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"Symbol Digit Modalities Test" normative values for Spanish home care residents: a pilot study

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Introduction. The Symbol Digit Modalities Test (SDMT) is a widely used test for the evaluation of neurological disorders. Normative data have been published for this test in different populations, however there are no values regarding elderly persons residing in geriatric homes. This study has aimed to apply the SDMT on a sample made up of Spanish elderly people living in geriatrics home care residents to obtain normative values, considering gender, age and education level.

Methodology. The standard pen and paper version of the SDMT was administered to 821 home care residents older than 55 years. Information regarding age, gender and education was obtained by means of personal health records provided by each institution. A descriptive analysis was made to generate tables including normative data. The final values were adjusted based on age and educational level of the participants and presented in weighted scales.

Results. The SDMT was filled out by 321 participants. Final distribution of the sample made it possible to calculate normative values based on age. A negative correlation was observed between the SDMT mean score and age of the participants while education significantly affected the results obtained.

Conclusions. The SDMT normative data obtained after the application of the SDMT in the elderly living in home care residents were found to be strongly influenced by age and education. Use of the oral version is recommended for future studies of this kind.

Keywords: Attention, Reference values, Neuropsychological Test, Age factors

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Valores normativos del "Symbol Digit Modalities Test" de aplicación en poblaciones españolas residentes en geriátricos: un estudio piloto

Introducción. El "Symbol Digit Modalities Test" (SDMT) es una prueba de valoración de trastornos neurológicos ampliamente utilizada. Se han publicados valores normativos de esta prueba en diferentes poblaciones, aunque no existen valores de este tipo relativos a personas mayores residentes en geriátricos. El objetivo de este trabajo es el de aplicar el SDMT a una muestra compuesta por personas mayores de origen español que residen en geriátricos para obtener sus valores normativos, teniendo en cuenta la edad, el sexo y el nivel educativo.

Metodología. La versión escrita del SDMT fue aplicada a 821 personas mayores de 55 años, residentes en instituciones geriátricas. La edad, sexo y nivel educativo se obtuvo mediante hojas de registro disponibles en los geriátricos. Se realizó un análisis descriptivo para generar tablas incluyendo valores normativos. Los valores finales fueron ajustados en función de la edad y el nivel educativo de los participantes y presentados en escalas ponderadas.

Resultados. El SDMT fue cumplimentado por 321 participantes. La distribución final de la muestra permitió el establecer valores normativos para 10 intervalos en función de la edad. Se observó una correlación negativa entre los valores medios del SDMT y la edad de los participantes. El nivel educativo influyó significativamente en los resultados obtenidos.

Conclusiones. Los valores normativos obtenidos tras la aplicación del SDMT en personas mayores internadas en residencias geriátricas se encuentran fuertemente influenciados por la edad y el nivel educacional. Se aconseja el empleo de la versión oral para futuras investigaciones de este tipo.

Palabras Clave: Atención, Valoración Neuropsicológica, Valores Normativos, Edad

INTRODUCTION

Neuropsychological functional evaluation has great clinical interest given the increasingly clearer association

between different neurocognitive deficits and the risk of suffering certain diseases such as Alzheimer, schizophrenia or even cerebrovascular accidents.¹ Given this situation, it is of great interest for the scientific community to be able to recur to normative values that make it possible to establish comparisons between diverse population groups, and even to determine possible cutoffs. However, these normative values generally depend largely on sociocultural, economic and educational factors since they are variables that have a clear effect on the result obtained on certain neuropsychological tests.

The "Symbol Digit Modalities Test (SDMT)"² is a known neuropsychological test focused on the evaluation of certain neurocognitive functions, principally working memory, information processing speed, sustained, focalized and selective attention, visuospatial function and constructional praxias.³ Even though it is a test of generalized use that is frequently included in short batteries of neuropsychological examination, normative reference values are not available for all of the populations for which it can be applied. Thus, although the SDMT has been being updated,⁴ and normative values have been established for different population groups, considering age, gender, presence or not of diseases, and even sexual orientation,⁵ as far as the authors know, there is no information of this type regarding institutionalized elderly persons.

Given this situation, the purpose of this descriptive study is to establish normative values of SDMT for application to populations made up of institutionalized elderly Spanish persons, considering their age, gender and educational level. It is expected that the independent analysis of these variables will have an effect on the screening function of the test.

METHODOLOGY

Participants

In order to form a part of this study, the subjects should be older than 55 and be living in residences for the elderly distributed throughout the Regional Community of Galicia. All those diagnosed clinically of dementia and/or who had health problems that prevent them from carrying out the SDMT were excluded in accordance with the information obtained from their personal physician.

The participants were recruited through a collaboration agreement between the University of Vigo and the geriatrics management company "Geriatros S.A," and agreed to be included in the study after being informed about its characteristics and objective. The study was conducted in agreement with the Declaration of Helsinki⁶ and considering the regulations of the European Union on medical research, and it was also approved by the Ethics Committee of Vigo

after obtaining the informed consent of all the participants and their family member or those closest to them.

Cultural and demographic information

Using the registry sheets of each geriatric site, the data were obtained regarding age, gender and educational level of each one of the residents participating in the study.

Symbol Digit Modality Test

The written version of the SDMT was applied by previously trained personnel, using, for such effect, the card having standard dimensions available in Spanish.⁴ The objective of the test consists in identifying nine symbols with different geometric forms that correspond with numbers 1 to 9. After, a series of blank boxes, located below the geometric figure, should be covered by hand, writing in the corresponding number. After a test period in which the subject can be helped to cover the first 10 boxes, 90 seconds are allowed, during which, the greatest number of boxes possible must be covered, the maximum score being 110.

Statistical analysis

The same statistical procedure was performed as that used in other NEURONORMA normative studies.⁷ Said procedure can be summarized into the following principal steps: a) use of mid-point in the intervals⁸ to maximize the information available for each age range. The mid-point of the age interval provides rule for subjects of this age and one more year. (b) Pearson's correlation coefficient (r) and determination (r^2) by age, education level and gender were calculated for the SDMT, (c) to assure a normal distribution, the distribution of frequencies of the original scores was adjusted to the NSS_A scale (NEURONORMA score).

Distribution of accumulative frequencies was generated for each age range and study level. Percentiles were assigned to the scores based on their locations within the distribution. After, the percentiles were converted into scores on a scale (from 2 to 18). Based on these data, the normative values were identified (NSS_A). The values obtained were rounded down to the nearest whole value (for example, 10.75 was rounded down to 10).

The NEURONORMA Scale makes it possible to group subjects who have different levels on the SDMT under the same value of the scale, considering the degrees of academic training or age, and makes it possible to make comparisons and trackings of the population.

Table 1	Description of the sample			
		N	%	Symbol-Digit Modalities Test
Mean				SD
Years of Education				
Without studies (0)	151	47.04	2.96	7.22
Primary (6)	125	38.94	5.79	8.69
Secondary (12)	33	10.28	6.79	6.19
University (20)	12	3.74	10.00	8.50
Age groups				
<65	16	4.98	9.13	11.05
66-68	13	4.05	8.38	13.07
69-71	16	4.98	5.00	6.14
72-74	29	9.03	4.55	6.74
75-77	28	8.72	7.07	10.80
78-80	38	11.84	5.92	7.82
81-83	53	16.51	3.89	6.84
84-86	43	13.40	3.77	6.14
87-89	39	12.15	5.64	8.88
>90	46	14.33	3.61	6.60
Gender				
Man	115	35.83	4.85	6.96
Woman	206	64.17	5.27	8.66
Diseases				
Mild Cognitive Deterioration	85	18.23	-	-
Arterial Hypertension	157	32.10	-	-
Diabetes (I, II)	70	14.63	-	-
Osteoarthritis	64	13.11	-	-
Total sample (n)	321	-	-	-

Notes: SD standard deviation; - not pertinent

RESULTS

Of a total population of 1177 persons, 821 met the inclusion criteria and were selected for the study. The results show that 61% of them did not answer the SDMT after it was explained, mainly stating lack of motivation, reduced space to cover the boxes and understanding problems. In this way, the sample, object of the study, was finally made up of 321 subjects with mean age of 80.7±8.1 years. The principal conditions found in this were mild cognitive

deterioration (18.2%), arterial hypertension (32.1%), diabetes (14.6%) osteoarthritis (13.1%).

The final distribution of the sample made it possible to establish normative values for 10 intervals based on age (Table 1). The effect of variables such as age and education level was shown as a conditioning element of the results on the SDMT, while gender did not show such influence. Thus, age showed an inverse and significant association ($r=-0.08$; $p<0.05$) in regards to the SDMT, while education level showed a direct and significant association ($r=0.23$; $p<0.05$).

Table 2 shows the values obtained on the SDMT in relation to level of studies and age intervals and their correspondence on the NEURONORMA scale. To correctly use this table, we should select the patient based on the values obtained on the SDMT and their age range or education level. Then, we will observe the two columns on the left (scale, percentile) that indicate the value of the SDMT on the NEURONORMA scale. The results obtained are concentrated around 10 values of the NEURONORMA scale, the range of the scale 8-17 being used for the adjustment of the age range, while for the adjustment for education level, the range was 9-17. This reflects the tendency of the distribution to high percentages (60-98%), within the low values obtained with the SDMT.

In this way, it is seen how a final score on the SDMT 2-3 obtained by a person without studies is comparable to a score of 11-13 obtained by another with university studies. Taking the reference values of the NEURONORMA into account, both subjects would be found on the same scale (11).

Similarly, a final score of 20-29 on the SDMT, obtained by a person over 90 years, is comparable to a score of 44 in a person younger than 65 years. According to the reference values of the NEURONORMA, both subjects would be found on the same scale (15).

CONCLUSIONS

The SDMT has been proposed as a test that is easy to administer and useful in the clinical setting. On the contrary, the results herein provided show that a large number of elderly persons living in geriatric residences reject its use. Thus, in this setting, it could have some limitations, as has been observed with other populations.⁹ In any event, the possibility that part of the sample that refused to answer the SDMT would have some degree of cognitive deterioration close to dementia cannot be ruled out and that this would even prevent them from initiating the test. In relation to this, it stands out that obtaining a score under 33 on the SDMT is generally a clear indicator of the existence of some type of cognitive disorder.¹⁰ Thus, it would have been

Table 2		Level of studies and age adjusted to the NEURONORMA scale (NSSA) for the "Symbol Digit Modalities Test"									
Scale	Percentile	Level of studies (Years)									
		Without Studies (0)	Primary (6)	Secondary (12)	University (20)						
2	<1										
3	1	-	-	-	-	-	-	-	-	-	-
4	2	-	-	-	-	-	-	-	-	-	-
5	3-5	-	-	-	-	-	-	-	-	-	-
6	6-10	-	-	-	-	-	-	-	-	-	-
7	11-18	-	-	-	-	-	-	-	-	-	-
8	19-28	-	-	-	-	-	-	-	-	-	-
9	29-40	-	-	-	-	-	-	-	-	3-6	-
10	41-59	-	1-4	4-6	7-10	11-13	14-16	17-24	25-27	28	-
11	60-71	2-3	5-7	7-11	12-14	15	16	18	-	-	-
12	72-81	4-5	8-9	10-14	15	16	18	-	-	-	-
13	82-89	6-9	10-14	15	16	18	-	-	-	-	-
14	90-94	10-14	15-21	-	25-27	28	-	-	-	-	-
15	95-97	15-33	22-41	16	18	-	-	-	-	-	-
16	98	34-46	42-47	18	-	-	-	-	-	-	-
17	99	47	48	-	-	-	-	-	-	-	-
18	>99	-	-	-	-	-	-	-	-	-	-

Scale	Percentile	Age range (Years)									
		<65	66-68	69-71	72-74	75-77	78-80	81-83	84-86	87-89	>90
2	<1	-	-	-	-	-	-	-	-	-	-
3	1	-	-	-	-	-	-	-	-	-	-
4	2	-	-	-	-	-	-	-	-	-	-
5	3-5	-	-	-	-	-	-	-	-	-	-
6	6-10	-	-	-	-	-	-	-	-	-	-
7	11-18	-	-	-	-	-	-	-	-	-	-
8	19-28	0-3	-	-	-	-	-	-	-	-	-
9	29-40	4	-	-	-	0-2	0-2	-	-	0	-
10	41-59	5-10	0-5	0-5	0-2	3-4	2-4	0-1	0	1-4	0-1
11	60-71	11	6-13	6-8	3-6	5-7	5-7	2-5	1-4	5-6	2
12	72-81	12	14-15	9	7-9	8-10	8	6-7	5-7	7-9	3-4
13	82-89	13-25	16-33	10-12	10-11	11-16	9-14	8-9	8-11	10-14	5-14
14	90-94	26-43	34-45	13-21	12-21	17-40	15-29	10-12	12-16	15-18	15-19
15	95-97	44	46	22	22-29	41-49	30-34	13-38	17-27	19-49	20-29
16	98	-	-	-	30	50	35	39-41	28	50	30
17	99	-	-	-	-	-	-	42	-	-	-
18	>99	-	-	-	-	-	-	-	-	-	-

interesting to have been able to correlate the values found herein with those of a cognitive screening test (for example,

the Minimental test), in order to obtain greater clarity on the normative values reflected in this study.

Both age and level of studies showed a clear influence on the final results of the SDMT, as has been observed in previous investigations.^{1,7,11} The education factor, which is of great importance in this type of neuropsychological tests, above all the greater the age of the subjects,⁵ could explain the extremely low values obtained by the herein analyzed sample (where practically half of the members lacked primary studies), when compared with the Spanish populations of similar age.⁷ This fact, together with the fact that oral version of the SDMT does not seem to be so affected by this factor,¹² makes it recommendable to use said version with elderly persons living in geriatric residences.

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