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Subjective Cognitive Decline in Community-Dwelling Older Adults With Objectively Normal Cognition: Mediation by Depression and Instrumental Activities of Daily Living

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Objective Subjective cognitive decline (SCD) refers to self-reported memory loss despite normal cognitive function and is considered a preclinical stage of Alzheimer's disease. This study aimed to examine the mediating effects of depression and Instrumental Activities of Daily Living (IADL) on the association between the scoring of Clinical Dementia Rating Scale-Sum of Boxes (CDR-SB) and Subjective Cognitive Decline Questionnaire (SCD-Q).

Methods A sample of 139 community-dwelling older adults aged 65–79 with normal cognitive function completed the SCD-Q, a comprehensive neuropsychological battery, and functional/psychiatric scales. We conducted 1) a correlation analysis between SCD-Q scores and other variables and 2) a path analysis to examine the mediating effects of depression and IADL on the relationship between CDR-SB and SCD-Q.

Results CDR-SB was found to be indirectly associated with SCD-Q, with depressive symptoms mediating this relationship. However, no direct association was observed between SCD-Q and CDR-SB. Additionally, IADL was not associated with SCD-Q and did not mediate the relationship between CDR-SB and SCD-Q. The model fit was acceptable (minimum discrepancy function by degrees of freedom divided [CMIN/DF]=1.585, root mean square error of approximation [RMSEA]=0.065, comparative fit index [CFI]=0.955, Tucker-Lewis index [TLI]=0.939).

Conclusion Our results suggest that SCD-Q is influenced by depressive symptoms, but not by IADL. The role of depressive symptoms as a mediator between CDR-SB and SCD-Q indicates that psychological factors may contribute to the perception of SCD. Therefore, interventions targeting depression may mitigate the concerns associated with SCD and reduce feelings of worse performance compared to others of the same age group.

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Keywords Alzheimer disease; Cognitive aging; Subjective health complaint; Neuropsychological tests.

INTRODUCTION

Approximately 12% of adults over the age of 65 report experiencing subjective cognitive decline (SCD), which is characterized by self-perceived cognitive impairment despite normal performance on standardized cognitive tests.[1] In recent years, SCD has garnered significant attention for its potential to predict the onset of Alzheimer's disease (AD) and related symptoms.[2-5] Studies have identified SCD as a key predictor of future mild cognitive impairment (MCI) and dementia, highlighting the importance of recognizing SCD as an early indicator of major cognitive decline.[6,7]

However, there is a gap concerning which specific aspects of SCD are considered risk factors that align with existing neuropsychological measures and ultimately lead to an AD diagnosis. The international consortium of the subjective cognitive decline initiative developed a conceptual framework by

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consensus that extends AD to the phase before MCI, during which cognitive tests may not detect any deficits.[8-11] Relying solely on SCD is inadequate for the reliable detection of preclinical AD, highlighting the need for exploring various cognitive domains beyond memory.[4,5,12]

Previous research suggests that depressive symptoms play a crucial role in influencing how individuals perceive and report cognitive decline.[13-15] In prodromal AD trials, Clinical Dementia Rating Scale-Sum of Boxes (CDR-SB), a measure of cognitive and functional impairment, is widely used as an inclusive primary outcome measure. Research suggests that depressive symptoms, rather than CDR-SB scores, are more predictive of reported cognitive complaints.[16-19] Another study has linked depressive symptoms and objective cognitive impairment to SCD, suggesting that both affect and reported impairments can influence subjective complaints.[20]

Instrumental Activities of Daily Living (IADL) has been proposed as a potential indicator of cognitive decline and AD risk beyond SCD.[12,21] Particularly in AD, studies suggest IADL performance is more closely linked to executive function than SCD itself, indicating potential struggles for those with SCD in tasks like shopping and managing finances.[22] SCD can predict future declines in memory and IADL performance, even after controlling for depressive symptoms, highlighting the importance of considering SCD in relation to functional abilities.[23]

The current understanding of how objective cognitive decline relates to SCD remains unclear, despite evidence linking depression and functional limitations to SCD. There is conflicting evidence regarding whether depressive symptoms overshadow the cognitive and functional predictive value of CDR-SB in prodromal AD trials, while functional limitations in IADL might serve as a more sensitive indicator of cognitive decline even after adjusting for depressive symptoms.

This ambiguity necessitates further investigation into the factors truly contributing to SCD. Therefore, this study aims to examine the complexities of the interplay between objective and subjective cognitive function while concurrently differentiating the effects of IADL and Geriatric Depression Scale (GDepS). Our hypotheses include: 1) CDR-SB is associated with Subjective Cognitive Decline Questionnaire (SCD-Q), 2) depressive symptoms mediate the relationship between CDR-SB and SCD-Q, 3) IADL mediates the relationship between CDR-SB and SCD-Q, and 4) depressive symptoms have a sequential mediating effect on IADL and SCD-Q.

METHODS

Study design and sample

For this descriptive cross-sectional study, community-dwelling older adults without dementia were recruited between September 2020 and April 2021. The inclusion criteria were as follows: 1) individuals aged 65 to 79 years, and 2) normal performance on cognitive tests and activities of daily living. Individuals were excluded if they 1) were illiterate, 2) had severe hearing or visual impairments, 3) had a history of being diagnosed with dementia or major neuropsychiatric disorders (i.e., schizophrenia, bipolar disorder, major depression, Parkinsonism, epilepsy, stroke, and head trauma), 4) had abnormal clinical findings due to cerebral hemorrhage, 5) had severe physical diseases, 6) had substance use disorders, or 7) had contraindications for an magnetic resonance imaging (i.e., claustrophobia or nonremovable ferromagnetic implants). To screen out individuals with undiagnosed dementia, or MCI, we used the criteria developed by the National Institute on Aging Alzheimer's Association[24] and the Seoul Neuropsychological Screening Battery-Core (SNSB-C).[25] Among the 165 individuals initially enrolled, 25 were excluded due to MCI as determined by the SNSB-C, and one participant withdrew after giving informed consent. Consequently, a total of 139 participants were included in the statistical analysis. This study was approved by the Institutional Review Board of Yongin Severance Hospital (9-2020-0080), and all participants provided informed consent.

Measures

SCD-Q

Rami et al.[26] developed and validated the SCD-Q to quantify SCD, wherein individuals self-assess perceived declines in their cognitive function over the past two years. The present study utilized the Korean version of the SCD-Q,[27] comprising 24 items. Scores range from 0 to 24, with higher scores denoting more significant cognitive decline. A cutoff point of 7 has been established.[27] SCD-Q demonstrated adequate internal reliability in this study (Cronbach's α=0.87), consistent with previous findings of strong reliability (Cronbach's α=0.90). Furthermore, its convergent validity coefficient exhibited notable significance (r=0.56; p<0.001).[26]

CDR-SB

The CDR-SB is an expanded version of the CDR, providing separate assessments for cognitive and functional performance across six domains: memory, orientation, judgment and problem-solving, community affairs, hobbies, and personal care.[17] In contrast to the CDR's global score, the CDR-SB covers a broader range of domains and demonstrates increased sensitivity in detecting the progression of AD from early to advanced stages.[19] Prior research reported a Cronbach's alpha of 0.65,[17] while the present sample yielded a slightly lower alpha of 0.60.

GDepS

The scale measures depressive symptoms in older adults. It consists of 30 dichotomous questions, with the total score indicating the level of depression: a score of 0−9 is considered normal, 10−19 suggests mild depression, and 20−30 indicates moderate to severe depression.[28] Consistent with previous findings of strong reliability (Cronbach's α=0.90),[28] this study demonstrated high internal reliability (Cronbach's α=0.90).

IADL

This self-report test assesses instrumental tasks that necessitate psychosocial functioning and cognitive domains of executive functions, such as planning, organization, and problem-solving. These tasks encompass managing finances, shopping, using the telephone, and administering medications. Scores range from 0 to 45, with higher scores indicating greater difficulty for the individual in independently performing IADL.[29,30] While prior research suggests strong internal reliability (Cronbach's α>0.90),[31] this study found a lower value (Cronbach's α=0.42). The low reliability of the scale might be caused by a cluster of responses in one category. The present sample demographics may not be adequately diverse, resulting in a skewed distribution of responses towards a particular category.

Statistical analysis

For each variable considered, we initially calculated descriptive statistics. Continuous data are presented as the mean and standard deviation, whereas categorical data are presented as counts (percentages). Subsequently, we explored the association between the continuous variables using Pearson's correlation coefficient. Finally, we conducted a structural equation model path analysis with SPSS Amos 23 (IBR Corp., Armonk, NY, USA) to test various hypotheses concerning the relationships among CDR-SB, GDepS, IADL, and their impact on SCD-Q.

A bootstrapping procedure was employed to estimate indirect effects and to conduct significance testing in mediation analysis.[32] To evaluate the fit of the structural model, various goodness-of-fit indices were used, as the sample size can affect the results and interpretation of these indices. The chi-square test is one such index, assessing the discrepancy between the observed and expected data. Ideally, a nonsignificant chi-square result indicates a "good" fit. However, it is crucial to recognize that reliance on the chi-square test alone can be deceptive, given its sensitivity to sample size. The root mean square error of approximation (RMSEA) is another commonly utilized indicator of model fit. The RMSEA considers both the complexity of the model and the sample size, offering a measure of the model's congruence with the data. An RMSEA value of 0.05 or lower indicates a better fit between the proposed model and the observed data.[33]

RESULTS

Characteristics of the participants

Table 1 presents the general characteristics of the 139 participants. The majority were female (n=98, 70.5%), with an average age of 73.46±3.82 years (ranging from 65 to 79 years). The average length of education was 10.05±4.47 years.

The variable "cardiovascular risk factors" indicated how

Table 1. Demographic and clinical characteristics of participants (N=139)

Variables	Value
Age (yr)	73.46±3.82
Sex	
Male	41 (29.5)
Female	98 (70.5)
Education (yr)	10.05±4.47
BMI (kg/m^2)	25.32±2.93
Cardiovascular risk factors	1.19±0.98
0	40 (28.8)
1	46 (33.1)
2	38 (27.3)
≥3	15 (10.8)
Alcohol	
Yes	31 (22.3)
Smoking	
Yes	7 (5.0)
SCD-Q	8.590±5.250
TMT-B*	-0.023±1.415
SVLT*	0.0381±1.200
BNT*	0.220±1.001
COWAT*	-0.004±0.951
CDR-SB	0.306±0.516
IADL	0.220±0.660
GDepS	10.810±6.870

Values are presented as mean±standard deviation or number (%). The independent t-test was used for continuous variables, and the chi-square test or Fisher's exact test was used for categorical variables. *neuropsychological tests are presented as Z-scores. Cardiovascular risk factors represent the number of the following conditions in an individual's medical history: hypertension, diabetes, dyslipidemia, and cardiovascular events. BMI, body mass index; SCD-Q, Subjective Cognitive Decline Questionnaire; TMT-B, Korean Trail Making Test for the elderly; SVLT, Seoul Verbal Learning Test; BNT, Boston Naming Test; COWAT, Controlled Oral Word Association Test; CDR-SB, Clinical Dementia Rating Scale-Sum of Boxes; IADL, Instrumental Activities of Daily Living; GDepS, Geriatric Depression Scale

many of the following conditions were in the participants' medical histories: hypertension (n=65, 46.8%), diabetes (n=34, 24.5%), dyslipidemia (n=47, 33.8%), and cardiovascular events (n=13, 9.4%). In our sample, most participants had at least one cardiovascular risk factor (n=99, 71.2%). Regarding other health-related risk factors, 31 individuals (22.3%) reported drinking alcohol, and 7 (5.0%) reported smoking cigarettes.

The associations between risk factors and neuropsychological tests

Pearson correlation coefficients were calculated to examine the associations among the measured variables, and the results are shown in Table 2. SCD-Q displayed significant positive correlations with the scores of GDepS (r=0.482, p<0.001), IADL (r=0.409, p<0.001), and CDR-SB (r=0.185, p<0.05). The correlation coefficients between TMT-B, SVLT, BNT, COWAT, and SCD-Q were found to be nonsignificant, indicating that only CDR-SB showed a statistically significant association with SCD-Q.

Path analysis and mediation analysis

To evaluate the fit of the hypothesized model, the chi-square test, RMSEA, comparative fit index (CFI), and Tucker-Lewis index (TLI) were used. The model fit was acceptable (minimum discrepancy function by degrees of freedom divided [CMIN/DF]=1.585, RMSEA=0.065, CFI=0.955, TLI=0.939). The maximum likelihood missing value estimation method was used to process missing values in the path analysis (Figure 1, which illustrates the mediation model).

CDR-SB

While there is a weak positive relationship with a correlation of 0.185 between SCD-Q and CDR-SB, no significant direct effect of the CDR-SB was found (excluding the mediator of depressive symptoms). Higher CDR-SB scores indicate a greater severity of cognitive and functional impairment. CDR-SB did not have a significant direct effect on SCD-Q in the mediation analysis conducted, unless considering depressive symptoms as a mediator.

Mediating effect of GDepS

A significant association was observed between the CDR-

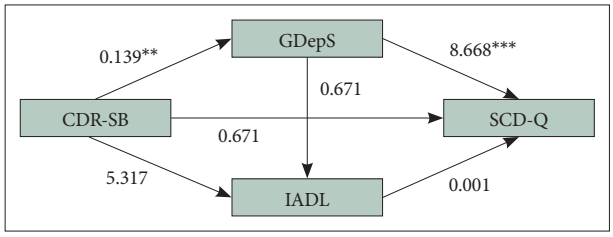

Figure 1. Diagram of the mediation model, showing the mediating role of depression and IADL on the relationship between CDR-SB and SCD-Q, along with standardized regression weightst between CDR-SB and GDepS (β=0.139, p<0.01); GDepS and SCD-Q (β=8.668, p<0.001). **p<0.01; ***p<0.001. CDR-SB, Clinical Dementia Rating Scale-Sum of Boxes; IADL, Instrumental Activities of Daily Living; GDepS, Geriatric Depression Scale; SCD-Q, Subjective Cognitive Decline Questionnaire.

Table 2. Associations between SCD-Q, neuropsychological tests, and related demographic factors (N=139)

	Age	Education	BMI	Cardiovascular risk factors	TMT-B	SVLT	BNT	COWAT	CDR-SB	IADL	GDepS	SCD-Q
Age	1											
Education	0.045	1										
BMI	0.074	-0.034	1									
Cardiovascular risk factors	0.043	-0.077	0.156	1								
TMT-B	-0.137	0.095	-0.023	0.152	1							
SVLT	0.055	-0.044	0.099	0.056	0.113	1						
BNT	0.107	0.213*	0.081	-0.033	0.043	0.035	1					
COWAT	0.071	0.094	0.082	0.046	0.063	0.230**	0.189*	1				
CDR-SB	0.035	-0.121	-0.062	-0.051	-0.154	-0.319**	-0.118	-0.055	1			
IADL	-0.014	-0.058	-0.039	0.022	-0.005	-0.077	-0.012	0.071	0.264**	1		
GDepS	0.011	-0.265**	0.002	0.024	-0.006	-0.101	-0.117	-0.096	0.265**	0.144	1	
SCD-Q	-0.034	-0.161	-0.087	-0.025	0.025	-0.136	-0.162	-0.154	0.185*	0.409**	0.482**	1

Cardiovascular risk factors refers to the number of cardiovascular conditions in the individuals' medical histories (i.e., hypertension, diabetes, dyslipidemia, and cardiovascular events). *the correlation is significant at the 0.05 level (two-tailed); **the correlation is significant at the 0.01 level (two-tailed). SCD-Q, Subjective Cognitive Decline Questionnaire; BMI, body mass index; TMT-B, Korean Trail Making Test for the elderly; SVLT, Seoul Verbal Learning Test; BNT, Boston Naming Test; COWAT, Controlled Oral Word Association Test; CDR-SB, Clinical Dementia Rating Scale-Sum of Boxes; IADL, Instrumental Activities of Daily Living; GDepS, Geriatric Depression Scale

SB, GDepS, and SCD-Q. However, there was no significant direct association between SCD-Q and CDR-SB. Despite the absence of a significant direct association between CDR-SB and SCD-Q, GDepS mediated the relationship between these two measures. Higher CDR-SB scores, which were associated with more symptoms of depression, corresponded to higher SCD-Q scores.

Mediating effect of IADL

There was no direct or indirect association between CDR-SB, IADL, and SCD-Q. IADL did not mediate the relationship between CDR-SB and SCD-Q.

DISCUSSION

Results summary

This study investigated the relationship between SCD-Q, IADL, and CDR-SB in community-dwelling older adults with objectively normal cognitive function. The findings revealed that the SCD-Q was indirectly related to the CDR-SB, with the GDepS acting as a mediator in this relationship. However, no direct link was found between the SCD-Q and the CDR-SB, suggesting that depression may influence how individuals perceive their cognitive decline, rather than directly causing it. This finding is consistent with previous studies suggesting that depressive symptoms could serve as an early indicator of cognitive decline, especially in relation to memory impairment.[14,34-37]

The findings from this study highlight the importance of conducting a comprehensive assessment of SCD in conjunction with CDR-SB and the GDepS. Early intervention during the cognitive impairment stage may be more effective when modifiable risk factors are identified and managed promptly.[38] These findings emphasize the necessity for patient-centered care, particularly in addressing symptoms of depression.[14] Recognizing the clinical characteristics of individuals with SCD who also experience worries could help explain the increased risk of AD development in this group.[39] Therefore, considering psychiatric factors is crucial when assessing reported complaints of memory decline.

In contrast, the analysis showed no significant association between IADL and SCD-Q, indicating that IADL does not serve as a mediator in the relationship between CDR-SB and SCD-Q. This finding is consistent with research showing most individuals with SCD maintain intact IADL abilities.[12]

Although both IADL and CDR-SB assess functional abilities, they differ in scope. CDR-SB is a more comprehensive measure of cognitive and functional abilities, including memory and personal care, whereas IADL specifically measures complex activities of daily life like managing finances and transportation.[40,41] This differentiation could explain the observed discrepancy in their connection to SCD-Q.[27,42,43]

These findings suggest the need for diverse assessments beyond IADL, potentially involving broader aspects of daily functioning and real-life participation, for tailored support in managing cognitive decline.[44] Further research is needed to understand how specific functional limitations relate to different facets of SCD.[27,42,43]

Despite the average participant age of 73, the study found no significant influence of age on SCD. SCD can occur at any age, with a prevalence of 10.4% in the 45−54 age group and 14.3% in individuals 75 years and older, as reported in Rami's study using the SCD-Q.[26,45,46] Future research could focus on comparing the 45−54 age group with older individuals to further explore the association between SCD and aging.

The potential limitations of this study are as follows: first, this cross-sectional design limits conclusions about causality, and replication with longitudinal data is recommended confirm these findings over time. Second, caution must be exercised when interpreting the results, as the small sample size can impact the precision of point estimates. Finally, while the original SCD-Q comprised two components—the subject's own perception and their caregiver's perception—only the subject's perception was utilized in this research. Although prior study suggests self-reported SCD is more sensitive than informant-reported SCD in predicting actual performance,[47] excluding caregiver input might limit the comprehensiveness of the assessment.

Despite these limitations, our findings are based on a specific demographic subset of community-dwelling older adults between the ages of 55 and 79 with normal cognitive function. This homogenous population ensures relevance to the research question and minimizes potential confounding factors associated with age and pre-existing cognitive impairment.[19] The identification of depression as an early marker of SCD offers a potentially modifiable target for intervention, paving the way for tailored strategies to support individuals in the preclinical stages.

Conclusions

Due to the fact that SCD can progress and affect different people differently, there is no one test that can determine a proper diagnosis. Therefore, identifying potential early markers of SCD through depressive symptoms and functional limitations can help tailor interventions to meet the unique needs of community-dwelling older adults and further optimize outcomes. Consequently, comprehensive assessments beyond the SCD-Q should be considered to detect subtle signs, exclude other potential causes, and identify patients who could benefit from additional testing.[48]

Availability of Data and Material

The datasets generated or analyzed during the study are not publicly available due to privacy concerns but are available from the corresponding author on reasonable request.

Conflicts of Interest

The authors have no potential conflicts of interest to disclose.

Author Contributions

Conceptualization: Woo Jung Kim, JiYeon Choi, Areum Kim, Sarah Soyeon Oh, Sang Hui Chu. Data curation: Sarah Soyeon Oh, Sang Hui Chu, Areum Kim. Formal analysis: Areum Kim. Funding acquisition: Woo Jung Kim, JiYeon Choi. Methodology: Woo Jung Kim, JiYeon Choi, Areum Kim. Project administration: Woo Jung Kim, Eun Lee. Supervision: Woo Jung Kim, Eun Lee. Validation: Woo Jung Kim, JiYeon Choi, Areum Kim. Visualization: Woo Jung Kim, JiYeon Choi, Areum Kim. Writing—original draft: Woo Jung Kim, JiYeon Choi, Sarah Soyeon Oh, Areum Kim. Writing—review & editing: Woo Jung Kim, JiYeon Choi, Areum Kim.

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