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Measurement of Subjective Cognitive Decline (SCD) Using Korean-Everyday Cognition (K-ECog) as a Screening Tool: a Feasibility Study

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The authors have no financial conflicts of interest.

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ABSTRACT

Background and Purpose: Everyday Cognition (ECog) has been widely used to differentiate individuals with mild cognitive impairment (MCI) and dementia from normal elderly individuals. It has also been used to assess subjective cognitive decline (SCD). This study investigated the feasibility of using ECog as a screening measure for SCD in community-dwelling elderly individuals.
Methods: The participants included 84 older adults with and 93 without SCD living in the community. These 2 groups were classified based on their response ("yes" or "no") to the question "Do you perceive memory or cognitive difficulties?" All participants were evaluated using the Korean-Mini Mental State Examination (K-MMSE), Short form of the Geriatric Depression Scale (SGDS), and the Korean version of Everyday Cognition (K-ECog).
Results: The scores of all participants were within the normal range on the K-MMSE and SGDS. The total K-MMSE score did not differ significantly between the 2 groups after controlling for age, education, and depression. The scores of SCD group were significantly higher than those of the non-SCD group for memory, language, and executive function: planning domains, as well as K-ECog total score. Receiver operating characteristic curve analysis revealed that the K-ECog total score was effective in moderately differentiating between subjects with and without SCD (area under the curve: 0.73).
Conclusions: ECog is a feasible and useful screening measure for SCD in older adults living in the community, and can be used to assess the full spectrum of cognitive and functional deficits, ranging from SCD to MCI and dementia.

Keywords: Everyday Cognition (ECog); Subjective Cognitive Decline (SCD)

INTRODUCTION

Self-perceived cognitive decline has received increasing attention in attempts to define the earliest symptoms of Alzheimer's disease (AD), based on its association with increased risk of objective cognitive decline in the future.[1-4] Mitchell and colleagues[3] performed a meta-analysis, which showed that approximately 6.6% and 2.3% of older people with subjective

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cognitive decline (SCD) will progress to mild cognitive impairment (MCI) and dementia each year. The risk of developing dementia was doubled in those with SCD compared with those without SCD.

In 2014, the working group of the Subjective Cognitive Decline Initiative (SCD-I) proposed a common framework for SCD studies that provided standardized terminology and diagnostic criteria.[2] The diagnostic criteria for SCD were: 1) self-experienced persistent decline in cognitive capacity in comparison with a previously normal status and unrelated to an acute event and 2) normal age-, gender-, and education-adjusted performance on standardized cognitive tests, which are used to classify MCI or prodromal AD.[2]

However, there is currently no single accepted approach for the assessment of SCD; thus, various measures have been applied. Rabin et al.[5] comprehensively reviewed the measures used to screen for SCD, reporting that the number of items/questions ranges from a single question to 57 items[6-8] and the response options range from binary (yes/no) to a 7-point scale.[9-11] These measures also varied in item content in that some measures only ask about memory, while others involve other cognitive domains as well as memory.[12-15] The response to items was based on variable reference points for comparison with the current state of cognitive function, such as "5 years ago," "10 years ago," "younger," and "high school or college."[13,16-20] Although this variability in assessment tools have resulted in inconsistent findings regarding SCD, no consensus has been reached among investigators regarding the optimal SCD scale.

Based on the data analysis of 19 SCD-I working group studies, Rabin et al.[5] reported that Everyday Cognition (ECog) was one of the commonly used measures across studies. This scale was originally developed to assess cognitively mediated functional abilities and has been widely used to differentiate subjects with MCI and dementia from normal older adults.[18] The Alzheimer's Disease Neuroimaging Initiative, a multisite longitudinal study for AD prevention and treatment involving more than 13 countries, has used the ECog for the measurement of activities of daily living (ADL).[21] The ECog consists of 39 items on a 4-point Likert scale, providing one global factor (Global Function) and 6 cognitively relevant domain-specific factors including memory, language, visuospatial function, and 3 executive functions (EFs) including planning, organization, and divided attention. The ECog has been used to measure subtle and mild functional changes in MCI in many studies[18,22,23] and is also being used to measure SCD.[24,25]

The Korean version of ECog (K-ECog) was recently validated as a useful tool for differentiating very early stages of impaired ADL and cognitive impairment in the community.[26] However, its feasibility as a screening measure for SCD has yet to be directly evaluated. The present study was conducted to investigate the feasibility of using the K-ECog as a screening measure for SCD in community-dwelling, elderly individuals.

METHODS

Participants
The participants were 84 community-dwelling adults with SCD and 93 without SCD (non-SCD) over 60 years of age. These 2 groups were classified according to their response ("yes" or "no") to the question "Do you perceive memory or cognitive difficulties?" Based

on Christensen's health screening questionnaire,[27] we excluded subjects with neurological or psychiatric history or suspected brain damage and those with chronic conditions (e.g., hypertension, diabetes, and hyperlipidemia) affecting cognitive function but not receiving treatment. All participants scored in the normal range on the Korean-Mini Mental State Examination (K-MMSE)[28] and the Short Form of the Geriatric Depression Scale (SGDS).[29]

Measurements

The K-MMSE, SGDS, and K-ECog were administered to all participants. The K-ECog[26] was composed of 39 items, including one global factor and 6 cognitively relevant domain-specific factors: 8 items for memory, 9 items for language, 7 items for visuospatial function, and 15 items for EF, including 5 items for planning, 6 items for organization, and 4 items for divided attention. For each item, the participants were asked to compare their current levels of functioning with their levels 10 years ago. Response options included the following: 1=better or no change, 2=occasionally worse, 3=consistently a little worse, 4=consistently much worse, and "non-applicable." A total of 39 items were used to generate a Global Function Score (total score), and items belonging to each individual domain were used to generate a score for each domain. The K-ECog Global Function Score, which was the sum of all items divided by the number of completed items excluding the number of "non-applicable" items, ranged between 1 and 4.

A licensed clinical psychologist and graduate students of clinical psychology trained by the authors (MS and YK) collected the data. They visited homes, community welfare centers, and senior centers in Seoul, Gyeonggi-do, Chuncheon, and Daegu, to administer the K-MMSE, SGDS, and K-ECog to the participants.

Statistical analysis

Group differences were analyzed using the Student's t-test. Pearson's χ^2 test was used for categorical variables. Internal consistency was assessed using Cronbach's alpha coefficient. Analysis of covariance (ANCOVA) and multivariate analysis of covariance (MANCOVA) were conducted to evaluate the differences in the K-ECog Global Function Score and 6 cognitive domain scores of the 2 groups (SCD and non-SCD), with age, education, and depression level as covariates. Receiver operating characteristic (ROC) curve analysis was performed to examine the ability of K-ECog to discriminate SCD from non-SCD, while controlling for the effects of age, education, and depression as covariates. The optimal cut-off score, sensitivity, and specificity of the K-ECog Global Function Score were also evaluated via ROC curve analysis.

Student's t-test, Pearson's χ^2 test, ANCOVA, and MANCOVA were performed using IBM SPSS Statistics 26 (IBM, Armonk, NY, USA). Statistical Analysis Software (SAS; SAS Institute, Cary, NC, USA) and MedCalc version 20.008 (MedCalc Software, Ostend, Belgium) were used for ROC curve analysis.

Ethics statement

The study protocol was reviewed and approved by the Institutional Review Board (IRB) of Hallym University (IRB No. HIRB-2014-51).

Table 1. Participants' demographics and SGDS and K-MMSE scores

Variables	SCD (n=84)	Non-SCD (n=93)	t or χ² or F	p-value
Age (yr)	71.39±7.56	68.53±6.66	t=−2.68	0.008
Sex	84	93	χ²=1.20	0.274
Male	32 (38.1)	43 (46.2)		
Female	52 (61.9)	50 (53.8)		
Education (yr)	8.37±3.74	9.72±4.20	t=2.25	0.026
0–6	33 (39.3)	24 (25.8)		
7 or more	51 (60.7)	69 (74.2)		
SGDS	2.39±2.32	1.34±1.68	t=−3.41	0.001
K-MMSE	27.37±1.96	27.48±2.16	F=3.65	0.058

Values are presented as mean±standard deviation or number (%).
SGDS: Short form of the Geriatric Depression Scale, K-MMSE: Korean-Mini Mental State Examination, SCD: subjective cognitive decline.

RESULTS

The participants' demographic and descriptive statistics are presented in **Table 1**. No significant group differences were found in sex ratio, but significant differences were detected between the SCD and the non-SCD groups in terms of age, education, and depression level. No significant group differences were found in the K-MMSE scores (F[1,172]=3.65, p=0.058).

Cronbach's alpha for the K-ECog Global Function Score was 0.87, and the coefficient alpha scores of the 6 domain scores were in the range of 0.67 to 0.88: memory (0.80), language (0.88), visuospatial function (0.71), EF: planning (0.74), EF: organization (0.78), and EF: divided attention (0.67).

There was a significant difference in the K-ECog Global Function Score between the SCD and non-SCD groups (F[1,172]=6.69, p=0.011). Significant group differences were also found in the 3 domain scores of the K-ECog (λ=0.93, F[6,339]=2.16, p=0.049, partial η²=0.07): memory (F[1,172]=5.99, p=0.015), language (F[1,172]=9.00, p=0.003), and EF: planning (F[1,172]=4.25, p=0.041) (**Table 2**).

Based on ROC curve analysis, the K-ECog Global Function Score was moderately accurate in differentiating older adults with SCD from those without SCD. The area under the curve (AUC) value was 0.73 (95% confidence interval [CI], 0.65–0.80) after adjustment for age, education, and depression level (**Fig. 1**). The K-ECog had a sensitivity of 71.4% (95% CI, 60.5–80.8) and a specificity of 52.7% (95% CI, 42.1–63.1) when an optimal cut-off score of 1.18 was used to differentiate between SCD and non-SCD status.

Table 2. Group differences in K-ECog

K-ECog	SCD (n=84)	Non-SCD (n=93)	F	p-value
Memory	1.72±0.53	1.48±0.36	5.99	0.015
Language	1.46±0.48	1.22±0.33	9.00	0.003
Visuospatial function	1.23±0.30	1.21±0.30	0.00	0.976
EF: planning	1.23±0.34	1.13±0.25	4.25	0.041
EF: organization	1.24±0.39	1.14±0.21	1.91	0.169
EF: divided attention	1.49±0.52	1.33±0.44	3.48	0.064
Global Function	1.40±0.31	1.25±0.24	6.69	0.011

Values are presented as mean±standard deviation and controlled for age, education, and depression level.
K-ECog: Korean version of Everyday Cognition, SCD: subjective cognitive decline, EF: executive function.
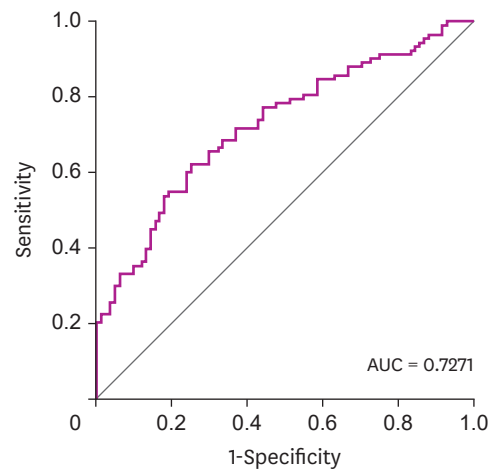
Fig. 1. ROC curve for K-ECog.
ROC: receiver operating characteristic, K-ECog: Korean version of Everyday Cognition, AUC: area under the curve.

DISCUSSION

The study showed good internal consistency of the K-ECog, indicating that the items in the K-ECog measure the same construct, and thus the total score (Global Function Score) represents all items. The K-MMSE total score did not differ significantly between the SCD and non-SCD groups after controlling for age, education, and depression level.

However, the K-ECog total score was significantly higher in the SCD group than in the non-SCD group. Both the SCD and the non-SCD groups reported the greatest degree of change relative to their baseline (compared with levels 10 years ago) in the memory domain, followed by EF: Divided attention and language domains. Complaints about memory loss and word-finding difficulty increase with age.[30,31] Many previous studies have also reported a decline in executive function, especially divided attention, due to the deterioration of the frontal lobes with aging.[32] It is interesting that the SCD group experienced a decline in the same cognitive domains as the non-SCD group, which is the normal aging group, although the SCD group reported a significantly higher number of complaints in memory, language, and EF: planning than the non-SCD group. Notably, no group difference was found for EF: divided attention, which had the second highest score in both groups. However, a group difference was found for EF: planning, which suggests that divided attention is a cognitive function that is significantly reduced even in normal aging, and thus cannot be used to distinguish the SCD in the normal elderly population.

Many studies have used questions specifically related to episodic memory assessment for SCD.[2,5,33] However, the SCD-I group emphasized that "cognitive complaints" in SCD refer to any cognitive domains and are not restricted to memory, as the first symptoms of AD are not limited to memory decline.[2] Therefore, SCD evaluation cannot be restricted to memory, especially considering that some SCD is may be a very early stage of atypical form of AD or non-AD dementia.[34] Several studies have reported cognitive complaints other than memory in SCD.[3,35] Our results also found that SCD complaints involving language and EF, as well as memory. In line with these findings, it is sensible to incorporate various cognitive domains in SCD assessment,[36] and the ECog, which evaluates various cognitive domains, is a useful tool for identifying cognitive complaints in SCD.

ROC curve analysis showed that the K-ECog total score effectively differentiated the SCD group from the non-SCD group after adjustment for age, education, and depression level, yielding an AUC of 0.73. The AUC is a global measure of diagnostic accuracy and a good indicator of the overall quality of the test. An AUC of 0.73 implied a "good" level of diagnostic accuracy.[37] When the K-MMSE and Korean-Montreal Cognitive Assessment were used to distinguish between individuals with MCI and the normal elderly, the AUCs were 0.63 and 0.67, respectively, corresponding to "sufficient" level.[38] Therefore, the K-ECog is a valid instrument for differentiating SCD from non-SCD in older adults living in the community.

The optimal cut-off score for the K-ECog to distinguish SCD from non-SCD was ≥1.18, yielding a sensitivity of 0.714 and a specificity of 0.527. To obtain a score of 1.18 on the K-ECog, approximately 7 out of 39 items must be answered as "occasionally worse" than they were 10 years ago. A score of 1.18 can be considered a very low score. However, this appears reasonable given that the optimal cut-off score for discriminating individuals with amnestic MCI from the normal elderly people reported in the validation study of K-ECog was 1.41, and the current study sample was community-based rather than clinical.[26]

Several community-based longitudinal follow-up studies have reported that SCD later progressed to MCI or AD.[3,39-42] SCD in the communities showed a more consistent pattern of atrophy involving the temporal and parietal cortices, whereas SCD in the clinics showed more diverse patterns in one study investigated brain atrophy in SCD in the communities and clinics.[43] These results suggest that SCD in the community may represent a preclinical stage of AD more closely rather than SCD in the clinic, underscoring the need to screen for SCD in the community.

The ECog has 2 versions, one each for self-rating and the rating of informant. The self-rating version was used in the present study. Since the results of this study may differ from those based on informant's rating, it is not certain whether the cut-off score proposed in this study is applicable to the informant's version. Rueda and her colleagues[44] reported that cognitively normal participants and the early MCI group reported slightly more problems in everyday function on the ECog compared with their informants, whereas the late MCI and dementia groups rated themselves as less functionally impaired than the informants' ratings. Thus, early MCI may be more reliable in assessing their functional capacity than their informants since the early MCI group showed a similar pattern of reporting compared to normal subjects in contrast to those with late MCI and dementia. Therefore, apparently older adults with SCD can also reliably assess their functional abilities. In addition, as the number of elderly living alone increases in Korea in recent years, it is not easy to obtain ratings from informants who know the elderly well. Therefore, self-rating could further increase the feasibility and usefulness of K-ECog in screening for SCD in the community setting.

In conclusion, ECog is a feasible and useful tool for the detection of SCD in community-dwelling elderly subjects. The results suggest that the ECog can be used to assess the full spectrum of cognitive and functional deficits, ranging from SCD to MCI and dementia.[24,45] Application of ECog in SCD screening and during follow-up can facilitate continuous monitoring of changes in cognitive and functional deficits until SCD progresses to MCI or even dementia.

Finally, the current study has some limitations. First, cross-validation studies with new samples are needed to establish the usefulness of the cut-off score. The specificity of the

cut-off score obtained in this study was low, suggesting caution against false positives. Second, the participants in this study were restricted to older adults living in the community. Individuals with SCD visiting the clinic may exhibit different characteristics than those in the community who participated in this study. Therefore, this study needs to be replicated in individuals with SCD who visit the clinic. Third, cognitive function was assessed only with K-MMSE and not using a detailed neuropsychological battery, suggesting that the participants might include individuals with undiagnosed MCI.

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