

Neuropsychological Assessment, Cognitive Aging, and Cognitive Reserve: Clinical and Gerontological Perspectives for Early Detection and Prevention

María Josefina Gonzalez Aguilar^{1*}, *Josefina Seggiaro*¹, *Karym Padilla-Picon*¹

¹Facultad de Ciencias Biomédicas, Universidad Austral, Argentina

*Corresponding author:

María Josefina Gonzalez Aguilar,

Av. Juan Domingo Perón 1500, B1629, Pilar, Buenos Aires, Argentina, Tel: (+54230) 438 7011, E-mail: jgonzalez@austral.edu.ar

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ABSTRACT

Population aging has become one of the most significant public health challenges worldwide, with an increasing prevalence of cognitive decline and neurodegenerative disorders among older adults. In this context, neuropsychology provides a clinical and conceptual framework for understanding cognitive aging, distinguishing between normal and pathological processes, and supporting early detection strategies. This review summarizes key neuropsychological concepts relevant to gerontology, with a particular focus on cognitive aging, dementia, and cognitive reserve. Emphasis is placed on the clinical and preventive value of neuropsychological assessment in older adults, particularly within primary care and interdisciplinary gerontological settings. Understanding these concepts is essential for promoting healthy aging, delaying functional decline, and guiding preventive interventions across the lifespan.

Keywords: Cognitive Aging, Neuropsychology, Dementia, Cognitive Reserve, Gerontology

INTRODUCTION

Global demographic changes have led to a sustained increase in life expectancy and an accelerated aging of the population. As a result, the proportion of older adults has grown significantly, posing new challenges for health systems and clinical practice. Population aging is associated with a higher prevalence of chronic conditions, including cognitive decline and neurodegenerative diseases, which may compromise autonomy, quality of life, and social participation [1].

Cognitive functioning has therefore become a central concern in gerontology and geriatrics. Older adults frequently report cognitive complaints that require careful clinical interpretation, as these may reflect normal aging processes, early stages of neurocognitive disorders, or the interaction of cognitive, emotional, and medical factors. Early identification of cognitive changes, differentiation between normal and

pathological aging, and implementation of preventive strategies are key objectives in gerontological care.

Neuropsychology offers theoretical models and clinical tools that contribute to these goals by providing an evidence-based understanding of the relationship between brain functioning, cognition, and behavior [2,3]. This review presents a clinically oriented overview of neuropsychology and its relevance to gerontology, focusing on cognitive aging, dementia, and cognitive reserve, with particular emphasis on primary care and preventive approaches.

CONCEPTUAL DEVELOPMENT

Neuropsychology and Neuropsychological Assessment in Gerontological Practice

Neuropsychology is the discipline concerned with investigating the relationships between brain functioning and cognitive, emotional, and behavioral processes [2,4]. From a clinical perspective, it focuses on understanding how neurological and psychiatric conditions, as well as age-related changes, affect cognitive functioning and daily behavior [5].

Neuropsychological assessment provides an objective and standardized evaluation of cognitive functioning, allowing clinicians to quantify the type and severity of cognitive deficits across domains such as memory, attention, executive functions, language, and visuospatial abilities [3,6]. In older adults, this assessment is essential not only for diagnostic purposes but also for monitoring disease progression, guiding clinical decisions, and evaluating functional autonomy [5].

Moreover, neuropsychological evaluation also identifies preserved abilities and cognitive strengths, which are critical for developing personalized recommendations and preventive strategies. In gerontological settings, neuropsychology contributes to differentiating psychiatric from neurological conditions, detecting early cognitive impairment, and supporting patients and families through counseling and education [6]. Within primary care, these tools provide a structured framework for interpreting cognitive complaints and determining the need for specialized referral.

Cognitive Aging: Normal and Pathological Processes

Aging is a heterogeneous and dynamic process characterized by gradual biological, psychological, and social changes. According to the WHO, aging results from the accumulation

of molecular and cellular damage over time, leading to a progressive decline in physical and mental capacities and an increased risk of disease [1].

Normal cognitive aging is typically associated with mild changes in processing speed, attention, and memory retrieval, while other functions may remain relatively preserved. This process has been described as involutive–adaptive, reflecting the coexistence of neuronal loss and compensatory mechanisms supported by brain plasticity [7,8]. However, structural and functional changes may gradually limit adaptive capacity, resulting in reduced synaptic plasticity with advancing age [8,9].

Older adults are also at increased risk of pathological cognitive decline. Mild Cognitive Impairment (MCI) represents an intermediate state between normal aging and dementia, characterized by cognitive decline greater than expected for age and education, without significant interference in daily functioning [10]. The identification of MCI is particularly relevant in gerontological practice, as it provides a critical window for early intervention and prevention.

Dementia and Alzheimer's Disease: Clinical Relevance in Gerontology

Dementia is a chronic and progressive syndrome characterized by acquired cognitive impairment affecting multiple domains and interfering with autonomy in daily activities [11,12]. Although current diagnostic classifications refer to major neurocognitive disorders, the term “dementia” remains widely used in gerontological and clinical contexts due to its strong association with aging.

Alzheimer's disease is the most common cause of dementia, accounting for approximately 60–70% of cases worldwide [13]. It is a progressive neurodegenerative condition characterized by cognitive, functional, and psychological deterioration [14]. Neuropathological features include cortical atrophy, accumulation of beta-amyloid plaques, neurofibrillary tangles, and neuroinflammatory processes [8,15,16].

Age is the primary risk factor for Alzheimer's disease, highlighting the importance of early detection and preventive strategies in gerontological care. Dementia should therefore be understood not only as a neurological condition but also as a complex clinical syndrome with profound psychological, social, and caregiving implications.

Domain	Normal Aging	Mild Cognitive Impairment (MCI)	Dementia
Memory	Mild slowing in retrieval; occasional forgetfulness; preserved recognition	Noticeable decline beyond age expectations; objective impairment on testing; preserved basic daily function	Significant impairment; affects learning and recall; interferes with daily activities
Attention & Processing Speed	Slower processing speed; generally preserved sustained attention	Mild to moderate decline; increased difficulty with complex tasks	Marked deficits; difficulty maintaining attention and completing tasks
Executive Functions	Mild decline in flexibility and multitasking	Impairment in planning and organization may be present	Significant impairment; poor judgment, planning deficits, functional impact
Language	Preserved basic language; occasional word-finding difficulty	Subtle naming or fluency deficits	Prominent deficits (anomia, comprehension difficulties in advanced stages)
Visuospatial Abilities	Generally preserved	May show mild impairment depending on subtype	Frequently impaired, especially in moderate to advanced stages
Functional Autonomy	Independent in activities of daily living	Largely preserved independence; subtle inefficiencies	Loss of independence; impairment in instrumental and basic activities

Table 1: Clinical Comparison of Cognitive Profiles in Normal Aging, Mild Cognitive Impairment, and Dementia

Table 1 summarizes the typical clinical patterns observed across normal cognitive aging, Mild Cognitive Impairment (MCI), and dementia. While individual trajectories may vary, this simplified comparison may assist clinicians—particularly in primary care and gerontological settings—in distinguishing between physiological aging and pathological cognitive decline.

Cognitive Reserve: Conceptual Models and Gerontological Implications

Cognitive reserve refers to the ability to cope with brain pathology and age-related changes while maintaining cognitive functioning through the use of preexisting cognitive processes or compensatory strategies [17,18]. This concept emerged to explain discrepancies between the degree of neuropathology and the clinical expression of cognitive impairment.

Different models have been proposed to conceptualize reserve mechanisms. Brain reserve refers to relatively passive and static neuroanatomical characteristics, such as brain size or synaptic density, which may provide resistance to structural damage [19,17]. In contrast, cognitive reserve is considered an active and dynamic process involving flexible and efficient cognitive strategies that allow individuals to better cope with

neural damage [20].

Because cognitive reserve cannot be directly measured, researchers rely on indirect indicators or proxies, including educational attainment, occupational complexity, cognitively stimulating activities, and premorbid intellectual functioning [21,22]. Higher cognitive reserve has been associated with delayed onset of dementia symptoms and reduced risk of progression from MCI to dementia [23,24]. However, once compensatory thresholds are exceeded, individuals with higher reserve may experience a more rapid clinical decline [18].

From a gerontological perspective, cognitive reserve highlights the importance of a life-course approach to cognitive health, emphasizing education, social participation, and cognitively stimulating activities as key protective factors.

Clinical and Preventive Implications for Gerontology and Primary Care

Integrating neuropsychological concepts into gerontological practice has significant clinical and preventive implications. Early identification of cognitive changes enables timely interventions aimed at maintaining autonomy and quality of life in older adults.

In primary care settings, understanding cognitive aging and cognitive reserve supports early detection of cognitive decline, risk stratification for neurodegenerative diseases, and implementation of non-pharmacological interventions. Preventive strategies targeting modifiable risk factors—such as education, lifestyle, and cognitive engagement—are particularly relevant in aging populations [25].

Neuropsychology provides a conceptual framework for understanding cognitive trajectories and guiding individualized recommendations, contributing to the promotion of healthy aging and the reduction of dementia-related burden.

FUTURE DIRECTIONS AND CONCLUSIONS

Further research is needed to clarify the mechanisms underlying cognitive resilience and to evaluate the effectiveness of preventive interventions across diverse populations. Longitudinal studies integrating neuropsychological assessment with biological, social, and environmental factors may provide valuable insights for gerontological practice and public health strategies.

Neuropsychology offers essential conceptual and clinical tools for understanding cognitive aging and supporting gerontological care. The concepts of cognitive aging, dementia, and cognitive reserve are central to early detection, prevention, and clinical decision-making in older adults. Integrating neuropsychological perspectives into gerontology and primary care may contribute to promoting healthy aging and mitigating the impact of neurodegenerative diseases.

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