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RESEARCH

A COMPOSITE SCORE FOR DOKUZ EYLUL COGNITIVE STATE NEUROCOGNITIVETEST BATTERY: A DOOR-TO-DOOR SURVEY STUDY WITH ILLITERATE, LOW AND HIGH EDUCATED ELDERLY IN TURKEY

ABSTRACT

Introduction: This study aimed to develop a composite score for the Turkish neuropsychological test battery named Dokuz Eylul Cognitive State for a large well educated and less educated elderly population, including those with mild cognitive impairment and dementia.

Materials and Method: Dokuz Eylul Cognitive State total scores were obtained by summing scores acquired from individual Dokuz Eylul Cognitive State subtests to establish a total composite score. Control participants (n=363) were dwelling in the community and tested by means of a door-to-door survey. The utility of the total score was further tested in independent samples of dementia patients with various etiologic backgrounds (n=53) or mild cognitive impairment (n=53) participants.

Results: Areas under the receiver operating characteristics curve in well and less educated dementia patients and healthy participants were found to be 0.931 and 0.954, respectively. A cut-off point of 72/73 of Dokuz Eylul Cognitive State for the well educated elderly had the highest sensitivity (83.8) and specificity (90.3), whereas a cut-off point of 49/50 for the less educated elderly had the highest sensitivity (91.2) and specificity (88.6). The Cronbach's · values of the Dokuz Eylul Cognitive State for well educated and less educated elderly were higher than 0.8.

Conclusion: These results support the validity of the Dokuz Eylul Cognitive State total score for the purpose of detecting and monitoring the progression of receiver operating characteristics and dementia in patients with different levels of education in clinical and research settings.

Key Words: Dementia; Mild Cognitive Impairment; Questionnaire.

ARAŞTIRMA

DOKUZ EYLÜL KOGNİTİF DURUM TEST BATARYASI İÇİN BİLEŞİK PUAN: TÜRKİYE'DEKİ EĞİTİMSİZ, DÜŞÜK VE YÜKSEK EĞİTİMLİ YAŞLILARLA ALAN ARAŞTIRMASI

ÖZ

Giriş: Bu çalışma yüksek ve düşük eğitimli hafif kognitif bozukluk ve demans hastalarını da içeren geniş bir yaşlı popülasyonu için Dokuz Eylül Kognitif Durum olarak adlandırılan Türkçe nöropsikolojik test bataryasının bileşik skorunu geliştirmeyi amaçlamıştır.

Gereç ve Yöntem: Bileşik skoru oluşturmak için Dokuz Eylül Kognitif Durum alt testlerinin toplamından elde edilen Dokuz Eylül Kognitif Durum toplam puanı kullanılmıştır. Kontrol grubu (n=363) toplum içinde yaşayan yetişkin bireylerdi ve testleri hane araştırması yoluyla yapıldı. Toplam skor daha sonra hafif kognitif bozukluk (n=53) ya da farklı etiyolojilere sahip demans (n=53) hastalarından oluşan bağımsız örneklemde test edildi.

Bulgular: Yüksek ve düşük eğitimli demans hastaları ve sağlıklı bireylerde alıcı işletim karakteristiği eğirisi altında kalan alan sırasıyla 0,931 ve 0,954 olarak bulundu. Yüksek eğitimli yaşlılarda 72/73 kesme değeri en yüksek duyarlılık (83,8) ve özgüllük (90,3) değerine sahipken; düşük eğitimli yaşlılarda 49/50 kesme değeri en yüksek duyarlılık (91,2) ve özgüllüğe (88,6) sahipti. Dokuz Eylül Kognitif Durum'un Cronbach · değerleri düşük ve yüksek eğitimliler için 0,8'den yüksek bulunmuştur.

Sonuç: Bu sonuçlar Dokuz Eylül Kognitif Durum toplam skorunun klinik ve araştırma alanlarında, farklı düzeylerde eğitime sahip hafif kognitif bozukluk ve demans hastalarının taranması ve ilerlemenin gözlenmesinde geçerliliğini desteklemektedir.

Anahtar Sözcükler: Demans; Hafif Kognitif Bozukluk; Kognitif Tarama Testi.

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Introduction

Dementia is a prevalent disease among the elderly and neuropsychological assessment may play a key role in its diagnosis by providing objective information about cognitive deficits and changes (1). The Delphi consensus study reported that 60% of people with dementia live in developing countries and it is predicted that by 2040, this percentage will reach 71% (2). In almost all cognitive assessment tools, the level of education significantly influences the participant's performance on the test (3). Low education is considered to be associated with dementia, possibly due to the cerebral reserve hypothesis (4). The American Psychological Association (APA) has stated that only highly educated, normative majority samples have been used for many neuropsychological tests (5). The validated cognitive tests that are frequently used in Western countries do not reflect the actual cognitive performance of individuals who live in developing countries, and may lead to misdiagnosis of dementia mainly due to the literacy or reasonable level of education requirements of such tests (6). It is, therefore, necessary to define education-specific cut-off scores derived from population-based studies to avoid flooring effects among the low education group (3).

According to a 2013 report by the Turkish Statistical Institution (TUIK), the illiteracy or low level of education rate is 4% among the elderly, which is equivalent to over 5.5 million people in Turkey's population (7). Considering that the prevalence of dementia among people over 65 in Turkey is about 13%, there is a strong need for a valid test in Turkey, which involves gathering data from an epidemiological study of both educated and illiterate people. Our objective was to develop a composite score for a newly developed neuropsychological test named "Dokuz Eylül Kognitif Degerlendirme/Dokuz Eylul Cognitive Assessment" (DEKOD) for use with both well educated and less educated population groups in Turkey. By means of this battery, a profile of cognitive impairment can be described using multiple data points across cognitive domains.

We aimed to develop a total score for the Turkish DEKOD neuropsychological battery that would provide a normative-based summary score of global cognitive performance that could also be used to identify level of cognitive impairment. We hypothesized that this score can be helpful in differentiating dementia, mild cognitive impairment (MCI), and normal aging.

Materials and Method

Participants

Four hundred ninety community dwelling participants, 65 years old or above, were screened for dementia in a door-to-door type epidemiological study. Addresses to be surveyed were assigned by TUIK according to socio-economic and cultural backgrounds of the residents. The Narlıdere area in Izmir province in western Turkey was chosen by TUIK as an examplary pilot area for the Turkish population. A detailed random sampling method has been described elsewhere (8). Oral informed consent was obtained from all participants or their relatives living in the same house. The study was approved by the ethics committee of the Faculty of Medicine of Dokuz Eylul University.

Cognitive testing, which included the DEKOD, the rMMSE-T (revised Mini Mental State Examination-Turkish), the GDS (Geriatric Depression Scale), the IADLs (Instrumental Activities of Daily Living Scale) and the CDR (Clinical Dementia Rating Scale) was administered by a neuropsychologist. An intrarater retest was administered to 17 elderly participants after a period of 2-7 days. An interrater retest was administered to 14 elderly participants after a period of between 3-15 days by two neurologists. Clinical diagnosis was made by a senior neurologist according to the dementia and MCI diagnosis criteria mentioned in the following section. A total of 46 participants with severe dementia, other neuropsychiatric illnesses or hearing loss were excluded from the sample. Also, a few control participants with a native language other than Turkish were excluded. Overall, a total of 444 (338 healthy elderly, 53 with dementia and 53 with MCI) participants were included to the study. Two groups were identified according to education: Less educated (0-4 years of education) and well educated (5 or more years of education).

Diagnostic Criteria for Dementia and Mild Cognitive Impairment

The clinical diagnosis of dementia was assessed by a senior neurologist according to the criteria of the Diagnostic and Statistical Manual of Mental Disorders, 4rd Edition (DSM IV). Alzheimer's Disease (AD) and Vascular Dementia (VaD) participants in the dementia group were diagnosed as probable/possible AD or probable/possible VaD, using National Institute of Neurological and Communication Disorders and Stroke/AD and Related Disorders Association (NINCDS-ARDRA) and National Institute of Neurological Disorders and Stroke-Association Internationale pour la

Recherche et L'Enseignement en Neurosciences (NINDS-AIREN) criteria. The diagnosis of MCI subjects was conducted according to the following criteria established by Petersen et al. (1999): (a) Subjective memory complaint, (b) normal activities of daily living, (c) normal general cognitive function, (d) abnormal memory functioning determined for age [neuropsychological tests reveal 1.5 standard deviations (SD) below normative values], and (e) not demented.

Development of DEKOD

Although the prevalence of elderly people in Turkey who are illiterate or have little formal education is about 63% (8), the current validated neuropsychological test batteries which are routinely used in dementia clinics usually address subjects with at least 5 years of education. Therefore, there is a need for a neurocognitive testing battery for all illiterate, less and well educated people older than 65. We suggested the DEKOD as an easily administered neurocognitive test for which participants do not need to use pen or paper.

Description of Subtests of the DEKOD

The DEKOD is composed of attention, calculation and judgment, naming, verbal category fluency, and memory subtests, taking 30 minutes to administer in total.

- Attention (10 points): A short version of the Digit Span (forward and backward) subtest of the Wecshler Memory Scale-Revised (WMS-R, Wechsler, 1981) is used to assess attention. The participant is asked to repeat the numbers in the same order as they were presented (digits forward), then asked to repeat another series of numbers in reverse order (digits backward). The test begins with three numbers, increasing to seven digits until the participant makes two consecutive errors.
- Calculation (5 points): The participant is asked to calculate five simple (5+3= ; 21-8= ; 13x5= ;39÷13=) arithmetic operations.
- Abstract Thinking / Judgment (3 points): Three common proverbs in Turkish are given.
- Language (Verbal/Category Fluency, Boston Naming Test) (32 points): 12 items from the 15-item version Boston Naming Test (BNT) used by the Consortium To Establish a Registry for Alzheimer's Disease (CERAD) is used to assess naming ability and an animal list is used to assess verbal/category fluency.
- Immediate memory (30 items, 20 points): A list of ten frequent, concrete words (oil, arm, building, letter, ticket, cat, engine, gras, stick, shore) from Alzheimer's Disease Assessment Scale-cognitive subscale (ADAS-Cog) is given to the participant to encode. The list is repeated three times with the same words in a random order. The sum of immediate recalled words is recorded after each trial.
- Memory (free recall) (10 points): After approximately 20 minutes of immediate memory, the participant is asked to recall the words from the given list of ten words. One point was scored for each correct word.
- Memory (recognition) (20 points): This is a recognition test of the words from the immediate memory subtest with ten true words and ten false words. The participant is asked to say "yes" when the examiner reads a word from the immediate memory subtest and "no" when the examiner reads a false word. One point was scored for each true word from the immediate memory list and false word that was not from the given list.

Statistical Analysis

A receiver operating characteristics (ROC) analysis was performed to establish the cut-off points of the DEKOD for MCI and dementia screening. The highest sensitivity and specificity of cut-off points of the test were selected. Correlations between test-retest and Kappa analyses were evaluated in order to determine the reliability of the DEKOD. Cronbach's · coefficients were calculated for internal consistency of the test.

Results

Demographic and Cognitive Characteristics

The study was conducted with 338 healthy elderly (183 male and 261 female, 70.7±5.4 years of age), 53 dementia (11 male, 42 female 74±7.8 years of age) and 53 MCI (23 male, 30 female 71.7±5.6 years of age) participants. The demographic and cognitive characteristics of participants are summarized in Table 1. When compared by age, less educated healthy elderly (70.7±5.3) and MCI participants (71.2±4.9) were significantly younger than participants with dementia (78.7±7.7). All three groups – healthy elderly, MCI and dementia – differed significantly from each other in their DEKOD and rMMSE-T scores (Table 1).

The DEKOD total score was inversely correlated with age (r=-0.59, p=0.00) and clinical stage [CDR (r=-0.65, p=0.00) and GDS (r=-0.44, p=0.00)]. A strong positive correlation was observed between the DEKOD and the rMMSE-T (r=0.78, p=0.00) and the IADLs (r=0.72, p=0.00).

Table 1— Demographic Characteristics and Test Scores of the Healthy Elderly, MCI and Dementia Subjects.

	Healthy Elderly n= 338		MCI n= 53		Dementia n= 53	
	0-4 Years of Education n= 150	5 Years or More Education n= 188	0-4 Years of Education n=31	5 Years or More Education n= 22	0-4 Years of Education n=43	5 Years or More Education n= 10
Age Mean (SD)	70.7 (5.3)*	70.6 (5.5)	71.2 (4.9)*	72.6 (5.8)	78.7 (7.7)	71.9 (6.0)
Gender (M/F)	37/113	112/76	11/20	12/10	6/37	5/5
DEKOD Meanscore (SD)	66.3 (12.6)	83.5 (10.7) ++	57.7 (9.7) **	69.1 (8.1) **	29.9 (17.3)	49.8 (25.1)
MMSE Meanscore (SD)	24.2 (3.4)	26.7 (2.1) ++	23.6 (3.3) **	23.2 (3.3) **	14.8 (6.0)	16.4 (7.2)
GDS Meanscore (SD)	4.5 (3.5)	2.3 (2.6)	4.5 (3.3) *	3.3 (2.7) **	6.9 (3.6)	7.0 (3.8)
IADL Meanscore (SD)	21.4 (2.3)	21.3 (2.0)	20.0 (3.1) **	22.0 (1.4) **	7.3 (6.0)	12.5 (7.4)
CDR Meanscore (SD)	0**†	0**††	0.4 (0.3)**	0.3 (0.3)**	1.22 (0.7)	0.81 (0.65)

SD: StandardDeviation, M: Male, F: Female, MCI: Mild Cognitive Impairment, DEKOD: Dokuz Eylul Cognitive Assessment Test, MMSE: Mini Mental State Examination, GDS: Geriatric Depression Scale, IADL: Instrumental Activities of Daily Living, CDR, Clinical Dementia Rating Scale, *significantly different from dementia group (p<0.05), **significantly different from dementia group (p<0.005), †significantly different from MCI group (p<0.05), ††significantly different from MCI group (p<0.005).

Table 2— Comparison of DEKOD and rMMSE-T in Dementia and MCI Groups.

		DEKOD						rMMSE-T					
		Cut-Off	Sensitivity	Specifity	AUC	PPV	NPV	Cut-Off	Sensitivity	Specifity	AUC	PPV	NPV
High Educated	Dementia	72/73	84%	90%	0.93	0.28	0.99	22/23	98%	90%	0.96	0.80	0.98
(5 years or more)	MCI	75/76	80%	79%	0.86	0.05	0.90	26/27	61%	85%	0.83	0.09	0.90
Low-Educated	Dementia	49/50	91%	90%	0.95	0.76	0.95	17/18	95%	83%	0.91	0.76	0.91
(0-4 years)	MCI	60/61	70%	65%	0.72	0.24	0.86	22/23	67°%	55%	0.56	0.22	0.83

AUC: Area Under the Curve; PPV: Positive Predictive Value; NPV; Negative Predictive Value.

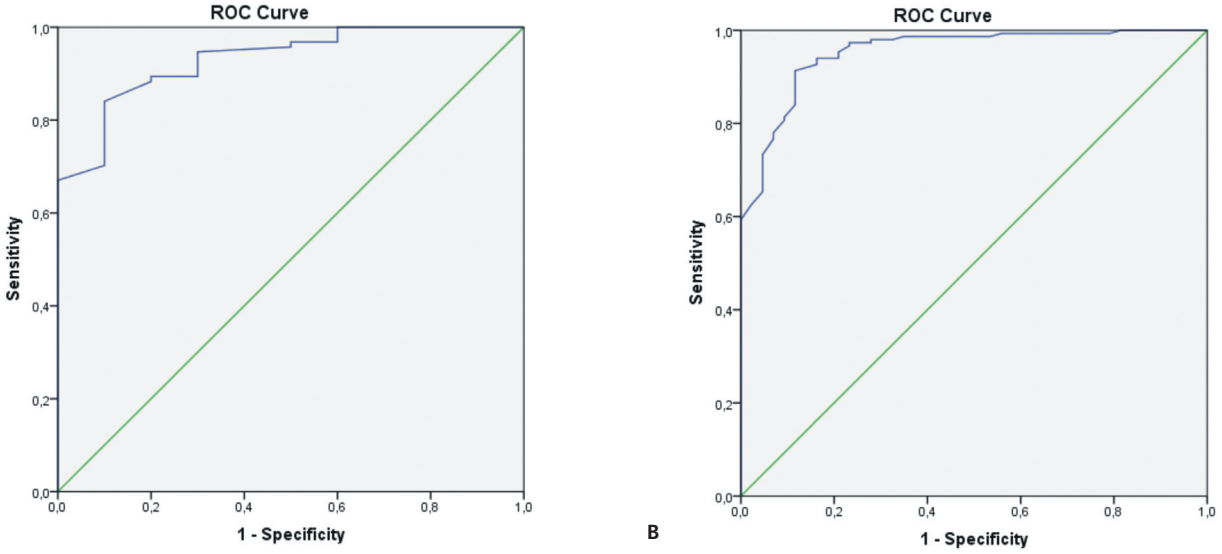

Figure 1— A. Receiver operating characteristic (ROC) curve for educated healtly elderly versus dementia subjects. Area under ROC curve = .931 (Standart error (SE) = 0.032; 95% confidence interval (CI) = 0.870-0.993. **B.** ROC curve for less educated healthy elderly versus dementia subjects. Area under ROC curve= .954 (SE= 0.016; 95% CI= 0.922-0.985)

Validity of DEKOD

We found that the DEKOD is a valid cognitive test for the Turkish speaking population, based on a door-to-door type epidemiological study. The sensitivity and specificity rates for differentiating dementia patients from healthy control participants were over 80% in the educated, illiterate and less educated population groups. The comparison of DEKOD and rMMSE-T values in dementia and MCI groups are shown in Table 2.

The DEKOD was also efficient in differentiating MCI from HC in the educated group, but was less effective in differentiating the less educated MCI from the less educated HC.

Healthy Elderly Versus Dementia

In the ROC curve for the DEKOD in educated healthy elderly compared to dementia participants, the area under the curve (AUC) was found to be 0.931 (Figure 1A). A cut-off point of 72/73 had the highest sensitivity (84%) and specificity (90%). The positive predictive value (PPV) was found to be 27.6%. Likewise, negative predictive value (NPV) was 99% when the disease prevalence was 5%. When the positive likelihood ratio (+LR) and negative likelihood ratio (-LR) were calculated, they were found to be 8.3 and 0.2, respectively.

In the ROC curve for the DEKOD in the less educated healthy elderly versus dementia participants, the AUC was found to be 0.954 (Figure 1B). A cut-off point of 49/50 had the highest sensitivity (91%) and specificity (89%). The PPV was 76.5% and the NPV was 95%. When +LR and -LR were calculated, they were found to be 8.27 and 0.1, respectively.

Healthy Elderly Versus MCI Participants

In the ROC curve for the DEKOD in educated healthy elderly versus MCI participants, the AUC was found to be 0.862 (Figure 2A). A cut-off point of 75/76 had the highest sensitivity (80%) and specificity (79%). The PPV was 0.5% and the NPV was 90%. Additionally, +LR and -LR were calculated to be 3.8 and 0.25, respectively.

In the ROC curve for the DEKOD in less educated healthy elderly versus MCI participants, the AUC was found to be 0.719 (Figure 2B). A cut-off point of 60/61 had the highest sensitivity (70%) and specificity (65%). The PPV was found to be 24.5% and the NPV was 85.9%. +LR and -LR were calculated to be 20 and 0.46, respectively.

Reliability of the DEKOD

An internal consistency analysis was performed for both educated and less educated elderly participants in terms of total score and items of the DEKOD. Correlations and Kappa

values for intrarater and interrater test-retest reliability of the DEKOD were also calculated.

The Cronbach's α values of the DEKOD for educated and less educated elderly participants were higher than 0.86, indicating good internal consistency. Strong and statistically significant correlations between intrarater and interrater test-retest scores of elderly participants were observed [0.781 ($p<0.01$); 0.756 ($p<0.01$), respectively] when a Kappa analysis was performed.

Discussion

The purpose of this study was to examine the validity and reliability of a brief cognitive assessment test, the DEKOD, to differentiate illiterate or less educated demented and MCI participants from healthy elderly control (HC) participants in the Turkish speaking population. The results of the study revealed that the DEKOD is a useful cognitive screening tool for detecting dementia, regardless of educational level, with a high reliability and validity in the population above 65 years of age. The main advantage of the DEKOD is that it provides a tool that does not require reading and writing, therefore is easily administered to illiterate individuals. The test also has good sensitivity and specificity when applied to educated MCI participants. However, the test seems not to be sensitive enough to differentiate MCI participants from HC in the less educated population. The clinical diagnosis of dementia does not only include the assessment of cognitive impairment but also impairment in daily living activities. In the current study, the IADLs was used to assess functional status of the participants. In line with previous studies (9), we found that impairment of IADLs significantly correlated with DEKOD scores. Therefore, combined use of the DEKOD and IADLs would help to improve the sensitivity for detecting MCI in the less educated population.

DEKOD Test in Dementia

It is well known that better educated participants outperform illiterate or less educated participants on cognitive tests (10). The cut-off scores used in the cognitive assessment of educated participants may lead to incorrect evaluations of the cognitive state of illiterate or less educated participants in terms of the diagnosis of mild cognitive impairment or dementia. We have developed the DEKOD to address the assessment challenges involved in cognitive screening of illiterate or less educated dementia and/or MCI participants, and evaluated its validity by means of a trial with the community-dwelling elderly. Recently, Babacan-Yıldız et al. (10) have developed the COST (Cognitive State Test), which

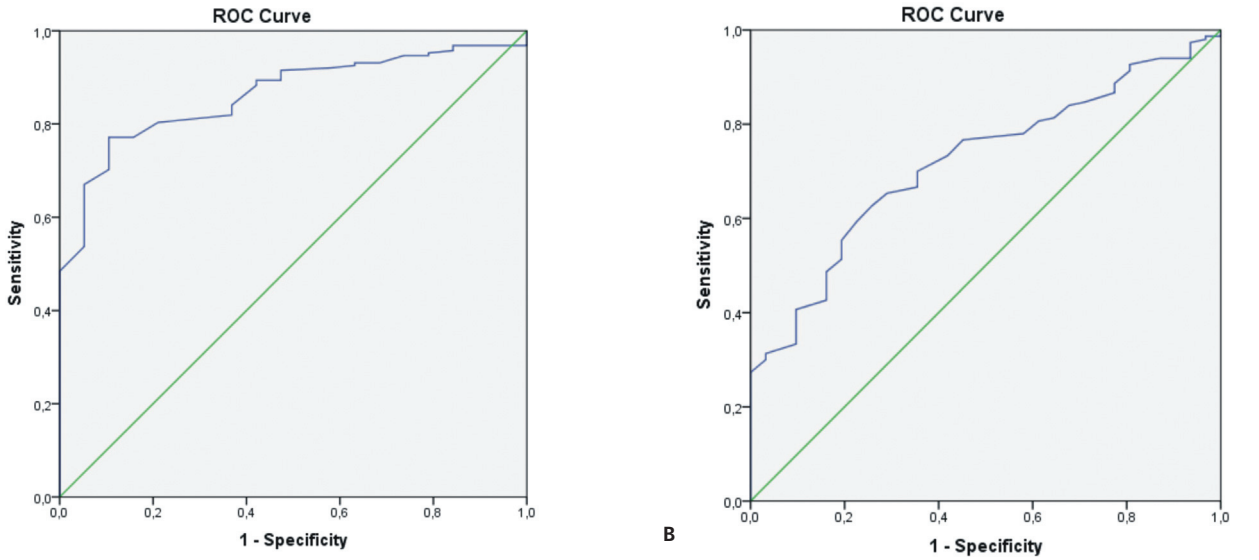

Figure 2— A. Receiver operating characteristic (ROC) curve for educated healthy elderly versus MCI subjects. Area under ROC curve= .862 (SE= 0.032; 95% CI= 0.799-0.925). **B.** ROC curve for less educated healthy elderly versus MCI subjects. Area under ROC curve= .719 (SE= 0.044; 95% CI= 0.633-0.804)

serves the same purpose in the Turkish speaking population. The COST was administered only to enrolled AD patients among those who were referred to an outpatient clinic, along with a relatively small sample size of healthy controls (n=114), and cannot be extrapolated to the general population of Turkey. The main strength of the present study is that data collection for the DEKOD was based on a door-to-door survey that involved a representative sample of elderly people living in the community.

The Montreal Cognitive Assessment (MoCA) has been suggested as a cognitive screening tool for the detection of MCI (11). Selekler et al. (12) reported that the MoCA provides an efficient way to discriminate Turkish MCI and AD patients from the healthy elderly. However, the sample size of their study is very small (MCI, n=20; AD, n=20; healthy participants, n=165) and the mean education level is approximately ten years of schooling in the targeted population. Therefore the test cannot be generalized to the Turkish population and the MoCA needs to be validated on a large sample group before being recommended for use in clinical practice.

In Turkey, one of the most commonly used screening tools is the Mini Mental State Examination (MMSE) (13). The first Turkish version of the MMSE (MMSE-T) was validated with an elderly group of participants who had received at least five years of education (14). Thus, it did not reflect the cognitive properties of the community-dwelling elderly. In their community-based study, Keskinoğlu et al. (8) revised the MMSE-T (rMMSE-T) and suggested a cut-off score as 22/23, with 91% sensitivity, 97% specificity, 59% positive predictive value and 99.6% negative predictive value. The rMMSE-T is a brief screening tool that assess orientation, registration, attention and calculation, recall, naming, repetition, comprehension, reading, writing and drawing abilities of both literate and illiterate elderly.

Still, in clinical settings it was observed that a more comprehensive assessment of memory encoding, retrieval and recognition, as well as naming, verbal fluency and calculation abilities, was needed. Therefore, the aim of developing the DEKOD was to detect the abnormalities in these cognitive domains. Although the cognitive domains that have been assessed by rMMSE-T and DEKOD are similar to each other, DEKOD offers a relatively more detailed evaluation of the above mentioned skills than rMMSE-T does. Furthermore, DEKOD includes the subtests that assess verbal fluency and judgment which are two considerable components of executive functions. In terms of the DEKOD's validity, the study was conducted on a large scale elderly population, including demented patients with various etiologies and MCI participants. The DEKOD total score showed a good positive correlation with rMMSE-T and IADLs and a weak negative correlation with CDR and GDS scores. These results suggest that the DEKOD can distinguish severe stages of dementia. Aside from the subtests of the DEKOD that assess memory, calculation and naming, its subitems that include verbal fluency, abstract thinking and attention also allow screening for frontal lobe disturbance appearing in frontotemporal or Lewy-body dementia.

The high sensitivity and specificity values of the DEKOD suggest its usefulness as a diagnostic tool in screening educated and less educated dementia patients. The PPV indicates the probability that the disease is present when the test is positive. The PPV of the DEKOD obtained from educated and less educated elderly show that the test is good at diagnosing dementia in the less educated group, but not in educated participants. Because the predictive value is affected by the prevalence (8), the low PPV value was foreseen because of the relatively low disease prevalence among these participants. The negative predictive values of the DEKOD are high for both educated and less educated groups, indicating that if a participant has a higher score than the cut-off values, no dementia is present.

DEKOD Test in MCI

MCI is defined as a transitional state from normal aging to dementia (15). MCI patients may convert to Alzheimer's Disease, VaD or other types of dementia. The cumulative conversion rate of MCI to dementia was found to be about 21.9% in community-based studies, with an annual conversion rate of 3% (9).

In the present study, the DEKOD showed relatively good sensitivity (80%) and specifity (79%) for the educated MCI group. The mean scores of healthy elderly participants were significantly higher than those of MCI participants, regardless of education level (Table 1). However the sensitivity (70%), specificity (65%) and positive predictive value (24.5%) tests showed that the DEKOD did not serve so well to differentiate between the cognitive states of less educated MCI and healthy elderly participants. This result may be explained by the difficulty in providing operational criteria that distinguish MCI from normal cognitive aging (16), and because cognitive impairment due to age may be mainly affected by the low level of education. Cognitive tests specially designed to screen

for MCI such as the MoCA (11), or Memory Alteration Test (M@T) (17) have not been studied to assess the effect of educational level on the cognitive performance of MCI and healthy elderly participants. Therefore, it is suggested that the validity and reliability of the above mentioned tests, together with the DEKOD, for use with the MCI and healthy elderly participants with low levels of education, should be examined thoroughly.

Although the diagnostic criteria for MCI require normal activities of daily living (15), recent studies have reported that there is a significant association between MCI and IADL impairment (18). In the present study, the IADLs did not show any differences between either educated or less educated subgroups of MCI and healthy control participants. However, illiterate or less educated MCI participants performed lower on the DEKOD test when compared to age-matched healthy elderly participants. The combined use of the DEKOD along with a functional abilities assessment scale is suggested in order to distinguish in less educated MCI participants from healthy controls.

The main limitation of our study is the heterogeneity of the studied population, including both probable/possible AD or probable/possible VaD participants in dementia group and amnestic and non-amnestic MCI participants in MCI group. DEKOD must be administered in a larger and defined subgroups of dementia and MCI populations. In order to determine DEKOD's ability to distinguish these subgroups of dementia and MCI, further studies are needed to be conducted in clinical settings.

We believe a test like the DEKOD that examines cognitive domains such as memory, attention, calculation, verbal fluency, naming and abstract thinking, without requiring writing or reading skills, is a valid test in differentiating those with dementia from the healthy elderly, regardless of education. Moreover, it has still high sensitivity for distinguishing MCI participants from healthy elderly in the community-dwelling population with an education level of 5 years or more. In the less educated population, the DEKOD should be interpreted more cautiously or should be used together with functionality scales for better evaluation.

Conflict of Interest: None.

Description of Authors' Roles

P. Kurt was responsible for data collection and wrote the paper. P. Keskinoglu designed the study, and supervised the data collection. E. Yaka was responsible for data collection and clinical diagnosis. R. Ucku was responsible for study design. G. Yener was responsible for study design, test preparation, data collection and clinical diagnosis.

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