Normative data for the Dementia Rating Scale in the French-Quebec population

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Abstract

The Dementia Rating Scale is used to measure cognitive status of adults with cortical impairment, especially of the degenerative type, by assessing five cognitive functions, namely attention, initiation/perseveration, construction, conceptualization and memory. The present study aimed to establish normative data for this test in the elderly French-Quebec population. Four hundred and thirty-two French-speaking elderly from the province of Quebec (Canada), aged 50 to 85 years, performed the Dementia Rating Scale-2. Age and education were found to be associated with total score on the test, while gender was not. Percentile ranks were then calculated for age- and education-stratified groups.

Keywords

Norms, Normative studies, Neuropsychological tests, French Canadian, Elderly, Aging, Cognitive functioning, Dementia

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The Dementia Rating Scale (DRS) was first developed by Mattis (1976) in order to assess the cognitive status of individuals with brain dysfunction. More specifically, the purpose of the scale was to measure cognition among patients with known cortical impairment, especially of the degenerative type (Mattis, 1988). The DRS comprises thirty-six tasks divided among five subscales, devised to assess the following cognitive functions: Attention (37 points), Initiation/Perseveration (37 points), Construction (6 points), Conceptualization (39 points) and Memory (25 points), for a maximum total score of 144 points. The tasks comprised in each subscale are presented in Table 1. Based on a normative study by Montgomery and Costa (1983), Mattis (1988) proposed that a score below 123 is suggestive of possible dementia.

The second edition of the DRS (DRS-2), published by Jurica, Leitten and Mattis (2001), comprised new and improved features such as an updated scoring booklet, but the test itself remained unchanged. Schmidt (2004) also published an alternate form of the test, named *DRS-2: Alternate form*. This alternate form aimed to reduce practice effects that may occur with repeated administrations of the test on a patient by providing new item content that mirrors the original form. The DRS is a well-known test of general cognition and is widely used in clinical and research settings. Its five subscales allow to establish a cognitive profile and to distinguish among dementias such as Alzheimer's disease, Parkinson disease, Huntington disease, vascular dementia and frontotemporal dementia (e.g. Cahn-Weiner, Grace, Ott, Fernandez & Friedman, 2002; Kertesz & Clydesdale, 1994; Llebaria et al., 2008; Lukatela et al., 2000; Paulsen et al., 1995; Rascovsky, Salmon, Hansen & Galasko, 2008). Moreover, several studies tend to show its superiority compared to common tests of general cognitive status such as the Mini-Mental State Examination (MMSE; Folstein, Folstein & McHugh, 1975). Indeed, according to Gould, Abramson, Galasko and Salmon (2001), the DRS-2 provides more precise estimates of change than the MMSE. The DRS-2 is also more sensitive than the MMSE for early stages of cognitive impairment and thus better detects mild cognitive impairment (Matteau et al., 2011).

The effects of sociodemographic factors on DRS and DRS-2 scores were clearly demonstrated in the literature. Indeed, several authors have documented the significant association between age and DRS score, with younger subjects performing better than older ones (e.g., Baird, 2006; Bank, Yochim, MacNeill & Lichtenberg, 2000; Pedraza et al., 2010; Rilling et al., 2005; Strutt et al., 2012). A positive correlation between education level and performance on the DRS was also consistently reported (e.g., Bank et al., 2000; Lyness, Hernandez, Chui & Teng, 2006; Pedraza et al., 2010; Rilling et al., 2005; Strutt et al., 2012). The effect of gender, however, is less clear. Some studies found no significant effect of gender on DRS performance (e.g., Chan, Choi & Salmon, 2001; Lucas et al., 1998), while others found this variable to be significantly associated with scores on at least one subscale of the test (e.g. Bank et al., 2000; Lyness et al., 2006; Pedraza et al., 2010). For example, Lyness et al. (2006) found that men performed significantly better than women on the Attention subscale. However, Bank et al. (2000) found that female participants obtained higher total scores on the DRS.

In addition to age, sex, and education, a few authors found that culture also impacted DRS performance. A significant difference was observed between American and Chinese healthy participants, with Chinese participants obtaining the lowest results on the total DRS score and on the Initiation/Perseveration and Memory subscales (Chan et al., 2001). The difference in the Initiation/Perseveration subscale was mostly attributable to the verbal fluency task, in which subjects have to list items that can be found in a supermarket. According to the authors, the retrieval process was more difficult and slower for Chinese participants because they were less familiar with the concept of supermarkets. As for the Memory subscale, a possible hypothesis to explain the worst performance of the Chinese participants is that the sentence to remember (i.e. *The boy has a brown dog*) was more meaningful for American participants, thus being easier to remember (Chan et al., 2001). However, the Chinese participants performed better than the Americans on the Construction subscale, possibly due to their enhanced ability to draw simple geometric figures in the Chinese logographic writing system (Chan et al., 2001). In another study, Spanish speakers scored significantly lower than education-, age-, and gender-matched English speakers on the total DRS score, and more specifically on the Attention, Conceptualization and Memory subscales (Lyness et al., 2006). The authors suggested that this could be explained by language features and by cultural and educational differences (Lyness et al., 2006). Indeed, although the two groups were matched for years of education, their educational experience was not necessarily comparable. Recently, Strutt et al. (2012) found that American English-speaking subjects out-performed age- and education-matched American Spanish-speaking subjects assessed with a Spanish translation of the DRS-2. The greatest difference between the two groups was found on the Memory subscale, where most errors of Spanish-speaking participants were committed on three specific orientation items: current president, governor and mayor, items significantly related to their level of acculturation. Finally, race was found to be significantly correlated with the total score on the DRS in a sample involving African American, Caucasian and Hispanic adults, with Caucasian obtaining higher scores (Bank et al., 2000). These data, combined with recent evidence about the impact of culture on cognition in general (Hedden et al., 2002; Park & Huang, 2010; Park, Nisbett & Hedden, 1999), strongly suggest the necessity of culture-specific norms for an accurate estimate of cognitive performance on neuropsychological tests.

Normative data for the DRS and DRS-2 have been published for various populations of elderly people. Most normative studies were conducted with community-dwelling English-speaking subjects (e.g., Lucas et al., 1998; Montgomery & Costa, 1983; Pedraza et al., 2010; Rilling et al., 2005). Montgomery and Costa (1983) initially provided norms for the DRS based on a sample of 85 English-speaking community-dwelling subjects aged 65 to 81. Lucas et al. (1998) developed normative data stratified by age, based on a sample of 623 community-dwelling English-speaking Caucasian subjects of over 55 years old and also provided an equation to obtain age- and education-corrected scaled scores; these norms were adopted for use in the DRS-2. Recently, Pedraza et al. (2010) reappraised these original norms (Lucas et al., 1998) by using robust norming. This approach consists of longitudinal follow-up of individuals included in an initial normative sample and exclusion of all individuals diagnosed, over the years, with dementia, thus increasing the test sensitivity. Some normative data have been published based on samples of medical subjects with no cognitive impairment (Bank et al., 2000; Lichtenberg, Ross, Youngblade & Vangel, 1998). For example, Bank et al. (2000) provided age- and education-stratified norms from a sample of 180 English-speaking African American, Caucasian and Hispanic inpatients aged from 61 to 94 in a geriatric medical rehabilitation service. Some norms were also developed among more specific populations. For example, Marcopulos, McLain and Giuliano (1997) provided norms stratified by age and education from a biracial sample of 133 community-dwelling English-speaking Caucasian and African American subjects of 55 years old and over with limited education (10 years or less). Education-stratified norms for Spanish-speaking elderly adults were also published by Lyness et al. (2006), based on a sample of 54 subjects aged 55 to 89 years old. More recently, Strutt et al. (2012) also provided age- and education-stratified norms for Spanish speakers based on a sample of 157 individuals aged 50 to 80 years old. Finally, Pedraza et al. (2007) provided normative rates of change from baseline to first follow-up, based on a sample of 1080 community-dwelling English-speaking European American and African American subjects aged 65 and older.

The validity of the DRS-2 to detect mild cognitive impairment and dementia in the French-speaking elderly of Quebec has been shown (Matteau et al., 2011; Matteau, Dupré, Langlois, Provencher & Simard, 2012; Villeneuve et al., 2011) but no normative data for the DRS-2 are currently available for French-Quebec older adults. It is important to address this issue, as recent studies have highlighted the fact that the validity of norms depends on the similarity between the examinee and the normative sample to which he or she is being compared (e.g. Arsenault-Lapierre et al., 2011; Bank et al., 2000; Pedraza et al., 2010). Development of norms for French-speaking Quebecers is also relevant since, as mentioned previously, cultural background can affect performance on the DRS (e.g., Chan et al., 2001; Lyness et al., 2006; Rilling et al., 2005), as well as cognition in general (Hedden et al., 2002; Park et al., 1999; Park & Huang, 2010).

In summary, there is no DRS-2 normative data for French-speaking Quebecers, despite the fact that this scale is used in numerous French-speaking clinical and research groups in Quebec (Canada). Furthermore, the case of French-Quebecers is particularly interesting as those individuals have French as a mother tongue but share many of their cultural referents with English-Americans persons. This places limitations on using either French norms or English-American norms. The aim of the present study was therefore to establish normative data for the DRS-2, taking into account the linguistic and cultural reality of the elderly French-speaking population of Quebec.

[Insert Table 1 about here]

Methods

Participants

Four hundred and seventy participants, aged 50 to 85 years old, whose mother tongue and usual language was French, were recruited for this study. These participants were recruited via public advertisements or were relatives of patients participating in various research projects. All participants were recruited in the province of Quebec, more specifically in Quebec City (42.82%), Montreal (45.37%) and Sherbrooke (11.81%). For each participant, medical and psychiatric history, based on self-report, was documented so that any subject with a history of neurological disease, psychiatric illness, head injury or stroke was excluded from the study. Participants were screened for cognitive impairment using standard tests of cognitive functioning (i.e. Montreal Cognitive Assessment, MoCA [Nasreddine et al., 2005]; Mini-Mental State Examination, MMSE [Folstein et al., 1975]). Subjects scoring <26 on the MoCA or MMSE were excluded from the study (n=11). Participants with probable depression were also excluded (n=27) based on screening results from the Geriatric Depression Scale (GDS; Yesavage et al., 1983), the Beck Depression Inventory (BDI; Beck, Steer & Brown, 1996) or the Hamilton Depression Rating Scale (HDRS; Hamilton, 1960; 1967). Cut-offs were >10 for 30-item GDS, >4 for 15-item GDS, >1 for 5-item GDS, >10 for BDI and > 13 for the HDRS. The final sample consisted of four hundred and thirty-two (432) subjects and included 148 men (34.26%) and 284 women (65.74%). The group had a mean age of 67.08 years (*SD*=8.38) and a mean educational level of 14.37 years (*SD* = 4.14; range = 3 to 30). Compared to the actual demographic data of Quebec population, highly educated participants were overrepresented in our sample (Institut de la statistique du Québec, 2006; Table 2).

[Insert Table 2 about here]

Materials and Procedure

Precise verbal instructions were provided for each task; administration and scoring procedures are well-described in the professional manual (Mattis, 1988). Within each subscale, the most difficult tasks were presented first. When performance was successful for the initial mandatory tasks (marked in bold in Table 1), the examiner awarded maximum credit for subsequent tasks and proceeded to the following mandatory task or subscale. This standard procedure reduces administration time for cognitively intact subjects or those with subtle cognitive deficits. The administration of the DRS-2 lasts approximately 10 to 15 minutes in healthy subjects, whereas it lasts approximately 30 to 45 minutes in cognitively impaired patients (Strauss, Sherman & Spreen, 2006).

Statistical analyses

Spearman and Pearson correlations were performed between DRS total score and sociodemographic variables, namely gender, age and years of education, to determine which of these variables is associated with the test performance. Due to skewness of the DRS total score, percentile ranks were then determined and stratified according to the sociodemographic variables significantly correlated with the total score. To maximize the number of data available in each stratum, overlapping cell norm tables were used (Pauker, 1988). All statistical analyses were performed using SPSS 20.0.

Results

The mean DRS score was 139.56 (SD = 3.94; maximum score = 144) in the total sample. For each subtest, the mean scores were: Attention = 35.96 (SD = 1.25; maximum score = 37), Initiation/Perseveration = 36.04 (SD = 1.87; maximum score = 37), Construction = 5.93 (SD = 0.29, maximum score = 6), Conceptualization = 37.48 (SD = 1.98; maximum score = 39) and Memory = 24.15 (SD = 1.25; maximum score = 25). Distribution of total scores is shown in Figure 1. Age, $r(432) = -0.20$, $p < 0.001$, and education, $r(432) = 0.25$, $p < 0.001$, were significantly correlated with the DRS-2 total score, but gender, $r(432) = 0.07$, $p = 0.16$, was not. Normative data were thus stratified according to age and education level. Percentiles ranks for each subtest and total score are shown in Tables 3-7 for five age- and education-normalized groups: 50-60, 61-65, 66-70, 71-75, and 76-85 years old. For each subtest and total DRS, the scores matching to percentiles 1, 2, 5, 10, 15, 25, 50 and 95 are reported. These percentiles correspond to Z-scores of -2.33, -2.05, -1.65, -1.28, -1.04, -0.67, 0.00 and 1.65, respectively. Percentiles can be interpreted as follow: ≤ 5 = significant cognitive impairment; 10 = mild cognitive impairment; 15 = score at the boundary of normal and impaired cognitive functioning; 50 = score corresponding to median of the population.

[Insert Figure 1 about here]

[Insert Tables 3-7 about here]

Discussion

This study aimed to establish normative data for the DRS-2 to take into account the linguistic and cultural reality of the French-speaking elderly population of Quebec. This is important since recent studies support the validity of the test to detect MCI and dementia (Matteau et al., 2011; Matteau et al, 2012; Villeneuve et al., 2011). Moreover, the DRS is a very useful clinical tool for assessing cognitive functioning since many studies support its efficacy to distinguish among several dementias (e.g. Cahn-Weiner et al., 2002; Kertesz & Clydesdale, 1994; Llebaria et al., 2008; Lukatela et al., 2000; Paulsen et al., 1995; Rascovsky et al., 2008) and its superiority over the MMSE (Gould et al., 2001; Matteau et al., 2011).

In this study, the total score on the DRS-2 was found to be significantly associated with age (negative correlation) and years of education (positive correlation), but not with gender. The results of the present study are in line with those of previous studies conducted in other cultural communities. Indeed, in most studies, age was found to be negatively correlated with the performance on the DRS (e.g., Baird, 2006; Bank et al., 2000; Pedraza et al., 2010; Rilling et al., 2005), whereas education was found to be positively correlated with total score on the test (e.g., Bank et al., 2000; Lyness et al., 2006; Pedraza et al., 2010; Rilling et al., 2005). The role of gender is however unclear in the literature, with some studies showing a gender effect on the

DRS (e.g., Bank et al., 2000; Lyness et al., 2006; Rilling et al., 2005) and others not (e.g., Chan et al., 2001; Lucas et al., 1998). No explanation was suggested by the authors but overall, studies in which gender was correlated with DRS scores tended to have less educated participants (e.g., Bank et al., 2000; Lyness et al., 2006; Rilling et al., 2005). No association between gender and DRS performance was found in the present study, which is in accordance with previous results (e.g., Chan et al., 2001; Lucas et al., 1998) and could be possibly due to the fact that our sample was somewhat highly educated.

The positive association between education and cognitive skills is well-documented in the literature. In several studies, educational level was strongly associated with cognitive performance (e.g., Wilson et al., 2009; Zahodne et al., 2011). However, the relation between education and cognitive changes in aging is less clear. In a recent study by Sattler, Toro, Schönknecht and Schröder (2012), high education was found to reduce the risk of Alzheimer's disease and MCI. Roberts et al. (2012) also found low education to be a risk factor for the development of MCI. Indeed, people with less education may be at greater risk for cognitive decline as they age (Marcopulos & McLain, 2003). These findings are in line with the theory of cognitive reserve, which states that individuals with more education can sustain greater brain damage before the apparition of a functional deficit because of more efficient processing mechanisms (Stern, 2002). However, Zahodne et al. (2011) found that education was related to cognitive performance, but not to cognitive decline.

Previous studies have also investigated the relationship between age and cognition. A recent study by Singh-Manoux et al. (2011) demonstrated cognitive decline in all cognitive domains, except vocabulary, in a ten-year follow-up study of individuals aged 45 to 70. Schaie (2005) explored six cognitive factors and found that inductive reasoning, spatial orientation, perceptual speed and verbal memory declined with age, while numeric facility (i.e. the ability to understand numerical relationships, work with figures and solve quantitative problems) and verbal ability showed no decline over time. These results support the negative association between DRS and age found in the present study since DRS assesses some of these cognitive functions.

This study is the first to provide DRS-2 normative data for the French-speaking elderly population of Quebec. As mentioned above, both culture and language have an impact on cognition and it is therefore important to use normative data that are adjusted for the population to which they are applied. The large group of participants (N=432) is a considerable strength of the present study. There are however some limitations, such as the overrepresentation of highly educated individuals in the sample. In fact, compared to actual Quebec demographics (Institut de la statistique du Québec, 2006), this sample contains more individuals with at least 12 years of formal education. Ideally, a random sampling method would have increased the representativeness of this sample. Thus, clinicians should carefully interpret percentile ranks because some age groups with low education comprised relatively small number of subjects, especially for younger ones. Another limitation is the important ceiling effect that was observed for the Construction subscale, thus questioning its sensitivity to detect mild cognitive impairment.

To conclude, the present study is the first to provide normative data for this population, thus allowing a better detection of cognitive impairment in Quebec. Populations in developed countries advance in age, thus the detection of the cognitive disorders becomes a political and healthy priority. By providing a model of normal performance on the DRS-2, the present norms will facilitate identification of pathological cognitive deficits in the French-Quebec population.

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References

Arsenault-Lapierre, G., Whitehead, V., Belleville, S., Massoud, F., Bergman, H., & Chertkow, H. (2011). Mild cognitive impairment subcategories depend on the source of norms. *Journal of Clinical and Experimental Neuropsychology, 33*(5), 596-603. doi: 10.1080/13803395.2010.547459

Baird, A. (2006). Fine tuning recommendations for older adults with memory complaints: Using the Independent Living Scales with the Dementia Rating Scale. *The Clinical Neuropsychologist, 20*(4), 649-661. doi: 10.1080/13854040590967072

Bank, A.L., Yochim, B.P., MacNeill, S.E., & Lichtenberg, P.A. (2000). Expanded normative data for the Mattis Dementia Rating Scale for use with urban, elderly medical patients. *The Clinical Neuropsychologist, 14*(2), 149-156. doi: 10.1076/1385-4046(200005)14:2;1-Z;FT149

Beck, A.T., Steer, R.A., & Brown, G.K. (1996). *Beck Depression Inventory-II: Manual.* San Antonio, TX: The Psychological Corporation.

Cahn-Weiner, D.A., Grace, J., Ott, B.R., Fernandez, H.H., & Friedman, J.H. (2002). Cognitive and behavioral features discriminate between Alzheimer's and Parkinson's disease. *Neuropsychiatry, Neuropsychology, and Behavioral Neurology, 15*(2), 79-87.

Chan, A.S., Choi, M.K., & Salmon, D.P. (2001). The effects of age, education, and gender on the Mattis Dementia Rating Scale performance of elderly Chinese and American individuals. *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences, 56*(6), P356-P363. doi: 10.1093/geronb/56.6.P356

Crocco, E.A., Castro, K., & Loewenstein, D.A. (2010). How late-life depression affects cognition: Neural mechanisms. *Current Psychiatry Reports, 12*(1), 34-38. doi: 10.1007/s11920-009-0081-2

Folstein, M.F., Folstein, S.E., & McHugh, P.R. (1975). "Mini-Mental State": A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research, 12*(3), 189-198. doi: 10.1016/0022-3956(75)90026-6

Gould, R., Abramson, I., Galasko, D., & Salmon, D. (2001). Rate of cognitive change in Alzheimer's disease: Methodological approaches using random effects models. *Journal of the International Neuropsychological Society, 7*(7), 813-824.

Hamilton, M. (1960). A rating scale for depression. *Journal of Neurology, Neurosurgery, and Psychiatry, 23*(1), 56-62.

Hamilton, M. (1967). Development of a rating scale for primary depressive illness. *The British Journal of Social and Clinical Psychology, 6*(4), 278-296. doi: 10.1111/j.2044-8260.1967.tb00530.x

Hedden, T., Park, D.C., Nisbett, R., Ji, L.J., Jing, Q., & Jiao, S. (2002). Cultural variation in verbal versus spatial neuropsychological function across the life span. *Neuropsychology, 16*(1), 65-73. doi: 10.1037/0894-4105.16.1.65

Hudon, C., Belleville, S., & Gauthier, S. (2008). The association between depressive and cognitive symptoms in amnestic mild cognitive impairment. *International Psychogeriatrics, 20*(4), 710-723. doi: 10.1017/S1041610208007114

Institut de la statistique du Québec. (2006). *Répartition de la population de 15 ans et plus selon le niveau de scolarité, le sexe et le groupe d'âge, Québec, 2006*. Retrieved from http://www.stat.gouv.qc.ca/donstat/societe/education/etat_scolarisation/scol_pop_15_sex_a_qc.htm.

Jurica, P.J., Leitten, C.L., & Mattis, S. (2001). *Dementia Rating Scale-2: Professional manual*.

Lutz, FL: Psychological Assessment Resources.

Kertesz, A., & Clydesdale, S. (1994). Neuropsychological deficits in vascular dementia vs Alzheimer's disease. Frontal lobe deficits prominent in vascular dementia. *Archives of Neurology, 51*(12), 1226-1231. doi: 10.1001/archneur.1994.00540240070018

Lichtenberg, P.A., Ross, T.P., Youngblade, L., & Vangel, S.J. (1998). Normative Studies Research Project test battery: Detection of dementia in African American and European American urban elderly patients. *The Clinical Neuropsychologist, 12*(2), 146-154. doi: 10.1076/clin.12.2.146.2010

Llebaria, G., Pagonabarraga, J., Kulisevsky, J., Garcia-Sanchez, C., Pascual-Sedano, B., Gironell, A., & Martinez-Corral, M. (2008). Cut-off score of the Mattis Dementia Rating Scale for screening dementia in Parkinson's disease. *Movement Disorders, 23*(11), 1546-1550. doi: 10.1002/mds.22173

Lucas, J.A., Ivnik, R.J., Smith, G.E., Bohac, D.L., Tangalos, E.G., Kokmen, E., … Petersen, R.C. (1998). Normative data for the Mattis Dementia Rating Scale. *Journal of Clinical and Experimental Neuropsychology, 20*(4), 536-547. doi: 10.1076/jcen.20.4.536.1469

Lukatela, K.A., Cohen, R.A., Kessler, H.A., Jenkins, M.A., Moser, D.J., Stone, W.F., … Kaplan, R.F. (2000). Dementia Rating Scale performance: A comparison of vascular and Alzheimer's dementia. *Journal of Clinical and Experimental Neuropsychology, 22*(4), 445-454. doi: 10.1076/1380-3395(200008)22:4;1-0;FT445

Lyness, S.A., Hernandez, I., Chui, H.C., & Teng, E.L. (2006). Performance of Spanish speakers on the Mattis Dementia Rating Scale (MDRS). *Archives of Clinical Neuropsychology, 21*(8), 827-836. doi: 10.1016/j.acn.2006.09.003

Marcopulos, B.A., & McLain, C. (2003). Are our norms «normal»? A 4-year follow-up study of a biracial sample of rural elders with low education. *The Clinical Neuropsychologist, 17*(1), 19-33. doi: 10.1076/clin.17.1.19.15630

Marcopulos, B.A., McLain, C.A., & Giuliano, A.J. (1997). Cognitive impairment or inadequate norms ? A study of healthy, rural, older adults with limited education. *The Clinical Neuropsychologist, 11*(2), 111-131. doi: 10.1080/13854049708407040

Matteau, E., Dupré, N., Langlois, M., Jean, L., Thivierge, S., Provencher, P., & Simard, M. (2011). Mattis Dementia Rating Scale 2: Screening for MCI and dementia. *American Journal of Alzheimer's Disease and Other Dementias, 26*(5), 389-398. doi: 10.1177/1533317511412046

Matteau, E., Dupré, N., Langlois, M., Provencher, P., & Simard, M. (2012). Clinical validity of the Mattis Dementia Rating Scale-2 in Parkinson disease with MCI and dementia. *Journal of Geriatric Psychiatry and Neurology, 25*(2), 100-106. doi: 10.1177/0891988712445086

Mattis, S. (1976). Mental status examination for organic mental syndrome in the elderly patients. In L. Bellak & T.B. Karasu (Eds.), *Geriatric Psychiatry: A Handbook for Psychiatrists and Primary Care Physicians* (77-121). New York, NY: Grune and Stratton.

Mattis, S. (1988). *Dementia Rating Scale: Professional manual*. Odessa, FL: Psychological Assessment Resources.

Montgomery, K.M., & Costa, L. (1983). *Neuropsychological test performance of a normal elderly sample*. Paper presented at the International Neuropsychological Society Meeting, Mexico City.

Nasreddine, Z.S., Phillips, N.A., Bédirian, V., Charbonneau, S., Whitehead, V., Collin, I., … Chertkow, H. (2005). The Montreal Cognitive Assessment, MoCA: A brief screening tool for mild cognitive impairment. *Journal of the American Geriatrics Society, 53*(4), 695-699. doi: 10.1111/j.1532-5415.2005.53221.x

Park, D.C., & Huang, C. M. (2010). Culture wires the brain: A cognitive neuroscience perspective. *Perspectives on Psychological Science*, *5*(4), 391-400. doi: 10.1177/1745691610374591

Park, D.C., Nisbett, R., & Hedden, T. (1999). Aging, culture, and cognition. *The Journals of Gerontology*. *Series B, Psychological Sciences and Social Sciences*, *54*(2), P75-P84. doi: 10.1093/geronb/54B.2.P75

Pauker, J.D. (1988). Constructing overlapping cell tables to maximize the clinical usefulness of normative test data: Rationale and an example from neuropsychology. *Journal of Clinical Psychology, 44*(6), 930-933.

Paulsen, J.S., Butters, N., Sadek, J.R., Johnson, S.A., Salmon, D.P., Swerdlow, N.R., & Swenson, M.R. (1995). Distinct cognitive profiles of cortical and subcortical dementia in advanced illness. *Neurology, 45*(5), 951-956.

Pedraza, O., Lucas, J.A., Smith, G.E., Petersen, R.C., Graff-Radford, N.R., & Ivnik, R.J. (2010). Robust and expanded norms for the Dementia Rating Scale. *Archives of Clinical Neuropsychology, 25*(5), 347-358. doi: 10.1093/arclin/acq030

Pedraza, O., Smith, G.E., Ivnik, R.J., Willis, F.B., Ferman, T.J., Petersen, R.C, … Lucas, J.A. (2007). Reliable change on the Dementia Rating Scale. *Journal of the International Neuropsychological Society*, *13*(4), 716-720. doi: 10.1017/S1355617707070920

Préville, M., Boyer, R., Grenier, S., Dubé, M., Voyer, P., Punti, R., … Brassard, J. (2008). The epidemiology of psychiatric disorders in Quebec's older adult population. *Canadian Journal of Psychiatry, 53*(12), 822-832.

Rascovsky, K., Salmon, D.P., Hansen, L.A., & Galasko, D. (2008). Distinct cognitive profiles and rates of decline on the Mattis Dementia Rating Scale in autopsy-confirmed frontotemporal dementia and Alzheimer's disease. *Journal of the International Neuropsychological Society, 14*(3), 373-383. doi: 10.1017/S135561770808051X

Rilling, L.M., Lucas, J.A., Ivnik, R.J., Smith, G.E., Willis, F.B., Ferman, T.J., … Graff-Radford, N.R. (2005). Mayo's Older African American Normative Studies: Norms for the Mattis Dementia Rating Scale. *The Clinical Neuropsychologist, 19*(2), 229-242. doi: 10.1080/13854040590945328

Roberts, R.O., Geda, Y.E., Knopman, D.S., Cha, R.H., Pankratz, V.S., Boeve, B.F., … & Petersen, R.C. (2012). The incidence of MCI differs by subtype and is higher in men: The Mayo Clinic Study of Aging. *Neurology, 78*(5), 342-351. doi: 10.1212/WNL.0b013e3182452862

Sattler, C., Toro, P., Schönknecht, P., & Schröder, J. (2012). Cognitive activity, education and socioeconomic status as preventive factors for mild cognitive impairment and Alzheimer's disease. *Psychiatry Research, 196*(1), 90-95. doi: 10.1016/j.psychres.2011.11.012

Schaie, K.W. (2005). What can we learn from longitudinal studies of adult development? *Research in Human Development, 2*(3), 133-158. doi: 10.1207/s15427617rhd0203_4

Schmidt, K. S. (2004). *Dementia Rating Scale-2: Alternate Form*. Lutz, FL: Psychological Assessment Resources.

Singh-Manoux, A., Kivimaki, M., Glymour, M.M., Elbaz, A., Berr, C., Ebmeier, K.P., … & Dugravot, A. (2011). Timing of onset of cognitive decline: Results from Whitehall II prospective cohort study. *British Medical Journal, 344*. doi: 10.1136/bmj.d7622

Stern, Y. (2002). What is cognitive reserve? Theory and research application of the reserve concept. *Journal of the International Neuropsychological Society, 8*(3), 448-460. doi: 10.1017.S1355617701020240

Strauss, E., Sherman, E., & Spreen, O. (2006). *A Compendium of Neuropsychological Tests : Administration, Norms, and Commentary, Third Edition*. New York, NY: Oxford University Press.

Strutt, A.M., Ayanegui, I.G., Scott, B.M., Mahoney, M.L., York, M.K., San Miguel Montes, L.E. (2012). Influence of socio-demographic characteristics on DRS-2 performance in Spanish-speaking older adults. *Archives of Clinical Neuropsychology, 27*(5), 545-556. doi: 10.1093/arclin/acs049

Thomas, A.J., & O'Brien, J.T. (2008). Depression and cognition in older adults. *Current Opinion in Psychiatry, 21*(1), 8-13. doi: 10.1097/YCO.0b013e3282f2139b

Villeneuve, S., Rodrigues-Brazète, J., Joncas, S., Postuma, R.B., Latreille, V., & Gagnon, J.F. (2011). Validity of the Mattis Dementia Rating Scale to detect mild cognitive impairment in Parkinson's disease and REM sleep behavior disorder. *Dementia and Geriatric Cognitive Disorders, 31*(3), 210-217. doi: 10.1159/000326212

Wilson, R.S., Hebert, L.E., Scherr, P.A., Barnes, L.L., Mendes de Leon, C.F., & Evans, D.A. (2009). Educational attainment and cognitive decline in old age. *Neurology, 72*(5), 460-465. doi: 10.1212/01.wnl.0000341782.71418.6c

Yesavage, J.A., Brink, T.L., Rose, T.L., Lum, O., Huang, V., Adey, M., & Leirer, V.O. (1982-1983). Development and validation of a Geriatric Depression Screening Scale: A preliminary report. *Journal of Psychiatric Research, 17*(1), 37-49. doi: 10.1016/0022-3956(82)90033-4

Zahodne, L.B., Glymour, M.M., Sparks, C., Bontempo, D., Dixon, R.A., MacDonald, S.W., &

Manly, J.J. (2011). Education does not slow cognitive decline with aging: 12-year evidence from the Victoria Longitudinal Study. *Journal of the International Neuropsychological Society*, *17*(6), 1039-1046. doi: 10.1017/S1355617711001044