Original articles

Association between psychosocial and functional factors and language and verbal fluency performance in older adults

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ABSTRACT

Purpose: to identify psychosocial and functional factors associated with language and verbal fluency performance in older adults.

Methods: a study conducted with 149 older adults registered in a primary health care service in a city in inland São Paulo. Instruments such as a sociodemographic questionnaire, the Addenbrooke Cognitive Examination-Revised (verbal fluency and language domains), Geriatric Depression Scale, Perceived Stress Scale, Medical Outcomes Study, WHOQOL-OLD, and Instrumental Activities of Daily Living Scale, were used. Participants were divided into tertiles, according to their language and verbal fluency performance: T1 = best performance, T2 = median performance, and T3 = worst performance. Groups T1 and T3 were compared, and a binary regression was conducted to analyze the factors associated with the best language and verbal fluency performance.

Results: higher educational attainment, higher income, and better functioning were the factors associated with the best language performance comparing T1 and T3, while higher educational attainment and better functioning were associated with the best verbal fluency.

Conclusion: educational attainment and functioning proved to be important factors associated with good language and verbal fluency performance, while income was associated only with good language performance.

Keywords: Aged; Aging; Language; Cognition; Association

INTRODUCTION

Communication requires a broad understanding of human interaction, including verbal and nonverbal signs, motivation, and sociocultural roles. Language is essential to communication and, since it is a complex cognitive function, it depends on other cognitive processes, such as attention, memory, and executive function[1]. This last one is recruited in various language tasks, and the more complex the language need, the greater its recruitment. Verbal fluency tasks can be considered indicators of executive function, as they assess aspects such as working memory, self-regulation, and inhibition. They also assess language and the capacity of the semantic memory system to store and retrieve information. Hence, performance failures in verbal fluency tasks may be related to cognitive decline[2].

The literature has pointed out that advanced age[3-6], low educational attainment[3-6], income[6], health problems[7], and psychological problems (e.g., depression[7] and perceived stress[8]) are factors associated with language and verbal fluency difficulties. Anxiety and depressive symptoms can trigger a decrease in cognitive performance and affect older adults' quality of life – which is a broad and multifactorial concept. It is related to self-esteem, personal well-being, functional capacity, socioeconomic level, emotional status, social interaction, intellectual activity, self-care, family support, health status, cultural and ethical values, religiosity, lifestyle, satisfaction with activities of daily living, and the environment where one lives[9].

Communication health is another important determiner in the maintenance of older adults' quality of life, as it enables social inclusion and interaction and prevents isolation and depression. In this regard, language difficulties can impair interpersonal relationships and interfere with the quality of life, increasing the risk of diseases, functional loss, and consequent institutionalization[10,11].

Older adults report cognitive function difficulties involving attention, memory, and language, which may indicate a real loss. However, many such complaints can be also associated with functional and psychological factors, including stress, anxiety, depression, and excessive self-demanding[12]. According to the Lancet Commission (2000)[13], approximately 40% of the worldwide cases of dementia can be ascribed to 12 potentially modifiable risk factors, namely: low educational attainment, middle-age arterial hypertension and obesity, diabetes, smoking, excessive alcohol use, sedentarism, depression, low social contact, hearing loss, traumatic brain injury, and air pollution. Hence, they indicate a clear preventive potential, which requires close cooperation between researchers, policymakers, and health professionals, also involving older adults and new technology. Education is a classic socioeconomic status indicator, and individuals with lower educational attainment are at greater risk of developing dementia than those with higher educational attainment. This may be due to the greater cognitive reserve in people with higher educational attainment. Cognitive reserve is the capacity of the brain to cope with or compensate for neuropathology or impairment. Moreover, increased cognitive activity has proved to have a buffer effect against rapid cognitive decline[14].

Even though the literature has explored social, emotional, and functioning factors associated with language and verbal fluency, few studies have simultaneously considered all of these. Thus, this research aimed at identifying the psychosocial and functional factors associated with language and verbal fluency performance in older adults.

METHODS

This study is an integral part of larger research named "Follow-up with older caregivers in primary healthcare", conducted by the Health and Aging research group at the *Universidade Federal de São Carlos* (UFSCar). It followed all recommendations and ethical guidelines of Resolution 466/2012[15] and was approved by the UFSCar Research Ethics Committee, Brazil (evaluation report no. 1.123.813; CAAE: 80458017.7.0000.5504). All participants signed an informed consent form.

This quantitative cross-sectional study had a sample of 149 older adults dwelling in the area served by Family Health Centers in a municipality in inland São Paulo, according to a sample calculation considering the 5% significance level or alpha (type I error) and 80% sample power (20% type II error or beta). The inclusion criteria were being ≥ 60 years old and registered at one of the Family Health Centers of the municipality. The exclusion criteria were difficulties that hindered them from being interviewed, such as severe hearing impairment, history of stroke with severe sequelae, and alcohol or psychoactive drug use that hindered them from understanding and answering the instruments.

Data were collected in two stages between June 2016 and July 2017 by members of the Health and Aging research group, made up of undergraduate

and postgraduate Gerontology and Health Sciences students. In the first stage, based on lists furnished by health services, Interviewers visited older adults in their homes to verify the inclusion and exclusion criteria. Questionnaires were administered to those who met the criteria and agreed to participate, thus collecting sociodemographic, functional, social-support, and quality-of-life information. Then, the second part of the home interview was scheduled, which took place no later than a week from the first one. The second stage comprised cognitive assessments, including language and verbal fluency; data on depressive and stress symptoms were also collected.

The dependent variables (language and verbal fluency) were assessed with the Addenbrooke Cognitive Examination-Revised (ACE-R). It is a short cognitive assessment battery encompassing domains of orientation and attention, memory, verbal fluency, language, and visuospatial skills, with an overall score ranging from 0 to 100 points. Language is assessed with comprehension, reading, writing, repetition, and picture naming tasks, with a total score of 26 points. Verbal fluency is divided into the semantic (animal names) and phonemic categories (words beginning with the letter P), with a total score of 14 points[16].

In language and verbal fluency performance analysis, the scores obtained in these domains were organized in decreasing values. Hence, the sample was divided into tertiles, in which T1 was the group of older adults with the best performance, T2 was the tertile with a median performance, and T3 was the tertile with the worst performance. Therefore, they were established as follows: for language, T1 (N=53, scores from 22 to 26), T2 (N=57, scores from 16 to 21), and T3 (N=39, scores from 0 to 15); and for verbal fluency, T1 (N=64, scores from 7 to 14), T2 (N=37, scores from 5 to 6), and T3 (N=48, scores from 0 to 4). Language and verbal fluency performances were analyzed between T1 and T3 to identify the associated psychosocial and functional factors.

Independent variables were investigated based on the following measures.

Psychosocial factors

- **Educational attainment** (in years).
- **Family income** (in Brazilian reais).
- **Depressive symptoms**: assessed with the Geriatric Depression Scale (GDS-15), with 15 yes-or-no questions. The scores were added – the higher the score, the greater the presence of depressive symptoms[17].
- **Stress:** assessed with the Perceived Stress Scale (PSS), which measures how individuals perceive stressful situations. It has 14 items that indicate the stress level perceived by older adults, with answers ranging from 0 (never) to 4 (always). The final score is the sum of the answers – the higher the score, the greatest the perceived stress[18].
- **Social support**: assessed with the Medical Outcomes Study (MOS), with 19 items addressing five support dimensions, namely: material, affective, emotional, positive social interaction, and information. The score ranges from 15 to 100 points in each dimension – the higher the score, the higher the received social support level[19].
- **Quality of life:** assessed with WHOQOL-OLD, which has 24 questions divided into six domains, namely: sensory abilities, autonomy, past, present, and future activities, social participation, death and dying, and intimacy. The maximum score is 100 points – the higher the score, the better the quality of life[20].

Functional factors

- **Functioning**: assessed with the Instrumental Activities of Daily Living Scale, which evaluates the degree of independence to use the telephone, travel, do the groceries, prepare meals, do chores, take medications, and handle money. The score, which ranges from 7 to 21, was added – the higher the score, the more independent the older adult[21].

The collected data were entered into a Windows Excel spreadsheet and analyzed in the Statistical Package for the Social Science (SPSS), version 21.0. The sample profile was characterized by descriptive statistics, with measures of central tendency and dispersion (mean, standard deviation, and minimum and maximum values) of the continuous variables, and measures of frequency (absolute [N] and percentage [%] values) of the categorical variables, in both groups.

After verifying the normality of the data with the Kolmogorov-Smirnov test, the Mann-Whitney nonparametric test was used to analyze the difference between the medians of groups T1 and T3. The 5% significance level was used (p≤0.05).

Univariate and multivariate binary logistic regression analyses were used to verify the association of independent variables on language and verbal fluency performance. Independent variables that were

associated with language and verbal fluency performance in the univariate analysis (with p-value ≤0.20) were included in the multivariate model. Regarding language, the following were included: educational attainment (in years), age (in years), family income (in reais), social support – information (in points), social support – material (in points), functioning (in points), social support– emotional (in points), quality of life (in points), and social support – social interaction (in points). Regarding verbal fluency, the following were included: educational attainment (in years), functioning

(in points), family income (in reais), and age (in years). Independent variables whose combined p-value was >0.05 were eliminated with the stepwise forward method.

RESULTS

Most participants were females (79.2%), with a mean age of 70.3 years.

Psychosocial and functional characteristics of T1 and T3 according to language and verbal fluency performance are respectively shown in Tables 1 and 2.

Table 1. Sociodemographic, psychosocial, and functional characteristics of groups T1 and T3, in relation to language performance (N=92). São Carlos, SP, Brazil, 2016-2017

VARIABLES		T1 Language (N=53) Mean (SD)	T3 Language (N=39) Mean (SD)	p-value
SOCIODEMOGRAPHIC	Educational attainment	6.04 (3.34)	1.67 (1.99)	**<0.01**
	Age	67.49 (5.12)	72.51 (7.58)	**<0.01**
	Family income	2479.11 (1542.70)	1325.93 (558.30)	**<0.01**
COGNITIVE	ACE-R	79.00 (9.84)	45.41 (8.34)	**<0.01**
	Verbal fluency	7.92 (2.50)	4.13 (2.19)	**<0.01**
PSYCHOSOCIAL	Social support– emotional	82.64 (26.74)	91.53 (14.00)	0.16
	Social support– information	81.96 (25.87)	92.05 (16.41)	**0.02**
	Social support– social interaction	82.25 (27.46)	89.48 (21.08)	0.12
	Social support– affective	86.79 (25.35)	91.11 (19.90)	0.58
	Social support– material	83.62 (25.98)	92.82 (11.10)	0.45
	Quality of life	85.43 (8.16)	81.92 (11.42)	0.26
	Stress	17.53 (9.73)	18.62 (11.01)	0.66
	Depressive symptoms	3.64 (2.95)	4.08 (3.17)	0.56
FUNCTIONAL	Functioning	19.81 (3.06)	18.49 (2.92)	**<0.01**

Mann-Whitney test
Captions: SD: standard deviation; ACE-R: Addenbrooke Cognitive Examination-Revised; T1: group with the best language performance; T3: group with the worst language performance; N: number of participants

Table 2. Sociodemographic, psychosocial, and functional characteristics of groups T1 and T3, in relation to verbal fluency performance (n=112). São Carlos, SP, Brazil, 2016- 2017

VARIABLES		T1 Verbal Fluency (N=64) Mean (SD)	T3 Verbal Fluency (N=48) Mean (SD)	p-value
SOCIODEMOGRAPHIC	Educational attainment	5.25 (3.27)	2.29 (2.59)	**<0.01**
	Age	69.02 (5.81)	71.10 (8.03)	0.28
	Family income	2294.91 (1431.51)	1605.70 (713.12)	**0.01**
COGNITIVE	ACE-R	76.63 (10.87)	47.02 (11.68)	**<0.01**
	Language	21.91 (3.62)	14.06 (4.39)	**<0.01**
PSYCHOSOCIAL	Social support– emotional	84.28 (23.31)	87.91 (20.07)	0.54
	Social support– information	84.21 (21.12)	88.13 (21.23)	0.24
	Social support– social interaction	85.31 (21.45)	85.00 (24.66)	0.97
	Social support– affective	88.46 (21.82)	90.55 (19.63)	0.97
	Social support– material	85.87 (20.93)	87.60 (21.75)	0.73
	Quality of life	83.00 (9.66)	82.16 (11.18)	0.86
	Stress	16.05 (9.29)	18.21 (9.60)	0.23
	Depressive symptoms	3.44 (2.66)	3.73 (2.86)	0.73
FUNCTIONAL	Functioning	19.85 (1.48)	18.33 (3.77)	**0.01**

Mann-Whitney test
Captions: SD: standard deviation; ACE-R: Addenbrooke Cognitive Examination-Revised; T1: group with the best verbal fluency performance; T3: group with the worst verbal fluency performance; N: number of participants

Tables 3 and 4 show the final model of the multi-variate logistic regression for factors respectively associated with language and verbal fluency performance. The followingin dependent variables were associated in combination with good language performance in older adults: greater educational attainment (OR = 1.58, 95% CI = 1.15-2.16), higher family income (OR = 1.00, 95% CI = 1.00-1.00), and better functioning (OR = 1.57, 95% CI = 1.02-2.43). As for good verbal fluency performance, the associated variables were greater educational attainment (OR = 1.53, 95% CI = 1.25-1.86), and better functioning (OR = 1.36, 95% CI = 1.08-1.70).

Table 3. Multivariate logistic regression for the good language performance in groups T1 x T3 (n=92). São Carlos, SP, Brazil, 2016-2017

	Variable	p-value	OR*	95% CI*
T1xT3	Educational attainment	<0.01	1.58	1.15 – 2.16
	Income	0.03	1.00	1.00 – 1.00
	Functioning	0.04	1.57	1.02 – 2.43

*OR= odds ratio; 95% CI = 95% confidence interval for the odds ratio
Captions: T1: group with the best language performance; T3: group with the worst language performance

Table 4. Multivariate logistic regression for the good verbal fluency performance in groups T1 x T3 (N=112). São Carlos, SP, Brazil, 2016-2017

	Variable	p-value	OR*	95% CI*
T1xT3	Educational attainment	<0.01	1.53	1.25 – 1.86
	Functioning	<0.01	1.36	1.08 – 1.70

*OR= odds ratio; 95% CI = 95% confidence interval for the odds ratio
Captions: T1: group with the best verbal fluency performance; T3: group with the worst verbal fluency performance

DISCUSSION

This article aimed at identifying psychosocial and functional factors associated with language and verbal fluency performance in older adults. In this study, greater educational attainment was associated with good performance in both language and verbal fluency. These results agree with the literature and reinforce the importance of attending school for lifelong cognition[3-6,14,22,23].

Learning to read and write, along with other experiences acquired in school, is known to influence brain organization toward performancein neuropsychological tasks. Hence, it is a protective factor against cognitive function decline and neurological diseases. Educational experiences and the use of more complex cognitive skills can strengthen the cognitive reserve and preserve both cognition and functioning[6,24].

Cognitive reserve is a construct that is being developed with various factors – e.g., educational attainment, occupation, quality-of-life indices, and physical activity. Education is associated with a lower risk of developing dementia and better cognitive functioning. For instance, Mondini et al. (2022)[25] verified the contribution of age, sex, comorbidity, educational attainment, and occupation to provide cognitive reserve in a longitudinal study in older adults. Participants (n=3,081) were assessed at the beginning of the study with a battery of neuropsychological tests – those with unimpaired profiles were classified as subjective cognitive decline; those slightly impaired, as mild neurocognitive decline; and those severely impaired, as major neurocognitive decline. In follow-up, 543 individuals were assessed a second time, and 125, a third time. Participants were classified as resistant or in decline, according to whether their cognitive profile was respectively maintained or worsened. In the baseline, the best predictors of performance in all of them were age, educational attainment, and occupation. Furthermore, in all assessments, individuals without cognitive changes had higher educational attainment and occupational levels than those with them. Educational attainment and occupation were predictive factors for cognitive performance in all groups, from subjective cognitive decline to the most severely impaired participants. The impact of educational attainment and age was also analyzed with imaging and behavioral assessments of verbal fluency in a study conducted with 48 healthy young and older adults with high and low educational attainments. Participants performed a semantic and phonemic task during functional magnetic resonance imaging. Brain activation involved regions related to language, executive skills, and working memory. Although the study encompassed both young and older adults, education proved to have a greater impact on verbal fluency performance than age[26].

Besides educational attainment, studies also demonstrate that having more complex occupations, being fluent in a second language, being physically active, having adequate leisure activities, engaging in social activities, and keeping healthy eating habits can help improve the cognitive capacity and protect against future cognitive decline, as pointed out in a review article[27]. Nonetheless, unlike the results in the present research, studies have not yet indicated the gains of educational attainment to specific cognition domains (e.g., language and verbal fluency), but only to overall cognitive capacity.

It must be highlighted that low educational attainments common among Brazilian older adults, especially those with lower incomes. According to the Brazilian Institute of Geography and Statistics (IBGE), there were more than 28 million older adults in Brazil in 2018, which represents 13% of its total population, and in this age range, almost six million were illiterates[28]. Therefore, it is essential to understand the specificities of the Brazilian population, to which this study contributed by analyzing a low-income sample. The importance of educational attainment in Brazil was also observed by Brigola et al. (2019)[22], who assessed 540 older adults divided into three groups: no formal education, 12 to 24 months of school attendance, and 25 to 48 months of school attendance. According to the study, the group with no formal education was 10.1 times as likely to have worse cognitive scores and functional capacity, whereas older adults who had attended school for 12 to 24 months were 4.6 times as likely to have worse cognitive scores and functional capacity than the group who had longer formal education.

The data in the present study also showed an association between income and good language performance. Older adults' income is an important determiner of their health status, as those with lower incomes generally have worse health conditions[29]. A cross-sectional study with older adults (N = 1,197) from a region of Southern Brazil aimed to analyze the association between income and cognitive decline. It concluded that the socioeconomic environment is related to cognitive decline and must be addressed in public policies focused on older adults' health[30].

Socioeconomic interference was also present in other studies worldwide. A systematic review verified a positive association between educational attainment and income/wealth and healthy aging and cognitive functioning[31].

On the other hand, a meta-analysis involving European and North American cohorts analyzed the relationships between higher socioeconomic status, brain volume, and lifelong cognitive capacity. Educational attainment was positively related to intracranial and total gray matter volume. However, there was no evidence that higher socioeconomic status was specifically related to gray matter volume and cognitive function in adults. According to the authors, current results do not support the neuroprotective hypothesis that higher socioeconomic status could mitigate cognitive decline or gray matter atrophy in aging[32].

Nevertheless, the findings presented here show that functioning, measured by performance in instrumental activities of daily living, was associated with good language and verbal fluency performance, with respective 1.57 and 1.36 odds ratios – which corroborates the literature[29,33]. Instrumental activities of daily living depend on language; hence, if the performance of these activities is impaired, language may also suffer changes, and vice-versa. Such data is reinforced in another national study that compared functioning and language in 60 older adults – participants and nonparticipants of multidisciplinary intervention groups in primary health care – and found a correspondence between the language and functioning variables[23].

The association between cognition and functioning was demonstrated in a German multicentric longitudinal study, which assessed 3,215 participants aged 75 to 98 years with Lawton's scale of instrumental activities of daily living and the Consortium to Establish a Registry for Alzheimer's Disease (CERAD) for cognitive assessment, using the verbal fluency test as an executive function measure. They verified that cognition was associated with functioning – worse performances in neuropsychological tests (including verbal fluency) increased the risk of functional impairment[34].

Verbal fluency tasks, despite involving language, are known as clinically useful executive function measures to monitor the cognitive decline in the aging process[35]. Given the importance of the executive function to maintain functional capacity, verbal fluency is an important measure because the executive control observed in this type of task requires a set of functions that direct the person's behavior – which leads to the belief that there is a correspondence between verbal fluency and functional capacity. Nevertheless, the literature still lacks a theoretical scheme and controlled research capable of clarifying the underlying balance between verbal fluency and functioning in aging[33].

In this study, no statistically significant associations were found between the other psychosocial factors and language and verbal fluency performance. This contradicts the initial hypothesis in this study and the existing literature, which indicates that depressive symptoms[4,36] and stress[8] can impair executive function, verbal fluency, and other cognitive variables in older adults, and that language is positively associated with the quality of life and social support[37].

Therefore, the findings in this study show that educational attainment and functioning were factors associated with good language and verbal fluency performance in this sample, while income was associated with language. These data can help plan preventive measures and public policies considering these variables to maintain cognition in older adults in the community. Investments in education have positive lifelong consequences and even impact language maintenance in advanced age. It can also be inferred that independence to perform activities of daily living must be stimulated as a means to keep language and communication skills active in older adults.

On the other hand, the results must be carefully approached because the cross-sectional design does not enable cause-and-effect relationship analyses between study variables. Moreover, the study had a small sample from a specific region, which prevents the generalization of the findings.

Future studies should explore aspects of functional performance, including basic and advanced activities of daily living, and complementary language and verbal fluency assessments. Studies with larger samples and different characteristics may contribute to in-depth research of factors associated with language and verbal fluency performance.

CONCLUSION

Educational attainment and functioning proved to be important factors associated with good language and verbal fluency performance in older adults, whereas income was also associated with good language performance. These findings are important because these social factors are potentially modifiable with public policies in all life cycles. Therefore, they can help plan multidimensional measures involving various sectors toward healthier aging.

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