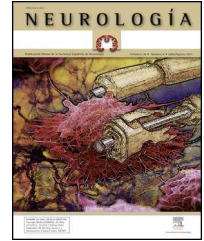


NEUROLOGÍA

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ORIGINAL ARTICLE

Semantic verbal fluency in elderly Mexican adults: reference values[☆]



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Received 16 August 2013; accepted 11 December 2013

Available online 25 March 2015

KEYWORDS

Normative data;
Neuropsychological
assessment;
Verbal fluency

Abstract

Introduction: The semantic verbal fluency test (SVF) is sensitive to detecting cognitive decline. It is fast and easy to use in any cultural context; therefore, it is included in most of the neuropsychological assessment protocols.

Objective: To estimate normative values for the SVF test (animals), in an elderly population aged 65 years and over.

Materials and methods: 1233 subjects who were healthy, cognitively preserved, residents of two areas (rural and urban) of Mexico were assessed. A neurological and neuropsychological exploration battery was applied, including SVF.

Results: The age average was 73 + 6 and schooling was 4.0 + 3.9 years, with 59% women. The average of the words generated in the SVF test was 14 + 5, and a correlation of 0.16 of these scores with age, education, and gender was found ($P < .001$); this allowed the estimation of the percentiles in accordance with these variables.

Conclusions: The most important contribution provided by this study was that the data analysis enabled normative values to be obtained for an elderly Mexican population aged 65 years and over. It was also confirmed, as other neuropsychological assessment studies have done that the SVF test is influenced by socio-demographic variables, such as age and education, aspects to be considered at the time of obtaining normative values. Finally, it was noted that the average scores obtained were lower than other published reference values, due to the low educational level of our sample.

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[☆] Please cite this article as: Chávez-Oliveros M, Rodríguez-Agudelo Y, Acosta-Castillo I, García-Ramírez N, Rojas de la Torre G, Sosa-Ortiz AL. Fluidez verbal-semántica en adultos mayores mexicanos: valores normativos. Neurología. 2015;30:189–194.

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PALABRAS CLAVE

Datos normativos;
Evaluación
neuropsicológica;
Fluidez verbal

Fluidez verbal-semántica en adultos mayores mexicanos: valores normativos**Resumen**

Introducción: La prueba de fluidez verbal semántica (FVS) es sensible para detectar deterioro cognoscitivo, es rápida y fácil de utilizar en cualquier contexto cultural, por ello se incluye en la mayoría de los protocolos de evaluación neuropsicológica. El objetivo fue estimar valores normativos de la prueba FVS (animales), en una población de adultos mayores de 65 años.

Material y método: Se evaluó a 1233 sujetos sanos, cognitivamente conservados, residentes de 2 áreas (rural y urbana) de México. Se aplicó una batería de exploración neurológica y neuropsicológica, incluyendo la FVS.

Resultados: El promedio de edad de la muestra fue de 73 + 6 y escolaridad de 4,0 + 3,9 años, el 59% fueron mujeres. El promedio de palabras generadas en la prueba FVS fue de 14 + 5 y se encontró una correlación de 0,16 de estas puntuaciones con la edad, escolaridad y género ($p < 0,001$), permitiendo con ello el cálculo de los percentiles de acuerdo con estas variables.

Conclusiones: El aporte más importante de este estudio es que el análisis de los datos permitió obtener valores normativos para una población mexicana de adultos mayores de 65 años. Además, confirmamos, al igual que otros estudios de evaluación neuropsicológica, que la prueba FVS está influida por variables sociodemográficas, como edad y escolaridad, aspectos que en el momento de construir el baremo se deben tomar en cuenta. Por último, destacamos que debido al bajo nivel educativo de nuestra población de estudio, la media de las puntuaciones obtenidas para FVS resultó inferior a otros valores normativos publicados.

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Introduction

Verbal fluency, whether normal or pathological, is one of the most widely studied aspects of language. It has been examined with a variety of approaches from the perspective of the neurosciences, particularly neuropsychology, and this measure is frequently included on assessment protocols for cognitive deficits caused by multiple cerebral disorders.

Semantic verbal fluency (SVF), defined as the ability to utter words that match a predefined category, is considered a cognitively complex task. Scientists know that it requires intervention not only by linguistic processes, but also by memory processes (working memory, semantic memory) and executive processes (initiation, sustained attention, search strategy, and cognitive flexibility).¹

The SVF test may be presented using different categories, including animals, fruits, colours, tools, etc., but the literature informs us that the animal naming task is the most common variant.^{2,3} This test may be applied easily and quickly, and it may also be performed in both clinical and research settings, with subjects who cannot be assessed by other means (illiterate individuals and those with visual or other sensory impairments). It can also be carried out in rural or urban areas and in any type of cultural setting.⁴

Another advantage of this test is that it has been shown to be sensitive for detecting brain damage.⁵ Although decreasing verbal fluency has been observed throughout the normal ageing process, it has also been reported that early losses in this function may occur in processes, especially dementia disorders, which give rise to cognitive decline.^{6,7}

On the other hand, several published studies have reported that SVF results may be affected by sociodemographic variables, including sex, years of education, age, and profession.^{8–10} This impact may vary between one study

and another, and for this reason, using this test for diagnostic or research purposes requires gathering normative data in the setting in which the test will be used. The purpose of this study is to estimate normative values in a population of healthy and cognitively well-preserved subjects aged 65 years and older from 2 areas (rural and urban) in Mexico.

Materials and methods

This study developed from the multi-centre epidemiology project Dementia Care in Mexico, undertaken by the 10/66 Dementia Research Group. The protocols followed by the 10/66 Dementia Research Group, its study methodology, and data obtained from all participating countries have already been published.¹¹ This study was approved by the ethics committee at the Manuel Velasco Suárez National Institute of Neurology and Neurosurgery in Mexico; all participants signed an informed consent form.

We evaluated 1003 subjects from an urban area of Mexico (Mexico City) along with 1000 subjects from a rural area (Morelos). The process of selecting the urban area required identifying middle- to low-income zones (classified by INEGI,¹² the Mexican National Institute of Statistics and Geography) with an urban profile in terms of education, employment, income, residential amenities, and access to health services. Criteria for the rural area were low population density and presence of traditional agrarian activities. In this case, we included only those subjects who had lived most of their lives in that area or in similar conditions. We completed a door-to-door census to identify subjects eligible to participate in the study (aged 65 and older).

To estimate normative values for the verbal fluency test, we selected 1233 subjects from the sample total: 631 from the urban area (51.2%) and 602 from the rural area (48.8%).

Table 1 Demographic data by area of residence

	Urban, n (%)		Rural, n (%)		Total N (100%)	Sig. P-value
<i>Age range (years)</i>						
65-69	183	49.5	187	50.5	370	.425
70-74	197	54.9	162	45.1	359	
75-79	129	50.0	129	50.0	258	
80+	122	49.6	124	50.4	246	
<i>Education (years)^a</i>						
0	118	39.7	179	60.3	297	.001
1-5	208	39.5	319	60.5	527	
6-8	153	66.5	77	33.5	230	
9 or more	152	84.9	27	15.1	179	
<i>Sex^a</i>						
Women	407	55.4	328	44.6	735	.001
Men	224	45.0	274	55.0	498	
Total	631	51.2	602	48.8	1233	

N: number of participants.

^a Difference between groups is statistically significant ($P < .01$, chi-square test).

The remaining 767 were excluded because they met diagnostic criteria for dementia or had a history of depressive symptoms. To identify subjects with depressive symptoms, we used the Neuropsychiatric Inventory (NPI),¹³ concretely the brief version (NPI-Q)¹⁴ which has been validated in Spanish.¹⁵ Dementia was diagnosed using the detection algorithm designed by the 10/66 Dementia Research Group and previously validated.¹⁶ The algorithm combines the results from various scales included in the patient interview: the Geriatric Mental Status Interview,¹⁷ cognitive evaluation, sociodemographic questionnaire, and interview with an informant/caregiver.

Three tasks were used to evaluate cognitive state: Spanish-language versions of the Community Screening Instrument for Dementia (CSI-D)¹⁸ and the modified word learning and SVF tasks from the Consortium to Establish a Registry for Alzheimer's Disease.¹⁹ The SVF test was conducted using the following instructions: 'I would like you to list words belonging to the 'animals' category. Please think of any kind of flying or swimming animals, woodland creatures, and animals of all types. Now name as many animals as you can. You have one minute to do so.' All animals named within the one-minute time limit were counted to generate the final score.

Data were analysed using statistics software SPSS 15.0 to obtain central tendency and dispersion measures given as mean (SD) and percentile rank. The chi-square test was used to compare sociodemographic variables (age, sex, years of education) using the area of residence as a reference. We used multiple regression analysis to obtain correlations between demographic data and scores on the SVF test, and the Pearson correlation coefficient for correlations between CSI-D and the SVF.

Results

We present results from 1233 cognitively intact elderly adults with a mean age of 73.7 (6.4) years and 4.0 (3.9) years of education, from 2 areas of residence: rural (631)

and urban (602). Mean score on the SVF test for the total sample was 14.8 (5.0) words listed in a minute.

For descriptive purposes, age and years of education were stratified into four groups: for age, 65 to 69; 70 to 74; 75 to 79; and 80 or more; for years of education, no school or 0 years, 1 to 5 years, 6 to 8 years, and 9 years or more. Table 1 shows the frequencies for these variables. No significant differences for age were observed between urban and rural residence, but differences for sex and years of education were significant ($P < .01$).

The dependent variable in the linear regression model was the score on the SVF test; the independent variables were demographic data (age, years of education, sex, and area of residence). Each variable was entered to observe its interactions in order to obtain the best model. We also tested for collinearity: according to tolerance values and variance inflation factors, as well as the Durbin-Watson statistical value (approaching 2.0), residuals can be assumed to be independent.

The model yielded a coefficient of $R^2 = 0.16$, which accounts for 16% of the total variance, with a significance level of $P < .001$ (Table 2).

Table 3 displays percentile scores for the SVF test by age and years of education. We observe that scores on the SVF test are higher in groups with more years of education (more than 9 years) and in younger subjects (aged 65-69). As a result, normative results were stratified for these two variables and calculated from percentile ranks. Similarly, considering the low educational level in our sample, we provide the very lowest percentile scores, at 1, 5, and 10, in addition to the most commonly reported percentiles of 25, 50, 75, and 90. Lastly, a Pearson correlation analysis of the SVF scores and total scores on the CSI-D test found a correlation of 0.498 ($P < .01$).

Discussion

Several published studies have used the SVF test and described it as a useful neuropsychological tool for both

Table 2 Linear regression analysis: demographic variables and score on the SVF test

Verbal fluency	Non-standardised coefficient		P-value
	β	Standard error	
Sex			
Male	0.70	.27	.09
Rural area	−0.94	.28	.01
Age group			
65-69	Reference		
70-74	−0.73	.34	.034
75-79	−1.44	.38	.000
80 +	−2.02	.38	.000
Years of education			
0	Reference		
1-5	0.90	.33	.007
6-8	1.90	.41	.000
9 or more	5.08	.46	.000
Constant	13,802	.53	.000

clinical and research settings since it provides a simple means of evaluating patients of all ages, especially the elderly.

In this study, we analysed the number of words in a single semantic category that elderly adults were able to list. The sample contained 1233 individuals of both sexes, distributed in four age groups, and residing in either a rural or an urban area of Mexico. According to Manubens et al. (2005),²⁰ this sample is large enough to allow us to determine normative values for a test and extrapolate results to other populations with similar sociodemographic and cultural features.

Normative data for this test have already been collected from adult Spanish speakers in countries such as Spain^{21–24} and Argentina,²⁵ and also from children,²⁶ and two previous normalisation studies have been carried out in Mexico.^{2,27} However, the methodology differs from our own in all of the above cases. For example, the study by Lozano-Gutiérrez and Ostrosky-Solís²⁷ features a smaller sample size for the same age group (575). The study by Mokri et al.,³ presenting normative data for the Isaacs Set Test, uses a 30-second version of the SVF test and its results are therefore not comparable to our own. For the above reasons, we proposed framing our analysis to contemplate how our study population's cognitive function might be influenced by such sociodemographic variables as age, years of education, sex, and area of residence.

We determined a mean score on the SVF for the sample total of 14.8 (5.0), which was lower than scores published in earlier normative data.^{4,26,28–30} This result may be due to two factors. First of all, the age limit for normative data presented by other authors was 95 years, whereas the oldest individual in our study was 104 years old. Secondly, the educational level in our population is low (4.0 years of education on average) compared to that in other studies.^{22,25} As shown by the literature, educational level is one of the most important factors affecting performance on tests of this type. This study is no exception; we observe here that the group

Table 3 Percentile values for the SVF test by age and years of education

Percentile	Age 65-69				Age 70-74				Age 75-79				Age 80+			
	Education (years)				Education (years)				Education (years)				Education (years)			
	0	1-5	6-8	>9	0	1-5	6-8	>9	0	1-5	6-8	>9	0	1-5	6-8	>9
n = 63	n = 146	n = 85	n = 76	n = 76	n = 85	n = 158	n = 63	n = 53	n = 71	n = 119	n = 37	n = 31	n = 78	n = 104	n = 45	n = 19
P1	5	4	7	9	0	1	6	6	0	1	7	7	0	0	4	8
P5	7	8	10	11	6	7	8	11	4	8	8	10	5	7	7	8
P10	8	9	11	13	9	8	10	12	7	9	10	12	7	8	9	12
P25	11	12	14	16	11	12	12	17	10	11	11	16	10	10	11	13
P50	13	15	17	18	14	14	15	20	12	14	14	18	12	13	14	16
P75	16	18	20	23	16	18	18	22	15	17	16	21	18	15	19	19
P90	20	20	22	26	18	22	23	25	18	22	21	26	19	18	21	21
M	14.0	14.9	16.7	19.3	13.6	14.4	15.1	19.5	12.2	14.1	14.4	18.5	12.6	12.8	14.6	17.0
SD	4.1	4.4	4.3	5.0	4.2	4.7	4.6	5.1	4.3	5.0	4.2	4.5	4.7	4.3	4.9	6.4

with the highest educational level (more than 9 years of education) scored higher on the test, and this group may present less cognitive impairment and a greater cognitive reserve.³¹

We should point out that area of residence was considered in our regression model, unlike in other studies. This variable had a statistically significant effect on the mean score on the SVF test. However, we did not account for rural and urban residence when creating the scales because stratifying the sample by age and years of education had delivered small groups, and dividing them further would not have resulted in reliable and representative normative values for these groups.

Lastly, correlating scores on the SVF test to total score on CSI-D revealed a statistically significant difference ($P < .01$); this may highlight the construct validity of this test when we consider the neurocognitive basis required to perform the tasks it includes.

In line with other studies, our results confirm that the SVF test is mainly influenced by two sociodemographic factors, age and level of education, which is why we place the most emphasis on these variables. Examining these variables reduces errors in the process of interpreting results, and it can also reduce diagnostic errors in clinical practice.³²

Data obtained in this study may provide a reference for studying cognitive functions in populations within the age range of 65 to 104 years. Our results will be especially useful as a reference for studying patients in the early stages of cognitive impairment or dementia, since this test has been shown to be highly sensitive to processes of this type.⁷ We therefore consider it necessary to undertake further studies in clinical populations, since this step is particularly important for accumulating valid discriminative evidence for SVF in our setting.

We believe that this study's most important contribution is that it provides clinicians and dementia researchers with normative data for the Mexican population older than 65 for a test that is widely used in this field.

Funding

The prevalence study carried out by the 10/66 Dementia Research Group was financed by the US Alzheimer's Association (IIRG-04-1286).

Conflicts of interest

The authors have no conflicts of interest to disclose.

Acknowledgements

We would like to thank the Mexican National Institute of Public Health and the Faculty of Medicine at Universidad Nacional Autónoma de México.

The authors would like to thank Prof. Astrid Schilman for her assistance with the statistical analysis in this project.

References

1. Lezak MD, Diane B, Howieson D, Loring W. *Neuropsychological assessment*. New York: Oxford University Press; 2012.
2. Marino CJ, Alderete MA. Variación de la actividad cognitiva en diferentes tipos de pruebas de fluidez verbal. *Rev Chil Neuropsicol*. 2009;4:179–92.
3. Mokri H, Avila-Funes JA, Meillon C, Gutiérrez Robledo LM, Amieva H. Normative data for the Mini-Mental State Examination, the Free and Cued Selective Reminding Test and the Isaacs Set Test for an older adult Mexican population: the Coyoacán cohort study. *Clin Neuropsychol*. 2013;27:1004–18.
4. Carnero C, Maestre J, Narta J, Mola S, Olivares J, Sempere AP. Validación de un modelo de predicción de fluidez verbal semántica. *Rev Neurol*. 2000;30:1012–5.
5. López Pérez-Díaz AG, Calero MD, Navarro-González E. Predicción del deterioro cognitivo en ancianos mediante el análisis del rendimiento en fluidez verbal y en atención sostenida. *Rev Neurol*. 2013;56:1–7.
6. Carnero-Pardo C, Lendínez-González A. Utilidad del test de fluencia verbal semántica en el diagnóstico de demencia. *Rev Neurol*. 1999;29:709–14.
7. Tovar-Rivera E, López-Martínez C, Becerra-Laparra IK, Gómez-Sandoval C, Roldán-Valadez EA. Correlación entre funciones ejecutivas y volúmenes cerebrales de pacientes adultos Mayres con y sin déficit cognitivo. *Rev Invest Med Sur Mex*. 2012;19:149–55.
8. Labos E, Trojanowski S, Del Rio M, Zabala K, Renato A. Perfiles de fluencia verbal en Argentina. Caracterización y normas en tiempo extendido. *Neurol Arg*. 2013;5:78–86.
9. Álamo CD, Mir ML, Olivares T, Barroso J, Nieto A. Efecto de la edad, nivel educativo y estado cognitivo general sobre la fluidez verbal en hispanoparlantes. Datos normativos preliminares. In: First International Congress on Neuropsychology; 1999 [Internet] [accessed 25.06.12]. Available from: <http://www.uninet.edu/union99/congress/libs/val/v01.htm>
10. Boone KB, Victor TL, Wen J, Razani J, Ponton M. The association between neuropsychological scores and ethnicity, language, and acculturation variables in a large patient population. *Arch Clin Neuropsych*. 2007;22:355–65.
11. Prince M, Ferri CP, Acosta D, Albanese E, Arizaga R, Dewey M, et al. The protocols for the 10/66 Dementia Research Group population-based research programme. *BMC Public Health*. 2007;7:165.
12. INEGI. *Estadísticas del Medio Ambiente del Distrito Federal y Zona Metropolitana 2002*. Aguascalientes, México: Instituto Nacional de Estadística, Geografía e Informática; 2005.
13. Cummings J, Mega M, Gray K, Rosenberg-Thompson S, Carusi D, Gornbein J. The Neuropsychiatric Inventory: comprehensive assessment of psychopathology in dementia. *Neurology*. 1994;44:2308–14.
14. Kaufer D, Cummings J, Ketchel P, Smith V, MacMillan A, Shelley T, et al. Validation of the NPI-Q, a brief clinical form of the Neuropsychiatric Inventory. *J Neuropsychiatry Clin Neurosci*. 2000;12:233–9.
15. Boada M, Cejudo J, Tárraga L, López O, Kaufer D. Neuropsychiatric Inventory Questionnaire (NPI-Q): validación española de una forma abreviada del Neuropsychiatric Inventory (NPI). *Neurología*. 2002;17:317–23.
16. Prince M, Acosta D, Chiu H, Scazufca M, Varghese M. 10/66 DRG. Dementia diagnosis in developing countries: a cross-cultural validation study. *Lancet*. 2003;361:909–17.
17. Copeland J, Dewey M, Griffith-Jones H. A computerised psychiatric diagnostic system and case nomenclature for elderly subjects: GMS and AGE CAT. *Psychol Med*. 1986;16:89–99.
18. Hall KS, Hendrie HC, Britain HM, Norton JA Jr, Rodgers DD, Prince CS, et al. The development of a dementia screening

- interview in two distinct languages. *Int J Methods Psychiatr Res.* 1993;3:28.
19. Morris JC, Heyman A, Mohs RC, Hughes JP, Van Belle G, Fillenbaum G, et al. The Consortium to Establish a Registry for Alzheimer's Disease (CERAD). Part I. Clinical and neuropsychological assessment of Alzheimer's disease. *Neurology.* 1989;39:1159–65.
 20. Manubens JM, Barandiaran M, Martinez-Lage P, Frances I, Martinez C, Garcia ML, et al. Valores del protocolo neuropsicológico GERMCIIDE en una muestra de sujetos normales. *Neurología.* 2005;20:174–9.
 21. Fernández T, Ríos C, Santos S, Casadevall T, Tejero C, López-García E, et al. "Cosas en una casa", una tarea alternativa a "animales" en la exploración de la fluidez verbal semántica: estudio de validación. *Rev Neurol.* 2002;35:520–3.
 22. Benito-Cuadrado MM, Estaba-Castillo S, Böhm P, Cejudo-Bolívar J, Peña-Casanova J. Semantic verbal fluency of animals: a normative and predictive study in a Spanish population. *J Clin Exp Neuropsychol.* 2002;24:1117–22.
 23. Villodre R, Sánchez-Alfonso A, Brines L, Nuñez AB, Chirivella J, Ferri J, et al. Fluencia verbal: estudio normativo piloto según estrategias de agrupación y saltos de palabras en población española de 20 a 49 años. *Neurología.* 2006;21:124–30.
 24. Adrián JA, Hermoso P, Buiza JJ, Rodríguez-Parra MJ, González M. Estudio piloto de la validez, fiabilidad y valores de referencia normativos en la escala PRO:NEURO en adultos mayores sin alteraciones cognitivas. *Neurología.* 2008;23:275–87.
 25. Fernández AL, Marino C, Alderete AM. Valores normativos en la prueba de Fluidez Verbal-Animales sobre una muestra de 251 adultos argentinos. *Rev Arg Neuropsic.* 2004;4:12–22.
 26. Nieto A, Galtier I, Barroso J, Espinosa G. Fluencia verbal en niños españoles en edad escolar: estudio normativo piloto y análisis de las estrategias organizativas. *Rev Neurol.* 2008;46:2–6.
 27. Lozano Gutiérrez A, Ostrosky-Solís F. Efecto de la edad y la escolaridad en la fluidez verbal semántica: Datos normativos en población hispanohablante. *Rev Mex Psic.* 2006;23:37–44.
 28. Fernandez-Turrado T, Pascual-Millan LF, Fernandez-Arin E, Larrode-Pellicer P, Santos-Lasaosa S, Mostacero-Miguel E. Modelo de análisis en dos mitades para tareas de fluidez semántica. *Rev Neurol.* 2007;44:531–6.
 29. Ostrosky-Solis F, Lozano Gutierrez A, Ramirez Flores M, Ardila A. Same or different? Semantic verbal fluency across Spanish-speakers from different countries. *Arch Clin Neuropsych.* 2007;22:367–77.
 30. Peña-Casanova J, Quiñones-Ubeda S, Gramunt-Fombuena N, Quintana-Aparicio M, Aguilar M, Badenes D, et al. NEURONORMA Study Team. Spanish multicenter normative studies (NEURONORMA Project): norms for verbal fluency tests. *Arch Clin Neuropsych.* 2009;24:395–411.
 31. Stern Y. What is cognitive reserve? Theory and research application of the reserve concept. *J Int Neuropsychol Soc.* 2002;8:448–60.
 32. González HM, Mungas D, Hean MN. A semantic verbal fluency test for English- and Spanish-speaking older Mexican-Americans. *Arch Clin Neuropsych.* 2005;20:199–208.