practiced some physical activity.

When comparing the baseline characteristics of the 108 participants evaluated in phase I, two members groups were created: Group 1: only individuals who participated in phase I (n = 44) *versus* Group 2: individuals who participated in both phases (I and II = 64). The only variable which presented a statistical significance was the global cognitive functioning (Table 1).

Concerning sociodemographic data, most of the 64 participants (81.3%) were female (n = 52). The average education level was 12.67 years (SD = 5.2), with an average of 30.78 years of formal professional activities (SD = 12.59) and 15.86 years of retirement (SD = 9.64). Besides that, the mean age in phase I was 69.17 years old (SD = 6.12, range: from 60 to 83), while in stage II it was 73.19 years old (SD = 6.12, range: from 64 to 87).

Instruments

Clinical and sociodemographic questionnaire

Structured interview aiming to assess sex, age, marital status, education level, profession, years of retirement, intellectual activities (reading, crossword puzzles, learning a second language and use of electronic devices, such as computers, tablets, and smartphones), physical activities, as well as symptoms of anxiety and depression.

Cognitive functions

Mini-mental state examination (MMSE). A screening aid that allows a global view of a patient's cognitive function. Scores may range from zero to one, out of 30 points in total (Bertolucci, Brucki, Campacci, & Juliano, 1994; Folstein, Folstein, & McHugh 1975). The cut-off numbers used in this study were the following: 21 points for the illiterate people group (>1 year); 22 points for people with low education level (1-5 years); 23 for people with average education level (6-11 years), and 24 for people with high education level (≥12 years). These values were based on a study by Kochhann et al. (2010) carried out with older adults in Southern Brazil. Cronbach's alpha was 0.80 (Santos, Cerchiari, Alvarenga, Faccenda, & Oliveira, 2010).

Wechsler adult intelligence scale (WAIS) – 3rd edition; digital symbol-coding subtests. The Coding subtest mainly assesses processing speed. Digital Symbol subtest assesses attention, immediate memory and working memory. The internal consistency/Cronbach's alpha was 0.84 for the Digital Symbols subtest concerning people aged 60 to 89 (Nascimento, 2004; Wechsler, 2004).

Verbal fluency test (animal category). A task that evaluates executive functions components, such as verbal fluency and word generation. The administrator requests the individual to say, as quickly as possible, the name of various animals in the course of one minute (Strauss, Sherman, & Spreen, 2006). Cronbach's alpha was 0.74 (Santos, 2009).

Rey auditory-verbal learning test (RAVLT). It is composed by two word lists, with 15 word each. The first list is repeated five times (A1, A2, A3, A4, A5) so that participants memorize the largest number of words. Afterwards, a distracter list is read (B), followed by a recollection of the first list (A6). After 20–30 minutes, participants are asked to remember the first list (A7) (Boake, 2000; Rey, 1958). A1 assesses immediate memory, and the A1-A5 sum assesses the summary of the learning process. A6 measures immediate recollection, while A7 evaluate delayed recollection (Malloy-Diniz, Fuentes, Mattos, & Abreu, 2018). In Brazil, the normative standards for the test have been developed for an age range going from 16 to 89 years old (Malloy-Diniz, Lasmar, Gazinelli, Fuentes, & Salgado, 2007). The instrument internal consistency varied from 0.80 to 0.95 (Mitrushina, 1999).

Symptoms of anxiety and depression

Beck anxiety inventory (BAI). It assesses anxiety symptomatology intensity through a list of symptoms, comprised of 21 items, on which subjects must indicate how they felt in the last two weeks, by using a four-point scale. In this study, it were used the cut-off points suggested by the manual, subdivided as follows: 0 to 10: minimal symptoms, 11 to 19: mild, 20 a 30: moderate, and 31 to 63: serious. Regarding internal consistency, Cronbach's alpha was 0.90 (Cunha, 2001; Leite et al., 2012).

Geriatric depression scale 15-item version (GDS-15). It consists of a 15-question instrument to assess depression symptoms intensity (Yesavage et al., 1982-1983). Scores lower than five indicate the absence of symptoms and scores above five attest the presence of depressive symptoms. The scale presented a 0.81 Cronbach's alpha (Almeida & Almeida, 1999; Paradela, Lourenço, & Veras, 2005).

Ethical procedures

Firstly, the study project was send to the Department of Health Sciences and submitted to an ethical research committee, recognized by the National Health Council (CNS) under the number 12324413.4.0000.5336 in phase I and 63196816.8.0000.5336 in phase II. After accepting join in the study, the participants signed down the free and informed consent (TCLE). The ethical procedures are based on the Guidelines and Standards Regulating Research Involving Human Beings (Resolution No. 510/16 and Resolution No. 466/12 by the National Health Council).

Data collection procedures

In both phases (I and II), the assessment was carried out by a psychologist and Psychology students, who have been previously trained. The instruments were applied in a psychological health center, as well as in vacant and adequate rooms inside the University. The sample were assessed in a single meeting individually, with an average duration of two hours.

The instruments application order was: Clinical and sociodemographic questionnaire, cognitive tests (MMSE, RAVLT, Coding, Digital Symbol, RALVT recollection, Verbal Fluency – Animals) and symptoms of anxiety and depression scales. Participants who demonstrate a need for treatment were referred to free Psychology services, offered by the community. The results were given back in April 2018, in groups, with an average number of 10 members per group/meeting. At the time, it were presented the study global results and it was provided a brief report including the main results of each individual. Most participants received their results in person ($n = 42$) while the remaining of them ($n = 22$) received their outcomes by the phone.

Data analysis procedures

The variables univariate distribution under investigation was estimated by means the Shapiro-Wilk test, adopting a significance level of 0.5. Some variables presented asymmetric distribution, thus, the subsequent hypothesis tests were carried out using non-parametric analyses. In order to compare cognitive variables in the two assessment instances, Wilcoxon signed-rank test was used for repeated measures. Temporal comparisons of nominal variables were carried out using McNemar's chi-square tests for matched pairs. The significance level adopted in this study was $\alpha = 0.05$.

Subsequently, correlation analyses were carried out in order to verify the association level between variables. Afterwards, multiple linear regression analyses were carry through, using as dependent variables (VD) the scores of participants' cognitive performance variations (Δ) in stages I and II, while sociodemographic information and symptoms of anxiety and depression were used as independent

Table 2. Comparison of socio-demographic variables in a four-year period (n = 64).

Variables	Stage I n	Stage I %	Stage II n	Stage II %	McNemar's Chi-square (2)	p
Marital Status					3.57	0.17
Married	39	61	34	53.1		
Widow/Widower	15	23.4	20	31.3		
Single	10	15.6	10	15.6		
Reading					1.57	0.99
No	10	15.6	9	14.1		
Yes	54	84.4	55	85.9		
Crossword Puzzles					4.06	0.99
No	26	40.6	25	39.1		
Yes	38	59.4	39	60.9		
Use of computer					4.3	0.79
No	24	37.5	26	40.6		
Yes	40	62.5	38	59.4		
Learning another language					4.05	0.58
No	47	73.40%	44	68.8		
Yes	17	26.60%	20	31.2		
Physical activity					2.9	<0.001
No	51	79.7	33	51.60%		
Yes	13	20.3	31	48.40%		

Table 3. Comparison of cognitive performance in a four-year period (n = 64).

Variables	Mean and Standard Deviation	Median (range)	Wilcoxon (z)	p
Global cognitive function (MMSE)			−2.51	0.012
Stage 1	28.09 (1.58).	28.00 (8).		
Stage 2	27.28 (2.65).	28.00 (13).		
Immediate verbal episodic memory (RAVLT A1)			−1.28	0.2
Stage 1	5.14 (1.53).	5.00 (6).		
Stage 2	4.86 (1.73).	5.00 (7).		
Delayed verbal episodic memory (RAVLT A7)			−2.46	0.014
Stage 1	8.13 (3.5).	8.00 (15).		
Stage 2	7.28 (3.5).	7.00 (14).		
Processing Speed (Coding)			−2.82	0.005
Stage 1	45.14 (14.41).	47.50 (69).		
Stage 2	42.39 (16.07).	45.00 (78).		
Attention and immediate/working memory (Digital Symbols)			−1.51	0.131
Stage 1	13.38 (3.91).	12.50 (19).		
Stage 2	12.88 (3.19).	13.00 (16).		
Verbal fluency and word generation (Fluency - Animals)			−0.87	0.384
Stage 1	15.68 (4.39).	16.00 (24).		
Stage 2	16.25 (4.21).	16.00 (18).		

variables (VI), in order to investigate which variables may explain cognitive function variations detected in the four-year interval. For collinearity purposes, it was only used the measure of one of the collection phases for the following variables: age (stage II) and education level (phase I). For all other sociodemographic variables it was considered the amounts shown in phase I and II: learning a second language, reading, crossword puzzles, use of electronic devices, exercising, symptoms of anxiety and depression.

In an effort to identify the strongest predictors of performance variations (Δ) in the regression models, step-wise selection (via p-values) was conducted. The resulting models after this data-driven approached were considered exploratory since the available sample size precluded validation of these results.

Results

First of all, sociodemographic variables were examined in both phases. McNemar's chi-square test provided the results of the comparison made between phases. However, only the physical activity showed significant increase in four years. The results of this analysis are presented in Table 2.

Comparing the performance in the cognitive tests in phases I and II, it was possible to see a decline in global cognitive function (MMSE), in delayed verbal episodic memory (RAVLT A7), and in processing speed (Coding). It was not found significant differences in the other cognitive tests. The scores average and the comparison between phases I and II are report on Table 3.

Lastly, Tables 3 and 4 shows the explanatory models for variations in participants' cognitive performance when comparing both phases. The exploratory regression models were estimated with a non-ideal proportion of cases per independent variable. Besides that, the parameter estimates and the proportion of outcome variance explained are likely to be over-optimistic, because they are optimized for the particular sample and may not replicate in other samples. Therefore, results should be interpreted with caution.

The predictors of each variable in relation to the variations in participants' cognitive performance were:

Table 4. Multiple linear regression in order to forecast differences in cognitive performance between stages I and II (n = 64).

Difference in cognitive performance between stage 1 and 2 (VD)	In-sample R^2 (variance explained)	Predictors (VI)	Non-standardized Beta coefficient (β)	Standardized Beta coefficient (β)
Global cognitive function (ΔMMSE)	29.00%	BAI 2	−0.141	−0.459
		Learning another language 2	1.284	0.249
Immediate verbal episodic memory (ΔRAVLT A1)	16.90%	Crossword puzzles 2	1.108	0.327
		Gym 1	1.213	0.295
Delayed verbal episodic memory (ΔRAVLT A7)	6.90%	BAI 2	−0.106	−0.289
Processing Speed (ΔCoding)	29.00%	Education level	0.774	0.450

a. symptoms of anxiety and learning a second language were predictors of global cognitive function, and together accounted for 29% of MMSE's performance variations;
b. education level was a predictor of processing speed, with a 29% explanatory power in the Coding subtest;
c. crossword puzzles and physical exercise were predictors of immediate verbal episodic memory, and together accounted for 16.9% of RAVLT A1's performance;
d. symptoms of anxiety were the predictor of delayed verbal episodic memory, with a 6.9% explanatory power in RAVLT A7.

There were no predictors for the remaining cognitive components - attention and memory (immediate and working memory) (Digital Symbol), verbal fluency and word generation (Verbal Fluency).

Discussion

This main objective of this article was to examine cognitive variations in the older adults through a non-hospital sample during four-year term. Furthermore, to investigate if age, education level, intellectual activities, physical exercise, symptoms of depression and anxiety may explain variations in the cognitive performance of aged adults in this period. Finally, variables of interest were speed processing and anxiety, as described in previous literature.

Results indicated a decrease in global cognitive function, in processing speed and in the delayed verbal episodic memory as the main changes in the cognitive function. Despite these differences being significant on a statistical level, it is worth highlighting that a decrease in the scores does not indicate cognitive decline because, even though, the sample average remained within expected levels for the age range in question, not characterizing a clinical condition (Irigaray & Schneider, 2012). However, these results reveal a trend in cognitive decline as years go by, even in older adults in a non-hospital situation (Deary et al., 2009).

The decline in global cognitive function indicated by the comparison between phase I and II may have happened due to the natural physiological aging process (Faber, Scheicher, & Soares, 2017; Rebok et al., 2014). Other studies have also showed a performance decrease in cognitive tracking tests, with a longitudinal assessment (Li, Zhu, Qiu, & Zeng, 2017; Rawtaer et al., 2017). The decline of cognitive abilities may have varied, complex, isolated or multifactor causes. This condition may occur as a consequence of mood status, which may even represents an early sign of dementia (Soares & Rossignoli, 2014).

In this study, it was possible to verify that lower levels of anxiety and the process of learning a second language are predictors of improved global cognitive performance within a four-year period. High levels of anxiety, as well as the presence of emotional suffering, have been identified as connected with cognitive damage in older adults (Leung, Cheng, Yu, Yiend, & Lee, 2018; Sinoff & Werner, 2003). Another study pointed out that learning a second language is connected with an improvements in cognitive functions, since it has reinforce attention, control, and memory skills, inhibition, and other executive functions (Bialystok, 2009).

The processing speed has also experienced a significant decrease in this sample, supporting literature findings that indicate a reduction in this element as the aging process befalls (Lu, Chan, Fung, & Lam, 2016; Nouchi, Saito, Nouchi, & Kawashima, 2016). In this study, the predictor of processing speed was the education level, indicating that the more years the participant has studied, the better is her/his processing speed. Reports are proving that more years of study are positively associated with improved cognitive performance (Oliveira et al., 2017) and processing speed in older adults (Ihle et al., 2018).

The results of this study indicate a decline in the delayed verbal episodic memory scores, predicted only by anxiety symptoms. Findings by Moon, Yang, and Jeong (2015) study support these outcomes, pointing towards a relationship between anxiety disorders and a decrease in verbal episodic memory. Moreover, aged people with episodic memory decline and global cognitive impairment may reveal a greater risk of developing Alzheimer's disease (Charchat-Fichman, Caramelli, Sameshima, & Nitrini, 2005).

In this study, some cognitive function showed deficits over the years, as global cognitive functioning, delayed verbal episodic memory, and processing speed. In fact, a large body of research describes a decrease in executive functions in older people (Lopes, Bastos, & Argimon, 2017; Monica, Johnsen, Atzori, Groeger, & Dijk, 2018), which is an expected process as they get old, especially in clinical populations.

However, other assessed features remained stable, as attention, memory (immediate verbal episodic, immediate, working memory) and executive functions (verbal fluency and word generation). Thus, the results suggest that during four years, the participants have been, in general, preserved these functions. The outcome is interesting in terms of slowing down theoretical models, supporting the classical cognitive slowing down theory for this non-clinical population.

A hypothesis to explain the stability of such cognitive functions is the substantial increase in healthy habits in the last four years, such as exercising. It is believed that this circumstance may have helped in maintaining cognitive functions on stable levels, considering that exercising may improve brain plasticity and neurogenesis capacity, contributing positively to a given individual's cognitive function (Cotman & Berchtold, 2002).

Other result suggest that there were no significant statistical differences when comparing the two attention instances analyzed, results that are different from the ones found by Arsic et al. (2015), who has pointed to a decrease in cognition and in attention quality during the aging process. The attention capacity of the sample is preserved. The explanatory hypothesis is that some protective elements, such as physical and intellectual activities, were strengthened throughout the years, facilitating this outcome (Argimon, 2006; Vaportzis & Gow, 2018).

The working memory also was found stable, supporting another study that assessed the same population with an active lifestyle (Carral et al., 2017). Participants have also maintained scores in cognitive tasks that measured immediate memory and immediate verbal episodic memory. Intellectual activities (e.g. crossword puzzles) and exercising have been identified as predictors of improvement in old adults' memory performance (Lachman et al., 2010; Oliveira, Pena, & Silva, 2015). The relationship between aged people exercising and improved cognitive function has been extensively reinforced by studies in literature (Engeroff, Ingmann, & Banzer, 2018; Kirk-Sanchez & McGough, 2014; Nouchi et al., 2014; Pedroso et al., 2018; Shih, Paul, Haan, Yu, & Ritz, 2018).

Exercising, especially activities such as yoga/meditation, contributes positively to improved attention performance in this population (Gothe, Kramer, & McAuley, 2017), and it may be considered a protective aspect in terms of executive functions (Assed, Carvalho, Rocca, & Serafim, 2016; Souza, Porto, Souza, & Silva, 2016). Despite the fact that only the physical activity reached a statistically significant increase in the second phase of this study, the practice of intellectual activities (reading, crossword puzzles, use of electronic devices, and learning a second language) remained stable. The use of technological devices can benefit episodic memory and executive functions in this population (Basak & Qin, 2018). The cognitive stability found may be explained by the increase in the frequency of physical activities and by the endurance of intellectual activities carried out by the participants (Vaportzis & Gow, 2018).

These results are important for both theoretical and empirical levels. More precisely, regarding policies and interventions across largely driven by contextual factors in Brazil. It is concluded that participants had a decrease in cognitive performance during this four-year period, but there were no changes in clinical conditions, which characterizes a non-pathological decrease. However, it is believed that this sample may experience cognitive decline in the future if alterations remain at this speed of progression, revealing a trend in cognitive decline as years go.

Finally, some limitations of the study need to be mentioned. The sample loss was bigger than the expected percentage, which was 15% (Argimon & Stein, 2005). It is emphasized the importance of a careful interpretation of these results, considering the reduced number of participants, as a consequence of the sample loss. Because of that, for future longitudinal studies, it is indicated the assessment of a larger number of participants, since the sample loss may be greater than previously expected.

Furthermore, it can be supposed that the participants who usually attend to university' surveys have a more active profile, characterized by the performance of activities which are inherently protective of cognitive functions. Despite the expected cognitive decline in some elements, the participants in this study remained functional and active. Studies also established benefits of an active lifestyle in older adults, the influence of education levels, the importance of leisurely and physical activities as variables that operate in order to protect an individual's cognition and well-being, with regard to longevity (Santos, Andrade, & Bueno, 2009; Souza, Porto, Souza, & Silva, 2016).

Disclosure statement

The authors declare no conflict of interest.

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