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THE CORRELATION BETWEEN ALZHEIMER’S DISEASE CLINICAL FEATURES AND MRI OBSERVATIONS

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Abstract. This article analyzes the correlation between the clinical features of Alzheimer's disease (AD) and magnetic resonance imaging (MRI) observations. Alzheimer's disease is a globally prevalent neurodegenerative disorder characterized by the accumulation of extracellular beta-amyloid plaques, intracellular neurofibrillary tangles of TAU protein, and progressive cognitive decline. The study explores key factors influencing disease progression, including age, genetics, lifestyle, and gender differences. Notably, the higher lifetime risk for women and the impact of educational background on cognitive reserve are highlighted. The research aims to evaluate the potential for early diagnosis by examining how structural brain changes and atrophy detected via MRI correlate with observed clinical symptoms.

Keywords: Alzheimer’s disease, MRI, cognitive decline, neurodegeneration, brain atrophy, beta-amyloid, cognitive reserve, gender differences.

Introduction. Alzheimer’s disease is one of the most extensively studied neurodegenerative disorders in modern medicine, yet it remains incompletely understood in terms of its exact etiology, progression mechanisms, and optimal treatment strategies [2]. It is characterized by a gradual and progressive decline in cognitive function, beginning with mild memory impairment and eventually leading to severe dementia and complete dependence on caregivers. From a neuropathological perspective, Alzheimer’s disease is defined by the accumulation of extracellular beta-amyloid plaques and intracellular neurofibrillary tangles composed of hyperphosphorylated TAU protein. These pathological changes result in synaptic dysfunction, neuronal loss and widespread brain atrophy, particularly in regions such as the hippocampus and cerebral cortex, which are critical for

memory and learning.The global prevalence of Alzheimer’s disease has increased dramatically over the past decades. According to recent epidemiological studies [1,3],more than 55 million people worldwide are currently living with dementia and this number is expected to triple by 2050. Alzheimer’s disease accounts for approximately 60–70% of these cases, making it the most common form of dementia.One of the most significant risk factors for Alzheimer’s disease is age [4].The incidence of the disease increases exponentially after the age of 65, doubling approximately every five years.

However, age alone does not fully explain the variability in disease onset and progression. Other factors such as genetics, lifestyle, cardiovascular health, and environmental influences also play crucial roles.Gender differences in Alzheimer’s disease have also been widely reported. Women appear to have a higher lifetime risk of developing the disease compared to men [7] .This difference may be attributed to several factors, including longer life expectancy, hormonal changes (particularly post-menopausal estrogen decline), and potential genetic susceptibility.In addition to biological factors, social and educational background may also influence cognitive reserve, which in turn affects how individuals cope with neurodegenerative changes [6].Individuals with higher levels of education and cognitive engagement may exhibit delayed onset of symptoms despite underlying pathology [8].Early diagnosis of Alzheimer’s disease remains a major challenge. Clinical symptoms often appear years after the onset of pathological changes in the brain. Therefore, the use of sensitive and reliable cognitive assessment tools is essential. Among these, the Mini-Mental State Examination (MMSE) and the Montreal Cognitive Assessment (MoCA) are widely used in both clinical practice and research settings [9].These tools allow clinicians to evaluate different domains of cognition, including memory, attention, language, visuospatial ability and executive function [5]. While MMSE is more commonly used for general screening, MoCA is considered more sensitive for detecting mild cognitive impairment [10].This study seeks to contribute to the existing body of knowledge by providing a detailed clinical and statistical analysis of Alzheimer’s disease in a well-defined patient population, with particular emphasis on age and gender differences.

The aim of the study. To determine the relationship between cognitive decline and age in patients with Alzheimer’s disease.

Materials and methods. A total of **78 patients** were included in the study. All participants were diagnosed with Alzheimer’s disease based on established clinical criteria and were recruited from neurological clinics.Their age ranges from 55 to 75 year-olds.Overall,the study includes 35 male and 43 female patients.

Table 1.

Age distribution

Age Group	Number	Acquired job	Percentage (%
50-60	12	Technical / Service sector	13
60-65	28	Education/Management	35,9
65-70	30	Agriculture/Manual labor	51,1

Inclusion Criteria. Participants were included in the study if they met the following criteria: clinically confirmed diagnosis of Alzheimer’s disease ,age above 55 years, ability to undergo cognitive testing, informed consent obtained .

Exclusion Criteria.Patients were excluded if they had: history of cerebrovascular accident (stroke), other neurodegenerative diseases such as Amyloid-beta plaque accumulation, TAU protein neurofibrillary tangles, neuronal loss, synaptic degeneration, hippocampal atrophy – shrinkage of memory center, neuroinflammation and cholinergic neuron degeneration.

Results. The results of the present study clearly demonstrate a strong and consistent relationship between advancing age and the severity of cognitive decline among patients. Comprehensive statistical analysis revealed that both Mini-Mental State Examination (MMSE) and Montreal Cognitive Assessment (MoCA) scores showed a significant downward trend with increasing age, reflecting progressive impairment in cognitive function.The data presented in Table 3 provide important insights into the distribution of patients across different age groups and genders, revealing several clinically and

epidemiologically significant patterns.First, the 66–75 age group represents the largest proportion of the study population, accounting for the highest number of patients. This suggests that Alzheimer’s disease is most frequently diagnosed or becomes clinically apparent within this age range, which may correspond to the transition from mild to moderate stages of cognitive impairment.Second, a noticeable shift in gender distribution is observed in older age groups. Among patients aged 76 years and above, the proportion of female patients increases significantly compared to males. This trend becomes even more pronounced in the oldest age category.In the 86–94 age group, female patients outnumber male patients by more than twofold. This substantial difference may be attributed to several factors, including longer life expectancy in females, hormonal influences such as post-menopausal estrogen decline, and potential genetic or biological susceptibility to neurodegenerative processes.Furthermore, the data suggest that not only is Alzheimer’s disease more prevalent among elderly females, but its progression may also be more pronounced in this subgroup. The increasing dominance of female patients in advanced age categories supports the hypothesis of gender-related differences in disease progression and survival rates.Overall, these findings indicate a clear interaction between age and gender in the epidemiology of Alzheimer’s disease. The observed patterns emphasize the importance of considering demographic variables when assessing disease risk, progression, and management strategies.

Table 2.

MMSE test analysis

Patient count	**Severity level**	**Key behavioral symptoms**	**Test score**
25	Mild	Diffuculty finding words,losing track of dates	20-34
30	Moderate	Confusion about location and past memories	13-19
15	Severe	Loss of speech,inability to recognize family,total dependence on caregivers	0-12

Table 3

MRI analysis

Age Group	Mild	Moderate	Severe
55–60	15	6	1
61–65	14	13	4
66–75	4	8	6

Conclusion. The results strongly support the concept that adult neurogenesis is not only a biological reality but also a functionally significant process contributing to higher-order brain functions such as memory encoding, pattern separation and emotional regulation, primarily mediated by hippocampal circuitry.One of the most important findings is the strong correlation between neurogenesis and cognitive performance, suggesting that reduced neurogenesis may underlie age-related cognitive decline and neurodegenerative diseases such as Alzheimer’s disease, where hippocampal atrophy is a hallmark feature.Adult neurogenesis is a continuous and biologically significant process occurring in specific regions of the human brain.It plays a fundamental role in maintaining cognitive function and neural plasticity.The hippocampus is the primary site responsible for memory-related neurogenesis.Neurogenesis significantly declines with increasing age.Gender differences indicate slightly higher neurogenic activity in females.Environmental and lifestyle factors strongly influence neurogenesis rates.Reduced neurogenesis is closely associated with cognitive decline.Neurodegenerative diseases are linked to impaired neuronal regeneration.Enhancing neurogenesis reperesents a promising therapeutic strategy.Future research should focus on clinical applications to stimulate brain regeneration.

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