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ORIGINAL ARTICLE

Utility of the Spanish version of the Everyday Cognition scale in the diagnosis of mild cognitive impairment and mild dementia in an older cohort from the Argentina-ADNI

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Abstract

Introduction The performance of activities of daily living in elderly patients with memory disorders is directly related to living independently and to autonomy. Documenting and assessing functional capacity through detailed scales is important for both diagnostic and treatment recommendations. The Everyday Cognition (ECog) scale is a relatively new informant-rated measure of cognitive and functional abilities. In the present study, the discriminant validity of the ECog scale was evaluated in cognitively intact controls (CN) and in patients with mild cognitive impairment (MCI) and mild Alzheimer's disease (AD) from the Argentina-ADNI cohort to establish diagnostic accuracy. In addition, we compared the sensitivity and specificity of ECog against Functional Assessment Questionnaire (FAQ) scale to discriminate among the three groups.

Methods We evaluated 15 CN, 28 MCI, and 13 mild AD subjects. External, convergent and divergent validity and internal consistency were examined.

Results The average total score on the ECog was significantly different across the three diagnostic syndromes ($p < .05$). The ECog was more sensitive than FAQ in discriminating between CN and MCI patients and between MCI and AD subjects. The ECog showed a strong correlation with FAQ, and moderate correlations with neuropsychological tests. Cronbach's alpha was .98.

Conclusions The ECog scale is an efficient instrument for the differentiation of individuals with mild dementia or MCI from normal older adults, with good accuracy and good correlation with other tests measuring daily and cognitive functions. Comparing against FAQ, ECog was more useful in assessing changes in functionality in MCI patients.

Keywords Activities of daily living · Aging · Alzheimer's disease · Cognitive disorders · Mild cognitive impairment

Introduction

Functional capacity refers to the performance of basic (BADL) and instrumental (IADL) activities of daily living. BADL are those activities related to daily personal care such as feeding, showering, dressing, eating, toileting, walking and continence. IADL are more complex activities related to solving everyday situations and include managing finances, doing the laundry, preparing meals, shopping for food, using the phone and taking medications. Appropriate performance on these activities is directly related to independent living in the community and subject's autonomy. In patients with memory disorders, progressive functional impairment reduces subject's quality of life. Not being able to live independently causes distress in both patients and families, and means that help and supervision from a caregiver or family member is needed.

According to the latest published diagnostic criteria for Alzheimer's disease (AD) [1, 2], preserved functionality set an arbitrary limit between mild cognitive impairment (MCI) and the dementia syndrome since impairment in these activities is a well-established diagnostic criteria for dementia. However, recent research had challenged this paradigm by showing that MCI subjects may have subtle difficulties in performing highly cognitively demanding or complex

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activities [1, 3, 4]. In fact, some studies suggested that this subtle functional impairment may predict conversion to AD [5] and may be associated with faster rates of longitudinal functional decline in MCI [6]. Therefore, the remaining next question is how we can precisely measure these mild functional changes in MCI subjects.

Currently, assessment of functional capacity is the result of clinical judgment made by a trained clinician on the basis of a general description of everyday functioning obtained from the patient and from a reliable informant. More precise evaluation could be done by observing the way that a subject performs a real activity of daily living and by asking subjects and informants to report how is the functioning of the subject in daily living. In everyday clinical practice informant report-based assessment is more practical to study than performance-based assessment [7].

There is not currently a "gold standard" evaluation tool to characterize activities of daily living in patients with memory disorders. The earliest studies in these populations often used antiquated methods developed for use with older people in rehabilitation settings. One of these scales is the Barthel Index [8] which is probably the best known assessment of functional ability for older patients. However, it mainly focuses on physical disability such as focal deficits after a vascular event and cognitive deficits tend to confound assessment [9]. The Lawton IADL is an appropriate instrument to assess independent living skills necessary to live in the community among older adults [10]. Although the skills assessed by this questionnaire are more complex than the more basic abilities assessed by the Barthel Index [9], the instrument may not be sensitive enough to detect subtle changes in function in early stages of neurodegenerative diseases. To enhance diagnostic sensitivity and specificity, the ADL scales were designed or modified for linking functional impairment with cognitive decline. The Functional Activities Questionnaire (FAQ) is both an informant and patient-based questionnaire of performance of 10 different activities [11] and is appropriate for older adults with normal cognition, MCI, as well as mild, moderate, and advanced dementia [12]. Previous results suggest that the FAQ can detect mild impairments on IADL in MCI and that it also have utility for distinguishing between MCI and mild AD [13]. However, it was developed to measure social function in older adults and cognitive or affective states may affect the global score and interpretation [11]. Scales such as the Blessed Dementia Rating Scale [14], the Disability Assessment for Dementia [15] or the Bayer Activities of Daily Living Scale [16] are commonly used tools in memory clinics, but none of them was constructed based on a domain-specific cognitive model.

The Everyday Cognition (ECog) scale [17, 18] was created to assess the functional abilities of older adults across a wide range of ability in the continuum between normal aging and AD dementia, including MCI patients and can sensitively evaluate the performance of everyday activities that reflect cognitive functioning. The ECog scale was shown to have external, convergent and divergent validity. In addition, its global score has been shown to discriminate between controls and MCI subjects, because it is sensitive to early functional problems [17, 18]. Due its features, the ECog scale deserves special attention in AD research, as it was administered as part of the Worldwide Alzheimer's disease neuroimaging initiative (ADNI) and Argentina-ADNI longitudinal research study [19, 20].

In the present study, the discriminant validity of the ECog scale was evaluated in cognitively intact controls and in patients with MCI and mild dementia from the Argentina-ADNI cohort to establish diagnostic accuracy. In addition, we compare the sensitivity and specificity between the ECog and the FAQ scales to discriminate between normal cognition, MCI, and mild AD.

Subjects and methods

Structure and design of the study

The Argentina-ADNI is the first worldwide ADNI center in Latin America. The methodological organization is comparable with other worldwide ADNI programs and has been described in detail elsewhere [19]. All participants were evaluated in a uniform manner at entry and longitudinally thereafter with instruments that include an extended neuropsychological test battery; a determination of amyloid β1-42, total tau protein (t-tau), and tau phosphorylated at position threonine 181 (p-tau181) in cerebrospinal fluid (CSF); a 3 T magnetic resonance imaging (MRI) scan; and a positron emission tomography with fluorodeoxyglucose (PET-FDG) and ^{11}C-Pittsburgh compound-B (PET-PIB) imaging. Presentation and interpretation of the biomarkers results were shown in another manuscript [19].

Participants

We included 15 clinically normal elderly (CN), 28 mild cognitive impairment (MCI), and 13 mild Alzheimer's disease (AD) dementia subjects from the Arg-ADNI database.

After each clinical assessment, study neurologists (RFA, MJR, and PC) reviewed the functional, neurologic, and neuropsychological data and reached a consensus regarding the presence or absence of dementia based on the National Institute of Neurological and Communicative Disorders and Stroke–Alzheimer's disease and Related Disorders Association criteria for probable AD. Only those who were not diagnosed with dementia were considered for a diagnosis of MCI, which was defined according to Petersen's criteria [3].

Finally, participants were assigned to diagnostic categories by Arg-ADNI as previously described [19, 21]. At baseline, CN participants had not memory complaints, has a Clinical Dementia Rating (CDR) global score of 0, Mini Mental State Examination (MMSE) score of 24–30 (inclusive), and no memory impairment on the delayed recall of 1 paragraph from the Logical Memory II subscale of the Wechsler Memory Scale-Revised (WMS-R). MCI participants had a memory complaint corroborated by an informant, a CDR global score of 0.5 with a mandatory requirement of the memory box score being 0.5 or greater, MMSE score of 24–30 (inclusive), memory impairment on the WMS-R without functional impact, and absence of dementia based on the National Institute of Neurological and Communicative Disorders and Stroke–Alzheimer's Disease and Related Disorders Association criteria for probable AD [22]. Mild AD dementia subjects had also a memory complaint corroborated by an informant, a CDR global score of 0.5 or 1, MMSE score of 20–26, memory impairment on the WMS-R, functional impairment in daily activities and were classified by the expert neurologists as being demented [22].

MMSE, WMS-R, and CDR scores were considered as global cognitive functioning, functional, and memory criterion, respectively. WMS-R (maximum score of 25)12 was used with cut-off scores as follows based on education: normal subjects ≥ 9 for 16 years of education, ≥ 5 for 8–15 years of education, and ≥ 3 for 0–7 years of education. For subjects with MCI and subjects with AD, these scores were ≤ 8 for 16 years of education, ≤ 4 for 8–15 years of education, and ≤ 2 for 0–7 years of education. The functional capacity of the participants was determined by the opinion of experienced investigators through clinical interview and the CDR composite score. The ECog and FAQ scales were not used for diagnostic purposes and were carried out immediately after the inclusionary tests by trained and blinded neuropsychologists.

This study was approved by the Medical Ethics Committee of FLENI, Buenos Aires, Argentina. Written informed consent was obtained from all participants and/or their legally acceptable representative. The research was conducted in accordance with the Declaration of Helsinki (1975).

Instruments

Functional Assessment Questionnaire (FAQ)

The FAQ [11] is a validated questionnaire filled by the subject and an informant. It provides information on the patient's physical, psychological, social and role functions. It can be used to screen initially for functional problems during the past month. It includes ten different ADL. Subjects are required to establish the level of independence for each activity (from 0 to 4). The FAQ is useful to monitor functional changes over time [23] and to differentiate subjects with MCI and mild AD [13]. In elderly people with dementia, the FAQ is a consistently accurate instrument with good sensitivity (85%) to identify an individual's functional impairment. The FAQ demonstrates high reliability (> 0.90). It was included in the uniform data set (UDS) compiled by the National Alzheimer's Coordinating Center (NACC) and in the protocol from ADNI study.

Everyday Cognition (ECog) scale

The ECog was designed to be a multidimensional, psychometrically sound measure of everyday function in older adults [17]. It was built to measure everyday function in multiple domains. Each functional domain was defined by the underlying cognitive abilities thought to be most critical to those ADL. The ECog scale is a validated informant-rated questionnaire that includes 39 items. Each of the items was formulated describing a change in the last 10-year period in everyday function in six key cognitive domains: memory, language, visuospatial abilities, planning, organization, and divided attention. It is administered separately to the participant and the informant. Response options includes: 1 = better or no change compared to 10 years earlier, 2 = questionable/occasionally worse, 3 = consistently a little worse, and 4 = consistently much worse. An "I don't know" response option is also included. It has been shown to have excellent psychometric properties including good test–retest reliability ($r = .82$, $p < .001$) as well as evidence of various aspects of validity including content, construction, convergent and divergent, and external validity [17]. The total score on the ECog has been previously shown to successfully discriminate between cognitively intact controls and individuals with MCI [18, 24] and to predict progression from clinically normal to MCI [24]. In addition, the association between ECog scale and biomarkers, such as hippocampal volume [25] or neuronal metabolism [26], was demonstrated.

Statistical analyses

Analyses were performed using Statistical Package for the Social Sciences version 19.0 software (SPSS Inc., Ill., USA). Continuous variables were expressed as mean (SD), and categorical variables as frequencies (%). The χ^2 test was used for comparisons for categorical variables. The ANOVA test or one-way analysis of variance was used for comparisons for continuous variables. For multiple comparisons, Bonferroni's post hoc tests were applied.

Receiver operating characteristic (ROC) curve analysis and area under the curve (AUC) were performed to evaluate discriminating power between CN subjects and participants with MCI or dementia. The diagnostic accuracy was

assessed by establishing the Sensitivity (Sn) and Specificity (Sp) for the best cutoff. Construct validity was tested with Spearman correlation between the ECog scale and relevant clinical and demographic measures. Internal consistency was measured using Cronbach's alpha. Differences between the means were considered statistically significant at $p < .05$.

Results

A total of 56 participants were included and had a baseline evaluation (Fig. 1). There were 15 CN, 28 MCI, and 13 mild AD dementia subjects enrolled. For the full sample, the average age was 71.89 ± 7.27, 57% were female, and average years of education was 13.29 ± 4.03. All subjects were white and Spanish-speaking.

Table 1 presents the demographic characteristics, the mean scores for MMSE, and the results of the neuropsychological tests classified by diagnostic group. The three groups were similar with respect to years of education and gender. Participants with normal cognition were significantly younger than those with MCI and dementia, and those with MCI were significantly younger than the mild dementia group. When we considered the three groups, there were no statistically significant difference on MMSE, Boston Naming Test, or Trail Making A but the three groups differed on RAVLT and Trail Making B. As expected CN differed from AD patients on MMSE, RAVLT, Boston Naming Test, and Trail Making A and B. When we analyzed CN versus MCI, we found statistically significance on RAVLT and Trail Making B and no difference on MMSE ($p = .96$), Boston Naming Test ($p = .69$), Trail Making A ($p = .99$). When we considered MCI versus AD patients, there were differences on all the tests administered.

A total of six different chronic comorbidities were identified in the sample. The three diseases with the highest prevalence were hypertension, lipid metabolism disorders, and thyroid disease. There was no difference among CN, MCI, or AD groups.

We found a significant difference among the three groups using ECog scale but not using FAQ. As expected, CN and AD patients had significant differences in all functional tests. When we analyzed CN versus MCI patients, it is interesting to point that we observed a statistically significant difference with ECog scale ($p < .001$) but not using FAQ ($p = .51$). There were statistically significant differences

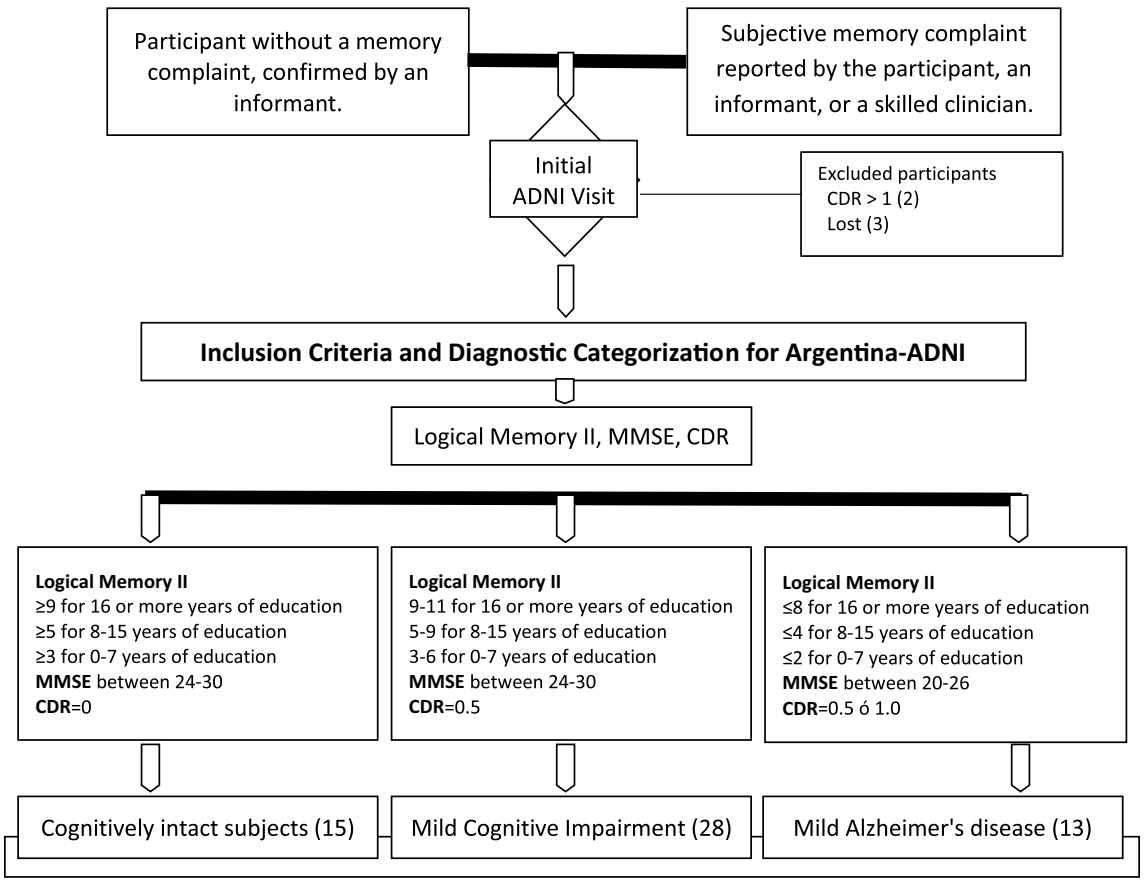

Fig. 1 Flow diagram of study participants. *MMSE* mini-mental-state examination, *CDR* Clinical Dementia Rating scale

Table 1 Characteristics of the Argentina-ADNI cohort by diagnostic group

	Controls		MCI		AD		F/χ^2	p	$p < .05$
	M	SD	M	SD	M	SD			
Age (year)	64.9	8.1	70.1	6.8	73.1	5.5	5.10	.01	a, b
Gender (male/female)	5/10		13/15		6/7		.76	.68	
Education (year)	14.5	3.4	13.1	4.4	12.2	3.9	1.26	.29	
MMSE	29.2	1.5	28.6	1.3	22.0	3.2	60.16	< .001	a, b
Global CDR	0	0.1	0.5	0.2	0.7	0.3	89.7	< .001	a,b,c
RAVLT delayed recall	8.2	2.4	3.3	2.5	0.4	0.8	47.5	< .001	a, b, c
BNT	26.0	7.6	25.5	5.8	20.0	5.5	4.12	.02	a, b
Trail making A (seconds)	33.8	8.7	51.1	21.4	125.5	121.4	9.22	< .001	a, b
Trail making B (seconds)	75.8	29.1	143.4	86.7	288.9	97.0	26.77	< .001	a, b, c
ECog	41.9	3.2	60.9	17.7	88.2	30	14.8	< .001	a,b,c
FAQ	0	0	2.9	3.9	12.8	9.8	15.5	< .001	a,b
Chronic comorbidities									
Hypertension	5		9		6		.81	.67	
Diabetes	1		1		1		.37	.83	
Dyslipidemia	4		13		6		1.76	.41	
Cardiac arrhythmia	0		2		0		2.07	.35	
Ischemic heart disease	0		0		1		3.37	.19	
Thyroid disease	4		6		1		1.70	.43	

Multiple comparisons abbreviated as a: controls differ from subjects with AD, b: subjects with MCI differ from subjects with AD, c: controls differ from subjects with MCI

AD Alzheimer's disease, *MCI* mild cognitive impairment, *CDR* Clinical Dementia Rating Scale, *RAVLT* Auditory Verbal Learning Test, *BNT* Boston Naming Test, *ECog* Everyday Cognition, *FAQ* Functional Assessment Questionnaire

on all functional measures between MCI and AD groups ($p < .001$). Co-varying for age or education had no effect on these results.

Both scales were completed by reliable informants, people who lived with or knew the patients well. They were with participants for an average of 6 h a day. About half the informants were spouses; 38% were adult children; and the rest were formal caregivers knew them on average for nearly 5 years.

The ECog total score ranged from 39 to 134. Means, SDs, and frequency distribution for individual items are presented in Table 2. Ceiling effects were not observable. Memory domain scores showed similar distributions across all degrees of severity. Non-memory domains scores showed milder functional impact (Fig. 2).

The FAQ score ranged from 0 to 29. The distribution of the FAQ and ECog scale by diagnosis is shown in Fig. 3a, b, respectively. All control participants were rated as unimpaired (below the cut-off point) on both scales. The ECog scale appeared to offer additional information, especially in patients with MCI. Almost 95% showed a wide range of severity on ECog compared to 40% on FAQ.

Table 3 shows the results of Spearman correlations with other key variables. The ECog scale showed a strong correlation with the FAQ score ($r = .77$, $p < .001$). As a measure of general cognitive functioning, the MMSE was moderately correlated with ECog ($r = .56$, $p < .001$). Memory and language cognitive tests were strongly positively correlated ($r = .71$ and .58, respectively, $p < .001$). Attention and executive tests were moderately negatively correlated ($r = .48$ and .35, respectively, $p < .05$) with the ECog total score.

Sensitivity (Sn), specificity (Sp), and optimal cut-off scores for classifying participants into diagnostic groups are provided in Table 4. The ROC curve obtained by plot at different cut-off scores is shown in Fig. 4. The AUC the ECog scale for participants with mild AD (compared with MCI) was .81 ($p < .001$), which was comparable to that for the FAQ (AUC = .76, $p = .003$). However, for discriminating mild AD and MCI, the ECog showed a high level of Sn (84% versus 78%). The AUC for the ECog in participants with MCI (versus CN) was higher than for the FAQ ($p < .001$). AUCs for participants with mild AD versus CN were .99 ($p < .001$) for both the ECog and FAQ scores.

The Cronbach's alpha was .98, indicating excellent internal consistency. Deletion of any item or any cognitive domain did not improve the internal reliability of ECog scale.

Table 2 Means, SD, and frequency distributions for individual items of the ECog scale

Domain	Items	Mean (SD)	4 Points *n* (%)	3 Points *n* (%)	2 Points *n* (%)	1 Points *n* (%)	0 Points *n* (%)
Memory	1. Remembering a few shopping items without a list	1.78 (1.26)	6 (10.7)	12 (21.4)	9 (16.1)	20 (35.7)	8 (14.3)
	2. Remembering things that happened recently (such as recent outings, events in the news)	1.91 (1.35)	11 (19.6)	7 (12.5)	10 (17.9)	20 (35.7)	7 (12.5)
	3. Recalling conversations a few days later	1.93 (1.33)	10 (17.9)	9 (16.1)	10 (17.9)	19 (33.9)	7 (12.5)
	4. Remembering where I have placed objects	2.15 (1.45)	15 (26.8)	8 (14.3)	10 (17.9)	14 (25.0)	8 (14.3)
	5. Repeating stories and/or questions	2.00 (1.41)	12 (21.4)	10 (17.9)	7 (12.5)	18 (32.1)	8 (14.3)
	6. Remembering the current date or day of the week	1.65 (1.22)	6 (10.7)	9 (16.1)	7 (12.5)	26 (46.4)	7 (12.5)
	7. Remembering I have already told someone something	2.02 (1.37)	11 (19.6)	10 (17.9)	11 (19.6)	15 (26.8)	8 (14.3)
	8. Remembering appointments, meetings, or engagements	1.75 (1.28)	7 (12.5)	9 (16.1)	11 (19.6)	19 (33.9)	9 (16.1)
Language	1. Forgetting the names of objects	1.33 (.82)	0 (0.0)	5 (8.9)	15 (26.8)	28 (50.0)	7 (12.5)
	2. Verbally giving instructions to others	1.09 (.77)	0 (0.0)	4 (7.1)	7 (12.5)	34 (60.7)	10 (17.9)
	3. Finding the right words to use in conversations	1.22 (.71)	0 (0.0)	2 (3.6)	15 (26.8)	31 (55.4)	7 (12.5)
	4. Communicating thoughts in a conversation	1.16 (.76)	1 (1.8)	2 (3.6)	9 (16.1)	36 (64.3)	7 (12.5)
	5. Following a story in a book or on TV	1.36 (1.16)	6 (10.7)	2 (3.6)	8 (14.3)	29 (51.8)	10 (17.9)
	6. Understanding the point of what other people are trying to say	1.33 (1.02)	4 (7.1)	3 (5.4)	7 (12.5)	34 (60.7)	7 (12.5)
	7. Remembering the meaning of common words	1.11 (.76)	0 (0.0)	4 (7.1)	7 (12.5)	35 (62.5)	9 (16.1)
	8. Describing a program I have watched on TV	1.15 (1.06)	4 (7.1)	2 (3.6)	5 (8.9)	31 (55.4)	13 (23.2)
	9. Understanding spoken directions or instructions	1.16 (.99)	3 (5.4)	3 (5.4)	5 (8.9)	33 (58.9)	11 (19.6)
Visuospatial abilities	1. Following a map to find a new location	1.07 (1.09)	3 (5.4)	4 (7.1)	4 (7.1)	27 (48.2)	17 (30.4)
	2. Reading a map and helping with directions when someone else is driving	1.16 (1.13)	3 (5.4)	6 (10.7)	4 (7.1)	26 (46.4)	16 (28.6)
	3. Finding my car in a parking lot	1.16 (1.12)	4 (7.1)	3 (5.4)	6 (10.7)	27 (48.2)	15 (26.8)
	4. Finding my way back to a meeting spot in the mall or other location	1.25 (1.13)	5 (8.9)	3 (5.4)	4 (7.1)	32 (57.1)	11 (19.6)
	5. Finding my way around a familiar neighborhood	1.22 (.94)	2 (3.6)	5 (8.9)	4 (7.1)	36 (64.3)	8 (14.3)
	6. Finding my way around a familiar store	1.16 (.88)	2 (3.6)	3 (5.4)	5 (8.9)	37 (66.1)	8 (14.3)
	7. Finding my way around a house visited many times	1.05 (.70)	1 (1.8)	2 (3.6)	3 (5.4)	42 (75.0)	7 (12.5)
Planning	1. Planning a sequence of stops on a shopping trip	1.33 (1.19)	5 (8.9)	5 (8.9)	5 (8.9)	28 (50.0)	12 (21.4)
	2. The ability to anticipate weather changes and plan accordingly	1.20 (.93)	2 (3.6)	5 (8.9)	3 (5.4)	37 (66.1)	8 (14.3)
	3. Developing a schedule in advance of anticipated events	1.24 (1.12)	5 (8.9)	2 (3.6)	6 (10.7)	30 (53.6)	12 (21.4)
	4. Thinking things through before acting	1.27 (1.04)	4 (7.1)	2 (3.6)	9 (16.1)	30 (53.6)	10 (17.9)
	5. Thinking ahead	1.42 (1.10)	5 (8.9)	3 (5.4)	10 (17.9)	29 (51.8)	8 (14.3)
Organization	1. Keeping living and work space organized	1.38 (.97)	2 (3.6)	6 (10.7)	10 (17.9)	30 (53.6)	7 (12.5)
	2. Balancing the checkbook without error	1.16 (1.03)	3 (5.4)	3 (5.4)	7 (12.5)	29 (51.8)	13 (23.2)
	3. Keeping financial records organized	1.16 (1.03)	3 (5.4)	3 (5.4)	7 (12.5)	29 (51.8)	13 (23.2)
	4. Prioritizing tasks by importance	1.24 (1.09)	5 (8.9)	2 (3.6)	4 (7.1)	34 (60.7)	10 (17.9)
	5. Keeping mail and papers organized	1.16 (1.07)	4 (7.1)	1 (1.8)	9 (16.1)	27 (48.2)	14 (25.0)
	6. Using an organized strategy to manage a medication schedule	1.18 (.98)	4 (7.1)	1 (1.8)	5 (8.9)	36 (64.3)	9 (16.1)
Divided attention	1. The ability to do two things at once	1.47 (1.09)	4 (7.1)	4 (7.1)	15 (26.8)	23 (41.1)	9 (16.1)
	2. Returning to a task after being interrupted	1.44 (1.08)	4 (7.1)	5 (8.9)	10 (17.9)	28 (50.0)	8 (14.3)
	3. The ability to concentrate on a task without being distracted by external things	1.38 (1.09)	4 (7.1)	5 (8.9)	8 (14.3)	29 (51.8)	9 (16.1)
	4. Cooking or working and talking at the same time	1.22 (.94)	3 (5.4)	2 (3.6)	7 (12.5)	35 (62.5)	8 (14.3)

ECog Everyday Cognition, *SD* standard deviation

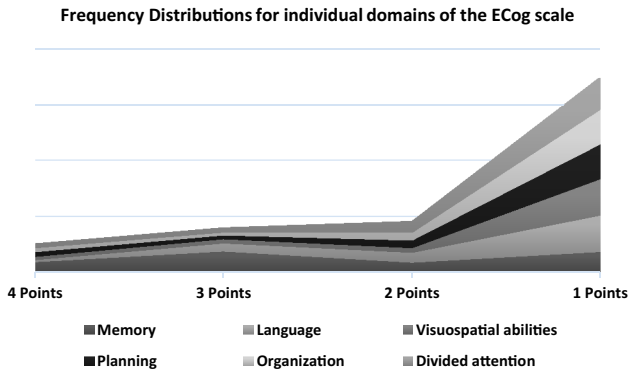

Fig. 2 Frequency Distributions for individual domains of the *ECog* scale

Discussion

This study investigated the diagnostic accuracy of the Spanish version of the ECog scale in the three groups of the sample of Argentina-ADNI. We included cognitively intact controls, subjects with MCI, and patients with mild AD. The ECog scale showed high accuracy and discriminative power in differentiating CN, MCI, and mild AD.

Overall, the clinical usefulness of the ECog scale is evident, since it could distinguish between the study groups with acceptable accuracy. The ECog scale showed more accuracy in evaluating a wide range of impairment in everyday function compared to FAQ and subsequently had the potential to improve diagnostic differentiation between CN and MCI or mild AD groups. In addition, the ECog scale showed the known continuum of functional impairment, since ECog total score was significantly lower in CN than in MCI and the latter lower than in mild AD. On the other hand, the FAQ showed less ability in characterizing subtle impairment in functionality in MCI patients (Fig. 3) and in differentiating CN from MCI (Fig. 4). Finally, FAQ showed less sensitivity to discriminate between MCI from mild AD subjects (Table 4).

To conclude, in our sample, ECog was more useful than FAQ for patients with MCI who had minimum impairment in ADL, and both scales were appropriate to detect functional impairment in patient who had mild dementia.

The FAQ [11] and ECog scales [17, 18] were designed to be use specifically in patients with cognitive decline. FAQ evaluates actual real performance in different every day activities in the month previous to the examination, whereas ECog evaluates a change in cognitive and functional activities compared to 10 years previous in the life of the subject. Some of the activities considered in ECog are highly sophisticated such as capacity to follow a map in a new place or planning a few stops in a shopping tour. We hypothesize that ECog evaluates more advanced instrumental activities than FAQ and this could explain why in our sample, it was more sensitive than FAQ for subtle changes in the MCI group. Another possibility is that the ECog simply includes more items and thus a broader range of possible scores. Again, our findings indicate that the ECog was more sensitive to the early functional changes present in MCI and that the ECog was able to differentiate between people diagnosed with mild impairment in memory only and those mildly

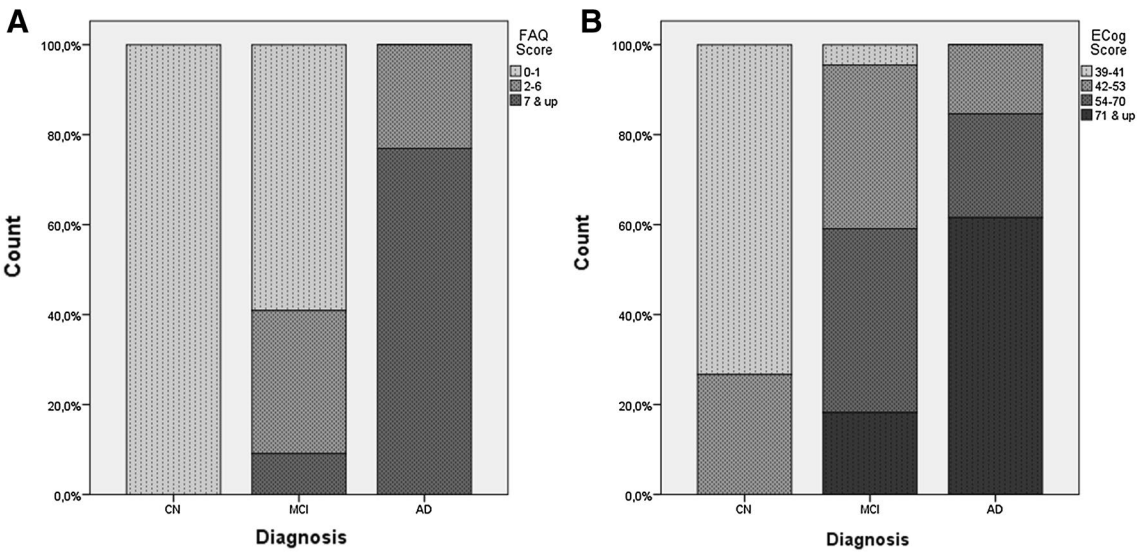

Fig. 3 Distribution of baseline FAQ (**a**) and ECog (**b**) rating by diagnosis. For both histograms, the more severe range of impairment is at the base of each bar, with successively less impaired range above. *AD* Alzheimer's disease, *CN* controls, *ECog* Everyday Cognition, *FAQ* Functional Activities Questionnaire, *MCI* mild cognitive impairment

Table 3 Correlations between the ECog total score and other key variables

Variable	Ecog total score	
	Spearman Rho	*p*
Age	.42	.003
Education	−.17	.246
MMSE	−.56	<.001
RAVLT delayed recall	−.71	<.001
BNT	−.58	<.001
TMT A	.48	.001
TMT B	.35	.038
FAQ	.77	<.001

RAVLT Auditory Verbal Learning Test, *BNT* Boston Naming Test, *ECog* Everyday Cognition, *FAQ* Functional Assessment Questionnaire

impaired in several domains. One strength of the ECog is that it was developed to assess functional abilities that are clearly linked to specific cognitive abilities. Our results are consistent with prior work indicating that the ECog domains are correlated with specific neuropsychological impairments [18, 25]. This is important, because some functional losses in ADL may be related to physical impairments rather than cognitive changes. Finally, the inclusion of non-memory domains could help with differential diagnosis of atypical variants of AD.

Several recent studies have suggested that when patients with MCI are intensively examined in relation with actual performance of daily activities, subtle alterations in the ability to perform IADL can be detected [27–32]. In addition, subjects with this subtle IADL impairment may more likely develop dementia over time than unimpaired MCI subjects [33–37]. These findings suggest that the functional decline in patients with MCI may identify a MCI group at risk of developing dementia. Further longitudinal studies are still

Table 4 Discrimination between diagnostic groups for the ECog, CDR, and FAQ

	Test	Cut-off score	AUC	Sensitivity	Specificity	PPV	NPV
MCI versus mild AD	ECog	54	.81 (CI .66–.96)	84 (CI 56–96)	60 (CI 56–96)	52 (CI 32–72)	89 (CI 67–97)
	FAQ	3	.76 (CI .61–.92)	78 (CI 45–94)	60 (CI 42–75)	37 (CI 19–59)	90 (CI 70–97)
CN versus MCI	ECog	45	.96 (CI .91–.99)	90 (CI 69–97)	80 (CI 61–90)	74 (CI 53–87)	92 (CI 75–98)
	FAQ	.5	.77 (CI .62–.93)	54 (CI 29–77)	90 (CI 74–96)	70 (CI 40–89)	81 (CI 65–91)
CN versus mild AD	ECog	44	.99 (CI .98–.99)	99 (CI 77–99)	82 (CI 52–94)	87 (CI 62–96)	99 (CI 70–99)
	FAQ	1	.99 (CI .98–.99)	99 (CI 77–99)	99 (CI 76–99)	99 (CI 77–99)	99 (CI 78–99)

AD Alzheimer's disease, *MCI* mild cognitive impairment, *ECog* Everyday Cognition, *FAQ* Functional Assessment Questionnaire, *PPV* positive predictive value, *NPV* negative predictive value

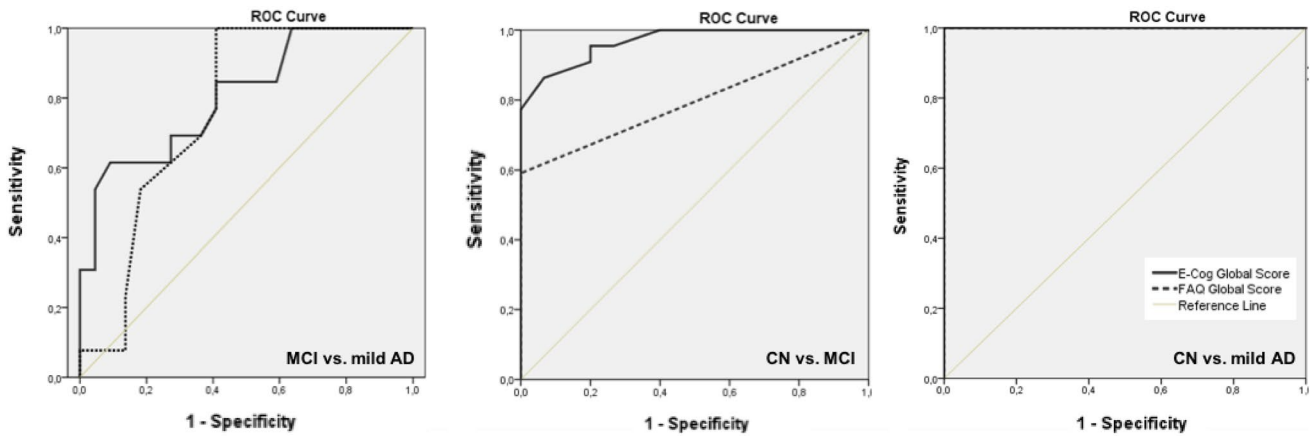

Fig. 4 Receiver operating characteristic curve for ECog and FAQ scales. *AD* Alzheimer's disease, *CN* controls, *ECog* Everyday Cognition, *FAQ* Functional Activities Questionnaire; *MCI* mild cognitive impairment

needed to assess the added diagnostic value of IADL decline for subsequent dementia.

The determination of performance in real life is not only important in research but also in the clinical setting, since this information is useful for making practical recommendations such as the need of supervision in certain items, the need of care from a family member or social services. Systematic use of appropriate and sensitive scales of functionality is necessary to identify early changes in function. This early diagnosis could trigger an intervention and solve a problem that potentially may prevent further impairment in autonomy. We found here that if we rely solely on the clinical interview by experts without using specific scales, early impairment could be missed. We suggest that the ECog scale should be used to establish mild functional impairment without autonomy lost in subjects who meet criteria for MCI and who are flagged as at risk for converting to dementia.

Concerning discriminant validity in dementia population, the global performance of the ECog to correctly classify subjects with dementia diagnosis versus MCI was adequate. The ECog scale distinguished between MCI and mild AD in a similar manner to the FAQ, but with higher sensitivity. The power of discrimination between MCI and mild AD groups was lower than the diagnostic accuracy values between CN and MCI or mild dementia. This distinction may be due the proximity of score means in the impaired subjects [38]. The present study also contributes to the previous reports of functional measures to distinguish mild AD from MCI [13, 38, 39]. The ECog scale may be an important tool for clinicians to improve their ability on the differential diagnosis of AD and MCI.

This study has several limitations. We recognize that the sample sizes for all three groups are too small to provide strong conclusion. However, since this is a well-defined population intensively studied with clinical, radiological, and biomarkers assessments using the same procedures as ADNI worldwide, we considered that our data are robust despite the small size. The cross-sectional design of this study is another limitation of this study. Longitudinal research is needed to show the added prognostic value of the ECog scale. Another limitation recently suggested is that ADL evaluation should be performance-based. However, we have opted for report-based assessment, because we consider that real-life testing would take much longer and it would not be ecological.

Conclusions

The ECog scale is a reliable, easy to administer and validated scale to differentiate people with normal cognition, MCI and mild dementia. In addition, the ECog scale demonstrated sensitivity to early functional changes in people with MCI.

This is the baseline evaluation of the ADNI cohort of the Argentinean sample. In future research, we will follow this cohort at 12, 24, and 36 months and assess functional capacity using the same scales to see progression and we will report if subjects with MCI with impairment in ECog have a different clinical course than MCI subjects without impairment.

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Compliance with ethical standards

Ethical approval This study was approved by the Medical Ethics Committee of FLENI, Buenos Aires, Argentina. The research was conducted in accordance with the Declaration of Helsinki (1975).

Informed consent Written informed consent was obtained from all participants and/or their legally acceptable representative.

Conflict of interest The author(s) declared no potential conflicts of interest with respect to the authorship and/or publication of this article. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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