Executive functions and functional impairment in Latin seniors suffering from depression

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ABSTRACT
Functional impairment (FI) relates to the condition of executive functions (EFs). While EFs become affected by age and educational level (EL). Seniors suffering from depression (SSDs) on the other hand show EF-related deficiencies; however, there is hardly any literature available regarding their relationship with FI in Latin SSDs, who usually have low ELs. Objective: To verify the relationship between EFs and FI in SSDs of Latin origins, by controlling the effects associated with age and educational level. Methodology: Cross-sectional study, of cases and controls, conducted on a nonprobability sample, made up of 102 self-sufficient SSDs and 142 control subjects over age 50, monolinguals of Latin origin (Chileans), all assessed by means of a battery of assessments such as: Geriatric Depression Scale, Addenbrook’s Cognitive Assessment III, Trail making Tests A and B, STROOP word—color test, and semantic and phonological verbal fluency tests. A domain of composite EFs was established with standardized Chilean population scores, where age and educational levels were controlled. A simple linear regression analysis was conducted to determine the relationship between EFs and FI in SSDs. Results: Upon controlling age and educational levels, EFs explained an FI variance of 3.9% in SSDs; depression explained an EF variance of 3.2%, and 3.7% of FI. Conclusion: The results of the present study highlight the importance of a timely intervention when it comes to geriatric depression, considering the negative effect it has over the executive functions and the functionality of seniors.

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Introduction
Geriatric depression represents a major public health issue, as it implies higher social and economic costs, increasing the risk of morbidity and mortality (McCall & Kintziger, 2013; P. S. Wang et al., 2003), disrupting the quality of life of nearby relatives (Xie et al., 2018), and representing a risk factor in terms of dementia (Livingston et al., 2017; Norton et al., 2014). Additionally, depression accelerates brain aging (Han et al., 2018), increases the risk
of cerebrovascular accidents (Pan et al., 2011) and other medical conditions that compromise cognition (Tobe, 2019).

In that regard, some studies have reported immune-inflammatory alterations developing into cerebrovascular accidents that produce white matter lesions responsible for the decline of neuronal communication, which is the support of cognitive activities in general (Paranthaman et al., 2010). Uemura et al. (2014) found decreased oxygen transportation and a slowing down of the prefrontal metabolic activity in a group of elderly suffering from depression, associating these findings to poor performances of cognitive tasks requiring planning, monitoring, and cognitive adaptation. Volumetric reduction of the hippocampus was also found representing cognitive difficulties in memory and learning among seniors (Camfield et al., 2018; Sawyer et al., 2012). Jointly, these observations show that geriatric depression, besides predisposing a series of medical conditions and functional impairment (Buigues et al., 2015; Penninx, 2017), produce relevant effects on cognition, particularly on executive functions (EFs) (Alexopoulos et al., 2000; Bauermeister & Bunce, 2015; Dotson et al., 2018; Dybedal et al., 2013; Korsnes & Ulstein, 2014; Rajtar et al., 2017).

EFs represent a group of complex cognitive abilities that enable the definition, identification, and planning of objectives, as well as the execution and monitoring of actions for the attainment of goals (Diamond, 2013). EFs enable the performance of daily tasks of different degrees of complexity, while contributing to sustaining autonomy during senescence (Hart & Bean, 2010; Jefferson et al., 2006; Marshall et al., 2011). On the other hand, EF impairment has associated to risk of falls (Buracchio et al., 2011), frailty (Buigues et al., 2015), lower adherence to medical treatments (Insel et al., 2006), decreased psychotherapeutic response (Thompson et al., 2015), and a higher mortality risk (Johnson et al., 2007).

Deficiencies have been reported in the executive functions of seniors suffering from depression (SSDs) (Dotson et al., 2018; Dybedal et al., 2013; Klojčnik et al., 2017; Lugtenburg et al., 2017), identifying some socio-demographic variables, such as age, educational level (EL) and functional impairment (FI) modulators in this relationship, yet this relationship as well as this modulation is unclear. It is of general knowledge that aging decreases the operational capacity of executive functions (Fjell et al., 2017), becoming more noticeable in seniors suffering from depression (K. C. Wang et al., 2017). Therefore, a higher educational level in cognitively healthy seniors would favor EFs, in accordance with the cognitive reserve (CR) model (Chapko et al., 2018; Pernecky et al., 2019; Xu et al., 2016). EL would be the CR factor that would enable optimization and maximization of elderly cognition upon the recruitment of brain networks that seem to reflect the usage of alternative cognitive strategies (Stern, 2009). This would explain the delay in cognitive impairment during normal aging (Opdebeeck et al., 2016) or in degenerating processes such as dementia (van Loenhoud et al., 2019). EL would act as a type of CR (Opdebeeck et al., 2016), granting cognitive protection to elderly people. Nevertheless, some cohort studies conducted on Latin population (Mungas et al., 2018) have reported that EL is not a protection against cognitive impairment over time, and in the context of seniors suffering from depression, the relationship between EFs and EL would become even more confusing. A systematic review (Opdebeeck et al., 2015) reported that higher ELs did not entail EF benefits in SSDs, and even larger EF impairments were reported in some SSDs with higher educational levels (O’Shea et al., 2015).
Similarly to EF impairment, depression is a risk factor related to functional impairment and disruptions to the elderly’s daily living (Nakamura et al., 2017; Storeng et al., 2018). Therefore, it is natural that SSDs face greater difficulties to independently cope with their daily routines. FI in SSDs would have been influenced by multiple factors such as the severity of depression symptomatology (Kazama et al., 2011), the joint presence of vascular damage associated to depression (Hybels et al., 2016) and high cortisol levels (Shindel et al., 2019), compromising the instrumental activities of daily living (Morin et al., 2019).

A negative relationship between educational level and functional impairment has been reported among seniors not suffering from depression; such relationship would be mediated by EFs (Puente et al., 2015). Nevertheless, in North American SSDs with high educational levels, the available evidence suggests that executive functions would be responsible for the mediation between depression and functional impairment (Brewster et al., 2017). Hence, SSD's FI would be influenced by EF performance and EL, however, there is scarce information about how EF performance has an effect on the FI of Latin SSDs upon controlling EL effects.

Understanding the relationship between EFs and FI in SSDs of Latin origins who tend to have lower ELs (Nguyen et al., 2008) may become useful to health-care personnel, both in assessment and intervention processes, and may even serve to contribute to the development of public policies for FI prevention among SSDs. This is why the purpose of this research is to analyze the relationship between executive functions and functional impairment in seniors suffering from depression of Latin origins by controlling the effects of age and educational level. A negative association between depression and EFs is expected to emerge upon controlling the effects of age and EL among the participants of this study. Additionally, a positive association between depression and FI is also expected to arise. Lastly, identify how declining EFs relate to larger FI after controlling the effects of age and EL in SSDs.

Materials and methodology

Cross-sectional study in terms of cases and controls included 102 participants diagnosed with depression and 142 healthy controls, all adults aged 51 to 91, screened at the Clinical Neuropsychology Unit (CNP) of the Center for Research on Applied Gerontology (CIGAP), Universidad Santo Tomás, Antofagasta, Chile. SSD subjects were referred from the Geriatric Department of the Antofagasta Regional Hospital, while the subjects for the control group were recruited from the CNP.

Participants were assessed by CNP psychologists with a battery of validated and standardized neuropsychological tests prepared for the Chilean population, by age and educational level that included the Trail making test A and B (Arango-Lasprilla et al., 2015), Stroop Test (Rivera et al., 2015) and the Phonological and Semantic Verbal Fluency Test (Olabarrieta-Landa et al., 2015). Depression symptomatology was assessed using the Yesavage Geriatric Depression Scale (GDS-15) where a score ≥5 was considered as inclusion criteria for determining depression, and Addenbrook’s Cognitive Assessment III (ACE III) to check global cognitive functionality of study groups. Socio-demographic and health data were collected through interviews with relatives of each participant, where the Activities of Daily Living Questionnaire (ADLQ-T) (Muñoz-Neira et al., 2012) was included.
Exclusion criteria were applied: subjects who are illiterate or have sensory limitations (that will hinder assessment procedures), having been diagnosed with neurodegenerative diseases, cerebrovascular accidents, or dementias (with a score of ≥30 pts on the ADLQ), having been diagnosed with other psychiatric conditions such as schizophrenia, schizoaffective disorder, and/or substance abuse.

**Neurocognitive assessment**

Both groups were assessed for global cognitive status with the Addenbrooke’s Cognitive Assessment III (ACE III – Chilean version), which has high sensitivity (93.55%) and specificity (77.7%) to detect cognitive dysfunction in patients with dementia and other neuropsychiatric pathologies (Bruno et al., 2020). EF testing included: the Chilean versions of the Trail Making Test (TMT) Part A, measuring attention, visual search, and psychomotor speed and Part B, measuring set shifting, executive control and flexibility (Arango-Lasprilla et al., 2015), STROOP Test “word,” “color,” “word-color” and interference (Rivera et al., 2015) which verifies speed processing and the possibility of inhibiting an interference while processing a stimulus, and the Verbal Fluency (Semantic and Phonological subtests) that also assesses executive functioning and language ability (Olabarrieta-Landa et al., 2015). These tests conform to the most commonly used tests to assess EFs in senior people (Faria et al., 2015), and are validated and standardized for Latin-American population (Guàrdia-Olmos et al., 2015). They are frequently accepted for SSD assessments.

**Assessment of functional impairment (FI)**

The Activities of Daily Living Questionnaire, a version with a technology-related subscale (ADLQ-T), was applied to a family member of each participating subject. This scale considers the viewpoint of a relative of the senior participant assessed on six domains of basic and instrumental activities of daily living. The Chilean version additionally includes a domain referred to advanced daily activities related to technology (Muñoz-Neira et al., 2012). Altogether, the ADLQ-T delivers a functional impairment score, where the higher the score, the higher the impairment. It holds high reliability (Cronbach’s Alpha = 0.861), and good correlation level with other scales of functional assessment (Functional Assessment Questionnaire: \( r = 0.77 \); Instrumental Activities of Daily Living Scale: \( r = -0.75 \); Clinical Dementia Rating Scale: \( r = 0.72; p < 0.001 \)). With a score of ≥30 pts, it holds sensitivity and specificity of 0.81 and 0.90, respectively, in detecting FI in people with dementia. The neurocognitive and functional assessment process took an average of 60 minutes per case. In accordance with the standardized version for Chilean population, those participants who fail to complete the TMT A are assigned a score of 100, and 300 in case of failing TMT B (Arango-Lasprilla et al., 2015).

Subsequently and in order to determine the relationship between SSD, FI and EFs, a domain of composite EF was formed following the procedure explained below (Dybedal et al., 2013). Intercorrelation and reliability levels were estimated by the Cronbach’s Alpha index, using z-scores adjusted by age and educational level from the Chilean population standardized tests, as detailed in the following equation.
**Domain of Executive Functions (EFs)**

\[ EFs = \frac{(TMTA \ z \ score) + (TMTB \ z \ score) + (STW \ z \ score) + (STC \ z \ score) + (STWCs \ z \ score)}{5} \]

Proper Alpha and intercorrelation values for EF domain were obtained \((\alpha = 0.72; r = 0.342,\) respectively). Verbal Fluency Tests were excluded from the equation as their incorporation would have decreased reliability levels.

**Statistical analyzes**

Descriptive analyzes were conducted comparing sociodemographic and health aspects among SSD and control group participants. The Chi-square test was used for comparing the qualitative variables such as gender, age range (51 to 59; ≥60 years old), educational level (1 to 11; ≥12 years) as per the criteria used in the SALSA study (Barnes et al., 2014), severity of depression (GDS 5 to 9 pts vs ≥10 pts), and the presence or absence of metabolic diseases, such as Hypertension, Diabetes, Dyslipidemia, and Thyroid diseases. As for continuous variables such as age, years of schooling, depression symptomatology (Table 1) and cognitive tests performance (Table 2), the Student’s t-test, with Bonferroni correction was used to control the Type I error. Additionally, in order to determine the effect size, Phi or Cohen’s d were used for qualitative and continuous variables,

**Table 1. Characteristics of depressive and control groups.**

|                          | Depressive (SSD) \((n = 102)\) | Control (CG) \((n = 142)\) | χ²/t | \(p\) | Phi/d |
|--------------------------|---------------------------------|-----------------------------|------|-------|-------|
| Gender                   |                                 |                             |      |       |       |
| Woman                    | 77.5                            | 69.0                        | 2.12 | .09   |       |
| Men                      | 22.5                            | 31.0                        |      |       |       |
| Age Group                |                                 |                             |      |       |       |
| 50 to 59 years old       | 28.4                            | 16.2                        | 5.29 | * .02 |       |
| ≥ 60 years old           | 71.6                            | 83.8                        |      |       |       |
| Educational Level        |                                 |                             |      |       |       |
| Low (1 to 11 years)      | 61.8                            | 48.6                        | 4.15 | * −13 |       |
| High (≥ 12 years)        | 38.2                            | 51.4                        |      |       |       |
| Depression Severity      |                                 |                             |      |       |       |
| Mild (GDS 5 to 9 points) | 86.3                            |                             |      |       |       |
| Established (GDS ≥ 10 pts) | 13.7                          |                             |      |       |       |
| Metabolic Disease        |                                 |                             |      |       |       |
| Hypertension             | 52.0                            | 38.7                        | 4.21 | * .04 |       |
| Diabetes                 | 21.6                            | 17.6                        | 0.60 | .05   |       |
| Dyslipidemia             | 6.9                             | 5.6                         | 0.16 | .02   |       |
| Thyroid disease          | 18.6                            | 12.7                        | 1.63 | .08   |       |

|                          | M     | SD    | M     | SD    |
|--------------------------|-------|-------|-------|-------|
| Age                      | 66.35 | 9.38  | 67.18 | 7.96  | 0.73 | .09  |
| Years of schooling       | 9.74  | 3.23  | 10.05 | 3.06  | 0.77 | .09  |
| Depressive symptoms (GDS)| 6.91  | 2.04  | 1.92  | 1.28  | −21.69 | * −68 |
| Global Cognition (ACE III)| 80.89 | 11.77 | 84.86 | 10.66 | 2.75 | .35  |
| Functional impairment (ADLQ-T)| 8.03 | 0.84 | 6.49  | 0.54  | −3.09 | * −41 |

*p < 0.05; **p < 0.01; SSD: Group of seniors suffering from depression; CG: Non-depressive control group; χ²: Chi-square; t: Student’s t-test; M: Mean; SD: Standard deviation; d: Cohen’s d test. GDS: Geriatric depression scale; “ACE III: Addenbrooke’s Cognitive Assessment Test III. ADLQ-T: Activities of Daily Living Questionnaire”.


respectively. It is worth mentioning that standardized scores (z-score) were used for cognitive tests comparison, obtained from the Chilean standardization of every test, adjusted by age and educational level. As for FI comparison (Table 3), z-score was estimated by using the mean and standard deviation (12.39 and 11.84, respectively) of the control group reported in the Chilean ADLQ-T validation study (Muñoz-Neira et al., 2012). Then, a correlation analysis was applied using Pearson’s r test in order to determine the degree of association between EFs, FI, depression symptomatology, age, years of schooling, and global cognition (Table 3). Lastly, a simple linear regression analysis was applied using EF performance (z-score) and FI (ADLQ-T z-score) as a dependent variable, and establishing the presence of Depression (Geriatric Depression Scale ≥5) as a predictive variable (Table 4). Subsequently, a second simple linear regression analysis was conducted (Table 5) to determine FI variance range explained by EF by comparing SSD and control groups. A p < 0.05 level was used to show statistical significance. Statistical analysis was achieved with the aid of SPSS software, version 21 (IBM, USA).

**Ethics aspects**

All participants were informed about the nature of the study and subscribed an informed consent form. The design of the study and the reports are pursuant to the research ethics standards and inter-institutional recommendations. The study was approved by the Scientific Ethics Committee of the Universidad Santo Tomás (No CC60).

**Table 3.** Independent samples from t-test results comparing SSD and control groups on cognitive performance corrected by age, education (z-score), and functional impairment.

|                      | Depressive (SSD) (n = 102) | Control (CG) (n = 142) | t   | p   | d   |
|----------------------|---------------------------|------------------------|-----|-----|-----|
|                      | M            | SD      | M            | SD      |     |     |
| Stroop word test     | 0.42         | 1.04    | 0.47         | 0.90    | 0.41| .05 |
| Stroop color test    | 0.04         | 1.22    | 0.15         | 1.23    | 0.68| .08 |
| Stroop word-color test| −0.08       | 0.99    | 0.20         | 1.07    | 2.16| *   |
|                      |              |         |              |         | 1.87| .24 |
| Stroop interference  | −0.20        | 1.27    | 0.09         | 1.18    | 1.87| .24 |
| Trail making test A  | 0.33         | 1.73    | 0.82         | 1.09    | 2.53| *   |
|                      |              |         |              |         | 3.73| **  |
| Trail making test B  | 0.15         | 1.37    | 0.76         | 1.06    | 3.73| **  |
| Phonological verbal fluency test | 0.75 | 1.18 | 0.91 | 1.02 | 1.13 | .14 |
| Semantic verbal fluency test | 0.40 | 1.11 | 0.73 | 1.32 | 2.03 | *   |
| Executive functions domain (EFs) | 0.17 | 0.85 | 0.48 | 0.76 | 2.99 | *   |
| Functional impairment (ADLQ-T*) | −0.36 | 0.72 | −0.63 | 0.55 | −3.22 | **  |

*p < 0.05, **p < 0.01; SSD: Group of seniors suffering from depression; CG: Non-depressive control group; t: t Student test; M: Mean; SD: Standard deviation; d = Cohen’s d; ADLQ-T*: Activities of Daily Living Questionnaire (z-score).
Table 4. Linear regression model. Depression explaining executive function and functional impairment in all samples.

|                  | All samples (n = 244) |
|------------------|-----------------------|
|                  | EFs                   | FI (ADLQ-T)               |
|                  | \(\beta\) | \(t\) | \(p\) | \(R^2\) | \(\beta\) | \(t\) | \(p\) | \(R^2\) |
| Depression*      | -.189 | -2.999 | .003** | .032 | .203 | 3.229 | .001** | .037 |

**p < .01. Depression*: Geriatric Depression Scale ≥ 5 pts; EFs: Domain of composite executive function; ADLQ-T: Activities daily living questionnaire; FI: Functional impairment; \(\beta\): Standardized Beta

Table 5. Linear regression model. Executive function explaining functional impairment in depressive and control groups.

|                  | SSD group (n = 102) | Control group (n = 142) |
|------------------|---------------------|-------------------------|
|                  | FI (ADLQ-T)         | FI (ADLQ-T)             |
|                  | \(\beta\) | \(t\) | \(p\) | \(R^2\) | \(\beta\) | \(t\) | \(p\) | \(R^2\) |
| EFs (z-score)    | -.220 | -2.251 | .027* | .039 | -.59 | -.699 | .486 | -.004 |

*p < 0.05. EFs: Domain of composite executive function. ADLQ-T: Activities daily living questionnaire; SSD: Senior suffering from depression; FI: Functional impairment; \(\beta\): Standardized Beta.

Results

Socio-demographic variables

The total sample was composed of 244 subjects aged 51–91 (M = 66.83, SD = 8.57) and between 2 and 17 years of schooling (M = 9.92, DS = 3.13). The socio-demographic analysis (Table 1) reveals a higher global participation of women in the study (SSD: 77.5% and CG: 69.0%), yet homogeneously distributed into both groups (p =.14). No relevant differences were observed in terms of age (p = .46) and years of schooling (p = .44) of the participants under study; yet the SSD group showed lower educational levels (p = .04) and younger participants aged 50 to 59 (p = .02), with a low effect size (Phi = -.13 and Phi = .09, respectively). Similarly, no material differences were observed regarding the presence of diabetes, dyslipidemia, and thyroid disorders (ps = .43, .69 and .20), although subjects suffering from depression presented a higher percentage of hypertension (p = .04) with a low effect size (phi = .04). Lastly, the analysis of results on cognitive, functional, and mood tests revealed major differences in the means of the ACE-III and ADLQ-T, with poorer average performances for SSDs, yet with a low effect size in both dimensions under examination (ds = .35 and .41). SSDs showed higher depression symptomatology levels than the CG (p < .01).

As per Table 2, a significant and negative correlation was found between EFs, depression symptomatology, and FI levels, while there was a significant and positive correlation between FI, age, and depression symptomatology. Additionally, the years of schooling held a significant positive correlation with EFs and a negative correlation with FI. In the same vein, the global cognition level (ACE III) was positively associated with EFs and negatively associated with FI.

Comparing depressive and control subjects

Table 3 summarizes the results of the t-student test for independent samples used for assessing EF differences between SSD and control groups by using standardized scores
for the Chilean population (z-score) that control the effects of age and educational levels. The results show that SSD group has significantly poorer performances in Stroop word-color test, Trail making test part A and B, Semantic verbal fluency test, and domain of composite EF (ps = .03, .01, <.01, .04 and < .01, respectively). It is worth mentioning that the primary difference was observed in the Trail making test Part B, where an effect size close to moderate was achieved (d = .49). No significant differences were observed in the Stroop word test, Stroop color test, Stroop interference and Phonological verbal fluency test (ps = .67, .49, .06 and .27, respectively). Additionally, by using ADLQ-T means and standard deviations of the Chilean sampling without dementia, z-scores were obtained and compared with the groups. A significantly larger functional impairment was found in the SSD group with a low effect size, but close to moderate (d = .41).

Linear regression analyzis

As the SSD group evidenced a higher percentage of participants with hypertension, a stepwise regression analyzis was conducted establishing hypertension and depression as independent variables, and EFs and ADLQ-T as dependent variables. The analyzis yielded that hypertension did not show significance as a predictive variable of EFs or ADLQ-T (p = .21 and .08, respectively). Given this scenario and considering that age and educational levels were controlled on the basis of standardized scores, successive regression analyzis were conducted using only depression (Table 4) and EFs (Table 5) on a later phase, as predictive variables.

Table 4 shows the linear regression conducted with all participants (n = 244), using depression (Geriatric Depression Scale ≥5 pts) as an independent variable, and EFs and FI (ADLQ-T) as dependent variables. Upon controlling the effects of age and educational level and using standardized scores for EFs, depression explained 3.2% of EF variance and 3.7% of FI variance. As shown in Table 5, when comparing SSD and control groups by establishing EFs as an independent variable and functional impairment (ADLQ-T) as a dependent variable, EFs explained 3.9% of ADLQ-T variance only in the SSD group as opposed to the control group (p = .486).

Discussion

The present study was aimed at analyzing the relationship between executive functions and functional impairment among Latin seniors suffering from depression. The study showed that subjects suffering from depression evidenced poorer cognitive performances at executive function levels than healthy controls, in line with previous researches (Dotson et al., 2018; Dybedal et al., 2013; Klojčnik et al., 2017; Lugtenburg et al., 2017). However, standardized executive test scores were analyzed upon considering that the SSD group was made up of younger participants with lower educational levels than control subjects. Upon controlling these factors, depression accounted for the average results in SSD executive measures up to a variance of 3.2%. In similar studies (Bhalla et al., 2005; Gale et al., 2012; O’Shea et al., 2015; Santos et al., 2014), once the educational level was controlled and included as a cognitive reserve measure, no changes in the executive functions of seniors suffering from depression were found. Except from Opdebeeck et al. (2018) who analyzed composite measures of cognitive reserve, apart from the educational
level, they included factors such as “social participation” and “cognitively stimulating activities,” finding positive changes in the EFs of depressive seniors. These results aim in the direction to control depression and intervene in associated factors to improve SSD’s cognition.

The second hypothesis was confirmed. A positive association was found between depression and functional impairment in agreement with previous researches (Nakamura et al., 2017; Storeng et al., 2018). Authors such as Kazama et al. (2011) argue that the functional impairment of seniors suffering from depression is existent provided that depression is severe. On the contrary, this study evidenced that SSDs had functional alterations despite the majority (86.3%) showed low depression levels. These discrepancies may be explained by the differences in the educational level of the participants analyzed in both cases. In the study of Kazama et al. (2011), most subjects showed high ELs with more than 12 years of schooling; on the other hand, this research showed that 61.8% of SSDs had less than 12 years of formal schooling. Therefore, this analysis suggests that depression not only affects cognitive abilities, but may also compromise the functional autonomy of seniors suffering from depression, regardless of their educational level.

In the same vein, the third hypothesis was partially proven. Cognitive decline, evidenced in the poor results obtained with the instruments used for measuring executive functions affected functionality and boosted the presence of functional impairment among SSDs in up to a variance of 3.9%. Similar results were found in North American seniors suffering from depression with high educational levels (15.9 years of schooling in average) where the Stroop W-C test was positively associated with financial management (Morin et al., 2019). In this study, in spite of SSDs evidencing poorer performances in every executive measure (Stroop W-C, TMT A and B, and Controlled Oral Word Association Test), functional impairment associations were only found in Stroop W-C results. In this sense, there are authors (Bielak et al., 2017; Chaytor et al., 2006; Manchester et al., 2004) who argue that the tests for EF assessments show lower ecological validity levels and offer a weak correlation with the functional performance of subjects, particularly when FI scales are self-applied (Suchy et al., 2011). This emphasizes the importance of assessing functional impairment by incorporating a wide range of measurements – instruments would be ideal – oriented to measure functionality or focus on family reports, as it was in this case.

Lastly, the instruments used in this study were analyzed to check executive functions in seniors suffering from depression in light of the results. Besides being one of the most used tests to analyze senior population suffering from depression (Avila et al., 2009; Dybedal et al., 2013; Klojčník et al., 2017; Uemura et al., 2014), Part B of TMT was also the best behaved psychometric instrument in terms of evidencing cognitive difficulties of the subjects analyzed in this research. TMT B requires the use of multiple executive functions, such as planning, attention shifting, inhibition and processing speed (MacPherson et al., 2017). This is in agreement with the belief that SSDs show a dysfunction in the frontostriatal system of the brain (Alexopoulos et al., 2000) and metabolic impairment at prefrontal levels (Uemura et al., 2014) significantly associated to alterations in executive functions (Chepenik et al., 2007).

The phonological and semantic verbal fluency test was not included in this study as part of the composite domain of executive functions for statistical analyses, as its inclusion
diminished the reliability of this domain. This is consistent with the idea that verbal fluency tests relate better to the language domain and not to EFs (Whiteside et al., 2016) despite the fact that this instrument is broadly used to assess executive functions in the elderly (Faria et al., 2015). As for phonological verbal fluency, no material differences were found between SSD and control groups. Semantic verbal fluency was lower in the SSD group, similar to the findings from other studies (Dybedal et al., 2013). A meta-analysis (Henry & Crawford, 2005) argues that deficiencies in verbal fluency among SSDs do not reflect EF alterations, but rather suggest a larger cognitive impairment that can even associate to pre-clinical markers of Alzheimer (Mueller et al., 2015). Future researches shall consider the predictive value that semantic verbal fluency entails determining cognitive impairment trajectories in seniors suffering from depression.

The results of this study are promising but do have some limitations. The cross-sectional design makes it difficult to obtain causal conclusions; pharmacological treatment descriptions were not obtained and neither the type of depression suffered by subjects (unipolar vs. bipolar), the severity nor the course of the condition (recurrent vs. dysthmic) was defined; additionally, only urban participants were included, and no rural or ethnic senior subjects were assessed. Similarly, there was no information available regarding the level of premorbid intelligence (Bright & van der Linde, 2020) or the quality of the formal education received (Glymour et al., 2008; Mungas et al., 2018), which may interfere in EF performance. On the other hand, anxiety symptomatology may hold an influence over the cognitive performance of the elderly (Gulpers et al., 2016), yet no measurements were conducted in this aspect. Lastly, the level of motivation was not analyzed, although it has the potential of having an influence on the cognitive performance of the elderly assessed (Vallet et al., 2018) and therefore reducing performance levels in case of suffering from depression.

Future research should consider a larger number of Latin American participants from rural contexts and members of different ethnicities, as well as longitudinal designs where the levels of severity and types of depression can be detailed, also controlling the influence of pharmacology, anxiety, level of motivation and premorbid intelligence of subjects, as well as the quality of the formal education received.

Pursuant to these limitations, the results of the present study suggest that geriatric depression has an impact on the cognitive abilities necessary for structuring cognition and activating executive processes, it compromises functionality even to the extent of producing functional impairment, regardless of the senior being young or old or having high or low educational level. These findings increase the need for a timely intervention of geriatric depression, considering the negative effect it has over the functionality of the elderly, even when its severity is mild.

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Disclosure statement

MA, AL, NL, and AM report no potential conflict of interest.

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