A Population-Based Study for the Standardization of the Turkish Version of the Modified Mini Mental State Examination (3MS) and Assessment of Certain Environmental Risk Factors for Dementia: Methodology and Sample Characteristics

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SUMMARY

Objective: The diagnosis of neurocognitive disorders requires an objective assessment of the patient's cognitive status and activities of daily living. No cognitive screening test with normative values exists in Turkey. This study aimed to standardize a widely applicable cognitive screening test, determine the activities of daily living in a population-based sample, and identify certain individual and environmental risk factors for cognitive disorders.

Methods: Since the Mini-Mental-State-Examination (MMSE) is widely used in primary and secondary care, and a version for the uneducated, an expanded and modified version of the MMSE, the Modified Mini Mental Test (3MS), was selected for standardization. After the adaptation and pre-testing processes, a population-based study including individuals over the age of 55 was planned in order to determine the normative values using the primary healthcare system in Ankara, Turkey. An age-based stratification procedure was applied. Data were collected via a cognitive evaluation as well as from a survey form that was developed to identify certain health-related occupational and environmental risk factors associated with cognitive disorders. This study was funded by the Scientific and Technological Research Council of Turkey (Grant No: 214S048).

Results: A population-based study was conducted between January 2016 and June 2016. The data from a total of 2,158 participants were analyzed. The geographic distribution of the final sample was representative of the total population in Ankara. Of the study sample, 51.3% were female, and 60% had over 5 years of education. Approximately 25% of all participants were 'screening-positive' for neurocognitive impairment, and age was inversely related with daily functioning.

Conclusion: We were able to reach a population-based sample to determine the normative values of a widely applicable cognitive screening test and the activities of daily living as well as evaluate dementia-related risk factors in Turkey.

Keywords: Dementia, screening, cognitive function, epidemiology, risk factors. modified mini mental state examination

INTRODUCTION

The diagnosis of dementia and related cognitive disorders requires the evaluation of neuropsychological functioning and daily activities of living. Current classification systems emphasize the use of objective tools for neuropsychological assessment. The DSM-5 (Diagnostic and Statistical Manual of Mental Disorders-5) recommends the use of standardized neuropsychological testing for the diagnosis of both major and mild neurocognitive disorders (American Psychiatric Association 2013). The National Institute of Neurological and Communicative Diseases and Stroke/Alzheimer's Disease and Related Disorders Association (NINCDS-ADRDA) criteria indicate that an objective cognitive assessment is required.

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However, this assessment does not necessarily have to occur via neuropsychological testing, but can be performed with a bedside mental status examination (McKhann et al. 2011). To diagnose Alzheimer's Disease (AD), International Working Group (IWG) criteria requires an objective demonstration of impairment in the episodic memory domain (Cummings et al. 2013). Thus, demonstration of an existence of cognitive impairment must be made through objective measures in order to diagnose different forms of dementing disorders.

Several neuropsychological tests are used for the detailed evaluation of cognitive domains. Several tests with a complete standardization exist in Turkey for the assessment of different cognitive domains, including memory, executive functions, and attention (Cangoz et al. 2009, Karakas et al. 2013, Kudiaki and Aslan 2008). However, standardized neuropsychological testing requires qualified personnel and a significant amount of time. In addition, general practitioners may have difficulties interpreting the results. Therefore, for the objective assessment of cognitive domains in primary and secondary health care; short and widely applicable general cognitive screening tests covering different cognitive domains are crucial for proper screening and diagnosis of neurocognitive disorders.

Screening Tests for the Evaluation of Cognitive Disorders

General cognitive screening tests are used to screen cognitive disorders among the general population. So far, the following tests have been adapted to Turkish: Mini Mental State Examination (MMSE), Blessed Orientation-Memory-Concentration (BOMC), Montreal Cognitive Assessment (MOCA), and Addenbrook Cognitive Examination–Revised Form (ACE-R) (Akca Kalem et al. 2002, Kaya et al. 2014, Mihci et al. 2011). These tests have completed the adaptation process, underwent validity and reliability studies and cut-off points for AD (and in some tests, for MCI-Mild Cognitive Impairment) were determined. However, for none of these tests have normative values for the Turkish population been identified. Without age and education-adjusted norms, health care professionals are bound to use the cut-off scores, which will limit the informative value of the tests. For example, a highly educated, relatively young individual and a low-educated elderly person must be assessed with the same cut-off scores, even though it is generally the case that high educational attainment is positively correlated with test scores and age is negatively correlated with test scores. Therefore, the use of one universal cut-off score may lead to false negativity for the first case and false positivity for the second case.

Another factor limiting the use of the cognitive screening tests is their target population. In particular, the recently developed MOCA and ACE-R are both used only for screening the educated elderly, while the BOMC (developed in 1968) can be utilized for screening undereducated individuals. However, the coverage of the BOMC test is limited, comprising only orientation, memory and concentration domains, limiting its use for the screening and follow-up of different forms of dementia. There are several different Turkish versions of the widely-used MMSE, which can also be used to screen the undereducated (Babacan-Yildiz et al. 2016, Güngen et al. 1999, Keskinoglu et al. 2009). The different versions of the MMSE have different cut-off points. Babacan-Yıldız et al. used the first published Turkish adaptation of the MMSE (Gungen et al. 1999) for a validity and reliability study in the undereducated (2016). The cut-off for Alzheimer's Disease was determined as 23/24 (Babacan-Yildiz et al. 2016, Güngen et al. 2002). In their revised version of the MMSE, Keskinoğlu et al. determined the cut-off score for dementia as 18/19 (Keskinoglu et al. 2009). According to the Turkish Statistical Institute (2015), 21.9% of the Turkish population over 65 years of age is illiterate, while 43.0% had only a primary education. In addition, illiterate female elderly were four times more frequent than males (İstatistiklerle Yaşlılar, 2015 2016). The educational status of the elderly poses difficulties in the efficient use of standardized screening tests in primary care.

The lack of normative values, the scarcity of tests for the undereducated, and the clinical, rather than a community-based design, of the current studies (except Keskinoglu et al. 2009) in Turkey indicate that there is a need for a complete standardization of a widely applicable cognitive screening test.

The Modified Mini Mental State Examination (3MS)

The Modified-Mini-Mental State Examination (3MS) is based on the items and the structure of the Mini Mental State Examination. The test was developed by Teng and Chui in 1987 (Teng and Chui 1987). An adapted version of the test was used in a large-scale epidemiology project known as the 'Cache County Study' (Tschanz et al. 2002). The 3MS is a modified version of the MMSE. The test comprises the items of the MMSE and includes questions assessing additional cognitive functions. Differences between the 3MS and MMSE are as follows (Teng and Chui 1987):

a. The 3MS was intended to be more sensitive to small-scale changes in cognitive status, and therefore, the maximum score was increased to 100 (is 30 in the MMSE). Due to this increase, the weight of the items were changed. For example, the maximum score for orientation in the MMSE is 10 (1/3 of the total), while it is 20 in the 3MS (1/5 of the total).

b. Items assessing additional cognitive domains were added, including the assessment of frontal lobe functions (using a question about similarities), semantic fluency, and autobiographical memory.

c. The evaluation of certain domains is more detailed. For example, in the 3MS, if the participant does not recall spontaneously during recall trials, as conducted in a clinical evaluation, a semantic clue is presented followed by a recognition trial when necessary. This stepwise evaluation matches the criteria for the diagnosis of IWG AD (Cummings et al. 2013). In addition, the memory assessment is repeated as the last item in the test in order to increase the test's sensitivity (In fact, the performance in the second recall trial better identifies AD (Lyness et al. 2014)). Another example that aims to increase the accuracy of evaluation is the naming item. As opposed to the MMSE, which utilizes two words for naming, 3MS has five items.

d. An instruction guide was developed for standardization purposes. Quizzes were prepared in order to assess competence.

The changes to the 3MS increased the test's predictive power (Lyness et al. 2014) and provided psychometric advantages over the MMSE (McDowell et al. 1997). In the years following the 3MS's generation, normative values have been identified for different communities in North America (Bland and Newman 2001, Bravo and Hebert 1997, Tschanz et al. 2002). The 3MS has also been used as a cognitive assessment tool for different medical conditions (Li et al. 2016, Lyness et al. 2014, Pope et al. 2007).

Evaluation of Daily Activities of Living

The evaluation of Daily Activities of Living with standardized instruments is crucial for the diagnosis and follow-up of cognitive disorders. To the best of our knowledge, the only instrument with a completed adaptation process in Turkish is Functional Activities Questionnaire(Selekler et al. 2004). On the other hand, the Katz Index of Independence in Activities of Daily Living and The Lawton Instrumental Activities of Daily Living (IADL) Scale are frequently used in neurology, psychiatry, and geriatrics clinics (Graf 2008, Katz 1983, Lawton 1971, Li et al. 2016). The basic activities of daily living included by the Katz Index are bathing, dressing, self-care, mobilization, incontinence, and feeding. The IADL Scale assesses the ability of a person to do tasks such as using the telephone, going shopping, preparing food, housekeeping, doing laundry, using transportation, being responsible in taking one's own medications, and the ability to handle finances in a gradual fashion.

In clinical settings, these scales are used in a cross-sectional fashion. However, it is important to determine whether the individual was previously capable of performing the activity in question. In addition, it is also important to keep in mind the frequency of a given activity in persons with similar age and gender. For example, in some communities, male individuals are not scored on food preparation, housekeeping, or laundry items (Alexandre Tda et al. 2014). In Turkey, these two scales have been used in studies targeting samples with certain characteristics (e.g., AD patients, individuals with orthopedic disabilities, certain occupation groups, etc.). However, to the best of our knowledge, these basic and instrumental activities have not been assessed in a large-scale cognitively normal community sample.

While evaluating cognitive disorders, it is also important to determine to what extent the activities of daily living (ADL) are affected by cognitive performance. In general, MMSE scores have a linear correlation with ADL scores (Reisberg et al. 2011). In a U.S. sample, MMSE scores under 20 were associated with an objective impairment in ADL (Reisberg et al. 2011). However, no community-based study exists displaying such association in the Turkish population.

For the aforementioned reasons, the current study aimed to complete:

1. The standardization of the Turkish version of the 3MS, and
2. The adaptation of the ADL and IADL and the determination of the norms in a large Turkish sample.

Since the normative values of the 3MS would best be determined with a community-based sample, we also aimed to identify certain individual and environmental risk factors for dementia. The results of the current study were compared with previous community-based studies conducted in Turkey (Harmanci et al. 2003, Keskinoglu et al. 2006, Arslantaş et al. 2009).

METHODS

Standardization Study of the 3MS

After translation, cultural adaptation and pre-trial phases, we planned to conduct studies to determine the norms and validity-reliability of the test. We aimed to identify the norms for the educated and undereducated forms of the test in a population-based sample. As the next step, selected participants from the field study were planned to be invited to the Neurology and Psychiatry Outpatient Units at Hacettepe University. All participants attending the clinical phase will be evaluated according to the clinical protocols for cognitive disorders; including but not limited to blood tests, imaging and neuropsychological testing. The syndromic and etiologic diagnoses will be determined by the consensus of a neurologist and a psychiatrist who are authors of this study. The reliability-validity studies will be performed based on these clinical diagnoses and cut-off scores for AD and MCI will be determined. The timeline for the standardization studies is presented in Figure 1.

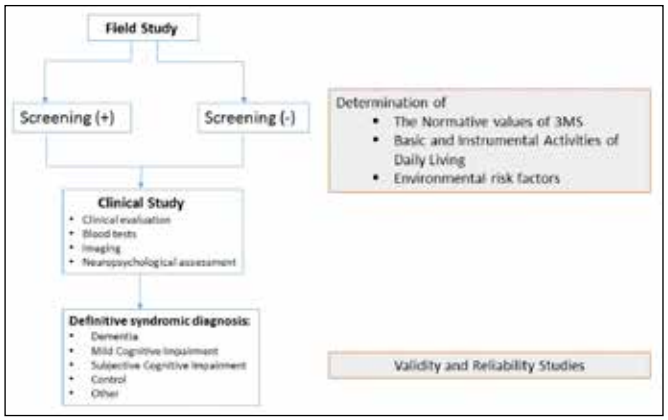

Figure 1. Timeline.
Figure 1 shows the timeline and the aims of each experimental step. The left side of the figure displays the steps, while the right side displays the outcomes. The procedures in the clinical study will be applied to each participant of that phase, along with additional tests when necessary. Etiological classifications will be undertaken for Dementia and Mild Cognitive Impairment groups. If we will not be able to recruit enough participants from the field study to the clinical phase for any group, patients from Neurology and Psychiatry Outpatient Units will be included 3MS: Modified-Mini-Mental Status Examination

Population and Sample Characteristics

Ankara was selected as the study population for the norm study. According to the Turkish Statistical Institute (2016), the population of Ankara is 5,346,518. There are 25 districts of Ankara, and at the time the study, there were 1,422 general practitioners who were serving in 342 Family Health Centers (FHCs). These primary care facilities covered a total of 893,505 individuals over 55 years of age in Ankara.

To estimate the target sample size, we used variables defined in previous studies (Brown et al. 2003, Jones et al. 2002), including age, education, and gender (Amaral-Carvalho and Caramelli 2012, Jones et al. 2002, Larouche et al. 2016). Based on previous local field studies and the authors' previous experiences, the non-response rate was estimated to be 40%.

The sample size was determined based on the prevalence of possible dementia. To our knowledge, no systematic study assessing the prevalence of dementia in Turkey has been conducted, and therefore, we based our estimates on data from the World Health Organization (WHO). Accordingly, the prevalence of dementia was estimated at 1.0% for the 55-64 age group, 1.5% for the 65-69 age group, 3.0% for the 70-74age group, 5.5% for the 75-79 age group, and 12.0% for those above 80 years of age (World Health Organization 2012). A stratified random sampling strategy was applied using the Neyman allocation. Given the potential 40% non-response rate, the initial sample size was calculated as 1,655 individuals (280 people in the 55-64 age group, 132 people in the 65-69 age group, 194 people in the 70-74 group, 252 people in the 75-79 group, and 797 people in the group above 80 years of age).

Since all 25 districts of Ankara were represented, and since there is nearly full population coverage within the primary care system, the sample selection was based on the primary care system. In Turkey, the number of family physicians in each FHC varies based on the population of their catchment area. However, every physician serves a similar number of individuals. After determining the FHCs and the number of physicians in each district, we applied a weighted approach based on the district's population. Within each district, candidate FHCs (or their substitutes) were randomly chosen. Family physicians participated in the study on a voluntary basis. Sample size was recalculated once the participating centers and the physicians were determined. Based on the total number of centers and the number of potential participants, the final target sample size was calculated as 1,740.

Data Collection Tools for the Field Study

The field form included four sections. The first section included questions regarding sociodemographics, the second section included questions from the 3MS (and MMSE), the third section evaluated the daily activities of living, and the fourth section screened for possible risk factors for dementia. The responses of the participants and caregivers were used to evaluate the risk factors and health status of the participants. Participants and their caregivers were specifically questioned about the presence of medical conditions such as hypertension, diabetes, heart disease, hypercholesterolemia, vitamin deficiencies, thyroid disorders, tobacco/alcohol/substance use, dental health issues, previous operations, and body mass index (Chui and Ramirez Gomez 2017, Sachdeva et al. 2016, Zhang et al. 2017). In addition, the participants/caregivers were also questioned about certain health behaviors, environmental characteristics, and occupational and environmental exposures to various toxins. The draft version of the form was piloted with 26 individuals in a FHC that was not included in this study. Feedback from both the applicants and the participants were evaluated, and a final version of the form was created.

Adaptation of the 3MS

Development of the Turkish 3MS

We chose one of the currently available versions of the Turkish MMSE since the 3MS also contains MMSE items, and because the MMSE scores were going to be used in the field study. Two versions of the MMSE were available at the study's onset (Keskinoglu et al. 2009, Güngen et al. 2002). We decided to use the revised version of the MMSE (developed by Keskinoglu et al.) because that version was based on a community study, the psychometric properties of the uneducated form was published, and a standardized guide was developed (Keskinoglu et al. 2009). Accordingly, the items from the revised MMSE were adapted and used 'as is.'

The development process of the educated form was previously published (Karahan et al. 2017). Briefly, we made changes to the memory and naming items of the educated form, and to the memory, naming, and visuo-spatial items of the undereducated form. No changes were made to the scoring, and each item was scored as it was in the original 3MS. In addition, we also adapted the guide and the instructions.

Translation and Adaptation of the 3MS

After obtaining permission from the original authors of the 3MS, forward and backward translations were completed by different translators. Following the adaptation steps detailed above, cognitively normal individuals evaluated the draft form in order to check for any language and/or cultural issues and to determine the length of testing. In addition, the item scores from this first draft were compared with scores obtained from neuropsychological tests measuring similar cognitive domains (Karahan et al. 2017). Based on these pre-trial results, the draft was re-evaluated by two dementia experts, and the final version of the 3MS used in this study was developed.

Adaptation of the Katz ADL and Lawton-Brody IADL and Their Use in the Field Form

The current Turkish versions of the Katz ADL and the Lawton IADL Scales were evaluated and re-translated. The versions were finalized following the back translation process.

Since these tests were not previously validated in cognitively normal individuals, we added an additional scale (the Functional Activities Questionnaire (FAQ)) that had been previously adapted to Turkish. For the ADL and IADL, in cases where the participant was dependent on others to perform any activity, we planned to gather information on the reasons of dependence. The forms included questions as to whether or not the dependent individual was also previously dependent on others when performing that particular activity. If the participant was not currently performing a particular activity, we questioned the caregiver as to his/her thoughts about whether the participant had the ability to perform the activity in question. If the participant could previously perform an activity independently, but had become dependent on others to do it by the time of questioning, the reasons for the current dependence (e.g., physical, mental, financial, etc.) were questioned. By doing so, we aimed to determine whether there was an actual 'impairment' in the activity level, and if so, the reasons for the impairment.

Determination of Environmental Risk Factors

In order to evaluate the individual and environmental risk factors for impaired cognitive performance, we prepared a questionnaire with two sections. One section included questions on health status and health behaviors, and the other included questions on certain occupational and environmental risk factors.

Data Collection

A team of twelve field staff (eight interviewers, three auditors, and one field coordinator) collected the data for the field study. The interviewers were selected from college graduates, and were recruited after a process including an interview, a field training, and theoretical and practical assessments. The interviewers underwent a three day didactic training followed by a theoretical examination. A practice session and a practical assessment was organized in a FHC that was not included in the study.

The field study was conducted between February 2016 and June 2016. All data were collected during visits to the FHCs. The participants were randomly selected based on the population registered to family physicians. Given the age group distribution, at each FHC, three participants from the 55-64 age group, two participants from the 65-69 age group, two participants from the 70-74 age group, two participants from the 75-79 age group, and seven participants above 80 years of age were selected and invited to enroll in the study. The majority of the data were collected at the FHCs. If any physical, mental, or other reasons prohibited the invited individuals from coming to the FHC, they were visited at their homes with their permission. If the registered individuals were residents of nursing homes, they were visited at the nursing homes after obtaining necessary permissions.

Data Analysis

The data were analyzed with IBM SPSS 22.0. After determining the minimum/maximum values and the reliability of the dataset, all missing, incorrect, or unreliable data were removed. Data were summarized by descriptive statistics (mean±SD or median [25-75 percentile], frequency and percentage as necessary).

Ethical Approval and Related Issues

This study was approved by the Kecioren Education and Training Hospital Clinical Research Ethical Committee (09.07.2014/ B.10.4.İSM.4.06.68.49). Additional administrative approval was obtained from the (formerly) Public Health Institution of the Turkish Ministry of Health.

All participants were informed about the study by verbal and written means. Only participants who provided signed informed consent were included in the study.

All participants who were evaluated during the pre-trials and the field study were given information regarding how to review the results of their evaluations. Those who screened positive for cognitive impairment were referred to appropriate health facilities.

RESULTS

In the field study, we reached 2,201 individuals from the 25 districts of Ankara. After excluding those participants whose data collection was deemed not appropriate, who left the study prematurely, and whose forms did not pass the reliability testing, there remained a total of 2,158 forms. The geographic distribution of the final sample represented the target population (i.e., there was no statistical difference between the target population and the final sample distribution, p>0.05) (Table 1, Figure 2).

Sociodemographic Characteristics

Of the 2,158 participants, 51.3% were female, 60.0% had greater than or equal to five years of education, 67.8% were currently married, 14.0% lived alone, and the monthly median household income was 1500 TL (500 USD). The characteristics of the sample are presented in Table 2.

Table 1. Distribution of the population over 55 years and the study sample (Ankara, 2016)

District	Population		3MS Sample	
	(Population >55 years of age in Ankara)	Percent	Number	Percent
Akyurt	4424	0.5	16	0.7
Altındağ	59773	6.7	134	6.2
Ayaş	4329	0.5	34	1.6
Bala	5927	0.7	20	0.9
Beypazarı	12229	1.4	24	1.1
Çamlıdere	3211	0.4	17	0.8
Çankaya	217111	24.3	330	15.3
Çubuk	14797	1.7	66	3.1
Elmadağ	8008	0.9	8	0.4
Etimesgut	56495	6.3	148	6.9
Evren	1203	0.1	19	0.9
Gölbaşı	15984	1.8	48	2.2
Güdül	4137	0.5	17	0.8
Haymana	8270	0.9	5	0.2
Kalecik	4889	0.5	16	0.7
Kazan	6089	0.7	19	0.9
Keçiören	141815	15.9	301	13.9
Kızılcahamam	9465	1.1	15	0.7
Mamak	86803	9.7	175	8.1
Nallıhan	10359	1.2	51	2.4
Polatlı	21904	2.5	115	5.3
Pursaklar	13510	1.5	35	1.6
Sincan	61664	6.9	214	9.9
Şereflikoçhisar	9133	1.0	43	2.0
Yenimahalle	111976	12.5	286	13.3
Unidentified	-	-	2	0.1
Total	893505	100.0	2158	100.0

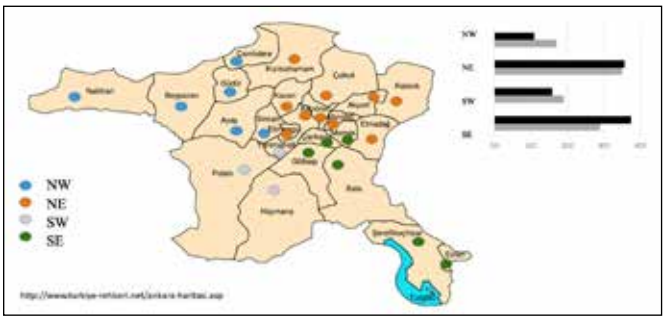

Figure 2. Geographic Distribution of the Sample.
Geographic distribution of the actual sample (gray bars in the graph) did not differ from the targeted population (black bars) (x2=6.03, df=3, p=0.111; x axis shows the percentage among the total population). NW: Northwest, NE: Northeast, SW: Southwest, SE: Southeast)

Table 2. Social and demographic characteristics of the study sample (n=2158) (Ankara, 2016)

	3MS Sample	
	Number	Percent
Age groups (years)		
55-64	468	21.7
65-69	326	15.1
70-74	288	13.3
75-79	294	13.6
≥80	782	36.2
Gender		
Male	1051	48.7
Female	1107	51.3
Marital Status		
Married	1463	67.8
Never married	16	0.7
Widowed/ Divorced	665	30.8
Other	14	0.7
Number of Children (median, 25%-75%)	3 [2 – 5]	
Level of Education		
0-5 years	1550	71.8
6-11 years	342	15.8
>11 years	266	12.3
Place of the interview		
Family Health Center	1802	83.5
House	296	13.7
Other	60	2.8
Income (median, 25%-75%) (TL)	1500 [1200 – 2000]	

Cognitive Performance

There are two versions of the revised-MMSE based on the level of the participants' education; a form for the educated (individuals with an education of five years or more) and a

Table 3. rMMSE scores* of the study sample based on educational status** (Ankara, 2016)

		n (%)	Mean	Median	Std. Deviation	Min	Max
Educated	rMMSE	1277 (59.4%)	24.68	25	3.67	9	30
Uneducated	rMMSE	873 (40.6%)	20.76	21	4.96	0	30

* rMMSE: revised Mini-Mental State Examination Scores (Derived from the 3MS),**Educated: Participants with 5 or more years of education, Uneducated: Participants with less than 5 years of education.

Table 4. Distribution of the study sample based on the rMMSE* cut-off scores (Ankara, 2016)

			Cut-off Scores		Total
			Below	Above	
Educational Status**	Uneducated	Number	273	600	873
		%	31.3	68,7	
	Educated	Number	279	998	1277
		%	21.8	78,2	
Total		Number	552	1598	2150
		%	25,7	74.3	

* rMMSE: revised-Mini-Mental State Examination Scores (Derived from the 3MS),**Educated: Participants with 5 or more years of education, Uneducated: Participants with less than 5 years of education. The cut-offs were 19 for the uneducated form and 23 for the educated form, as established in the original study (Keskinoğlu et al. 2009)

Table 5. Functional Activity Questionnaire Scores (Ankara, 2016)

			FAQ Cut-Off		Total
			Above	Below	
Age Groups (years)	55-69	Number	706	80	786
		%	89.8	10,2	
	70-79	Number	489	81	570
		%	85.8	14,2	
	>80	Number	438	334	772
		%	56.7	43,3	
Total		Number	1633	495	
		%	76,7	23.3	

form for the uneducated (less than five years of education, including illiterate individuals). The cut-off scores are 22/23 for the educated and 17/18 for the uneducated participants (Keskinoglu et al. 2009). Since we estimated rMMSE scores from the 3MS in the field study, the cut-off scores previously determined for these two versions (for the educated and uneducated) were used. Results indicate that 21.8% of the educated group and 31.3% of the uneducated group scored less than (screened positive for) the cut-off values of 23 and 19, respectively (Table 3). The distribution of the scores is presented in Table 4.

Activities of Daily Living

As described above, daily activities of living were evaluated with the Functional Activities Questionnaire-Turkish version, which was previously validated. The scores of 2,128 participants were determined. The frequency of participants with impaired functional activities was 10.2% in the 55-69 age group, 14.2% in the 70-79 age group, and 43.3% in the group older than 80 years (Table 5). When the items were evaluated across all age groups, impairment was most frequently reported in the "independent travel" item. The most common activity that could be performed independently among the participants in the 55-79 age group was "Simple cooking-heating abilities" and in the group over the age of 80 years was "Keeping track of current events" (Figure 3). The MMSE scores (estimated from the 3MS) and FAQ scores were negatively correlated (r=-0.468, p<0.001).

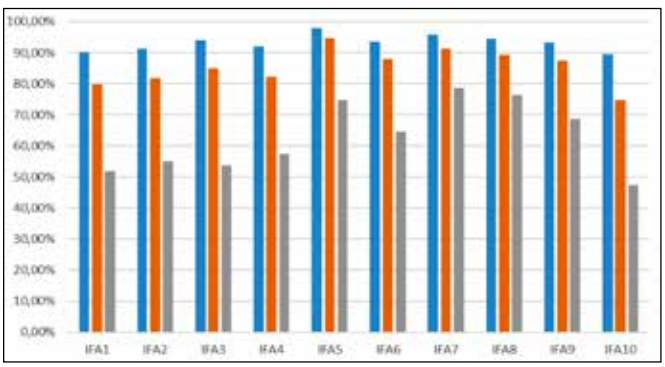

Figure 3. Items of Functional Activities Questionnaire among age groups
FAQ: Functional Activities Questionnaire. FAQ1: Paying bills, balancing checkbook; FAQ2: Assembling papers, tax returns; FAQ3: Shopping alone; FAQ4: Playing a game, hobby; FAQ 5: Basic heating, using stove; FAQ6: Preparing a balanced meal; FAQ7: Keeping track of current events; FAQ8 Paying attention to, understanding discussing media; FAQ9: Remembering appointments, family occasions, medications; FAQ10: Travelling (Selekler et al. 2004). y axis denotes the frequency of full functional independence in the given activity, x axis denotes individual items. The bars represent three age groups; blue 55-69 years, orange 70-79 years, and gray ≥80 years of age.

DISCUSSION

In our study, as a part of the standardization of a cognitive test, data for 2158 individuals were analyzed. Data were collected from each patient regarding social and demographic features, cognitive status, and daily activities of living, as well as health and health behaviors, and occupational and environmental risk factors for cognitive disorders. Of the study sample, 40.0% had less than 5 years of education, the median income was in the middle-income range, most of the sample were married, the median number of children was three, and the

majority of the participants was residing with their family. Results indicate that functional independence decreased with age, and there was an inverse correlation between functional status and cognitive performance.

Despite this study's many strengths, there were several limitations regarding the sampling strategy. In line with the permissions granted from the Ministry of Health, in each district, the sample was selected randomly from the list of the family physicians working at the FHCs. Thus, the study was conducted only with the physicians who agreed to participate. We do not know the characteristics of the elderly individuals who were registered in the lists of non-participating physicians, nor do we know anything about those who did not accept the invitation to participate in the study. In order to avoid potential bias, we undertook a consecutive selection strategy (i.e., when a physician/individual did not accept the invitation to participate in the study, the next physician/individual in the same age group was invited). Since there is no information on whether the physicians from the same FHCs in the same district served populations with different characteristics, we assumed that our selection method would avoid bias.

Another limitation regarding the sample selection, albeit with a smaller effect, was associated with the study duration and the participants' places of residence. We were not able to include individuals who were not residing at their residential addresses during the time of the study. However, we did include those residing in nursing homes. While it is possible that the response rates were different among these two groups of individuals, we do not have enough information to make such a comparison. Although including individuals from nursing homes might cause bias regarding the assessment of functional independence levels, the sample selection process was random, those in nursing homes were considered to be a part of the study population, and they had representational value; therefore, they were not excluded from the study.

The screening tool used in the current study (the MMSE, derived from the 3MS) was validated in Turkey with a population over the age of 65, and therefore, inclusion of data from individuals between 55-64 years of age might be considered a limitation. However, to our knowledge, a threshold for cognitive impairment for any screening test has not been established in Turkey for individuals under the age of 65. The data gathered from this field study do not indicate the rate of diagnosed cognitive diseases, but rather reveal the prevalence of individuals who screened positive. Since additional clinical evaluations were to be performed for the validity study, we did not directly associate the actual disease diagnoses with the data from the field study.

Data quality may be a concern for studies with a big sample size, such as the current study. In order to ensure the accuracy and reliability of the data collection process, a three day theoretical training and a one day practical training was conducted. In addition, the interviewers performing the cognitive testing were examined after the formal training, and an additional practical training session and supervision were supplied by the principle investigator. The auditors reviewed the interviewers' work on a daily basis, and randomly-selected questionnaires were appraised by the researchers during the field study. If these questionnaires contained any incorrect data or lacked certain data, the participants were re-contacted, and the necessary information were gathered. All data entry was organized into a two-step process.

In conclusion, by the end of the field study, we were able to reach a large enough sample to determine the normative values of the Turkish 3MS, to better understand the daily activities of living of individuals over 55 years of age, and to identify some dementia-related risk factors. We hope that our study will contribute to the fund of knowledge on dementia in Turkey.

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