Research Article

Cognitive screening in elderly people

Abstract

Elderly people are exposed to functional losses, which can either be natural transformations (senescence), or pathological (senility). Cognitive screening tests identify cognitive impairment and risk of developing dementia. This article aims to assess the effectiveness of three cognitive screening instruments in detecting cognitive impairment in elderly individuals with limited education. The study involved 920 individuals over the age of 60, who were recruited from driver's license centers in various Brazilian states. Participants were assessed using the cognitive screening tools: Battery Routes of Attention (BRA), to attentional capacity; Nonverbal General Intelligence Matrices (MIG), to non-verbal intelligence; and Visual Recognition Memory Test (Memore), to short-term memory. The study examined the correlation between the total scores on tests and the participants' profile (mean=69.10 and SD=6.54), according to sex, age, age group, education level, and state of Brazil. The analysis found a positive correlation between the total scores of cognitive tests and the level of education of the participants, with higher levels of education serving as a protective factor for cognition. There was moderate correlation between visual recognition memory and sex, indicating better mnemonic performances for female participants. Age was found to have a negative correlation with all cognitive screening tests. The use of cognitive screening batteries can provide relevant indicators to plan appropriate interventions with elderly people. Furthermore, these test results emphasize the significance of further research to enhance the credibility of cognitive screening tests and broaden their applicability to elderly populations with diverse cultural backgrounds.

Keywords: aged, cognition, attention, memory, neuropsychology

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Introduction

The recent decades have witnessed an upsurge in the global population's age due to improved health conditions and increased life expectancy. Japan is a prominent example of this trend, with the proportion of elderly people surging from 4.9% in 1950 to 28.4% in 2020.[1] Similarly, Brazil has also experienced a comparable trend of population aging. According to the 2022 census conducted by the Brazilian Institute of Geography and Statistics (IBGE), the percentage of the population aged over 60 is about 14,5%. Experts estimate that this figure will rise to 16.6% by 2030.[2,3] As people age, they commonly experience changes in cognitive, memory, and attention abilities, which can lead to difficulties in daily activities and managing complex tasks. Memory decline is a significant cognitive change in older adults, making it challenging to remember important information. Attentional abilities may also decline, resulting in difficulty sustaining focus on tasks. However, not all older adults experience significant cognitive decline, and some may even see improvements in certain areas.

Elderly people are exposed to functional losses, which can either be natural transformations, related to so-called senescence, or pathological, when related to senility.[3,4] A highly prevalent pathology in the elderly is dementia, labelled as Major Neurocognitive Disorder by the American Psychiatric Association in its Diagnostic and Statistical Manual of Mental Disorders: Fifth Edition, Text Revision.[5] Major Neurocognitive Disorder is defined as a significant decline in performance in one or more cognitive domains, which interferes with autonomy in daily activities, and can have several causes. Alzheimer's disease is notably the most common form of this clinical condition.[5–7] This cognitive impairment is related to possible memory loss, difficulty using and understanding words, inability to perform motor activities without motor impairment, and failure to identify objects.[7]

As people age, they become more susceptible to depression and dementia, which can lead to deficits in cognitive functions such as memory, language, executive functions, praxis, and gnosis. These deficits can negatively impact the autonomy, social interactions, and professional performance of the elderly. A neuropsychological evaluation is highly recommended to identify cognitive decline in older individuals, assess any impairment of cerebral areas in the case of neurological alterations, and provide a differential diagnosis between psychological/psychiatric and neurological syndromes.[8,9] Dementia is a pressing global health concern, with approximately 10 million people diagnosed with the condition each year worldwide. This alarming figure is expected to grow in the coming years.[10] Notably around 60% of the population affected by dementia resides in developing countries with medium to low family income. In Latin America, the prevalence of dementia stands at approximately 8 to 9%, further underscoring the urgent need to address this growing health issue.[7,11]

In Brazil, the data does not differ from the rest of Latin America. It is estimated that, in the Brazilian context, about 1.6 million people live with dementia.[10] Considering the population under the age of 65, some studies estimated the prevalence rate of dementia in the elderly at 7.9% for 2020.[11,12] In addition to Major Neurocognitive Disorder,[5] which characterizes dementia, the DSM-5-TR defines Mild Neurocognitive Disorder as a moderate decline in performance in one or more cognitive domains, not interfering with independence in carrying out daily activities.[5] Some other characteristics of the disorder are difficulties with memory, orientation, planning and decision-making. Mild Neurocognitive Disorder is associated with a significant risk of developing dementia, but this evolution does not occur in all cases: approximately 18% of cases spontaneously reverse Zhuang et al.

Other causes of cognitive impairment in older people include mental disorders, medication side effects, and metabolic and/or endocrine disorders.[13] Some causes, such as medication side effects and depression, can be reversed or improved with proper treatment.

Others, such as Alzheimer's disease, cannot be reversed, but the symptoms can be managed over time, while families can be prepared for predictable changes in older people's behavior and can organize for future care. based on prognosis.[14] In this sense, an early detection of cognitive impairment, whether caused by a Neurocognitive Disorder or another cause, allows for early intervention and preparation.[6,7,15,16] The absence of assessment of cognitive complaints in elderly people can make it difficult to treat the main morbidity and their respective comorbidities, increasing insecurity in the conduct of care strategies and monitoring of the health and quality of life of these individuals. To carry out the assessment of cognition and its deficits, information from the patient's clinical history is required, as well as information observed by family members, caregivers, and professionals.

In cognitive screenings, some of the cognitive functions most evaluated by the tests are memory, attention, temporal and spatial orientation, constructive praxis, language, and executive functions.[3] Furthermore, this procedure is commonly used to perform differential diagnoses and determine the severity of pathologies that are present, as well as to monitor their progression.[16] Some of the most frequently applied instruments for cognitive screening are the Mini Mental State Examination (MMSE), the Clock Drawing Test, and the Verbal Fluency Test.[17] The MMSE is the most known and used; however, some studies suggest that it has limitations in differentiating Mild Neurocognitive Disorder from healthy control subjects, and that it does not perform well in assessing executive functions. Therefore, the use of alternatives in the cognitive assessment of elderly people is suggested.[15,16] Excessively brief tests to detect cognitive impairment, such as the MMSE, can also lead to misinterpretations, as many require reading and writing skills, requiring some formal education. In these cases, people with a high level of education may have good results that hide their possible cognitive decline, while healthy people with a low level of education may have lower performances and, therefore, be mistakenly identified as suspected cases.[6,16,17] The error rate in the diagnosis of mild cognitive impairment, for example, can reach 91% in the first appointments.[18]

Psychological assessments must consider sociocultural and educational factors when interpreting results. They must also be suitable for use with populations that have limited or no formal education, have the capacity to differentiate between cognitive function loss and natural aging among individuals with limited educational opportunities, and be sensitive and specific enough to distinguish between various cognitive impairment diagnoses such as Mild Neurocognitive Disorder and Major Neurocognitive Disorder. This is supported by research conducted by Ortega et al.,[17] and Pellicer-Espinosa et al.,[6] on the importance of adapting psychological tests to diverse populations, as well as Tavares-Júnior et al.,[16] on the need for assessments to accurately differentiate between cognitive impairments. This article aims to assess the effectiveness of three cognitive screening instruments in detecting cognitive impairment in elderly individuals with limited education. This need arises from the specific requirements of this population and the importance of establishing appropriate tools for their cognitive screening.

Method

Participants

A study was conducted with 920 individuals between the ages of 60 and 90. The study will take place in driver's license centers located in various Brazilian states, including Bahia, Minas Gerais, Paraná, Rio de Janeiro, Santa Catarina, and São Paulo, and the tests were applied in the period between July and September 2022. The participants were individuals seeking their first driver's license, upgrading their current license, or renewing their National Certificate of Habitation.

Instruments

For data collection purposes, individual assessments were conducted at a single point in time utilizing the following tools: a) individual anamnesis, which was used to collect personal information (such as sex, age, and education) and health history (including current health status and medical/psychological treatment received at the time of evaluation). Only candidates who were approved in medical and psychological exams were considered for this study. The cognitive screening instruments used in this research were:

1) Battery Attention Routes (BRA): a battery of three psychological attention tests: Concentrated Attention Test (Route C), Divided Attention Test (Route D) and Alternating Attention Test (Route A). The objective of the battery is to assess the attentional capacity of the individual in performing a certain task, for a period of 2 minutes per test, based on pictorial visual stimuli, and following a zigzag trail, called "route", unwound in graphic material. Once the three tests (Route C, D and A) have been applied, the same individual or professional can assess the attention performance in a comparative way between the tests, by means of the General Measure of Attention (GAM). A BRA has evidence of validity internal, developmental, by related constructs and by clinical criteria, in addition to studies of precision of the scales, based on the test-retest procedure and normative standards for the Brazilian population.[19]

2) Nonverbal General Intelligence Matrices (MIG): it is a non-verbal general intelligence measurement instrument for adolescents and adults, based on the concept of fluid intelligence, which represents the ability to solve new problems, relate ideas, induce abstract concepts, and use analogies to understand differences between stimuli and concepts. The MIG is made up of 28 items, diagrammed in matrixes, in which the respondent must search, among the available alternatives, for the one that he considers most appropriate to complete the implicit reasoning in each exercise, in a total execution time of 6 minutes. The MIG has evidence of internal validity, by related and criteria constructs, precision studies and normative standards applied to the Brazilian population. The MIG has evidence of validity of the internal structure, by related constructs and based on the response process, as well as precision (coefficients of Chronbach's Alpha = 0.88 and Guttman's Lambda = 0.90 and normative tables applied to the Brazilian population.[20]

3) Visual Recognition Memory Test (Memore): The aim of this test is to evaluate the recognition of stimuli previously presented in a short-term visual memory task that is associated with working memory. This is achieved through assessing the ability of participants to recognize stimuli after a predetermined distracting activity. During the task, participants are instructed to memorize a set of 12 stimuli presented in color, divided into segments lasting one minute. Following a three-minute distracting activity, they are then asked to recognize the previously presented stimuli from a list of 24 stimuli, which lasts for three minutes. The Memore tool has been validated with respect to its internal structure and related constructs, as well as through precision studies and normative tables applied to the Brazilian population.[19]

Procedures

All instruments used in this study have been approved by the Federal Psychology Council for professional use in Brazil. The

participants who voluntarily agree to participate and signed the Free and Informed Consent Term were included in the current study. Participants were fully informed about the purpose of the research, as well as the potential risks involved, and were free to withdraw from the study at any time. The data analysis for this study only considered the responses from participants who completed the anamnesis and relevant psychological assessments. The statistical analysis of the data was conducted using the JASP software (version 0.16.4).

Results

The participants profile (age= 60-90, n=102, mean = 69.10 and a SD= 6.54) is synthesized in Table 1, according to sex, age group, education level, and state of Brazil. The first step of the analysis involved assessing the correlation between the outcomes of the different BRA tests. The correlation analysis revealed a strong positive correlation between Route C and Route D (r = 0.808, *p* < 0.001), as well as between Route D and Route A (r = 0.894, *p* < 0.001), and between Route C and Route A (r = 0.834, *p* < 0.001), demonstrating a strong correlation between them. Subsequently, correlations between the total scores of Memore and BRA tests were examined. It was found that there is a significant, moderate positive correlation between MEMORE test and Route C (r = 0.554, *p* < 0.001), Route A (r = 0.459, *p* < 0.001), and Route D (r = 0.475, *p* < 0.001). Foi observada uma correlação moderada e significativa entre os resultados dos escores totais do MIG e os testes da BRA (Route C, r = 0,456; *p* < 0,001), Route D (r = 0,506; *p* < 0,001) e Route A (r= 0,496; *p* < 0,001). The correlation between the total scores of MEMORE and MIG was positive, moderate, and significant (r= 0.573, *p* < 0.001). There was a significant correlation between the age of the participants and their performance on all cognitive screening tests. This was especially evident with regards to memory of visual recognition (rho=-.383**, p < 0.01), which is a component of short-term memory. Additionally, a significant negative correlation was found between memory of visual recognition and non-verbal intelligence (rho = -0.383**, p < 0.01, as evidenced by Table 2. A negative correlation has been observed between attentional performance, short-term memory, and non-verbal intelligence, with increasing age groups. This trend is consistent with findings from previous studies on cognitive decline in elderly individuals (Figure 1).

Table 1 Participants Profile (N=920)

Variable		Frequency	%
Sex	Female	365	39,7
	Male	555	60,3
Age Group	60-65	326	35,4
	66-70	268	29,1
	71-75	173	18,8
	76-80	97	10,6
	81-90	56	6,1
Education Level	Fundamental	302	32,8
	High school	363	39,5
	Higher level	255	27,7
State of Brazil	Bahia	103	11,2
	Minas Gerais	144	15,7
	Paraná	163	17,7
	Rio de Janeiro	141	15,3
	Santa Catarina	161	17,5
	São Paulo	208	22,6

Source: Authors' elaboration (2023)

Table 2 Correlation coefficients between age and the scores of the two instruments used (Spearman and p-value)

Variable	Age	Route C	Route D	Route A	MGA	Mem	MIG
Age	1,000						
Route C	-,302**	1,000					
Route D	-,293**	,785**	1,000				
Route A	-,260**	,814**	,855**	1,000			
MGA	-,284**	,886**	,901**	,957**	1,000		
Mem	-,383**	,234*	,179*	,242*	,275**	1,000	
MIG	-,185	,071	,166*	,217*	,187	,435**	1,000

Obs.: *The correlation is significant <0.05 (2 extremities)

** The correlation is significant <0.01 (2 extremities).

Source: elaborated by the authors (2023).

The correlation between the total scores of the cognitive screening tests and the participants' level of education suggests that attentional performance is also influenced by the duration of formal education, as well as age/age group. A positive, moderate, and significant correlation was observed between the total scores of the two cognitive screening tests and the level of education of the two participants (r= 0.301/0.418; p < 0.001). Specifically, participants who had completed only primary education achieved lower scores, while those who had completed higher education achieved the highest scores (Figure 2). It was verified, therefore, that higher levels of formal education act as a protective factor of cognitive performance in elderly people.

Regarding gender, a moderate and significant correlation was observed only with the visual recognition memory variable (r = 0.326, p < 0.001), indicating a more favorable mnemonic performance for female participants. No significant correlations were observed between the total scores of cognitive screening tests and the different living situations of the participants.
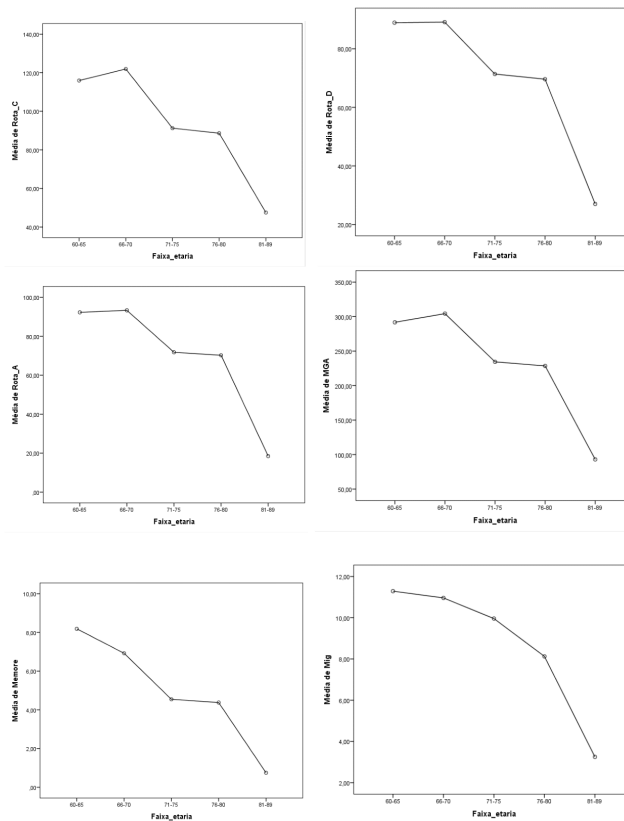
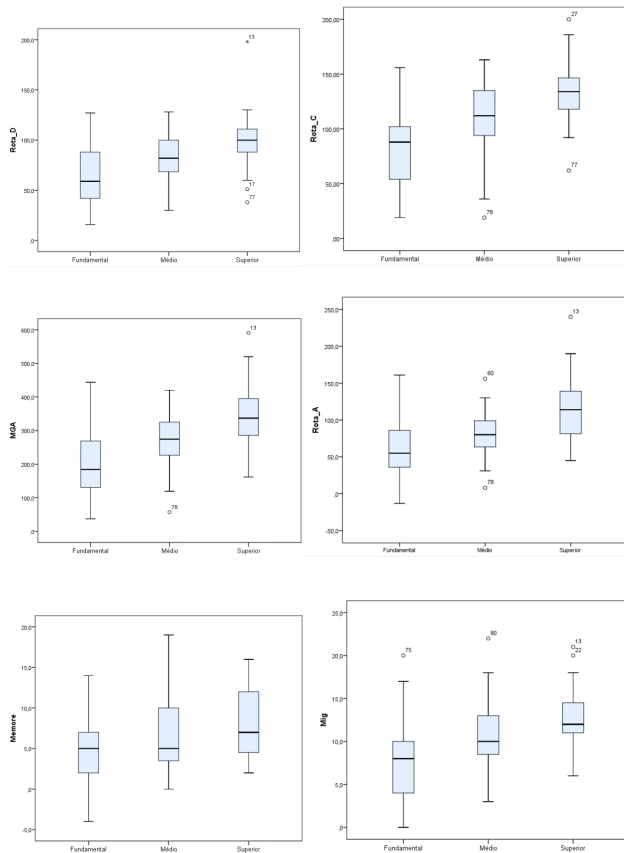**Figure 1** Cognitive screening test scores distributed by age groups.

Figure 2 Cognitive screening test scores distributed by educational levels.

Discussion

As people age, they may experience changes in their cognitive process and daily life skills. Studies have shown that these changes are common and can sometimes lead to difficulties in performing daily activities. The impact of aging on cognitive functions differs significantly among individuals and across various cognitive domains. Certain functions, such as working memory, attention, and inhibitory control, tend to exhibit higher vulnerability to the effects of aging.[21,22] Older adults often face a decline in processing speed, which results in a slower completion of mental tasks, including problem-solving and information retrieval. The aging process can have an impact on both short-term and long-term memory, making it more difficult for older adults to remember new information or recall specific details from their past experiences. Additionally, maintaining attention and focus on tasks for extended periods becomes increasingly challenging with age.[23] Older adults may struggle with filtering out distractions and staying concentrated on a particular task. Furthermore, executive functions, such as planning, decision-making, and problem-solving, may also be impacted in elderly individuals. This can lead to difficulties in managing complex activities, such as managing finances or medications.[24]

One of the most affected cognitive domains in older people is memory. The ability to recall information, such as names, dates, and events, may decline with age. This can make it challenging for older adults to remember important information, like medication schedules or appointment times. Another cognitive domain that may be affected in elderly people is attention. Attentional abilities refer to the capacity to concentrate on specific tasks, filter out distractions, and maintain focus for a prolonged period. As people age, their attentional abilities may decline, which can result in difficulty completing tasks that require sustained attention. However, it is important to note that not all older adults experience significant cognitive decline. Many older individuals maintain their cognitive abilities well into their later years. Furthermore, some older adults may even experience cognitive improvement in certain areas, such as emotional regulation or wisdom. The objective of this study was to evaluate the effectiveness of three cognitive screening instruments in aiding the non-diagnosis of compromised cognitive functions. These instruments included a battery of tests measuring concentrated, distributed, and alternating attention (BRA), a test assessing short-term visual recognition memory (Memore), and a test assessing non-verbal general intelligence (MIG). The results showed that all the scores obtained from the two instruments were positively correlated, which reveals coherence and consistency within the cognitive battery. These findings provided important conclusions regarding the effectiveness of these instruments and did not support the diagnosis of compromised cognitive functions in the elderly. Cognitive impairment is a significant problem among elderly individuals, and the prevalence of cognitive decline increases with age. Therefore, it is crucial to identify cognitive impairment as early as possible to prevent or delay the progression of cognitive decline. Cognitive screening tests can be an effective tool for detecting cognitive impairment and have been widely used in clinical and research settings.

Studies have shown that cognitive screening tests, as well as the instruments used in this study, can effectively detect cognitive impairment in elderly people.[25,26] These tests are simple, quick, and easy to administer, making them suitable for use in primary care settings. Furthermore, cognitive screening tests can also help identify individuals who may be at risk of developing dementia. Research has demonstrated that individuals with mild cognitive impairment (MCI) are at an increased risk of developing dementia.[27] Early identification of MCI through cognitive screening tests can enable early intervention and potentially delay or prevent the onset of dementia. The results of this study revealed a negative association between attentional performance, as measured by tests of concentrated, distributed, and alternating attention, and age/age groups. Additionally, a positive association was found between attentional performance and the education levels of the research participants. These findings are consistent with previous scientific studies in this area, including Mahoney et al., Wirth and Kunzmann et al., Grzeschik et al., Hanley and Tales et al., and Komorowska et al. Furthermore, our results support the evidence of validity and precision of the BRA tests, as previously demonstrated in Rabelo et al.[19]

The relevance of socioeconomic factors, such as education, in maintaining and preserving cognitive function is highlighted based on the results achieved through this study, as well as the influence of aging on attentional performance. These findings reinforce the importance of the cognitive screening tests as a valid and accurate tool for evaluating cognitive functions, as well as for investigating possible changes in attentional performance across different population groups. A positive and significant association was found between the participants' level of education and the total scores on the cognitive battery, indicating that higher education leads to less apparent cognitive decline in older adults. These results are consistent with existing scientific literature, which indicates that education may have a positive impact on cognitive function and reserve, which can help preserve intellectual activity and decision-making at older ages.[21,28] In this sense, a higher level of education acts as a protective factor for cognitive health. The study has yielded compelling results concerning the association between educational achievement and visual recognition memory. It was identified a notable correlation between the two factors, but the strength of the relationship was found to be relatively weak to moderate. This suggests that other factors besides education may also have an impact on visual recognition memory. The findings underscore the importance of conducting further research to explore the diverse range of factors that could affect visual recognition memory and the extent to which education contributes to this cognitive function.[29,30]

A significant negative correlation was also observed between age and attentional abilities in short-term visual recognition memory and overall intelligence. This suggests that cognitive decline in these abilities may be associated with aging, as reported in the specialized literature.[31] Therefore, it is essential to consider age variations among older adults during psychological evaluations, as highlighted in the technical manuals of the tests used in this study.[19,20,32] With the Brazilian population aging, as highlighted in recent studies,[1–3] it becomes crucial for psychology and health professionals to possess more efficient tools for early detection of potential cognitive decline in elderly people.[3,4] In this context, the use of cognitive tracking batteries has been shown to be an important option to assess the attentional, mnemonic and intelligence performance in elderly people.[6,16,17]

Conclusion

As people age, they may experience changes in their sensory systems, such as hearing or vision loss, which can contribute to increased distractions. Additionally, older adults may find it more challenging to ignore irrelevant information and focus on the task at hand, as their cognitive control processes may be less efficient compared to younger individuals. Cognitive screening tests are important tools for identifying cognitive impairment and individuals at risk of developing dementia among elderly people. Given the increase in the aging population, it is essential that healthcare professionals, including psychologists, have effective tools for early detection of

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cognitive decline in elderly individuals. Early detection can lead to prompt intervention, including cognitive stimulation and lifestyle changes that can help slow down cognitive decline or prevent it from worsening. Elderly people have become an increasingly present population, and with that, attention should also be progressively paid to their health and abilities to provide them with a better quality of life. Furthermore, based on the results presented through the evaluated sample, it is suggested that age has an influence on attention, short-term visual recognition memory, and non-verbal fluid intelligence, processes that often show a general decline over the years and should be carefully monitored. Education level is also an important factor in the prognosis of such cognitive aspects, as higher education is shown to be a protective factor against their decline, allowing for higher scores to be achieved compared to elderly individuals with lower education levels.

The use of cognitive screening batteries during assessment and rehabilitation activities can provide valuable information for clinical decision-making when working with elderly individuals. These screening tests can give healthcare professionals relevant indicators to plan appropriate interventions. Additionally, the results of these tests highlight the importance of continued research in this field to improve the validity of cognitive screening tests and expand their use to elderly populations from different backgrounds. It's essential that psychologists and healthcare professionals who administer cognitive screening tests are aware of age variations among the elderly. This awareness is critical to ensure a more accurate interpretation of the obtained scores and develop interventions that are suitable for everyone's needs. This study aimed to evaluate the effectiveness of three cognitive screening instruments in detecting compromised cognitive functions. Some limitations of this study should be acknowledged. Firstly, the sample size was relatively small, thereby limiting the generalizability of the findings to the broader elderly population. Additionally, the absence of a comparative study involving elderly individuals with and without a clinical history poses a constraint on drawing definitive conclusions. However, cognitive screening studies conducted in the elderly provide valuable insights for early assessment and monitoring. This, in turn, empowers specialized professionals to implement and adapt treatment and support strategies that cater to the specific needs of the elderly and their families, thereby enhancing overall care.

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Conflicts of interest

The authors declare that there is no conflict of interest.

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