Comparison of Cognitive Function in Dementia and Major Depressive Disorders Using The 7 Minute Screen Test

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Abstract: The 7 Minute Screen Test (7 MS) has been reported to have the highest sensitivity and specificity among tests for the early screening of Alzheimer's disease. This test encompasses several cognitive regions including memory, temporal orientation, verbal fluency, and visuospatial and visuoconstructional abilities. This study was undertaken in order to evaluate the diagnostic efficiency of the 7 Minute Screen in the differentiation of dementia and depression. The 7 Minute Screen and the Mini-Mental State Examination (MMSE) were performed with 26 inpatients exhibiting Alzheimer's type dementia (N=8), vascular dementia (N=8), major depressive disorder (N=10). The test battery consisted of the Benton Temporal Orientation (BTO), the Enhanced Cued Recall (ECR), the Clock Drawing (CD), and the Category Fluency (CF) tests. 1) No statistically significant differences were detected in the 7MS subtest scores of the 3 groups ($p>0.05$). On the Benton Temporal Orientation, the highest mean scores were obtained by the vascular dementia group. With regard to memory, the lowest mean scores were obtained in the vascular dementia group, but the Alzheimer's dementia group obtained the lowest Uncued Recall scores. However, the vacular dementia group scored lowest on Cued Recall. On the Clock Drawing and Category Fluency tests, the lowest mean scores were obtained by the Alzheimer's dementia group. 2) In the Alzheimer's type dementia group, Benton Temporal Orientation test scores were negatively correlated with the MMSE (γ=-0.730, $p<0.05$), and the Clock Drawing scores were correlated positively with level of education (γ=0.740, $p<0.05$). In the vascular dementia group, Cued Recall (γ=0.784, $p<0.05$), total memory (γ=0.804, $p< 0.05$) and Category Fluency (γ=0.885, $p<0.005$) were positively correlated with MMSE scores. In the major depressive disorder group, we noted a negative correlation between Cued Recall scores and age (γ=-0.725, $p<0.05$). The 7 Minute Screen proved superior to the Mini-Mental State Examination at detecting mild cognitive deficits. It might also prove useful in the discrimination of differences between dementia and depression. Our results suggest that 7MS is a useful test for the early prediction of dementia. However, further validation is necessary, as individual 7MS tests may be influenced by education level, age, and sex.

Key words: 7 Minute Screening, Alzheimer's disease, Vascular dementia, Major depressive disorder

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Introduction

Dementia is defined as a brain disorder which affects multiple cognitive functions, including memory, language, visuospatial perception, praxis, and judgement. Increasing the accuracy with which dementia can be detected in its early phases is crucial for effective treatment. In this regard, neuropsychological tests can be very efficient in the clinical detection of early stage cog-

nitive function impairments. The 7 Minute Screen (MS) is a neurocognitive screening instrument for use in primary care. This screening technique consists of four tests: orientation, memory, clock drawing, and verbal fluency. It has been reported to have several advantages, one of which being that any professional can learn to apply the tests rapidly, without clinical training[1]. This test also encompasses several relevant complex cognitive fields, and has proven able to discern Alzheimer's dementia from cognitive deficits associated with the normal aging process.

The Mini-Mental State Examination (MMSE), which has classically been the test of choice in geriatric mental state examinations, is known to be affected by age and level of education, and is associated with reduced sensitivity when the subject's cognition is only mildly impaired[2, 3].

The objectives of this study were to evaluate the efficiency of the 7 Minute Screen in order to discriminate differences between dementia and depression, and to determine whether the 7 Minute Screen was susceptible to influence by variables such as age, sex, and level of education.

Materials and Methods

Subjects

All of patients in this study had been previously admitted to the Department of Neuropsychiatry, at the Kosin University Gospel Hospital. The three study groups consisted of patients with DSM-IV[4] diagnoses of: Alzheimer's type dementia (N=8), vascular dementia (N=8), and major depressive disorders (N=10).

Patients' demographic characteristics are listed in Table 1. The mean patient age (±S.D.) was 72.88±7.49 years in the Alzheimer's type dementia group, 59.13±17.67 years in the vascular dementia group, and ±12.63 years in the major depressive disorder group. The female to male sex ratios were: 5/3=1.667 in the Alzheimer's type dementia group, 1/7=0.143 in the vascular dementia group, and 7/3=2.333 in the major depressive disorder group. The mean (±S.D.) education levels were: 5.25±4.74 years in the Alzheimer's type dementia group, 10.25±3.41 years in the vascular dementia group, and 6.00±5.10 years in the major depressive disorder group. The mean (±S.D.) scores of the Mini-Mental State Examination were 20.63±4.93 in the Alzheimer's type dementia group, 19.38±5.15 in the vascular dementia group, and 22.50±5.56 in the major depressive disorder group.

TABLE 1. Demographic characteristics

	Dementia of the Alzheimer's type	Vascular Dementia	Major Depressive Disorder
Age (Yr)	72.88 ±7.49	59.13 ±17.67	63.40 ±12.63
Sex (F/M)	5/3	1/7	7/3
Education (Yrs)	5.25 ±4.74	10.25 ±3.41	6.00 ±5.10
MMSE	20.63 ±4.93	19.38 ±5.15	22.50 ±5.56

Note. These data represent Mean ±S.D.
MMSE=Mini-Mental State Examination
*p<0.05, **p<0.005 by ANOVA with Tukey HSD

Methods

The 7 Minute Screen and the MMSE were performed with each of the 3 groups within the first week after admission. The 7 Minute Screen test battery consisted of four subtests: the Benton Temporal Orientation, Enhanced Cued Recall, Clock Drawing, and Category Fluency tests[5]. The Korean version of the MMSE was also used[6].

The obtained data were then subjected to analysis, using SPSS for Windows. The statistical significance of differences among the results of each subtest of the four illness groups was assessed bg ANOVA and Tukey HSD tests. Furthermore, the correlation between the results of the four subtests of each illness group, and variables including age, sex, education level, and MMSE scores were analyzed by Pearson's Correlation. The significance level was set at a p value of less than 0.05 ($p<0.05$).

Results

Mean Scores for the Subtests of the 7 Minute Screen

The mean scores for the four subtests of the 7 Minute Screen were as follows: Table 2. The mean (±S.D.) scores on the Benton Temporal Orientation test were 24.38±12.64 in the Alzheimer's type dementia group, 25.75±15.26 in the vascular dementia group, and 8.80

TABLE 2. Individual test scores of the 7 Minute Screen

	Dementia of the Alzheimer's type	Vascular Dementia	Major Depressive Disorder
Orientation	24.38 ±12.64	25.75 ±15.26	8.80 ±4.85
Memory	11.25 ±1.24	10.00 ±1.43	11.60 ±1.56
Uncued Recall	4.25 ±0.84	4.38 ±1.00	4.30 ±1.11
Cued Recall	7.00 ±1.12	5.63 ±1.16	7.30 ±1.16
Clock Drawing	2.38 ±1.07	2.75 ±1.00	2.90 ±0.87
Verbal Fluency	5.25 ±1.45	5.63 ±1.16	8.20 ±1.02

Note. These data represent Mean ±S.D.
*p<0.05, **p<0.01, ***p<0.001 by ANOVA with Tukey HSD

±4.85 in the major depressive disorder group. The mean (±S.D.) scores on the memory test were 11.25 ±1.24 in the Alzheimer's type dementia group, 10.00 ±1.43 in the vascular dementia group, and 11.60 ±1.56 in the major depressive disorder group. The mean (±S.D.) scores on the Uncued Recall test were 4.25 ± 0.84 in the Alzheimer's type dementia group, 4.38 ±1.00 in the vascular dementia group, and 4.30 ± 1.11 in the major depressive disorder group. The mean (±S.D.) scores on the Cued Recall test were 7.00 ±1.12 in the Alzheimer's type dementia group, 5.63 ±1.16 in the vascular dementia group, and 7.30 ±1.16 in the major depressive disorder group. The mean (±S.D.) scores on the Clock Drawing test were 2.38 ±1.07 in the Alzheimer's type dementia group, 2.75 ±1.00 in the vascular dementia group, and 2.90 ±0.87 in the major depressive disorder group. Finally, the mean (±S.D.) scores on the Category Fluency test were 5.25 ±1.45 in the Alzheimer's type dementia group, 5.63 ±1.16 in the vascular dementia group, and 8.20 ±1.02 in the major depressive disorder group.

In summary, patients with vascular dementia had the highest scores on the Benton Temporal Orientation test. Patients with vascular dementia exhibited the lowest scores on the memory test, especially on the Cued Recall test, while the Alzheimer's type dementia patients exhibited the lowest score on the Uncued Recall. Patient with Alzheimer's type dementia achieved the lowest scores on the Clock Drawing test, as well as on the Category Fluency test. Therefore, disturbances in the orientation and reduction of vocabulary were found to be more prominent in the dementia groups than in the patients exhibiting major depressive disorders. Memory impairment, also, was found to be most pronounced in the vascular dementia cases, particularly with regard to the Cued Recall test. Deficiencies in visuospatial ability were determined to be most severe in the Alzheimer's type dementia group.

Differences in Subtests between Illnesses

The differences in the four subtests of the 7 Minute Screen, according to the illness groups, were as follows Table 2. There were no statistically significant differences detected among the three illness groups on memory total scores, Benton Temporal Orientation scores, Cued Recal scores, Clock Drawing scores ($p<0.05$).

Factors Affecting the 7 Minute Screen

In the Alzheimer's type dementia group, the Benton Temporal Orientation test scores were negatively correlated with MMSE results (γ=-0.730, $p<0.05$), and the Clock Drawing scores were positively corrected with education level (γ=0.740, $p<0.05$), and negatively correlated with sex (γ=-0.902, $p<0.005$) Table 3. In the vascu-

TABLE 3. Correlation between individual test scores and age, sex, education and MMSE in the dementia of the Alzheimer's type

	Orientation	Memory	Uncued Recall	Cued Recall	Clock Drawing	Verbal Fluency
Age	0.280	0.460	-0.191	0.651	-0.137	0.043
MMSE	-0.730*	-0.243	0.021	-0.284	0.414	0.288
Education	0.306	0.168	-0.095	0.257	0.740*	0.408
Sex	0.503	-0.336	-0.261	-0.175	-0.902**	-0.421

Note. These data represent correlation coefficients(γ)
MMSE=Mini-Mental State Examination
*p<0.05, **p<0.01

TABLE 4. Correlation between Individual test scores and age, sex, education and MMSE in the vascular dementia

	Orientation	Memory	Uncued Recall	Cued Recall	Clock Drawing	Verbal Fluency
Age	-0.561	0.407	0.179	0.345	-0.361	0.347
MMSE	-0.691	0.804*	0.234	0.784*	0.086	0.885*
Education	0.294	-0.591	-0.239	-0.474	0.424	-0.575
Sex	0.452	-0.100	-0.626	0.414	0.179	-0.322

Note. These data represent correlation coefficients (γ)
MMSE=Mini-Mental State Examination
*p<0.05

TABLE 5. Correlation between Individual test scores and age, sex, education and MMSE in the major depressive disorders

	Orientation	Memory	Uncued Recall	Cued Recall	Clock Drawing	Verbal Fluency
Age	-0.071	-0.298	0.336	-0.725*	0.443	0.110
MMSE	0.168	0.153	0.346	-0.123	0.307	0.273
Education	0.274	0.233	-0.125	0.435	0.024	-0.196
Sex	0.081	-0.428	-0.072	-0.510	-0.108	0.114

Note. These data represent correlation coefficients (γ)
MMSE=Mini-Mental State Examination
*p<0.05

TABLE 6. Correlation between MMSE and age, sex and education in three groups

	MMSE		
	Dementia of the Alzheimer's type	Vascular Dementia	Major Depressive Disorder
Age	-0.377	-0.258	0.480
Education	0.170	0.384	-0.721*
Sex	-0.455	0.062	-0.186

Note. These data represent correlation coefficients (γ)
MMSE=Mini-Mental State Examination
*p<0.05

lar dementia group, scores on the Cued Recall (γ=0.784, p<0.05), total memory (γ=0.804, p<0.05) and Category Fluency (γ=0.885, p<0.005) tests were positively correlated with MMSE results Table 4. In the major depressive disorder group, we detected a negative correlation between the Cued Recall score and patient age (γ=-0.725, p<0.05) Table 5. Although the MMSE scores in the Alzheimer's type dementia, vascular dementia, and alcohol dependence patients were not correlated with such variables as age, education level, and sex, the MMSE scores in the major depressive disorder group were negatively correlated with education level (γ=-0.721, p<0.05) Table 6.

Discussion

Dementia is a typical neuropsychiatric disorder, characterized by chronic progression. Therefore, the early identification and diagnosis of dementia is important for effective treatment. Neuropsychological tests can be very clinically effective in the detection of early stage cognitive functioning impairment[7].

Cognitive impairment in the Alzheimer's dementia group was described as follows[8]. Memory impairment centered on episodic and semantic memory, while the most commomly reported linguistic abnormalities involved naming difficulties, and reduced verebal fluency on tasks which required constructional abilities and conceptual skills. Although frequently observed visuospatial disturbances, our study results in this regard were not consistent. Attention disturbances were based on the intellectual changes observed in the Alzheimer's dementia group. The Clock Drawing Test (CDT) might prove useful as an effective screening test for geriatric patients, as it would appear to impose only a minimal, if any, burden on such patients[9]. However, the CDT did not prove useful in the differentiation of early stage Alzheimer's dementia from that associated with normal aging, as the sensitivity of the test decreased in case of very mild Alzheimer's dementia. However, the CDT was able to discriminate moderate Alzheimer's dementia from the dementia associated with normal aging[10].

The earliest symptom of Alzheimer's dementia was memory impairment, which was characterized by disturbances in the acquisition and preservation of new information as well as marked delay of recall[11]. While verbal memory was affected similarly to nonverbal memory in cases of Alzheimer's dementia, directed memory loss was more a characteristic of vascular dementia. In cases of vascular dementia, delayed recall was a less definite phenomenon, the hippocampus was usually not involved, and the lesions were less specific in vascular dementia, In Alzheimer's dementia, the impairment of recall was caused primarily by hippocampal lesions. In the early stages of Alzheimer's dementia, concentration was relatively intact, and only mild visuospatial defects, impairments of memory and abstraction, and characteristic defects in linguistic word finding were reported. Verbal fluency was also impaired in the mild to moderate stages. Cerebrovascular disorders had previously been implicated as a risk factor of dementia, and vascular factors, including white matter changes, cerebral amyloid angiopathy, and coexistent stroke, were related to Alzheimer's dementia[12].

In vascular dementia, characteristic disorders in spontaneity, alertness, and activation have been noted, which resulted from deep white matter lesions and frontal-sub-

cortical lesions[13]. Depression accelerated the development of dementia in the late years, and 9% of male and 11% of female patients reporting late-life depression had developed dementia upon a 5-year follow up[14]. A complex relationship has been clearly demonstrated to exist between dementia and depression, and great deal of neurochemical and neuroanatomical evidence of this association has also been reported[15]. The differentiation of dementia from depression is not an easy proposition, and depression associated with features of fronto-subcortical dementia[16].

Patients with depression are sometimes misdiagnosed with dementia, while dementic patients have frequently have been misdiagnosed with depression. Cognitive disorders in depressed patients appear more similar to subcortical dementia than cortical dementia, evidencing delayed cognitive function, memory impairment, difficulties in problem solving, and visuospatial abnormalities[17]. Delays in the central information processing and attention defects could be detected with the results of the psychomotor and visuospatial tasks, although these methods were limited with regard to the differentiation of two illness groups[18]. Depressed patients performed well on memory tasks, including structures to be remembered items, in spite of their diminished motor performance and observed defects in memory and concept formation. Depressed patients also evidenced general defects in motivation, drive, and concentration[19].

Cerebrovascular disorders played a role in late-life depression, and the development of depression increased in elderly patients with vascular risk factors, including damage to the fronto-subcortical circuit after a stroke, transient ischemia, and hypertension[20]. Brain computerized axial tomography measurements of medial temporal atrophy could be used as noninvasive markers for the discrimination of Alzheimer's dementia, as the mean depth of the medial temporal lobe is significantly smaller in Alzheimer's dementia patients than in vascular dementia or depression patients[21]. Changes in the white matter, as well as other brain structures, are commonly reported on brain magnetic resonance images obtained from patients with late-life depression[22]. Periventricular lesions were reported more frequently in cases of Alzheimer's dementia, while the deep white matter lesions were reported more frequently on the brain magnetic resonance images from patitents with depression, although the two illness groups were related with regard to cerebrovascular risk factors[23].

The initial study of the sensitivity and specificity of the 7 Minute Screen determined that the screen was>90% accurate. The 7 Minute Screen was also reported to be a valuable tool for the screening of Alzheimer's disease in elderly Koreans[24, 25].

Our study, although limited by its small sample size, demonstrated that cognitive impairments were more prominent in dementia than in depression. In the subtests comprising the 7 Minute Screen, no differences could be found among the 3 illness groups on the Benton Temporal Orientation and Clock Drawing subtests, while definite differences were observed on the Uncued Recall and Category Fluency subtests. In the patients with Alzheimer's dementia, impairments were mainly observed on the uncued recall, visuospatial, and verbal fluency tests, while in the vascular dementia group, the problems occurred on orientation and cued recall tests. The 7 Minute Screen appeared more sensitive, in general than the MMSE. However, unexpectedly, the results of the Clock Drawing tests in the Alzheimer's dementia group were significantly influenced by education levels and sex, while the results of the Cued Recall tests in the major depressive disorder group was significantly influenced by age. However, it was also necessary to exclude the effects of variables such as age, sex, and education level on the test results[26, 27].

In conclusion, the 7 Minute Screen appears, as a whole, superior to the Mini-Mental State Examination with regard to the discernment of mild cognitive deficits, as well as the differentiation between illnesses. Although, the 7 MS appears to results in high accuracy, requires minimal training to administer and no clinical judgement to score, the test remains limited, as some individual test results in patients with certain illnesses can be influenced by education level, age, or sex.

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