Original Article

https://doi.org/10.1590/2317-6431-2020-2315

Audiology Communication Research
ISSN 2317-6431

Verbal fluency of younger and older adults from the Federal District: proposed normative values

Fluência verbal de adultos e idosos do Distrito Federal: proposta normativa piloto

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ABSTRACT

Purpose: To compare the performance of younger and older adults from the Federal District (FD) against normative data. **Methods:** Sixty healthy participants completed the unconstrained, phonemic and semantic verbal fluency tests of the Montreal Communication Assessment Battery. **Results:** The FD participants obtained lower mean scores (<0.001) compared to the normative average. There was no difference in performance between the age groups, except on the comparison with high-educated individuals. **Conclusion:** In the FD, the typical aging process did not impact verbal fluency for individuals who were educated to primary level. The lower mean scores relative to normative data highlight the importance of regional normative standards.

Keywords: Language; Aging; Language tests; Neuropsychological tests; Standards; Cognition

RESUMO

Objetivo: Comparar o desempenho de adultos jovens e idosos do Distrito Federal com os dados normativos. **Métodos:** Sessenta participantes hígidos responderam aos testes de fluência verbal semântica, livre e ortográfica da Bateria Montreal de Avaliação da Comunicação. **Resultados:** Participantes do Distrito Federal obtiveram médias menores (<0,001), comparados à média normativa. Não houve diferença no desempenho entre os grupos etários, exceto ao compará-los com indivíduos com maior escolaridade. **Conclusão:** Na amostra do Distrito Federal avaliada, o processo de envelhecimento típico não prejudicou a fluência verbal para indivíduos que concluíram o ensino fundamental. As médias menores, em relação aos dados normativos, evidenciaram a importância de padrões normativos regionais.

Palavras-chave: Linguagem; Envelhecimento; Testes de linguagem; Testes neuropsicológicos; Normas; Cognição

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Conflict of interests: No.
Authors' contribution: BCSS was involved in data acquisition, analysis and interpretation, and in editing the article; TOBT was involved in data acquisition, analysis and interpretation, and in editing the article; LDS was involved in data acquisition, analysis and interpretation; CS was involved in the writing, editing and critical intellectual review of the article; MLC was the supervisor and involved in devising and planning the study, writing the article, and in approval of the final draft for publication.
Funding: Fundação de Apoio à Pesquisa do Distrito Federal (FAPDF), process number 193.001.519/2017.
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Received: April 13, 2020; **Accepted:** May 23, 2020

INTRODUCTION

The verbal fluency test has been widely used to determine whether changes in language-cognitive profile occur during the process of normal aging[1-5]. In Brazil, the older population aged >65 years is growing rapidly, demographic data demonstrate a significant increase in life expectancy associated with a decrease in birth rate[6].

The verbal fluency test measures the ability for spontaneous retrieval and production of words under constrained retrieval conditions[7]. Its application entails asking the subject to produce as many words as they can within a set timeframe[8]. The results can predict language and cognitive deficits in cases of neuromuscular diseases traditionally characterized for progressing without cognitive impairment[9] and, to a greater extent, can detect deficits in cases of frontal lesions and dementia[8,10], as well as different performance patterns associated with substance use[11].

The test is incorporated into two communication assessment batteries, both of which are validated and standardized in Brazilian Portuguese: the Montreal Communication Assessment Battery (MAC Battery)[12] and the Montreal-Toulouse Language Assessment Battery (MTL-Brasil)[13]. Besides measuring verbal ability, the verbal fluency test assesses executive function and processing speed[2], and is consequently included in a number of neuropsychological assessment batteries[14,15]. In these instruments, word retrieval is assessed based on semantic[12,13] and orthographic-phonological[12,13] criteria and, in the absence of criteria, by means of the free verbal fluency test[12]. The Brazilian versions of the verbal fluency tests have durations of 60[15], 90[13] or 120-150 seconds[12]. Task times are longest on the MAC Battery, given they assess communication processing and its association with the right hemisphere, which is non-dominant for language processing, but involved in the word production task[12].

Elucidating the language-cognitive profile of typical aging in Brazil is challenging because of its broad demographic diversity. Brazilian studies have shown good sensitivity and specificity for the verbal fluency test[16]. The need for standardized language assessment instruments which enable diagnostic and prognostic classification in different sociocultural contexts was emphasized by the authors of the MTL-Brasil[17]. In the field of neuropsychological assessment and for interpreting tests, professionals are explicitly encouraged to consider the validity of the instruments for the population being assessed, in addition to the cultural and linguistic characteristics of the test subject[18].

With regard to performance on verbal fluency tests according to the Brazilian typical aging process, studies conducted in the South and Southeast regions of the country have shown mixed results. Some authors have reported better performance among younger individuals compared to older adults for number of words produced[3,5], whereas other studies found no significant differences between age groups[1,4,6].

It is important to note that some of the studies cited report differences associated with age, but these were qualitative differences, not explored in the present study[1,3,5].

Given that the normative study of the MAC Battery was performed with participants from the South of Brazil and no studies investigating the verbal fluency profile of adults from Federal District (FD) or the Mid-West region of the country were found in scientific publication databases, analyzing verbal fluency performance can help elucidate word production performance during the aging process in this region.

Therefore, it was considered important to analyze unconstrained, phonemic and semantic verbal fluency of a sample from the FD and compare the performance of older and younger adults from the region, according to the educational level for each age group. In addition, the verbal fluency performance of the FD volunteers was compared against normative values for a population from the Southern part of country. Differences were expected to be found between the younger and older adults and between FD and Southern regions. In the event of differences, the study also sought to propose normative values for the three verbal fluency subtests of the MAC Battery.

METHODS

The study was approved by the Research Ethics Committee, under CAAE 56190716.0.0000.0030, (document 1.657.122). All participants signed a free and informed consent form, drawn up in conformance with resolution CNS 466/2012.

The convenience sample comprised 30 older adults aged 60-75 years and 30 younger adults aged 19-39 years. Study participants were recruited predominantly in Ceilândia and the surrounding areas by the members of the University team called "FortaleçaMente", which conducts research and extension activities. Fifteen volunteers from each group had 2-7 years of education, while the remaining individuals had ≥8 years of education.

The study inclusion criteria were: older and younger adults having typical stable state of health, with no history of psychiatric or neurologic diseases, and residing in the FD for 10 years or longer.

Criteria for exclusion were: having a prior or current history of alcoholism or illegal drug use; serious prior neurological or psychiatric diseases; uncorrected visual or hearing deficits; being in use of poorly fitting dental prosthesis that could negatively affect performance on the tasks carried out; and use of benzodiazepines or other medications which could impact linguistic-cognitive performance.

Subjects whose performance on the brief assessment for sample selection suggested cognitive impairment, a score indicative of depression or dependence for activities of daily living were also excluded. These criteria were determined by applying the Brazilian versions of the following tests: the Geriatric Depression Scale (GDS)[19], Mini-Mental State Exam (MMSE)[20] and Lawton-Brody Instrumental Activities of Daily Living Scale[21].

Volunteers first completed a questionnaire collecting information on age, education, use of medications and other drugs, and presence of diseases.

For the analysis of the verbal fluency performance of the FD sample, the three verbal fluency subtests of the MAC Battery were applied[12]:

- Verbal fluency subtest com semantic criteria, in which the participant must produce as many words as possible of clothing or garments in 2 minutes.
- Verbal fluency subtest with phonemic criteria, in which the volunteer is instructed to produce as many words as

possible starting with the letter "p", except for proper nouns, within 2 minutes;

- Unconstrained verbal fluency subtest, which requires the participant to list as many words as possible, except for proper nouns and numbers, within 2 minutes 30 seconds.

The study assessment was applied in a quiet room at community centers for the aged or at participants´ homes, and the order of scales and tests was the same for all volunteers.

The Chi-squared and Mann-Whitney tests were applied to compare demographic and education data between age groups. The Mann-Whitney test was applied to compare verbal fluency performance of older and younger adults from the FD. For this analysis, the sample was stratified by age into two groups: younger and older adults, or by education also into two groups: low-educated and high-educated volunteers. For the comparison of the performance of FD volunteers against normative data for the MAC Battery, analysis of difference between two means was performed using Student´s *t*-test, where the age and education classifications proposed by the communication assessment instrument were taken into account. A probability (p-value) less than 0.05 was considered statistically significant. Normative data were expressed as 10th percentile of values attained in each group, from which the cut-off point for the FD was derived. All data were analyzed using the statistics software IBM SPSS *Statistics* 22 (Statistical Package for the Social Science).

RESULTS

The 30 older adults had a mean age of 66.77 years (SD 4.57), mean education of 7.57 years (SD 3.73), and were 90% female. The 30 younger adults had a mean age of 28.70 years (SD 7.93), mean education of 8.17 years (SD 4.06), and were 87% female. No statistically significant demographic differences were found for the variables gender, age or education, except when these variables differentiated the groups. Statistically significant differences in economic class were evident only for comparisons of high versus low-educated participants. Demographic data for the participants are given in Table 1.

Regarding the clinical characteristics of the sample, older adults had a mean MMSE score of 26.20 (SD 2.68) and younger adults had a mean score of 26.47 (SD 2.66). On the GDS, mean score was 1.53 (SD 2.03) among the older adults and 1.87 (SD 2.27) for the younger adults.

Comparisons of performance on semantic, phonemic and unconstrained verbal fluency subtests between younger and older age groups and between individuals according to education (low versus high-educated) revealed no difference between the two age groups. A difference was evident only when stratified by education, where unconstrained and phonemic verbal fluency scores were greater in high-educated individuals (Table 2).

Comparison verbal fluency performance of the groups divided according to these two demographic variables of age and education showed difference only on semantic verbal fluency, where younger adults who were high-educated scored better than older adults who had the same educational level (Table 2).

The comparison of verbal fluency performance of FD subjects against Brazilian normative averages by age and education as defined in the MAC Battery showed the following results: difference between subgroups of high-educated older adults for the semantic verbal fluency subtest, where mean performance for the FD was below the normative average; difference between subgroups of both low and high-educated younger adults for phonemic and semantic verbal fluency subtests, where mean performance for the FD was below the normative average (Table 3).

Based on the comparison of normative (Southern Brazil) data for the MAC Battery versus the normative data established in the present study for the FD population (Table 4), the proposed cut-off points should be higher for unconstrained verbal fluency and lower for phonemic and semantic verbal fluency for all subgroups in the FD population (Table 4).

Table 1. Demographic data on younger and older adults from the Federal District

Demographic variable	Older adults (n=30)	Younger adults (n=30)	p-value – x^2 test
Gender (n %)	27 (90%)	26 (87%)	0.688
Age	66.77 (4.57)	28.70 (7.93)	<0.001
Education	7.57 (3.73)	8.17 (4.06)	0.732
Economic class	31.57 (9.81)	26.83 (7.77)	0.072
Demographic variable	Low-educated participants (n=30)	High-educated participants (n=30)	p-value – Mann Whitney test
Gender (n %)	26 (87%)	27 (90%)	0.688
Age	47.37 (21.56)	48.10 (19.18)	0.888
Education	4.80 (1.85)	10.93 (2.78)	<0.001
Economic class	26.70 (7.94)	31.70 (9.62)	0.038
Demographic variable	Low-educated older adults (n=15)	Low-educated younger adults (n=15)	p-value – Mann Whitney test
Gender (n %)	14 (93%)	12 (80%)	0.283
Age	67.40 (5.08)	27.33 (8.80)	<0.001
Education	4.53 (1.88)	5.07 (1.83)	0.486
Economic class	28.27 (8.34)	25.13 (7.46)	0.068
Demographic variable	High-educated older adults (n=15)	High-educated younger adults (n=15)	p-value – Mann Whitney test
Gender (n %)	13 (87%)	14 (93%)	0.688
Age	66.13 (4.07)	30.07 (6.98)	<0.001
Education	10.60 (2.35)	11.27 (3.20)	0.780
Economic class	34.87 (10.33)	28.53 (7.96)	0.205

Subtitle: n = number of subjects; % = percentage

Table 2. Comparison of verbal fluency performance of groups and subgroups from the Federal District

	Age groups			
	Older adults (n=30)	Younger adults (n=30)		
			Statistic	
Subtest	Mean (SD)	Mean (SD)	Mann-Whitney U-Test	p-value
Unconstrained verbal fluency	47.37 (21.9)	52.72 (20.95)	371.5	0.335
Phonemic verbal fluency	15.70 (7.25)	16.80 (7.68)	413	0.584
Semantic verbal fluency	16.23 (4.31)	16.37 (5.35)	421	0.667
	Education groups			
	Low-educated younger adults (n=30)	High-educated younger adults (n=30)		
			Statistic	
Subtest	Mean (SD)	Mean (SD)	Mann-Whitney U-Test	p-value
Unconstrained verbal fluency	42.17 (17.13)	57.57 (22.68)	225	0.001*
Phonemic verbal fluency	13.90 (6.86)	18.60 (7.32)	286	0.015*
Semantic verbal fluency	15.50 (5.06)	17.10 (4.51)	351.5	0.144
	Low-educated age subgroups			
	Older adults (n=15)	Younger adults (n=15)		
			Statistic	
Subtest	Mean (SD)	Mean (SD)	Mann-Whitney U-Test	p-value
Unconstrained verbal fluency	42.93 (22.06)	41.36 (10.33)	97.50	0.747
Phonemic verbal fluency	13.40 (5.89)	14.40 (7.90)	108	0.870
Semantic verbal fluency	16.80 (4.95)	14.20 (4.99)	89.00	0.345
	High-educated age subgroups			
	Older adults (n=15)	Younger adults (n=15)		
			Statistic	
Subtest	Mean (SD)	Mean (SD)	Mann-Whitney U-Test	p-value
Unconstrained verbal fluency	51.80 (21.57)	63.33 (23.00)	81.00	0.202
Phonemic verbal fluency	18.00 (7.94)	19.20 (6.88)	104.5	0.744
Semantic verbal fluency	15.67 (3.66)	18.53 (4.93)	64.50	0.045*

Student's *t*-test; *Statistically significant values ($p \leq 0.05$)
Subtitle: n = number of subjects; SD = standard deviation

Table 3. Comparison of verbal fluency performance of Federal District samples and Brazilian normative averages

Subtests	High-educated older adults			Low-educated older adults		
	Mean for FD	Normative average for South	Statistic	Mean for FD	Normative average for South	Statistic
Unconstrained verbal fluency	51.8 (21.57)	43.72 (16.11)	df=8.08, CI=-3.86 to 20.02, t=1.45, p=0.169	42.93 (22.06)	31.46 (14.40)	df=11.47, CI=-0.74 to 23.69, t=2.01, p=0.064
Phonemic verbal fluency	18 (7.94)	21.36 (8.74)	df=-3.36, CI=-7.76 to 1.04. t=-1,.4. p=0.123	13.4 (5.89)	16.46 (6.26)	df=-3.06, CI=-6.32 to 0.20. t=-2.01, p=0.064
Semantic verbal fluency	15.67 (3.66)	23.48 (5.57)	df=-7.81, CI=-9.84 to -5.79, t=-8.27, p=0.000*	16.8 (4.95)	18.28 (4.45)	df=-1.48, CI=-4.22 to 1.26, t=-1.16, p=0.266
Subtests	**High-educated younger adults**			**Low-educated younger adults**		
	Mean for FD	Normative average for South	Statistic	Mean for FD	Normative average for South	Statistic
Unconstrained verbal fluency	63.33 (23.00)	61.88 (23.90)	df=1.45, CI=-11.28 to 14.19, t=0.24, p-value=0.810	41.36 (10.33)	39.66 (21.40)	df=1.70, CI=-4.27 to 7.66, t=0.61, p-value=0.549
Phonemic verbal fluency	19.20 (6.88)	27.06 (6.92)	df=-7.86, CI=-11.67 to -4.05, t=-4.43, p-value=0.001*	14.40 (8.00)	20.54 (8.84)	df=-6.14, CI=-10.51 to -1.76, t=-3.01, p-value=0.009*
Semantic verbal fluency	18.53 (4.93)	30.98 (6.29)	df=-12.45, CI=-15.17, t=-9.79 to 9.72, p-value=0.000*	14.20 (4.99)	20.96 (6.67)	df=-6.76, CI=-9.52 to -4.00, t=-5.25, p-value=0.000*

Student's *t*-test; *Statistically significant values ($p \leq 0.05$)
Subtitle: FD = Federal District; df = difference between means; CI = confidence interval of difference; t = value of difference calculated in standard error units

Table 4. 10th percentile and cut-off point of verbal fluency subtests for Federal District and South Brazil

Subtests	Older adults				Younger adults			
	High education		Low education		High education		Low education	
	10th percentile for FD	10th percentile for South	10th percentile for FD	10th percentile for South	10th percentile for FD	10th percentile for South	10th percentile for FD	10th percentile for South
Unconstrained verbal fluency	37.00	25.10	24.20	15.00	35.60	30.30	30.00	15.00
Phonemic verbal fluency	9.60	12.10	7.00	8.10	11.20	17.10	5.00	10.10
Semantic verbal fluency	12.40	16.10	11.40	13.00	12.60	22.00	8.60	13.10
Subtests	**Cut-off point for FD**	**Cut-off point for South**	**Cut-off point for FD**	**Cut-off point for South**	**Cut-off point for FD**	**Cut-off point for South**	**Cut-off point for FD**	**Cut-off point for South**
Unconstrained verbal fluency	37.00	26.00	24.00	15.00	36.00	31.00	30.00	15.00
Phonemic verbal fluency	10.00	13.00	7.00	9.00	12.00	18.00	5.00	11.00
Semantic verbal fluency	12.00	17.00	12.00	13.00	13.00	22.00	9.00	14.00

Subtitle: FD = Federal District

DISCUSSION

In the present study on verbal fluency conducted in the FD, a difference was found in the number of words generated by groups with different education, but not between the different age groups, except when comparing those that had higher educational level. Moreover, a difference in verbal fluency performance was found comparing participants from the FD against the normative average for the South of Brazil, leading to new proposed normative values for the FD that differed to current Brazilian norms for the MAC Battery.

With regard to comparison of verbal fluency performance between the age groups, no difference in results of the older and younger adults from the FD were observed. These results corroborate the findings of the study by Rodrigues et al.[4], who also found no statistically significant differences between groups in total number of words produced within 1 minute on both semantic and phonemic tasks. The present results are also in line with those of other investigations, which reported similar total scores across groups for 60-second tasks on the semantic verbal fluency test[1], and also absence of significance for age on the phonemic verbal fluency test[6].

In agreement with these results, some international studies report an absence of statistically significant differences between age groups on semantic and phonemic verbal fluency tasks[22], and also on the phonemic verbal fluency test[2].

By contrast, a large number of studies have shown age-related reduction in total words produced on the semantic, phonemic and unconstrained verbal fluency tasks[5], on semantic and phonemic versions[23] and on the unconstrained task only[3].

The disparities in findings of this study compared to other articles may stem from social, economic, cultural, educational or vocabulary-related differences in the study samples due to diversity of the populations. It is noteworthy that cultural differences, for example, in organizing semantic categories have been reported on analyses of performance of participants from different cultural backgrounds[18]. In addition, studies indicate that the environment can also influence the vocabulary of speakers of the same language living in different geographic regions of the same country[1,18]. Studies also emphasize that experiences associated with cognitive development during childhood can explain cognitive performance in adulthood. For example, poor socioeconomic status can be associated with poorer cognitive functions in late adulthood[18].

Thus, although the study of Pekkala et al.[18] has shown that sociodemographic variables modify verbal fluency performance, these variables, controlled for during sample selection, fail to explain differences between high-educated older and younger adults (Table 2).

Interestingly, verbal fluency differences were found between younger and older adults only for semantic processing of high-educated individuals. This finding agrees with a study which showed that age is more strongly associated with number of words produced on semantic tasks than on phonological fluency tasks[24]. Also, with regard to the potential of the verbal fluency test, the study by Canning et al.[8] showed that the semantic test can help in early detection of dementia. The results of the present study, revealing a difference between age groups only for the high-educated sample, confirm the impact of demographic variables and suggest that the analysis of performance on the semantic fluency test should differ according to educational level.

In the present study, the impact of demographic variables was reduced by employing sample selection criteria that matched younger with older adults for educational level. Thus, in the FD, after controlling for educational profile, it can be concluded that the typical neurological aging process did not influence communication-linguistic performance in terms of unconstrained and phonemic fluency. However, among high-educated individuals, the typical aging process can reduce the number of words retrieved when the test criterion is semantic.

With regard to neurobiological aspects, both verbal fluency tasks (semantic and phonemic) involve the ability of accessing semantic memory and proper functioning of frontal lobes[24]. By contrast, semantic processing involves a broad network of brain areas, where the degree of activation of the medial temporal region appears to be greater[25-27].

The results of the present study showing worse semantic verbal fluency performance in high-educated older adults compared to younger adults, suggest that the brain regions associated with semantic processing may be subject to greater compromise from typical aging than regions associated with phonemic processing.

Educational level was also found to influence verbal fluency performance. On comparison of participants with high versus low education, not stratified by age, the high-educated individuals had higher scores on unconstrained and phonemic verbal fluency subtests. This result has been reported in previous studies[4] and is most likely due to the more limited vocabulary of subjects with less education[4].

Comparison of verbal fluency results of the subgroups against normative data for the MAC Battery (Table 3), revealed a difference for phonemic and semantic verbal fluency in young adults and for semantic fluency in high-educated older adults. The functional involvement of semantic abilities in the quantitative verbal fluency performance of the samples from different Brazilian regions was again evident. The similar verbal fluency performance of the individuals of different age groups from the FD, and the performance difference of the FD sample compared with the normative data for the South of the country, reveals the influence of different demographic variables (other than age and education) on verbal fluency performance. The results of studies conducted in different parts of the world show disparities in verbal fluency performance[18].

In view of the regional performance differences evident in Brazil, the present study proposed adjusting the cut-off point for the FD (see Table 4). The authors of the original instrument (Protocole MEC)[28,29], and of the Brazilian translated, adapted and standardized version of the instrument (MAC Battery)[12], defined a cut-off point at which the assessor assumes communication impairments are associated with brain lesion and established this value as the 10th percentile[28,29]. In the present study, the same criteria used in the Brazilian normative study for rounding up was adopted[30]. The results given in Table 4 show that the cut-off point of the FD sample was higher for unconstrained and lower for semantic and phonemic/letter verbal fluency subtests, compared with the normative values for the Southern region of Brazil.

This study has several limitations, including the fact it was based on a quantitative analysis of words recalled by the participants, i.e. no analysis of lexical exploration strategies were performed. The assessment battery employed provides guidance on the method of interpreting the qualitative results, such as the strategies used to retrieve words, number of semantic fields explored, number of words pronounced per semantic field, presence and types of error, strategy for exploring semantic knowledge, distribution of words in the field and retrieval rate[12]. For the normative study, however, the battery only considers the total score, while the qualitative analysis includes complementary information for interpreting performance of lexical-semantic memory exploration[12]. Thus, the relevance of qualitative analyses in interpreting the results of individual assessments is clear, as demonstrated by a number of previous studies[1,3,5]. Therefore, future studies should characterize error types under the different fluency conditions, information which can be useful in analysis of the different contributions of verbal or executive processes in lexical access. In addition, it is important to bear in mind that the sample comprised predominantly women, akin to the normative study, in which this aspect was referred to as the *feminization* of aging. However, the Brazilian sample involved in the original version of the MAC Battery exhibited no apparent difference in verbal fluency between men and women[30].

CONCLUSION

The verbal fluency performance of older adults from the FD proved similar to that of the younger adults, suggesting that the typical aging process did not negatively impact verbal fluency.

The lower mean scores of the FD, relative to normative data for the South of the country, on both the semantic verbal fluency subtest for the high-educated group of older adults, and on the phonemic and semantic verbal fluency subtest for the group of younger adults, highlight the need for normative studies that establish norms specific to the local demographic profile.

No statistically significant difference for unconstrained verbal fluency performance was found between younger and older adults from the FD, or between the FD samples and normative averages.

In comparison with the values derived for the Brazilian normative sample in the South of the country, the cut-off points for the FD were higher for unconstrained verbal fluency, but lower for both semantic and phonologic/letter verbal fluency.

ACKNOWLEDGEMENTS

The authors would like to thank the members and the University of Brasília (UnB), specially the Faculty of Ceilândia (FCE), for the opportunity and for providing the tools and resources needed to carry out this study. The authors also extend thanks to the volunteers from the Federal District who agreed to take part in the study.

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