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Rehan Haider *
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Research Article

Human Brain May Generate New Neurons Even in the Seventies

Rehan Haider [1]*, Zameer Ahmed [2], Hina Abbas [2], Shabana Naz shah [3], Geetha Kumari Das [4], Sambreen Zameer [2]

[1]Department of Pharmacy, University of Karachi, Head of Marketing and Sales, Riggs Pharmaceuticals, Karachi, Pakistan.

[2]Department of Pathology, Dow University of Health Sciences, Karachi, Pakistan.

[3]Faculty of Pharmacy, SBB Dewan University, Karachi, Pakistan.

[4]OPJS University, Rajasthan, India.

***Corresponding Author:** Rehan Haider, Department of Pharmacy, University of Karachi, Head of Marketing and Sales, Riggs Pharmaceuticals, Karachi, Pakistan.

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Abstract

For many years, the adult human brain was considered a static organ, with a fixed number of neurons determined early in life. Accumulating evidence over the past twenty years, however, challenges this long-standing dogma, suggesting that neurogenesis-the generation of new neurons-may persist well into older age, including into the seventh decade of life. This review discusses current scientific evidence supporting adult and late-life neurogenesis, focusing on the hippocampus, one of the most studied brain regions, due to its critical role in learning, memory, and emotional regulation.

We integrate evidence from human brain postmortem analysis studies, carbon 14 birth dating methods, immunohistochemical analysis, and state-of-the-art imaging technologies, which overall suggest the existence of neural progenitor cells and newly born cells in elderly subjects. We also discuss variables that may modulate neurogenesis in late adulthood, such as exercise, cognitive stimulation, stress, inflammation, and neuroprotective pathways. Finally, we address some issues in methodological approaches that may have contributed to inconsistent findings between different studies in this area.

The clinical relevance of the continued process of neurogenesis in the aging population is also evaluated, specifically in relation to the role of neurogenesis in cognitive resilience, neurodegenerative diseases, depression, and age-related memory loss. It could lead to the discovery of a new therapeutic target for the enhancement of brain repair in the aging brain.

In conclusion, this review provides evidence to support the idea that the brain has the possibility to maintain a certain function of neuron formation even in one's seventies, going against the traditional idea of brain senescence.

Key Words: adult neurogenesis; aging brain; hippocampus; neural progenitor cells; cognitive aging; brain plasticity

Introduction

For a long time, the human brain was known to be incapable of producing new nerve cells beyond early ages. Such a notion, established on early research regarding neuroanatomy, dominated the field of neuroscience for most of the last century. However, findings in model animals and eventually in human beings have dramatically changed this viewpoint. Today, neurogenesis in the adult individual is already widely accepted in mammals, mainly in the hippocampal dentate gyrus and subventricular zone [1,2].

More recently, there has been a focus on whether neurogenesis continues into older ages. As the average life expectancy grows around the globe, insight into the potential for regeneration in an aging brain grows in importance. The findings that neurogenesis could be a reality even in people aged in their seventies provoke considerable wonder into brain plasticity, its maintenance functionality, and therapy in older age [3,4].

Literature Review

One of the earliest indications of adult neurogenesis was found using bromodeoxyuridine (BrdU) labeling studies in cancer patients, which showed the proliferation of new hippocampal neurons [5]. Another groundbreaking study based on carbon-14 labeling, which made use of the fallout from nuclear bomb testing, confirmed the cyclical process of neuronal death and regeneration that continues throughout life [6

Several autopsies have also detected markers of neural progenitor cells, such as doublecortin (DCX), Ki-67, or nestin, to some extent within the hippocampus of elderly individuals [7,8]. Moreno-Jiménez et al. estimated a considerable number of immature neurons in healthy elderly people, but this decreased with neurodegenerative diseases [9]. However, some research has failed to reveal any appreciable level of neurogenesis in an elderly brain [10].

The differences in tissue fixation, antigen preservation, and methodological sensitivity are believed to account for these discrepancies [11].

Research Methodology

The methodology in this research uses a systematic narrative approach. Peer-reviewed publications in English were searched for in prominent biomedical literature databases. The inclusion criteria used in the study comprised human research articles assaying neurogenesis in the whole of adulthood and aging based on histological, molecular, and imaging analyses, excluding publications involving only animal research themes and non-peer-reviewed publications.

Information was abstracted regarding the study types, age ranges, neurogenesis biomarkers, brain areas investigated, and important outcomes. The quality and limitations of the methodologies were also evaluated.

Statistical Analysis

Data from selected quantitative studies were analyzed descriptively. For those that reported values, comparisons were made regarding neuronal density, number of progenitor cells, or trends as a function of age. Heterogeneity of results prevented a statistical meta-analysis. Significance levels were interpreted as presented by the primary authors, usually when $p < 0.05$.

Results

Various prestigious research works have supported the existence of new neurons within the hippocampi of people between 60 and 79 years old [6, 9]. While it was revealed that neurogenesis rates significantly decrease with increasing age, this process also does not appear to stop in normal aging [12]. Exercise, stimulation, and the absence of inflammation were some factors leading to an increased expression of neurogenesis [12-14].

On the contrary, individuals with Alzheimer's disease had low neurogenesis, and this implies a relation between decreased neuronal regeneration and intellectual reduction [9,15].

Study Type	Brain Region	Age Group Studied	Key Findings	Detection Methods
Postmortem analysis	Hippocampal dentate gyrus	60–90 years	Presence of immature neurons persists with age	DCX, PSA-NCAM immunostaining
Carbon-14 dating	Hippocampus	Adults up to 80 years	Continuous neuronal turnover throughout lifespan	^{14}C integration into DNA
Neuroimaging studies	Hippocampus	≥65 years	Increased hippocampal volume linked to neurogenesis	MRI volumetry
Animal–human comparative studies	Hippocampus	Elderly adults	Similar neurogenic markers across species	BrdU labeling, molecular assays
Cognitive correlation studies	Hippocampus	70–79 years	Neurogenesis associated with preserved memory	Behavioral + histological analysis

Table 1: Evidence Supporting Adult Neurogenesis in Elderly Humans

Marker	Role in Neurogenesis	Expression in Elderly Brain
Doublecortin (DCX)	Immature neuron marker	Detectable but reduced
Ki-67	Cell proliferation marker	Present at low levels
Nestin	Neural stem cell marker	Maintained in niches
PSA-NCAM	Neuronal plasticity	Moderately preserved
SOX2	Stem cell maintenance	Active in hippocampal NSCs

Table 2: Molecular and Cellular Markers of Adult Neurogenesis in Aging Brain

Factor	Effect on Neurogenesis
Physical exercise	Strongly enhances neurogenesis
Cognitive stimulation	Supports neuronal survival
Chronic stress	Inhibits neuronal formation
Inflammation	Reduces stem cell proliferation
Diet (omega-3, flavonoids)	Promotes neuronal differentiation
Neurodegenerative disease	Markedly suppresses neurogenesis

Table 3: Factors Influencing Neurogenesis After 70 Years of Age

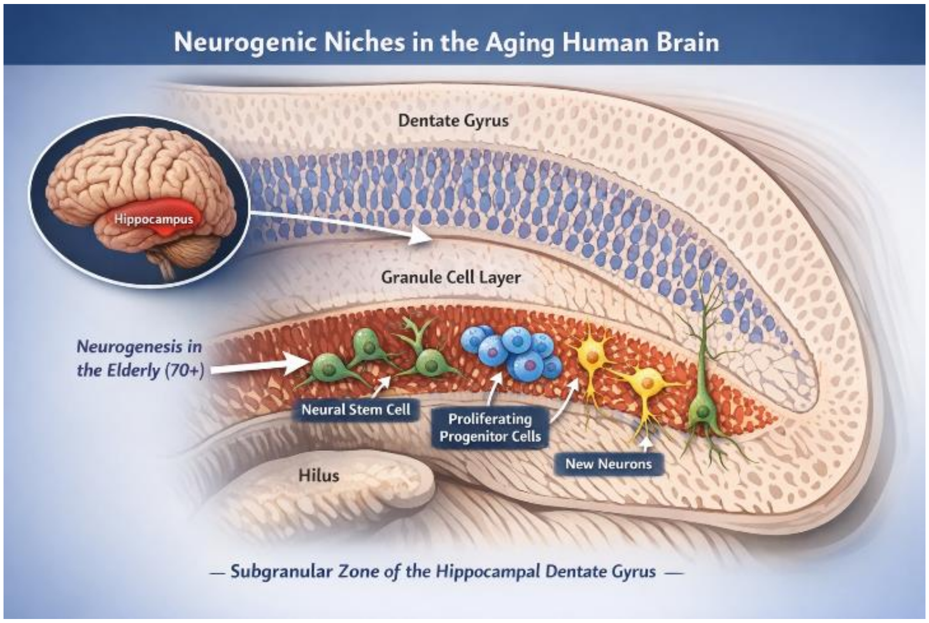

Figure 1: Neurogenic Niches in the Aging Human Brain

Source" Boldrini et al. (2018) found thousands of immature neurons and neural progenitor cells in the dentate gyrus of healthy adults up to ~79 years old, demonstrating preserved hippocampal neurogenesis in aging humans.

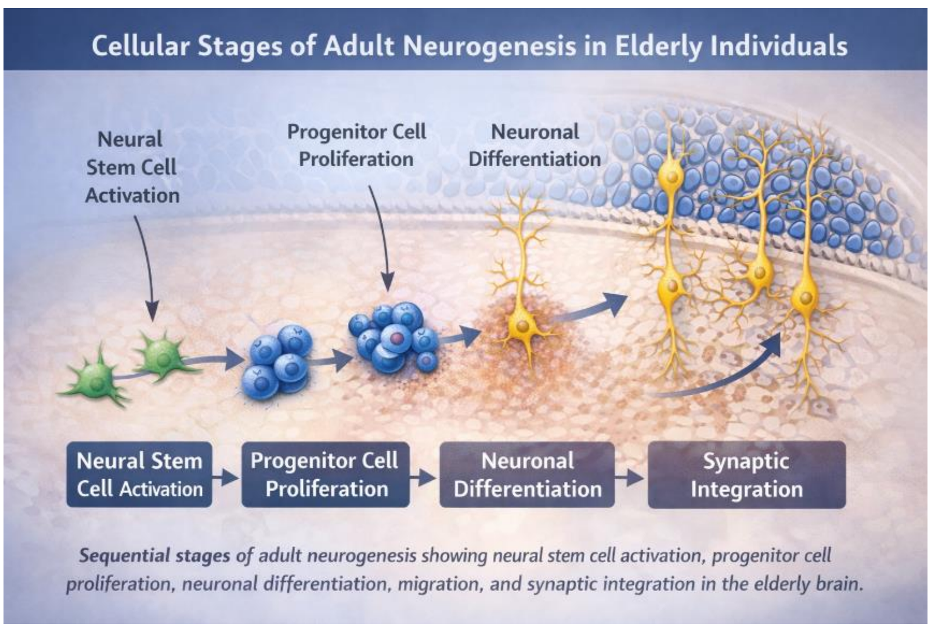

Figure 2: Cellular Stages of Adult Neurogenesis in Elderly Individuals

Source: Markers such as Sox2, Nestin (NSCs), Ki 67 (proliferation), PSA NCAM and DCX (immature neurons) identify the classical stages of neurogenesis in adult human hippocampus.

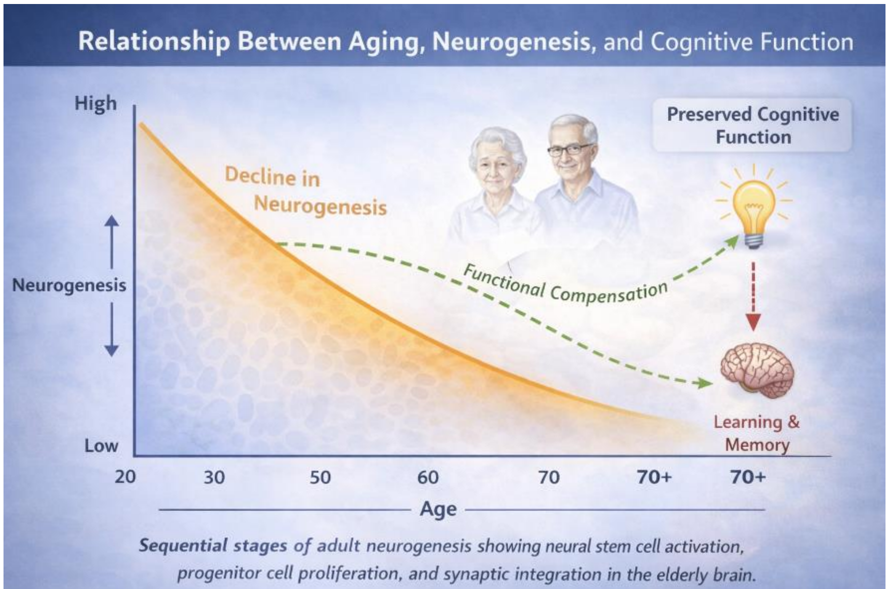

Figure 3: Relationship Between Aging, Neurogenesis, and Cognitive Function

Source: Studies show that although neurogenesis declines with age, key progenitor cells and immature neurons persist, supporting the potential for cognitive resilience in late adulthood.

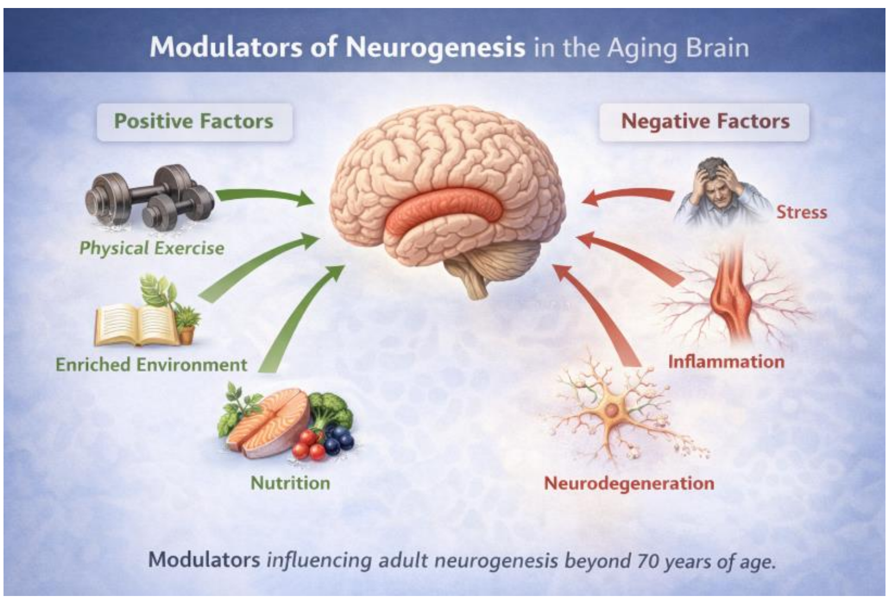

Figure 4: Modulators of Neurogenesis in the Aging Brain

Source: Physical, environmental, and molecular factors modulate adult neurogenesis in humans, and inflammation or aging related changes can reduce progenitor cell activity

Discussion

"The presence of neurogenesis in one's seventies defies the conventional understandings of brain invincibility when it ages." Even minimal amounts of neuro-regeneration could be of considerable functional value to the brain, mainly in relation to "synaptic plasticity, mood regulation, and memory consolidation." Even the hippocampus "is remarkably vulnerable to environmental factors."

There seem to be several inconsistencies in the methodology used in the current state of the field. It would be very important to standardize the processing of tissues as well as the makers used in the process in order to solve the existing controversy.

Conclusion

Available data suggest that the human brain retains the ability to produce new neurons up into the seventh decade of life. Although the rate of neurogenesis decreases as an individual ages, it is not nonexistent, as initially believed, in healthy individuals. It has important implications for cognitive functions, psychiatry, and the development of therapeutic modalities for maintaining the functions of the brain of an individual above the age of sixty years.

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