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Development of the Korean Version of the Consortium to Establish a Registry for Alzheimer's Disease Assessment Packet (CERAD-K): Clinical and Neuropsychological Assessment Batteries

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A Korean version of the Consortium to Establish a Registry for Alzheimer's Disease Assessment Packet (CERAD-K) was created. The English-American version of CERAD clinical and neuropsychological assessment batteries was translated into Korean, and the psychometrical properties of the cognitive tests in the CERAD-K were established. In the translation, including back-translation, the basic structures of all measures in the original CERAD batteries were maintained. The CERAD-K was administered in a standardized manner to 106 dementia patients (aged 70.4 ± 8.1 years), including 78 Alzheimer's disease (AD) patients, and 186 controls (aged 68.4 ± 4.6 years) who were recruited from 3 university hospitals and 2 elderly welfare centers. The cognitive tests in the CERAD-K successfully differentiated controls from the dementia patients and from the AD patients. They also showed substantial interrater reliability and 1-month test-retest reliability. The CERAD-K is an equally reliable and valid equivalent for the English version of the CERAD clinical and neuropsychological assessment batteries.

THE Consortium to Establish a Registry for Alzheimer's Disease (CERAD) developed the standardized clinical and neuropsychological assessment batteries for the evaluation of patients with Alzheimer's disease (AD; Morris et al., 1989). The CERAD investigators designed these instruments to create uniformity in the enrollment criteria and assessment methods of AD, promoting the gathering of reliable information on AD across research centers in the United States. The high accuracy rate of the diagnosis of AD through the CERAD clinical evaluation has been confirmed by neuropathological findings (Gearing et al., 1996). The CERAD neuropsychological assessment battery has also become popular in many clinical and research settings because of its brevity, portability, and usefulness in evaluating elderly patients with dementia, including those with very mild cognitive symptoms (Welsh-Bohmer & Mohs, 1997). The CERAD Assessment Packet, which consists of clinical and neuropsychological assessment batteries, can facilitate the standardized evaluation of dementia in many other countries as well as in the United States, including cross-cultural investigations on the clinical or epidemiological aspects of dementia. The CERAD clinical and neuropsychological assessment batteries have been translated into 11 languages and have promoted the formation of an international network of investigators (Heyman & Fillenbaum, 1997).

Following the initial development of the CERAD clinical and neuropsychological batteries, CERAD has also standardized neuropathological assessment (Mirra et al., 1991), neuroimaging evaluation (Davis et al., 1992), and rating for behavioral symptoms of dementia (Tariot et al., 1995). In addition, CERAD has published a series of articles on accumulated experience in AD for more than 10 years.

To pursue international collaboration of biological research on AD such as genetic and neuroimaging studies or epidemiological research on dementia, it is necessary for investigators to develop a valid instrument for the clinical diagnosis of dementia. To this end we standardized against the original English version a Korean version of the CERAD clinical and neuropsychological assessment batteries.

The notion of equivalence is critical in developing an instrument for cross-cultural research (Flaherty et al., 1988). It is also important in translating the original version of an evaluation tool into another language (Demers et al., 1994). Therefore, we sought to achieve the highest possible equivalence of the Korean version of the CERAD Assessment

Packet (CERAD-K) with the original. We took cultural and linguistic differences into account to achieve an equivalent Korean version. The psychometric properties of the various cognitive tests in the CERAD-K neuropsychological battery were also investigated in terms of reliability and validity.

Methods

Translation of the CERAD Assessment Packet

The fourth English version of the CERAD Assessment Packet (Protocol 4a for probable AD and Protocol 4b for vascular dementia, Parkinson's dementia, and other less common dementia), as revised in 1994, was used as an original text for translation. To achieve a satisfactory and equivalent translation of the original English version into Korean, we performed the following procedures.

Clinical assessment battery.—The original English version of the CERAD clinical battery was translated into Korean by a bilingual psychiatrist who was acquainted with the CERAD protocol. Several Korean psychiatrists and neurologists who were familiar with both English and Korean reviewed the translated material. We reworded and reformulated some items to minimize differences from the original version. We did not allow exclusion of any items, to maintain the structure of the instrument. The first translated version of the CERAD clinical battery was applied to controls ($n = 43$, age = 68.5 ± 12.3 years) and dementia patients ($n = 55$, age = 67.2 ± 12.4 years). On the basis of results from the preliminary application and analysis, we modified several items to improve comprehensibility and applicability.

Neuropsychological assessment battery.—The neuropsychological battery of Protocol 4a includes eight tests (Verbal Fluency, Modified Boston Naming, Mini-Mental State Examination, Word List Memory, Constructional Praxis, Word List Recall, Word List Recognition, and Constructional Praxis Recall). Because the Constructional Praxis and Constructional Praxis Recall tests assess nonverbal cognitive ability, we translated only the instructions for administration and scoring of the tests. We maintained the original line drawings. Similarly, we translated only the instructions for administering and scoring the Verbal Fluency test and kept the test format of the original version.

For the Mini-Mental State Examination (MMSE; Folstein, Folstein, & McHugh, 1975) in the CERAD neuropsychological battery, we translated all of the verbal questions except those concerned with reading and writing. Because there are a significant number of illiterate people in Korea, these items were replaced by two items focusing on judgment from the Korean version of the MMSE (MMSE-K; Park, Park, & Ko, 1991). The test words of the MMSE were translated into relevant Korean words by following principles of equivalence. These were almost identical with the words in the MMSE-K.

The 60-item version of the Boston Naming Test had already been standardized in Korea: the Korean version-Boston Naming Test (K-BNT; H. H. Kim & Na, 1997). We chose 15 items from the K-BNT to construct a 15-item Modified Boston Naming Test. Three groups of 5 items were identified as having high, medium, and low frequencies of occurrence. We also took phonemic and semantic dissimilarity into account in arranging the items.

The key issue in translating the verbal memory tests, Word List Memory and Word List Recognition, was for us to consider the word frequency, mental imagery, phonemic similarity, and semantic or word length equivalence (Demers et al., 1994). In some cases it was impossible for us to meet all these equivalence criteria. Most importantly, we considered the relative word frequency in the Korean language and the mental imagery of the words. Unfortunately, we had no frequency data of spoken words but only those of written ones (Y. C. Kim, 1986; Y. B. Lee, 1989). All of the words in the English version of the verbal memory tests had high frequencies. As hypothesized, some of these words had low or medium frequency in the Korean language, when they were translated by semantic equivalence. In these cases, we selected a high-frequency word in the same semantic category. All of the selected words in the Korean version had high mental imagery similar to the words used in the English version. It was difficult for us to make the word length or number of syllables strictly equivalent to those in the English version, considering both word frequency and mental imagery. Whereas verbal memory tests in the English version consist of five monosyllabic and five disyllabic words, those in the Korean version have four monosyllabic and six disyllabic words. It was also difficult for us to strictly keep the principle of phonemic similarity throughout the translation process. Phonemically similar words were purposely arranged not to be contiguous with one another.

The initial translated Korean version of the neuropsychological part of the CERAD was administrated to controls ($n = 14$, age = 67.5 ± 8.2 years) and dementia patients ($n = 9$, age = 72.9 ± 9.0 years). According to results from this preliminary study, we made minor modifications of instruction sentences and figures in the Modified Boston Naming Test and replaced a few words in the Verbal Memory Tests with new ones.

Back-translation.—The back-translation of the translated version into Korean, which was slightly modified by our preliminary study, was performed by one neurologist and one neuropsychologist who were blind to the study procedure. We discussed the modified Korean version of the CERAD and its back-translated English version with Dr. Heyman at CERAD headquarters at Duke University. After some minor modifications were made in the CERAD-K, we prepared to study its validity and reliability.

Standardization of the CERAD-K Administration

To ensure uniformity of data collected, we distributed the instruction manual describing standardized administration to the three sites participating in this study. Assessments of two dementia cases were independently videotaped at each participating site in the initial phase of our study, and those cases were presented in the plenary sessions after which a thorough review and discussion of the assessment was conducted by investigators from three CERAD sites. For all the videotaped cases, the interrater agreements across the three

centers on the scores of the cognitive tests as well as the diagnoses of cases was 100%. To confirm the equivalence to the original English version, we conducted frequent discussions with the investigators at CERAD headquarters.

Although the completion time of the CERAD-K varied with each examiner and participant, the clinical battery was usually completed within 40 to 50 min and the neuropsychological battery was usually completed within 20 to 30 min (less time for controls).

Reliability and Validity of the Cognitive Tests

Reliability.—To evaluate the interrater reliability of the cognitive tests in the clinical and neuropsychological parts of the CERAD-K, two raters simultaneously assessed 21 people (14 dementia patients and 7 controls) from one site. One examiner administered the tests and scored the responses. Another examiner observed and scored the responses independently. Examiners administered the cognitive tests to 20 people (10 dementia patients and 10 controls) 4 weeks after the initial assessment to determine test-retest reliability. All of these 20 people had not been included in the interrater reliability study. The mean clinical dementia rating (CDR) for dementia patients was 1.1 ($SD = 0.6$). Internal consistency was also examined with Cronbach's alpha for the Blessed Dementia Scale (BDS; Blessed, Tomlinson, & Roth, 1968) and Short Blessed Test (SBT; Katzman et al., 1983), which were included in the CERAD clinical battery, and MMSE, which was included in the neuropsychological battery.

Validity.—A total of 194 dementia patients and 212 nondemented elderly controls were enrolled from March 1995 to November 1998. Dementia patients were recruited from the dementia special clinics of three university hospitals in Korea: Seoul National University Hospital, Ulsan University Hospital, and Chung-buk University Hospital. Most of the participants were community-dwelling outpatients at the time of evaluation. Controls were the informants for dementia patients (mainly spouses of patients) and volunteers recruited from two welfare centers for elderly persons in Seoul. On entry into the study, informed consent was obtained from each participant according to the procedures approved by the individual hospital's institutional review board.

The dementia patients in the study met the criteria, which excluded severe neurological, medical, and psychiatric disorders outside of major causes of dementia, such as cerebrovascular disease, Parkinson's disease, and normal pressure hydrocephalus. Participants were aged 50 years and older, spoke Korean, and had reliable informants who could provide adequate clinical histories. The diagnosis of dementia was made according to the criteria from the fourth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM-IV*; American Psychiatric Association 1994). Diagnostic criteria for Alzheimer's disease were proposed by the National Institute of Neurological and Communicative Disorders and Stroke/Alzheimer's Disease and Related Disorders Association (NINCDS/ADRDA, McKhann et al., 1984), and the CERAD modified occurrence of memory loss for at least 12 months' duration instead of 6 months. Vascular dementia was diagnosed according to the criteria of the National Institute of Neurological Disorders and Stroke-Association Internationale pour la Recherche et l'Enseignement en Neurosciences (NINDS-AIREN; Román et al., 1993). Although the same exclusion criteria for dementia cases were applied to controls, participants with a history of cerebrovascular or Parkinson's disease were excluded.

The validity analysis on the cognitive tests in the CERAD-K was performed for 106 dementia cases and 186 nondemented controls who completed both clinical and neuropsychological parts of the CERAD-K. For the rest of the participants, only the clinical part of the CERAD-K was performed.

Statistical analysis.—We performed statistical analyses using SAS (Statistical Analysis System for Windows, Version 6.12). Intraclass correlation coefficients were obtained for interrater reliability, and all correlations were of the Pearson product-moment type. Because the control and dementia groups differed with respect to age, gender, and education, we used an analysis of covariance to compare the mean scores of the neuropsychological tests of dementia patients with those of controls after adjusting age, gender, and education.

We also performed principal component analysis (varimax rotation) with dementia patients to identify the subgroups of tests in the neuropsychological battery.

RESULTS

Demographic and Clinical Characteristics

Demographic characteristics of dementia patients and controls who completed both clinical and neuropsychological batteries of the CERAD-K are shown in Table 1. The percentage of women in the dementia group (67.0%) was lower than that in the control group (80.6%), $t(1) = 6.12$, $p < .05$. The mean age of dementia patients (70.4 years) was higher than that among controls (68.4 years), $t(290) = -2.28$, $p < .05$. The mean number of years of education was lower in the dementia group, $t(290) = 1.97$, $p < .05$.

Thirty-four dementia patients had a CDR score of 1 (Hughes, Berg, Danziger, Coben, & Martin, 1982), 28 patients had a CDR of 2, and 12 patients had a CDR of 3 or more. The rest (32 patients) had very mild or questionable dementia (CDR = 0.5). Among the dementia patients, 78 had AD (73.6%), 16 had vascular dementia (15.1%), and 7 had mixed dementia (6.6%). The other 5 patients (4.7%) had dementia due to Parkinson's disease, diffuse Lewy body disease, frontotemporal dementia, or dementia due to normal pressure hydrocephalus. Among the 78 AD patients, 29 (37.2%) had a CDR of 0.5.

Reliability and Validity of Cognitive Tests

Reliability.—All the neuropsychological tests, including the SBT, in the clinical battery of the CERAD-K had substantial interrater reliability. Intraclass correlation coefficients ranged from .97 (Constructional Praxis and SBT) to

Table 1. Demographic Characteristics of Dementia Patients and Controls Who Completed Both Clinical and Neuropsychological Batteries of CERAD-K

Variable	Control (n = 186) n (%)	Dementia (n = 106) n (%)
Gender		
Women	150 (80.6)	71 (67.0)
Men	36 (19.4)	35 (33.0)
Age		
50–64	35 (18.8)	27 (25.5)
65–69	83 (44.6)	23 (21.7)
70–74	49 (26.3)	21 (19.8)
75–79	16 (8.6)	19 (17.9)
80+	3 (1.6)	16 (15.1)
M (SD)	68.4 (4.6)*	70.4 (8.1)
Range	53–82	51–87
Education year		
0	13 (7.0)	28 (26.6)
1–6	98 (52.7)	37 (35.2)
7–9	28 (15.1)	8 (7.5)
10–12	28 (15.1)	18 (17.0)
13+	19 (10.2)	15 (14.2)
M (SD)	7.5 (4.1)*	6.4 (5.3)
Range	0–17	0–20
CDR score		
0	186 (100.0)	0 (0.0)
0.5	0 (0.0)	32 (30.2)
1	0 (0.0)	34 (32.1)
2	0 (0.0)	28 (26.4)
3	0 (0.0)	9 (8.5)
4	0 (0.0)	2 (1.9)
5	0 (0.0)	1 (0.9)
M (SD)	0 (0.0)	1.4 (0.9)

Notes: Number (percentage) of participants unless otherwise indicated; total percentages may not be 100 because of rounding. CDR = Clinical Dementia Rating Scale; CERAD-K = Korean version of the Consortium to Establish a Registry for Alzheimer's Disease Assessment Packet.

*$p < .05$, compared with dementia, by Student's t test (two-tailed).

1.0 (Word List Memory, Word List Recall, and Word List Recognition). All correlation coefficients for the test-retest reliability were also substantial for most measures (Table 2). There was a significant difference in the mean scores of the Word List Recall test between the first and second tests, which were 1 month apart ($p < .05$). Cronbach's alphas for the BDS, SBT, and MMSE were .93, .88, and .92, respectively.

Table 2. One-Month Test-Retest Reliability of Cognitive Function Tests in the Neuropsychological Part of CERAD-K (n = 20)

Test	Test 1, M (SD)	Test 2, M (SD)	R
Short Blessed Test	11.3 (10.2)	10.9 (10.1)	0.975
Verbal Fluency	10.2 (5.4)	10.7 (4.7)	0.704
Boston Naming Test	7.7 (5.1)	7.8 (4.6)	0.879
Mini-Mental State	23.4 (4.0)	23.8 (3.6)	0.578
Word List Memory	13.1 (7.0)	14.5 (3.7)	0.652
Constructional Praxis	8.0 (3.1)	8.5 (2.6)	0.544
Word List Recall	3.7 (2.6)	4.9 (2.6)[a]	0.653
Word List Recognition	6.9 (4.2)	7.5 (4.4)	0.741
Constructional Praxis Recall	3.3 (3.9)	4.6 (3.4)	0.612

Notes: All correlations are significant by Pearson correlation analysis (2-tailed, $p < .01$). CERAD-K = Korean version of the Consortium to Establish a Registry for Alzheimer's Disease Assessment Packet.

[a]The mean score of Test 2 is significantly greater than that of Test 1 by paired t test (2-tailed, $p < .05$).

Validity.—For all cognitive tests in the CERAD-K, the adjusted mean test scores in the dementia group were significantly different from those in the control group, $F(1, 287) = 387.1$, $p < .0001$ for BDS; $F(1, 287) = 782.8$, $p < .0001$ for SBT; $F(1, 287) = 200.9$, $p < .0001$ for Word Fluency; $F(1, 287) = 112.7$, $p < .0001$ for Modified Boston Naming; $F(1, 287) = 356.3$, $p < .0001$ for MMSE; $F(1, 287) = 214.0$, $p < .0001$ for Word List Memory; $F(1, 287) = 149.1$, $p < .0001$ for Constructional Praxis; $F(1, 287) = 375.7$, $p < .0001$ for Word List Recall; $F(1, 287) = 327.2$, $p < .0001$ for Word List Recognition; and $F(1, 287) = 213.0$, $p < .0001$ for Constructional Praxis Recall. Similar results were observed when only the AD group was compared with the control group, $F(1, 259) = 410.9$, $p < .0001$ for BDS; $F(1, 259) = 947.0$, $p < .0001$ for SBT; $F(1, 259) = 158.1$, $p < .0001$ for Word Fluency; $F(1, 259) = 103.7$, $p < .0001$ for Modified Boston Naming; $F(1, 259) = 413.1$, $p < .0001$ for MMSE; $F(1, 259) = 238.6$, $p < .0001$ for Word List Memory; $F(1, 259) = 151.8$, $p < .0001$ for Constructional Praxis; $F(1, 259) = 403.6$, $p < .0001$ for Word List Recall; $F(1, 259) = 302.9$, $p < .0001$ for Word List Recognition; and $F(1, 259) = 204.5$, $p < .0001$ for Constructional Praxis Recall. However, there was a considerable overlapping of score ranges for each test (Table 3).

We intended to explore the meaningful groups of tests in the neuropsychological battery of CERAD-K through a factor analysis for dementia patients. Three factors were found to account for 79% of the total variation of the eight tests in the neuropsychological battery. As shown in Table 4, Word List Memory, Word List Recall, and Word List Recognition weighed heavily on Factor 1. Verbal Fluency and Boston Naming weighed heavily on Factor 2, and Constructional Praxis weighed on Factor 3. Constructional Praxis Recall weighed mainly on Factor 3, in addition to Factor 1. The eight tests in the CERAD-K neuropsychological battery seemed to cover three cognitive domains including Memory (Factor 1), Language (Factor 2), and Constructional Ability (Factor 3). The MMSE weighed on Factors 1, 2, and 3.

The scores on the Modified Boston Naming Test for dementia patients on the three subgroups of items with high, medium, and low frequencies revealed a stepwise gradation (Table 5). This kind of gradation was also observed for controls. However, the difference between the mean scores of patients and controls did not show the same pattern of gradation. The Word List Memory scores of patients and controls showed a gradual increase trial after trial. The difference in the mean values for patients and controls also increased during successive trials.

Discussion

Investigators in several countries have translated or used instruments included in the CERAD Assessment Packet in clinical and research activities (Heyman & Fillenbaum, 1997; Tariot et al., 1995), and Demers and colleagues (1994) reported the experience of translating the CERAD instruments into French. This is the first study that confirms

Table 3. Comparisons of the Scores on the CERAD-K Cognitive Tests in the Control Group With Those of the Dementia and Alzheimer's Disease (AD) Groups

Test	Control (n = 186)	Dementia (n = 106)	AD (n = 78)
Blessed Dementia Scale[a]			
M (*SD*)	0.0 (0.0)	5.5 (3.5)*	5.2 (3.4)*
Range	0.0–0.5	0.5–17.0	0.5–17.0
Short Blessed Test[a]			
M (*SD*)	1.3 (1.8)	20.7 (8.2)*	20.6 (8.2)*
Range	0–8	0–28	0–28
J1. Verbal Fluency			
M (*SD*)	15.3 (3.5)	7.2 (4.8)*	7.8 (5.1)*
Range	9–26	0–21	0–21
J2. Boston Naming Test [15]			
M (*SD*)	10.4 (2.5)	6.2 (3.5)*	6.3 (3.6)*
Range	4–15	0–15	0–15
J3. Mini-Mental State [30]			
M (*SD*)	28.0 (1.7)	16.5 (6.5)*	16.4 (6.9)*
Range	20–30	3–28	3–28
J4. Word List Memory [30]			
M (*SD*)	17.9 (4.2)	8.0 (4.6)*	8.0 (4.9)*
Range	7–25	0–19	0–19
J5. Constructional Praxis [11]			
M (*SD*)	10.2 (1.2)	6.8 (2.8)*	6.9 (2.8)*
Range	6–11	0–11	0–11
J6. Word List Recall [10]			
M (*SD*)	6.4 (1.8)	1.2 (1.5)*	1.1 (1.5)*
Range	1–10	0–6	0–6
J7. Word List Recognition [10]			
M (*SD*)	9.4 (1.1)	5.7 (11.2)*	4.5 (3.3)*
Range	4–10	0–10	0–10
J8. Constructional Praxis Recall [11]			
M (*SD*)	6.4 (2.6)	1.6 (1.8)*	1.6 (1.8)*
Range	1–11	0–7	0–7

Note: CERAD-K = Korean version of the Consortium to Establish a Registry for Alzheimer's Disease Assessment Packet.

[a]Number of participants who performed the test: 212 controls, 194 dementia patients, and 146 AD patients.

*$p < .01$, ANCOVA adjusted for sex, age, and education.

the psychometrical properties of the full CERAD Assessment Packet translated into another language.

We attempted not only to ensure the equivalence of the CERAD-K to the original packet for comparability but also to confirm its reliability and validity. For the clinical assessment of CERAD, content and semantic equivalencies (Flaherty et al., 1988) for diagnostic evaluation between the two versions were first considered during the translation process. Several clinical experts reviewed the initial translated version, and the preliminary study was carried out for a small number of respondents. Each test in the neuropsychological battery was also translated under the concept of equivalence so that the structure, method of application (technical equivalence), and goal of each test (construct equivalence; Flaherty et al., 1988) could be maintained. Unfortunately, to choose Korean words spoken with high frequency we had to use word frequency data on written Korean rather than on spoken Korean, because word frequency data on spoken Korean were unavailable. In order to use spoken frequency, we would have needed to conduct a study on word association for nondemented elderly persons (Homma & Tsukada, 1992).

Table 4. Factor Loading for Three Factors in a Factor Analysis of the Neuropsychological Battery in Dementia Patients (n = 106)

Test	Factor 1	Factor 2	Factor 3
Verbal Fluency	0.22	0.84	0.15
Boston Naming Test	0.10	0.80	0.23
Mini-Mental State	0.47	0.68	0.43
Word List Memory	0.68	0.52	0.15
Constructional Praxis	0.05	0.25	0.89
Word List Recall	0.90	0.18	0.07
Word List Recognition	0.85	0.14	0.25
Constructional Recall	0.46	0.18	0.66
Percentage of variance explained	31	28	20

The clinicians who participated in our study found the clinical assessment battery of the CERAD-K useful in distinguishing patients with AD and other dementias. This work was also facilitated by the consensus case conference. The back-translation (Brislin, 1970) of both the clinical and neuropsychological parts of the CERAD-K that we performed to improve the semantic equivalence was also useful. A few points were highlighted in the discussion about the translation of CERAD-K with Dr. Heyman at CERAD headquarters. Items concerned with reading and writing in the MMSE were replaced by those concerned with judgment because of the significant number of illiterate people in Korea (Woo et al., 1998). We also developed a Korean version of the 15-item CERAD Boston Naming Test that we derived from the 60-item K-BNT.

It was shown that the SBT and all of the CERAD-K neuropsychological tests had substantial interrater and 1-month test-retest reliabilities. The interrater reliability in our study was derived from one rather than two test sessions and represents the reliability of scoring. The test-retest correlation was similar to that of the English CERAD tests (Morris et al., 1989). The relatively lower test-retest correlation for the MMSE and Constructional Praxis may be explained by the restricted range of scores (ceiling effect) for controls (n = 10) included in the test-retest analysis. The practice effect, which would influence the result of the test-retest reliability, was not found in any cognitive function tests except the Word List Recall test.

Table 5. Gradation in Scores of Subtests for Dementia Patients and Controls

Test	Dementia (n = 106)	Control (n = 186)	Difference (*M*)
Boston Naming Test (item frequency)			
High, *M* (*SD*)	3.7 (1.37)	4.8 (0.42)	1.1
Medium, *M* (*SD*)	1.4 (1.49)	3.1 (1.42)	1.7
Low, *M* (*SD*)	1.0 (1.19)	2.4 (1.29)	1.4
All items, *M* (*SD*)	6.2 (3.47)	10.4 (2.50)	4.2
Range	0–15	4–15	
Word List Memory (serial trials)			
Trial 1, *M* (*SD*)	1.5 (1.28)	3.7 (1.47)	2.2
Trial 2, *M* (*SD*)	2.9 (1.72)	6.4 (1.40)	3.5
Trial 3, *M* (*SD*)	3.6 (2.16)	7.7 (1.32)	4.1
All trials, *M* (*SD*)	8.0 (4.60)	17.9 (4.19)	9.4
Range	0–19	7–25	

The mean scores of the SBT, BDS, and all of the tests in the neuropsychological part of the CERAD-K in the dementia or AD group were significantly poorer than those of the control group, even after we controlled for the effects of age and education. This finding indicates that the cognitive tests in the CERAD-K have criterion equivalence to those in the English version. The ranges of most measures considerably overlapped between patients and controls. This occurred partly because patients with very mild dementia (CDR = 0.5) were included in our study. The difference between the other dementias, such as vascular dementia, and controls was not analyzed separately because of small sample size. The Trail Making Test in the neuropsychological portion of Protocol 4b for vascular dementia, dementia with Parkinson's disease, and less common dementia revealed that dementia patients had great difficulties in performing both Parts 1 and 2 of this test. Less educated controls had great difficulties completing Part 2. Therefore, these data are not available.

A factor analysis revealed that the neuropsychological part of the CERAD-K is composed of three primary factors: Memory, Language, and Constructional Ability. This finding is consistent with the original intention and design of the CERAD neuropsychological battery (Morris et al., 1989). Moreover, the Constructional Praxis Recall test, which was not included in the first edition of the English version, proved to be related mainly to constructional ability and memory. This finding suggests that the neuropsychological portion of the CERAD-K has good construct validity and that its factor structure is nearly equivalent to that of the English version (construct equivalence; Flaherty et al., 1988).

For the Boston Naming Test in the English CERAD neuropsychological battery, the mean score difference between dementia patients and controls depicted a stepwise increase from the high-frequency to low-frequency words (Morris et al., 1989). This meant that the lower the word frequency, the greater its discrimination power. This pattern was not shown in the CERAD-K. On the contrary, the mean score difference between patients and controls for low-frequency words was smaller than that for medium-frequency words. This might be related to the floor effect of low-frequency words in the Modified Boston Naming Test in CERAD-K. We found that even the controls had some difficulty providing correct answers for those words. The mean scores of Word List Memory in patients and controls and its difference between the two groups were found to increase gradually during three successive trials. This result suggests that learning ability by practice diminished further in dementia patients compared with controls and that the discriminating efficacy of Word Memory Test at Trial 3 was greater than that of Trial 1 or Trial 2.

Our study has several limitations. First, the number of the patients with other dementia included in our study was too small to perform separate analysis between vascular dementia and controls, or dementia with Parkinson's disease and controls. Therefore, validation on Protocol 4b of the CERAD clinical part for other dementia could not be provided. Second, the data from the longitudinal follow-up were not included in our analysis because only a few years follow-up evaluations have been conducted. Therefore, we could not ensure that each measure in the CERAD-K was sensitive enough to detect a small decline of ability in each cognitive domain in AD. Third, a normative study of the neuropsychological battery for an extended number of controls needs to be completed. We have been continuously collecting this data. Because the cognitive measures in this battery are mostly affected by age, gender, and level of education, adjustment for these factors will be required (Welsh et al., 1994).

Further investigations should be conducted to consider the following aspects. We recently adopted the CERAD Behavioral Rating Scale for Dementia (BRSD; Tariot et al., 1995) and the CERAD semi-quantitative visual rating scale for neuroimaging (Davis et al., 1992). We plan to standardize these instruments in a multicenter study. Furthermore, we need to proceed with the validation of clinical diagnoses by postmortem pathologic findings.

We have sent the back-translated CERAD-K to CERAD headquarters at Duke University for the certification process. Completing this, we plan to establish a consortium for the systematic multicenter study on dementia and an efficient registry system for the medical and social care for dementia patients in Korea. To obtain a copy of the CERAD-K, please contact the first author.

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