Cognitive-Communicative Differences Between Mild Cognitive Impairment and Healthy Aging: A Comparative Study Using the SCCAN

Author Information

Kostadin Chompalov
Department of Neurology, Medical University of Plovdiv, Plovdiv, Bulgaria
Corresponding author
Kostadin Chompalov
Department of Neurology, Medical University of Plovdiv, 66A Peshtersko shose Blvd, 4000 Plovdiv, Bulgaria
Email: kostadin.chompalov@mu-plovdiv.bg

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Abstract

Aim: To examine cognitive-communicative functioning in adults with Mild Cognitive Impairment due to Alzheimer's disease (MCI-AD) and compare performance with cognitively healthy older adults using the Bulgarian-adapted version of the Scales of Cognitive and Communicative Ability for Neurorehabilitation (SCCAN-BG).

Methods: This cross-sectional comparative study included 60 participants: 30 individuals with MCI-AD and 30 cognitively healthy controls comparable in education. Cognitive-communicative functioning was assessed across SCCAN domains, including orientation, memory, attention, oral expression, auditory and reading comprehension, writing, and problem solving. Group differences were analysed using non-parametric statistical methods.

Results: Overall SCCAN performance was lower in the MCI-AD group. Consistent group differences were observed in memory, attention, oral expression, and problem solving. These differences suggest reduced efficiency in tasks that require integrated cognitive-communicative processing. Reading comprehension and writing were largely preserved. Auditory comprehension showed a non-significant trend towards lower performance in the MCI-AD group.

Conclusion: Cognitive-communicative changes are evident at the MCI-AD stage and extend beyond memory impairment alone. The SCCAN-BG captures early, functionally relevant vulnerability in everyday communication. This supports its use for clinical monitoring and rehabilitation-oriented decision-making in populations at risk for Alzheimer's disease–related cognitive decline.

Keywords: cognitive-communicative functioning, Mild Cognitive Impairment due to Alzheimer's disease, healthy aging, SCCAN, clinical monitoring

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1. Introduction

Mild Cognitive Impairment is generally viewed as an intermediate stage between normal cognitive ageing and dementia, characterised by objective cognitive decline with preserved basic activities of daily living. In clinical practice, MCI-AD refers to individuals who meet established criteria for mild cognitive impairment with a presumed Alzheimer's disease etiology and who are at increased risk of progression to dementia (Albert et al., 2011; Petersen et al., 2014). However, growing evidence indicates that early cognitive changes are not limited to memory. Subtle involvement of attention and executive control may be present even in the absence of overt functional disability (Albert et al., 2007; Brandt et al., 2009).

Everyday communication relies on the integration of cognitive and linguistic processes, including attention regulation, memory updating, and executive control. Even mild inefficiencies within this system may reduce communicative effectiveness in cognitively demanding situations, despite preserved basic language abilities. Such cognitive-communicative changes have been reported in MCI and early Alzheimer's disease without frank aphasia or clinically evident language impairment (Chapman et al., 2002; Taler & Phillips, 2008; Bayles et al., 2020).

In clinical practice, brief cognitive screening instruments are widely used to detect global cognitive decline. Although efficient, these tools primarily assess overall cognitive status and may be insensitive to early functional changes emerging in communication-rich contexts. Consequently, cognitive-communicative vulnerability in individuals with MCI-AD may remain under-recognised, despite its relevance for everyday interaction and participation. Early identification of such changes is important for clinical monitoring and timely, supportive intervention (Hedden & Gabrieli, 2004; Cicerone et al., 2019).

The Bulgarian-adapted version of the SCCAN (SCCAN-BG) assesses cognition within functionally meaningful communicative tasks. This approach allows subtle inefficiencies to emerge during everyday performance (Milman et al., 2008). Unlike traditional tests that target isolated cognitive domains, the SCCAN focuses on integrated cognitive-communicative functioning.

A Bulgarian-adapted version of the SCCAN has been developed and applied in preliminary clinical and research settings. Pilot data have been reported in patients with Alzheimer's disease and ischemic stroke, supporting the feasibility of SCCAN-based cognitive-communicative assessment in Bulgarian clinical practice (Chompalov et al., 2025a). In addition, SCCAN performance has been examined in cognitively healthy older adults compared with patients with Alzheimer's disease. These findings provided initial evidence of sensitivity to disease-related cognitive-communicative differences (Chompalov et al., 2025b).

The present study examined cognitive-communicative differences between adults with clinically diagnosed MCI-AD and cognitively healthy older adults using the SCCAN. It was expected that individuals with MCI-AD would show lower performance, particularly in domains requiring integrated cognitive and communicative processing. The aim was not diagnostic classification. Rather, it was to identify early, functionally relevant cognitive-communicative vulnerability that could inform clinical monitoring and rehabilitation-oriented decision-making.

2. Material and methods

2.1. Study design

A cross-sectional comparative design was used to examine differences in cognitive-communicative functioning between adults with MCI-AD and cognitively healthy older adults. No intervention or randomisation was applied.

2.2. Participants

The sample included 60 adults aged 49–84 years. Thirty participants had a clinical diagnosis of MCI-AD, and 30 were cognitively healthy controls. Participants with MCI-AD were recruited from a university neurology clinic and affiliated outpatient diagnostic centres. Healthy controls were recruited from the community and hospital-affiliated networks.

The diagnosis of MCI-AD was established by an experienced neurologist. It was based on clinical interview, reported cognitive complaints, objective cognitive impairment on examination, preserved independence in basic activities of daily living, and absence of dementia. Diagnostic judgment was consistent with contemporary criteria for MCI-AD. When available, biomarker data (e.g., cerebrospinal fluid analysis) were taken into account as part of routine clinical evaluation. Biomarker confirmation was not uniformly available across all participants. The designation MCI-AD therefore reflects primarily a clinical diagnosis. Global cognitive status was assessed using the Mini-Mental State Examination (MMSE) for descriptive purposes only.

All participants were native Bulgarian speakers. All had adequate vision, hearing, and language comprehension to complete the assessments.

2.3. Inclusion and exclusion criteria

MCI-AD group. Inclusion criteria were a clinical diagnosis of MCI-AD, preserved independence in basic daily activities, and sufficient sensory and language abilities for assessment. Exclusion criteria included a diagnosis of dementia, other neurological or psychiatric disorders affecting cognition, major sensory impairments, or severe systemic illness. Healthy control group. Inclusion criteria were absence of cognitive complaints, no history of neurological or psychiatric disease, and independent everyday functioning. Exclusion criteria were the same as for the clinical group.

2.4. Measures

Cognitive-communicative functioning was assessed using the Bulgarian-adapted version of the SCCAN (hereafter referred to as SCCAN-BG). The SCCAN-BG includes eight subtests assessing oral expression, orientation, memory, auditory comprehension, reading comprehension, writing, attention, and problem solving. Each subtest yields a raw score. The sum of all subtests constitutes the SCCAN-BG Total Score. Higher scores indicate better cognitive-communicative functioning.

The Bulgarian version of the SCCAN was developed through forward and backward translation with cultural adaptation. Normative data are not yet available. All analyses were therefore based on raw scores.

2.5. Procedure

Written informed consent was obtained from all participants prior to assessment. The study was conducted between 2023 and 2025 at the Neurology Department of St. George University Hospital in Plovdiv, Bulgaria, as part of an ongoing research project.

Assessments were administered individually in a quiet room under standardised conditions. The assessment battery included the Bulgarian-adapted version of the SCCAN and the MMSE. Breaks were provided as needed to minimise fatigue.

All assessments were conducted by the same trained clinician. When necessary, available clinical records were reviewed to confirm diagnostic information.

The study protocol, including approval for analysis of data collected within the approved project framework, was approved by the Ethics Committee of the Medical University of Plovdiv (Approval No. 4/10.04.2025; Decision R-KNE-20/16.07.2025) and was conducted in accordance with the Declaration of Helsinki (World Medical Association, 2013). Following assessment, all personal identifiers were removed. Data were coded and stored securely in compliance with applicable data protection regulations.

2.6. Statistical analysis

Descriptive statistics were calculated for demographic variables and SCCAN-BG scores. Because score distributions were discrete and ceiling effects were observed, non-parametric methods were used. Group differences were examined using the Mann-Whitney U test. Statistical significance was set at $p < .05$ (two-tailed). All analyses were performed using IBM SPSS Statistics for Windows, Version 22.0.

3. Results

3.1. Participant characteristics

The study included 60 participants: 30 individuals with MCI-AD and 30 cognitively healthy controls. Demographic and clinical characteristics are presented in Table 1.

Table 1. Demographic and Clinical Characteristics of the Study Groups

Characteristic	MCI-AD (n = 30)	Controls (n = 30)
Age, years (mean ± SD)	71.8 ± 8.1	65.6 ± 7.2
Age range (years)	54–84	49–78
Sex (female / male), n	15/ 15	2026-10-20 00:00:00
Education, years (mean ± SD)	14.4 ± 1.9	13.3 ± 2.1
Education range (years)	2016-12-01 00:00:00	2016-08-01 00:00:00
MMSE score (mean ± SD)	26.1 ± 2.9	29.1 ± 1.6
MMSE range	19-30	23-30

Note. Values are presented as mean ± standard deviation unless otherwise specified. MMSE = Mini-Mental State Examination. MMSE scores are reported for descriptive purposes only.

The two groups were comparable in years of formal education. As expected, participants with MCI-AD were older and had lower MMSE scores than controls, consistent with their clinical classification. MMSE scores are reported for descriptive purposes only.

3.2. Cognitive-communicative performance

Group-level performance on the SCCAN total score and subtests is presented in Table 2.

Table 2. SCCAN-BG Total Score and Subtest Performance in MCI-AD and Control Groups

SCCAN-BG domain	MCI-AD (n = 30) Mean ± SD (Range)	Controls (n = 30) Mean ± SD (Range)
SCCAN-BG Total	75.7 ± 7.9 (56–89)	85.2 ± 8.8 (49–93)
Oral expression	16.0 ± 3.3 (9–19)	18.1 ± 2.4 (9–19)
Orientation	11.4 ± 1.1 (8–12)	12.0 ± 0.0 (12–12)
Memory	9.4 ± 2.8 (3–17)	15.2 ± 3.7 (6–19)
Auditory comprehension	11.4 ± 1.5 (8–13)	12.0 ± 1.4 (7–13)
Reading comprehension	11.0 ± 0.9 (8–12)	11.0 ± 1.3 (8–12)
Writing	6.9 ± 0.3 (6–7)	6.9 ± 0.2 (6–7)
Attention	12.2 ± 2.3 (6–16)	13.3 ± 2.8 (4–16)
Problem solving	18.3 ± 3.7 (10–23)	20.1 ± 4.1 (5–23)

Note. Values are presented as mean ± standard deviation with observed ranges. Scores are reported descriptively.

Participants with MCI-AD demonstrated lower overall cognitive-communicative performance than healthy controls. Reduced performance was observed across several SCCAN-BG domains, most notably memory, oral expression, orientation, attention, and problem solving. Orientation scores in the control group showed ceiling effects (12/12).

In contrast, performance in reading comprehension and writing was comparable between groups. Auditory comprehension showed a tendency towards lower scores in the MCI-AD group but did not reach statistical significance.

3.3. Group differences in cognitive-communicative functioning

Non-parametric comparisons using the Mann–Whitney U test confirmed significantly lower SCCAN-BG total scores in the MCI-AD group compared with controls (U = 145.0, $p < .001$). Significant between-group differences were observed for memory (U = 114.5, $p < .001$), oral expression (U = 245.5, p =.001), orientation (U = 345.0, p =.006), attention (U = 317.0, p =.048), and problem solving (U = 292.0, p =.018).

No statistically significant differences were identified for reading comprehension or writing. Auditory comprehension showed a non-significant trend towards lower performance in the MCI-AD group (p =.055).

4. Discussion

4.1. Summary and interpretation of key findings

The present study examined cognitive-communicative functioning in adults with clinically diagnosed MCI-AD using the SCCAN-BG. Performance was compared with that of cognitively healthy older adults. Individuals with MCI-AD showed significantly lower overall cognitive-communicative performance. Group differences extended beyond memory and included oral expression, attention, orientation, and problem solving. This pattern reflects reduced efficiency across multiple cognitive-communicative domains rather than an isolated mnemonic deficit (Albert et al., 2011; Petersen et al., 2014).

The domains that differentiated the groups place sustained demands on attention and executive regulation during language-based activities. The observed profile suggests early compromise of regulatory cognitive processes in Alzheimer's disease-related cognitive decline. Episodic memory impairment remains central to MCI-AD. However, it appears alongside broader inefficiencies in cognitive control (Brandt et al., 2009; Saunders & Summers, 2010).

Memory showed the clearest separation between groups. This finding aligns with diagnostic models emphasising early episodic memory decline in MCI-AD (Albert et al., 2011; Petersen et al.1999). Within the SCCAN, memory performance reflects more than encoding and retrieval. It also involves managing these processes during functional communicative tasks (Milman et al., 2008). Lower memory scores therefore likely reflect limited allocation of cognitive resources under increased task demands. They do not indicate a purely memory-specific impairment.

Importantly, memory difficulties did not occur in isolation. Reduced memory performance co-occurred with weaker attention, oral expression, and problem solving. This pattern indicates integrated cognitive vulnerability. Prior research shows that executive and attentional inefficiencies often accompany memory deficits in MCI. These inefficiencies may amplify functional difficulties in complex communicative situations (Saunders & Summers, 2010; Chapman et al., 2002).

In contrast, reading comprehension and writing did not differentiate the groups. Auditory comprehension showed only a non-significant trend toward lower performance in the MCI-AD group. This relative preservation is consistent with evidence that overlearned and highly structured language abilities remain intact in early cognitive decline (Chapman et al., 2002; Taler & Phillips, 2008). Overall, these findings support the sensitivity of the SCCAN-BG to early cognitive-communicative vulnerability in clinically defined MCI-AD, particularly in contexts requiring efficient cognitive control during communication (Bayles et al., 2020).

4.2. Attention, executive processes, and oral expression

Beyond memory, the findings indicate early disruption of attentional and executive regulation in MCI-AD. Group differences were observed in attention, orientation, problem solving, and oral expression. Together, these results point to reduced efficiency of cognitive control processes supporting communication. Such vulnerabilities are well documented in prodromal Alzheimer's disease, even when global cognition appears preserved (Brandt et al., 2009; Saunders & Summers, 2010).

Lower attention scores indicate reduced capacity to sustain and direct cognitive effort. In everyday communication, attentional control supports focus, response coordination, and interaction monitoring. Subtle inefficiencies in these processes may reduce communicative effectiveness under increased cognitive demands. Prior studies show that attentional and working memory deficits often emerge early in MCI, especially in complex or time-pressured conditions (Saunders & Summers, 2010; Summers & Saunders, 2012).

Problem-solving performance reflects early executive vulnerability. SCCAN problem-solving tasks require reasoning, flexibility, and strategic organisation. Lower scores in the MCI-AD group align with evidence linking executive dysfunction to functional decline in MCI. Such deficits may be present even when brief cognitive screening remains within normal limits (Brandt et al., 2009; Summers & Saunders, 2012).

Oral expression also differentiated the MCI-AD group despite the absence of aphasia. This finding suggests reduced efficiency in cognitive systems supporting real-time language use. It does not reflect loss of core linguistic knowledge. Because oral expression depends on attention, working memory, and executive control, it is sensitive to subtle cognitive change.

Within the SCCAN, oral expression tasks require idea generation, response organisation, and self-monitoring. Lower performance likely reflects difficulty coordinating cognitive resources during speech. It does not indicate impairment of semantic or syntactic representations. This interpretation is consistent with reports of preserved basic language abilities alongside reduced fluency or flexibility in MCI (Chapman et al., 2002; Fleming & Harris, 2008).

Evidence from discourse and verbal fluency research supports this view. Early reductions in informativeness, coherence, and retrieval efficiency are documented in MCI and early Alzheimer's disease (Cottingham & Hawkins, 2010; Drummond et al., 2015). Together, these findings indicate early cognitive-communicative vulnerability in MCI-AD. This vulnerability is driven, in part, by reduced efficiency of attentional and executive control processes supporting spoken communication.

4.3. Preserved domains, ceiling effects, and interpretation of sccan profiles

Reading comprehension and writing did not differentiate individuals with MCI-AD from cognitively healthy older adults. Orientation and writing scores in the control group showed ceiling effects. These findings indicate relative preservation of specific cognitive-communicative abilities in the early stages of Alzheimer's disease-related cognitive decline. They also provide essential context for interpreting the overall SCCAN-BG profile.

Reading and writing are cognitively complex but rely heavily on overlearned linguistic knowledge. They depend on automatised routines. Consistent with prior research, literacy-related abilities tend to remain stable in early cognitive decline and are typically affected later in the disease course (Taler & Phillips, 2008; Bayles et al., 2020). Ceiling effects in these domains may reduce sensitivity at higher performance levels. At the same time, they reflect genuine preservation of function in healthy aging.

Orientation differences were statistically significant but small. They were influenced by ceiling performance in the control group. This pattern suggests that orientation is largely preserved in normal aging. Reduced scores in MCI-AD likely reflect lower efficiency under increased cognitive demands rather than overt disorientation (Aggarwal et al., 2005).

The selective preservation of reading, writing, and orientation contrasts with deficits observed in memory, attention, executive-related processes, and oral expression. This pattern indicates domain-specific and context-dependent vulnerability in MCI-AD. It does not support a model of global cognitive impairment. Instead, it aligns with contemporary views of early cognitive decline as reduced processing efficiency under functional demands (Albert et al., 2011; Petersen et al., 2014).

From a clinical perspective, these findings support interpreting the SCCAN-BG as a tool for identifying functional cognitive-communicative vulnerability. It should not be viewed as a diagnostic instrument for Mild Cognitive Impairment. The observed group differences do not define diagnostic boundaries. They illustrate how subtle inefficiencies emerge during communicative activity. By embedding cognitive demands in functionally meaningful tasks, the SCCAN framework captures vulnerabilities that may be missed by global cognitive screening alone (Bayles et al., 2020).

Given the heterogeneity of MCI outcomes, tools that characterise functional performance patterns may offer greater clinical utility than those focused on diagnostic classification alone (Mitchell & Shiri-Feshki, 2009; Sachdev et al., 2013). SCCAN-based profiles describe the interaction between cognition and communication. They support clinical monitoring and rehabilitation-oriented decision-making without implying diagnostic or prognostic certainty.

4.4. Clinical implications, limitations, and future directions

The present findings have direct implications for clinical assessment and rehabilitation-oriented practice in individuals with MCI-AD. Cognitive-communicative differences were most evident in functionally oriented communication tasks. They were less apparent on global cognitive screening measures. This suggests that reliance on brief screening alone may underestimate early functional vulnerability relevant to everyday communication.

SCCAN-based profiles provide structured insight into how cognitive inefficiencies emerge during communicative activity. In this sample, individuals with MCI-AD showed reduced efficiency in tasks requiring coordinated attention, memory, executive control, and verbal output. Performance remained relatively preserved in more constrained domains. This pattern highlights the clinical value of cognitive-communicative assessment for identifying early, context-dependent vulnerability affecting everyday participation (Bayles et al., 2020).

From a rehabilitation perspective, early identification of cognitive-communicative vulnerability supports proactive and supportive intervention. The focus shifts toward maintaining communicative effectiveness rather than remediating established impairment. Interventions targeting attention regulation, strategic communication, and compensatory use of preserved skills may reduce the functional impact of early inefficiencies. Cognitive-communicative assessment also supports interdisciplinary collaboration by linking cognitive change to functional communication outcomes within neurological and neuropsychological care.

Several limitations should be acknowledged. The sample size was modest, which limits statistical power and generalisability. The cross-sectional design precludes conclusions about longitudinal change or prognostic value. Diagnosis of MCI-AD was based primarily on clinical criteria. Although biomarker data were considered when available, they were not uniformly obtained across all participants. This limits etiological certainty at the group level. The MCI-AD group was also older than the control group, and age-related effects may have contributed to some differences. Normative data for the Bulgarian-adapted SCCAN are not yet available. Ceiling effects further reduced sensitivity in some domains.

These limitations define the boundaries of interpretation and guide future research. Longitudinal studies with larger samples are needed. Biomarker characterisation and population-specific normative data are also required. Such work will further clarify the clinical utility of SCCAN-based cognitive-communicative assessment in Mild Cognitive Impairment.

5. Conclusion

This study demonstrates that adults with clinically diagnosed MCI-AD exhibit measurable cognitive-communicative differences compared with cognitively healthy older adults, as assessed by the SCCAN-BG. These differences extend beyond memory and reflect reduced efficiency in integrated cognitive-communicative processing, particularly in domains involving attention, executive control, and verbal output.

The observed profile does not indicate overt communicative disability. Instead, it reflects early, context-dependent functional vulnerability that may affect everyday communication under increased cognitive demands. The preservation of more constrained or overlearned domains supports the selective nature of early cognitive-communicative change in MCI-AD.

By embedding cognitive demands within functionally relevant communicative tasks, the SCCAN-BG complements global cognitive screening and supports clinically informed monitoring and rehabilitation decisions.

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Conflict of interests

The author declares no conflicts of interest.

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