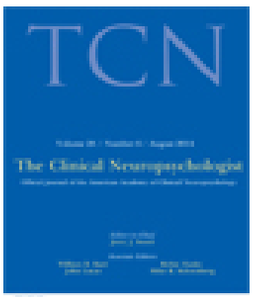

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Dementia Rating Scale-2 normative data for middle-and older-aged Castilian speaking Spaniards

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ABSTRACT

Objectives: The Dementia Rating Scale-2 (DRS-2) is frequently used as a dementia screening tool in clinical and research settings in Spain. The present study describes DRS-2 Total and subscale scores in community-dwelling Spaniards, aged 50–71, and provides normative data for its use in Castilian Spanish-speaking individuals. **Methods:** The sample consisted of 798 individuals who participated in an observational study on essential hypertension. Mean age was 62.8 years ($SD = 5.4$), mean education was 8.6 years ($SD = 3.4$) with 47.9% females. Almost all of them were receiving blood pressure-lowering drugs (93%) and most of them had fairly well-managed blood pressure control (M systolic/diastolic blood pressure = 142.3/77.0 ± 16.0/9.2 mm Hg). We applied a previously described method of data normalization from the Mayo's Older Americans Normative Studies to obtain the Castilian Spanish DRS-2 norms. **Results:** Worse performance on Total and subscale scores was associated with older age ($p < .05$) and fewer years of education ($p < .001$). Women obtained lower raw Total scores than men (131.68 ± 7.2 vs. 133.10 ± 6.90, $p < .005$), but had fewer years of education (7.96 ± 3.33 vs. 9.17 ± 3.45, $p < .001$). This gender difference disappeared after correcting for age and years of education. Total and subscale scores are presented adjusted by age, and normative data are shown for Total scores adjusted by age and years of education. **Conclusions:** These norms are useful for studying cognitive status and cognitive decline in research and clinical settings in Castilian Spanish-speaking populations.

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Dementia Rating Scale-2 Normative data for middle-and-older-age Spaniards

The Dementia Rating Scale (DRS) is a psychometric screening test for diagnosis and follow-up of dementia and cognitive impairment that is widely used in clinical and research settings (Kertesz & Clydesdale, 1994; Slachevsky et al., 2004). DRS was first published for professional use in 1988 (Mattis, 1988) and DRS-2 appeared in 2001, containing the same tasks, stimulus cards, and scoring system but with the addition of an improved scoring form, a scoring booklet with prompts for its administration, and norms for its application to North American English-speaking individuals (Jurica, Leitten, & Mattis, 2001). The DRS and DRS-2 consist of 36 tasks that evaluate 5 cognitive subscales, with scores ranging from 0 to 144. The cognitive domains measured are Attention (AT, 37 points); Initiation/Perseveration (IP), measuring executive functioning and semantic verbal fluency (37 points); Construction (CS), evaluating visuospatial and visuoconstruction abilities (6 points); Conceptualization (CT), assessing abstraction ability (39 points); and Memory (ME), evaluating orientation, visual and verbal memory, and recognition (25 points). The items are presented hierarchically within each subscale, meaning that if the first one or two tasks are performed correctly, subsequent tasks in the subscale are credited with a correct score. The time needed for testing ranges from 20 to 40 min (Pedraza et al., 2010).

The DRS-2 has been translated and adapted into Spanish (Arnold, Cuellar, & Guzman, 1998; Strutt et al., 2012) for its use with Spanish-speaking individuals living in the United States. In Spain, there is also an adaptation to Castilian Spanish (the Spanish spoken in the Iberian Peninsula), which is available from the publisher (Psychological Assessment Resources) (Jurica et al., 2001).

As is true with other neuropsychological tests, DRS-2 scores are greatly influenced by sociodemographic factors including age, ethnicity, and years of education. The largest normative data came from the MOANS (Mayo's Older Americans Normative Studies), which included 623 Caucasian Americans, English-speaking individuals, aged 55–105, who were all functionally independent, most having a high level of education (13.1 ± 3.1 years of education) (Lucas et al., 1998). Consequently, these norms might not apply to individuals with fewer years of formal education or from a different ethnic background. Some authors have tried to overcome these constraints by evaluating, for example, only individuals with little education, to provide complementary normative data (Marcopulos, McLain, & Giuliano, 1997). As for ethnicity, considerable discrepancies in performance were observed between groups of different ethnic backgrounds matched on age and education (Jervis, Beals, Fickenscher, & Arciniegas, 2007) and also different results were found within Spanish-speaking populations (Lyness, Hernandez, Chui, & Teng, 2006; Strutt et al., 2012). These differences were attributed to varied levels of acculturation, literacy, and educational programs such as happened in other neuropsychological tests in Spanish-speaking communities (Artiola i Fortuny, Heaton, & Hermosillo, 1998). All these previous findings support the importance of applying appropriate DRS-2 norms for different ages, educational backgrounds, and ethnicities.

Regarding DRS-2 for Castilian-speaking populations, the normative data for 392 healthy volunteers, 60–94 years old, who had 8.4 ± 2.4 years of schooling, are available from a PhD Dissertation (Gómez Liz, 2010). However, some dementia types might start earlier, for example, early onset Alzheimer's disease (AD) or frontotemporal dementia, which could start

before the age of 45 (Kelley, Boeve, & Josephs, 2009). Furthermore, longitudinal studies have shown that cognitive decline starts some 10–20 years before dementia is diagnosed (Amieva et al., 2008; Wilson et al., 2012). Normative data for younger individuals are consequently necessary to track their cognitive performance, be aware of subtle cognitive changes, and eventually help in dementia diagnosis.

The objectives of the present study were to describe DRS-2 Total and domain scores in a large sample of Spaniards of middle and old age with representation of all educational backgrounds and to provide Castilian Spanish normative data.

Method

Participants

All participants of this study were included in the ISSYS (Investigating Silent Strokes in hypertensives, a magnetic resonance imaging Study) observational study. The ISSYS aimed to investigate silent cerebrovascular lesions and cognitive function in hypertensive participants (Riba et al., 2012; Riba-Llena et al., 2013).

Briefly, the ISSYS study enrolled 1037 essential hypertensive participants, aged 50–71 years old, stroke- and dementia-free, who were randomly selected from 14 Primary Health care Services in the northern area of Barcelona city (Spain).

Our participants were born in Spain and educated at school in Spanish. Some of them were bilingual in Catalan (which is another language spoken in this area) and Spanish, but the DRS-2 was administered in Spanish to all of them. Although the northern area of Barcelona city comprises mainly people born and raised there, 30% came from different parts of Spain (mainly from the southern, central-western, and north-western parts of the country) (Departament Estadística, 2012).

At the baseline visit, only those who were free of previous stroke and dementia evaluated by medical records and a face-to-face interview with the participant or proxy were included in the study.

Medical history was collected both by searching in the patients' electronic medical records and by interview. The following information was collected: sociodemographic data (age, gender, country of origin, years of formal education, self-reported bilingualism, and occupation), personal medical records (heart and brain diseases, peripheral arterial disease, and endocrine and metabolic disorders), drug abuse (tobacco, alcohol and others), and current pharmacological treatment. The general protocol of the ISSYS project and the cognitive protocol of these baseline and follow-up visits have been published elsewhere (Riba et al., 2012; Riba-Llena et al., 2013).

After careful review of all data obtained in the baseline visit, and for the purposes of the current study, participants with conditions that could interfere with cognition were excluded: 17 because they had previous central nervous system disease (e.g. previous severe traumatic brain injury), 5 because they had severe or uncontrolled metabolic disease (e.g. diabetes mellitus or hypothyroidism), 26 because they had an active or uncontrolled psychiatric disease (e.g. bipolar disorder, major depression), 11 because they had severe and uncorrected sensorial deficit, 33 because they reported alcohol or drug abuse and 59 because they were illiterate and had significant limitations in the paper and pencil tasks. Sixty-six participants who were not born in Spain were eliminated because they had a different cultural and

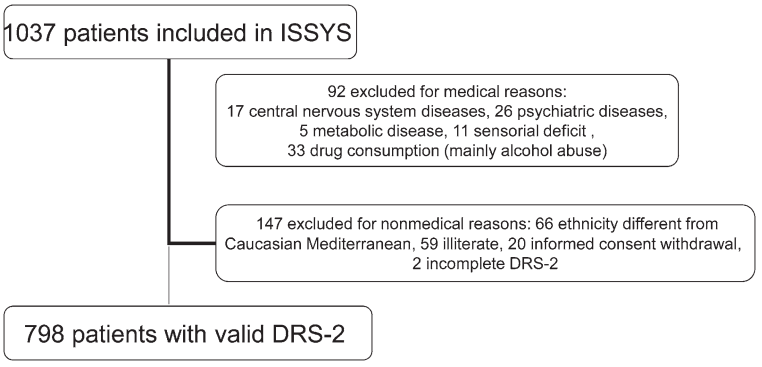

Figure 1. Study flowchart.
Note: ISSYS: Investigating Silent Stroke in hypertensives, a magnetic resonance imaging Study. DRS-2: Dementia Rating Scale-2.

educational background and showed worse scores in DRS-2 Total and IP than individuals born in Spain (both *ps* < .05, see Figure 1). Participants with several reasons for being excluded from this analysis were counted once, when the first reason was met.

This study was conducted in accordance with the Helsinki declaration and was approved by the local Ethics Committee. All patients gave their written informed consent prior to study entry.

Procedure

A single previous adaptation of the Castilian Spanish DRS-2 was used for the assessments after the license was obtained from the publisher (Mattis, 2001). This version is a literal translation of the original DRS-2 adapted to our geopolitical setting. . Adaptations were mainly done in orientation tasks (as an example the name of the governor was replaced by the name of the king). Also, we asked for 'metro' (meter, the length measuring unit of the Universal Metric System used in Spain) instead of 'inch' in the verbal recognition task. In most participants, the screening tool was administered by the same trained neuropsychologist (C.N.). There were a few individuals who were tested by a neurologist (I. R.-L. or P.D.) or a different neuropsychologist (I. F-C.), all of them trained in DRS-2 administration.

Statistical method

For descriptive purposes, normality for continuous variables was assessed by the Kolmogorov–Smirnov test. In univariate analysis, continuous data were analyzed using Pearson or Spearman correlations depending on normality. Continuous variables are presented as $M \pm SD$ and were compared using Student *t*-test or Mann-Whitney *U* test when appropriate. *P*-values <.05 were considered statistically significant. All analyses were done using the SPSS 15.0 statistical package.

The DRS-2 Total scores were normalized for age and years of education following the methodology previously described in the MOANS project (Ivnik et al., 1992a, 1992b, 1992c).

Creation of age-corrected normative tables

To better estimate population means and standard deviations, midpoint age ranges were used, with overlapping subsamples of participants contributing to the normative estimates derived for each age range (Pauker, 1988). Each midpoint age group provided norms for individuals of that age, plus or minus one year, but they were derived from a subsample of all participants who were within five years of the midpoint age. For example, norms for midpoint age 64 apply to ages 63–65 and were derived from all individuals between 59 and 69 years old. These procedures yielded six midpoint age groups and a larger sample size for norms as compared to the actual sample size (see Table 1).

Despite the larger subsamples created using this strategy, descriptive statistics ($M \pm SD$) of the entire cohort would not provide adequate normative estimates because the raw test scores were not normally distributed (see Figure 2, left-hand panel, for DRS-2 Total raw score distribution). Therefore, the raw-score frequency distribution was converted into age-adjusted scaled scores, DSS_A (DRS-2 Scaled Score age-adjusted, see Tables 4–9). First, for each age interval, the cumulative frequency distribution of the raw score was created. Raw scores were then assigned percentile ranks according to their place within the distribution and, finally, percentile ranks were converted to scaled scores between 2 and 18 (Ivnik et al., 1992a, 1992b, 1992c). This transformation produced a normalized distribution for DRS-2 (DSS_A Total is displayed in Figure 2, right-hand panel).

Creation of age- and education-corrected normative table

DSS_A Total was adjusted for years of education, that is, the number of years of formal education reported by the participant. To calculate DRS-2 Total score corrected for age and education, the following equation was applied: $DSS_{A\&E} = DSS_A - [\beta \times (\text{education-12})]$. To provide a good standard reference, that is achieving a mean and standard deviation very similar to that of DSS_A distribution, the score was adjusted by the difference between the predicted scores based on the subject's years of education and the predictive score given 12 years of education. This threshold of 12 years of education was reported to be a good cut-off for high-level education in a previous study (Guardia, Jarne, Peña-Casanova, & Gil, 2005; Guardia et al., 1997).

Results

The study sample consisted of 798 participants with a mean age of 62.8 ($SD = 5.4$) years and 8.6 (3.4) years of education, and 47.9% were women. Other socio-demographic and clinical characteristics are presented in Table 2.

Table 1. Midpoint age groups, norms groups, and sample sizes.

Sample size	Midpoint age	Age interval for midpoint	Age interval for norms	Sample size for norms
117	55	50–56	50–60	263
103	58	57–59	53–63	350
108	61	60–62	56–66	459
181	64	63–65	59–69	530
164	67	66–68	62–71	503
125	–	69+ (69–71)	65+ (65–71)	349

Note: Total $n = 798$.

Table 2. Baseline characteristics of the sample.

Characteristic	*M* (±*SD*) or *n* (%)
Gender, male	416 (52.1%)
Age (years)	62.8 (±5.4)
Bilingualism	112 (14%)
Education (years)	
2–3	71 (8.9%)
4–6	121 (15.2%)
7–9	323 (40.5%)
10–12	211 (26.4%)
13–14	11 (1.4%)
≥15	61 (7.6%)
Working class/profession	
Unskilled blue collar	251 (31.5%)
Skilled blue collar	179 (22.4%)
Administrative work	65 (8.1%)
Middle technical professional	56 (7.0%)
High technical professional	58 (7.3%)
Unknown	189 (23.7%)
Vascular risk factors	
Systolic blood pressure	142.3 (±16.0)
Diastolic blood pressure	77.0 (±9.2)
Blood pressure lowering drugs	746 (93.5%)
Hypertension duration, years	10.3 (±8.5)
Diabetes mellitus	189 (23.5%)
Hyperlipidemia	556 (70.2%)
Body mass index	30.5 (±4.7)
Toxic habits	
Current smoker	126 (15.9%)
Alcohol g/week	78.5 (4–218)
Previous diseases	
Ischemic cardiomyopathy	78 (9.8%)
Kidney disease	34 (4.3%)
Hepatopathy	51 (6.5%)

Note: For continuous variables *M* (±*SD*) and for categorical variables *Count (%)* are given, except for alcohol intake median (interquartile range), *n* = 798.

Table 3. Years of education for females and males within age groups.

Age groups	Years of education		*p*-Value
	Female (*n* = 382)	Male (*n* = 416)	
50–56	9.62 ± 2.84 (50)	10.30 ± 3.03 (67)	NS
57–59	8.20 ± 3.34 (46)	9.11 ± 3.35 (57)	NS
60–62	8.40 ± 3.40 (57)	8.92 ± 3.24 (51)	NS
63–65	7.49 ± 3.27 (88)	9.37 ± 3.65 (93)	<.001
66–68	7.51 ± 3.37 (86)	8.68 ± 3.32 (78)	<.05
69–71	7.22 ± 3.22 (55)	8.61 ± 3.75 (70)	<.05

Note: *M* (±*SD*) (*n*) are given.NS = differences are not statistically significant.

The older the age, the lower the score achieved in Total raw score ($r = -.28$; $p < .001$) and other domain scores (all $rs < -.1$, $ps < .05$). Higher education was related to better scores in Total score ($r = .48$, $p < .001$) and other domains (all $rs > .2$, $ps < .001$). As for the influence of sex, women had lower Total raw scores than men (131.68 ± 7.2 vs. 133.10 ± 6.90, $p < .005$). There were no differences between women and men concerning age (63.01 ± 7.96 vs. 62.62 ± 5.54). However, we found differences in years of education between sexes (women 7.96 ± 3.33 vs. men 9.17 ± 3.45, $p < .001$), especially in individuals over 63 years old (see Table 3 for detailed sex differences by age groups). Regarding bilingualism, we found that bilinguals and monolinguals had similar scores in all domains (all $ps > .05$).

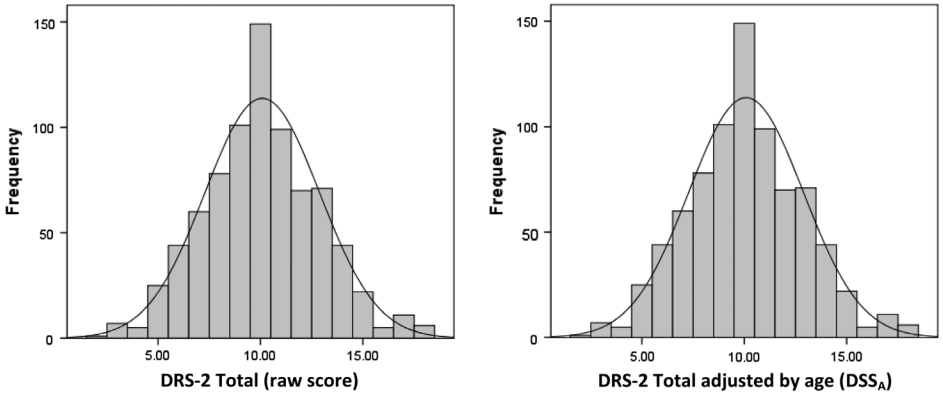

Figure 2. Frequency distribution of DRS-2 Total raw and scaled scores adjusted for age.
Notes: Left-hand panel: distribution of Total DRS-2 raw score before normalization ($M = 134.40$, $SD = 7.10$). Right-hand panel: distribution after correction for age ($M = 10$, $SD = 3$). DRS-2: Dementia Rating Scale-2.

Table 4. Dementia Rating Scale-2 raw and age-adjusted scores for persons 50–56 years old.

Scaled scores	Total	AT	IP	CS	CT	ME	Percentile ranges
2	<117	<29	≤24–29	<4	<24	≤18	<1
3	–	–	–	4	–	–	1
4	117	29–31	–	–	24	19	2
5	118–122	32	30–31	–	25	20	3–5
6	123–125	33	33	5	28	21	6–10
7	126–128	34	34	–	29–30	22	11–18
8	129–131	–	35	–	31–32	–	19–28
9	132–134	35	36	–	33–34	23	29–40
10	135–137	–	–	6	35	–	41–59
11	138–139	36	37	–	36–37	24	60–71
12	140	–	–	–	38	–	72–81
13	141	–	–	–	39	25	82–89
14	142	37	–	–	–	–	90–94
15	143	–	–	–	–	–	95–97
16	–	–	–	–	–	–	98
17	144	–	–	–	–	–	99
18		–	–	–	–	–	>99

Notes: Range = 50–60, $n = 263$. To find an individual's score adjusted by age locate the raw score in the central columns and read across left to the first column. Then proceed to Table 10.AT = attention subscale; IP = initiation/perseveration subscale; CS = construction subscale; CT = conceptualization subscale; ME = memory subscale.

Age-adjusted normative data for Total and domain scores are shown in Tables 4–9. Normative data for Total score adjusted for age and years of education are shown in Table 10. The linear regression formula applied to obtain this table is $DSS_{A\&E}$ Total = DSS_A Total − [.35 × (education-12)], where $DSS_{A\&E}$ Total is the DRS-2 Total age-and-education scaled score, DSS_A Total is the DRS-2 Total age-scaled score, and .35 is the coefficient estimate of the linear regression. Age-adjusted data for cognitive domains were not calculated due to previously reported scaling issues (Lucas et al., 1998; Rilling et al., 2005). The DRS and DRS-2 are screening tools with ceiling effects in cognitively normal individuals, particularly for cognitive domains. Consequently, regression analysis of a highly skewed score distribution could result in misleading results (Rilling et al., 2005). Notably, after these adjustments for age and education, women and men displayed no differences in $DSS_{A\&E}$ Total (10.81 ± 2.50 vs. 10.96 ± 2.50, $p > .05$).

Table 5. Dementia Rating Scale-2 raw and age-adjusted scores for persons 57–59 years old.

Scaled scores	Total	AT	IP	CS	CT	ME	Percentile ranges
2	<113	<28	<28	<4	<22	<19	<1
3	113–116	28–29	–	–	22–23	–	1
4	–	–	28–30	–	24	–	2
5	117–121	30–31	–	4	25	19	3–5
6	122–124	32–33	31–32	–	26–27	20	6–10
7	125–127	–	33–34	5	28–29	21	11–18
8	128–130	34	35	–	30–31	22	19–28
9	131–133	35	36	–	32–33	23	29–40
10	134–136	–	–	6	34–35	–	41–59
11	137–138	36	–	–	36	24	60–71
12	139	–	37	–	37	–	72–81
13	140	–	–	–	38	25	82–89
14	141–142	37	–	–	–	–	90–94
15	–	–	–	–	39	–	95–97
16	143	–	–	–	–	–	98
17	–	–	–	–	–	–	99
18	144	–	–	–	–	–	>99

Note: Range 53–63, *n* = 350. To find an individual's score adjusted by age locate the raw score in the central columns and read across left to the first column. Then proceed to Table 10.AT = attention subscale; IP = initiation/perseveration subscale; CS = construction subscale; CT = conceptualization subscale; ME = memory subscale.

Table 6. Dementia Rating Scale-2 raw and age-adjusted scores for persons 60–62 years old.

Scaled scores	Total	AT	IP	CS	CT	ME	Percentile ranges
2	<112	≤27–29	≤24–27	–	≤19–22	<17	<1
3	112–114	–	–	–	–	17	1
4	115	30	28–29	4	23	18	2
5	116–121	31	–	–	24–25	19	3–5
6	122–123	32	30–32	5	26–27	20	6–10
7	124–126	33	33	–	28–29	21	11–18
8	127–129	34	34	–	30–31	22	19–28
9	130–132	–	35	6	32–35	–	29–40
10	133–135	35	36	–	36	23	41–59
11	136–137	36	–	–	37	24	60–71
12	138–139	–	37	–	38	–	72–81
13	140	–	–	–	–	–	82–89
14	141	37	–	–	39	25	90–94
15	142	–	–	–	–	–	95–97
16	143	–	–	–	–	–	98
17	–	–	–	–	–	–	99
18	144	–	–	–	–	–	>99

Note: Range = 56–66, *n* = 459. To find an individual's score adjusted by age locate the raw score in the central columns and read across left to the first column. Then proceed to Table 10.AT = attention subscale; IP = initiation/perseveration subscale; CS = construction subscale; CT = conceptualization subscale; ME = memory subscale.

Finding an individual's $DSS_{A\&E}$ Total value requires a two-step process. First, select the table corresponding to the person's age (choose the table from Tables 4 to 9). Next, locate the participant's raw score in the body of this table and read across to the first column on the left to find the scaled score, the DSS_A Total. Then, use Table 10 to obtain the $DSS_{A\&E}$ Total value by locating the patient's DSS_A Total score in the far left column and the corresponding years of education in the top row, and search for the cell where they both intersect. This provides the $DSS_{A\&E}$ Total value. For example, a 60-year-old individual with 6 years of education scoring 132 points on the DRS-2 Total score would have a corresponding DSS_A Total score of 9 (see Table 6) and a $DSS_{A\&E}$ Total value of 11 (see Table 10). According to the DRS-2

Table 7. Dementia Rating Scale-2 raw and age-adjusted scores for persons 63–65 years old.

Scaled scores	Total	AT	IP	CS	CT	ME	Percentile ranges
2	<111	≤27–29	<26	≤3	<24	≤15–17	<1
3	111–114	–	26–27	–	–	–	1
4	–	30	–	–	–	–	2
5	115–119	31	28–29	4	24–25	18–19	3–5
6	120–122	32	30–31	5	26	20	6–10
7	123–125	33	32–33	–	27–28	21	11–18
8	126–127	34	34	–	29–30	22	19–28
9	128–131	–	35	–	31–32	–	29–40
10	132–134	35	36	6	33–34	23	41–59
11	135–136	–	–	–	35–36	24	60–71
12	137–138	36	37	–	37	–	72–81
13	139–140	–	–	–	38	–	82–89
14	141	37	–	–	–	25	90–94
15	142	–	–	–	39	–	95–97
16	–	–	–	–	–	–	98
17	143	–	–	–	–	–	99
18	144	–	–	–	–	–	>99

Note: Range = 59–69, *n* = 530. To find an individual's score adjusted by age locate the raw score in the central columns and read across left to the first column. Then proceed to Table 10.AT = attention subscale; IP = initiation/perseveration subscale; CS = construction subscale; CT = conceptualization subscale; ME = memory subscale.

Table 8. Dementia Rating Scale-2 raw and age-adjusted scores for persons 66–68 years old.

Scaled scores	Total	AT	IP	CS	CT	ME	Percentile ranges
2	<111	<29	24	≤3	<22	<16	<1
3	111	–	25–26	–	22	16	1
4	112–114	29	27	–	23	17	2
5	115–117	30–31	28–29	4	24–25	18	3–5
6	118–121	32	30–31	5	26	19–20	6–10
7	122–124	33	32	–	27–28	21	11–18
8	125–127	–	33–34	–	29–30	22	19–28
9	128–130	34	35	6	31–32	–	29–40
10	131–133	35	36	–	33–34	23	41–59
11	134–135	–	–	–	35	24	60–71
12	136–137	36	37	–	36–37	–	72–81
13	138–139	–	–	–	38	–	82–89
14	140–141	–	–	–	–	25	90–94
15	142	37	–	–	39	–	95–97
16	–	–	–	–	–	–	98
17	143	–	–	–	–	–	99
18	144	–	–	–	–	–	>99

Note: Range = 59–69, *n* = 503. To find an individual's score adjusted by age locate the raw score in the central columns and read across left to the first column. Then proceed to Table 10.AT = attention subscale; IP = initiation/perseveration subscale; CS = construction subscale; CT = conceptualization subscale; ME = memory subscale.

Professional Manual, this individual would fall in the cognitively intact range (Jurica et al., 2001).

Discussion

The aims of this paper were to assess the DRS-2 in middle-to older-aged community-dwelling Spaniards and to provide normative data for the DRS-2 in the Spanish language, specifically for Castilian-speaking communities. These data may be useful for the diagnosis of normal and impaired cognitive status in research and clinical practice in Spain.

Table 9. Dementia Rating Scale-2 raw and age-adjusted scores for persons 69–71 years old.

Scaled scores	Total	AT	IP	CS	CT	ME	Percentile ranges
2	104–109	≤28	≤24–26	≤3–4	≤21	<16	<1
3	110–112	–	–	–	–	–	1
4	113	29	27	–	22–23	16	2
5	114–117	30–31	28–29	–	24	17–18	3–5
6	118–121	32	30	5	25–26	19–20	6–10
7	122–124	33	31–32	–	27–28	21	11–18
8	125–126	–	33–34	–	29–30	–	19–28
9	127–129	34	35	–	31	22	29–40
10	130–132	35	36	6	32–33	23	41–59
11	133–135	–	–	–	34–35	24	60–71
12	136–137	36	37	–	36	–	72–81
13	138–139	–	–	–	37	25	82–89
14	140	–	–	–	38	–	90–94
15	141	37	–	–	39	–	95–97
16	142	–	–	–	–	–	98
17	143	–	–	–	–	–	99
18	144	–	–	–	–	–	>99

Note: Range = 65–71, $n = 349$. To find an individual's score adjusted by age locate the raw score in the central columns and read across left to the first column. Then proceed to Table 10.AT = attention subscale; CS = construction subscale; CT = conceptualization subscale; IP = initiation/perseveration subscale; ME = memory subscale.

Table 10. Normative data for Dementia Rating Scale-2 (DRS-2) Total adjusted by age and years of formal education ($DSS_{A\&E}$).

	Education (years)						
DRS-2 Total Scaled Score adjusted by age (DSS_A Total)	2–3	4–6	7–9	10–12	13–14	15–17	18
2	5	4	3	2	1	0	
3	6	5	4	3	2	1	0
4	7	6	5	4	3	2	1
5	8	7	6	5	4	3	2
6	9	8	7	6	5	4	3
7	10	9	8	7	6	5	4
8	11	10	9	8	7	6	5
9	12	11	10	9	8	7	6
10	13	12	11	10	9	8	7
11	14	13	12	11	10	9	8
12	15	14	13	12	11	10	9
13	16	15	14	13	12	11	10
14	17	16	15	14	13	12	11
15	18	17	16	15	14	13	12
16	19	18	17	16	15	14	13
17	20	19	18	17	16	15	14
18		20	19	18	17	16	15

Notes: The formula to obtain this table is $DSS_{A\&E} = DSS_A - [.374 \times (\text{education-12})]$.$DSS_A$ – Total DRS-2 Total Scaled Score adjusted by age.$DSS_{A\&E}$ – Total DRS-2 Total Scaled Score adjusted by age and years of education.

As previously described, age and education influenced the DRS-2 performance. We found that bilinguals and monolinguals had no differences in Total and subscale scores of the DRS-2. Consequently, these data might be useful in other Spanish provinces apart from Barcelona.

This cohort is homogeneous but differs in some aspects from the original DRS MOANS normative cohort, which comprised only United States citizens (Lucas et al., 1998). The main difference between these two cohorts is our participants' overall lower educational background as compared to the MOANS cohort. We had more participants with <8 years of education (ISSYS 28.2%, MOANS 1.5%), and fewer individuals with 12 years or more of

education (ISSYS 27.3%, MOANS 79.3%). One of the reasons for this difference might be that the law on compulsory basic education was adopted later in Spain (in 1970) as compared to the USA (Díez-Nicolás & Fernández-Ballesteros, 2001). Another difference is gender distribution; our percentages of females and males were almost equal, while there was a female predominance (68.1%) in MOANS participants. Last, our participants were also younger (aged 50–71) than MOANS participants (aged 55–105).

Compared to data reported by Gómez Liz, who included norms for 108 Castilian Spanish-speaking individuals aged 60–69 (Gómez Liz, 2010), our participants had worse raw scores in Total, AT, and CT results, but they performed better in the IP subscale. After correction for age and education, differences tended to disappear for $DSS_{A\&E}$ Total values. For instance, in our case, a 60-year-old participant with 139 points in Total raw score with 14 years of education would have a $DSS_{A\&E}$ Total score of 11; an individual with the same age and raw Total score but 4 years of education would have a $DSS_{A\&E}$ Total score of 14. In contrast, according to Gómez Liz, the same individual would have a $DSS_{A\&E}$ Total score of 10 and 12, respectively.

Compared with the last version of DRS-2 translated into Spanish in the USA (Strutt et al., 2012), our participants had fewer years of education than the 157 Latin-American individuals aged 50–80 in the Strutt et al. study (2–18 vs. 6–19 years of education). We found that at high education (≥7 years) our participants had in general better scores in DRS-2 Total whereas at lower education (<7 years) our participants had similar or lower scores in Total DRS-2 score than Strutt participants. Apart from education and age, there might be other factors such as the implementation of different academic programs, educational methodology, or acculturation rate contributing to the differences found between our Castilian Spanish participants and Spanish speakers in the United States (Lyness et al., 2006).

As strengths, this study has included a large sample of middle and old age participants with varied educational backgrounds who were randomly selected from a community-dwelling population. Our inclusion and exclusion criteria were also strict to avoid studying participants having medical conditions interfering with cognition. Last, we followed several of the MOANS recommendations to establish normative data (Ivnik, 2005).We used overlapping midpoint age intervals to maximize data utility, transformed raw scores into age-scaled scores for Total and subscales, and obtained age- and education-adjusted scores for Total DRS-2 score.

This study has several limitations. First, selection of participants was based on the absence of a previous dementia report in their clinical records, lack of previous cognitive and functional complaints, and on a normal cognition statement obtained directly from the participant or a proxy. Using a comprehensive cognitive evaluation would reduce the rate of false negative and false positive cases associated with screening tests. Longitudinal assessment with repeated measures and excluding participants who develop dementia over time would also lead to more precise normative data (this procedure is called robust normalization). This method avoids underestimating test means and overestimating variances, although it adds only a minimal effect in detecting cognitive impairment in the general population (Ritchie, Frerichs, & Tuokko, 2007). Robust DRS-2 norms are available for the United States population, but not for Spanish-speaking communities (Pedraza et al., 2010). A second limitation is that the current study participants were selected from an essential hypertension cohort. Hypertension is a common condition in middle-aged and elderly populations (>50% in individuals in their 60s in Spain) (Garin et al., 2014; Wolf-Maier et al., 2003), but it could impair

later cognition, especially executive function and processing speed (Hughes & Sink, 2016) and in our study might have an impact particularly on IP. The association of hypertension with cognitive deficits is stronger when blood pressure is untreated or uncontrolled (Gasquoine, 2011). Our participants had fairly well-managed blood pressure control (*M* systolic blood pressure <150 mm Hg and *M* diastolic blood pressure <80) and most of them were taking blood-pressure-lowering drugs (93.5%). Despite this, these norms might not apply to non-hypertensive individuals. Last, this study did not include participants over 71 years old, so the range of application is limited to people aged 50–71.

Aside from the limitations described and the intrinsic constraints of any normative study, the norms presented here should prove useful in the Castilian Spanish-speaking community.

Disclosure statement

No potential conflict of interest was reported by the authors.

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