Revista ARACÊ
ISSN: 2358-2472

ALZHEIMER'S VS ARTIFICIAL INTELLIGENCE: BUILDING A MEMORABLE FUTURE

https://doi.org/10.56238/arev7n1-108

Submitted on: 10/12/2024 **Publication date:** 10/01/2025

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ISSN: 2358-2472

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ABSTRACT

Alzheimer's Disease (AD) is one of the leading causes of dementia in the world, characterized by the progressive loss of memory and cognitive functions. With the increase in life expectancy and population aging, the early and accurate diagnosis of AD has become a priority in health systems. In this context, Artificial Intelligence (AI) has shown a promising tool to improve the diagnosis and management of the disease, especially through the analysis of neuroimaging tests, such as magnetic resonance imaging. The objective of this study is to review the applications of AI in the diagnosis of AD, highlighting the advances, challenges, and ethical implications involved. The research was based on an integrative literature review, using databases such as PubMed, Scielo and Google Scholar, with publications between 2015 and 2024. Articles that deal with the use of machine learning algorithms for early detection of changes associated with AD were analyzed. The results show that AI is able to identify patterns in neuroimaging exams that may go unnoticed by traditional methods, contributing to faster and more accurate diagnoses. In addition, AI makes it possible to personalize treatments, adjusting guidelines according to the individual characteristics of patients. However, challenges related to data privacy, financial forecasting, and training of professionals still pose barriers to large-scale implementation. It is concluded that AI offers significant potential to transform the diagnosis and treatment of AD, promoting earlier and more effective interventions. However, it is necessary to ensure that its use respects ethical and legal principles, ensuring the safety and privacy of patients. Future studies should focus on developing public policies that ensure equitable access to AI technologies in the field of health, improve the quality of life of Alzheimer's patients, and reduce the social and economic impact of the disease.

Keywords: Alzheimer's disease. Artificial Intelligence in Health. Quality of Life in the Elderly. Dementia. Population Aging.

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ISSN: 2358-2472

INTRODUCTION

Population aging is a reality that challenges health systems around the world, requiring specific strategies for the care of the elderly, especially in the context of neurodegenerative diseases. Among these pathologies, Alzheimer's Disease (AD) stands out, an irreversible condition that progressively affects patients' memory, judgment, and functionality. The advance of this disease has significant impacts on the quality of life of patients and imposes increasing challenges for family members and health professionals, which makes it necessary to search for solutions that enable early diagnosis and more effective treatments (WHO 2005).

In the contemporary scenario, Artificial Intelligence (AI) emerges as a promising tool to assist in the diagnosis and management of neurodegenerative diseases. AI's ability to analyze large volumes of data quickly and accurately has advanced advances in the early identification of Alzheimer's signs through technologies such as MRI and electroencephalography. These innovations are innovative for a more accurate follow-up of patients, enabling interventions that slow the progression of the disease and improve the prognosis (Garcia; Maciel, 2020).

The adoption of AI in the healthcare field is a growing trend that directly impacts the care of Alzheimer's patients (Brito *et al.,* 2021). Recent studies show that intelligent algorithms can identify patterns in neuroimages that are imperceptible to the human eye, increasing the accuracy of diagnoses and facilitating the development of personalized therapies. In this way, AI not only transforms medical practice, but also offers new perspectives for the treatment of neurodegenerative diseases, promoting medicine of outcomes (Medeiros *et al.,* 2022).

Given this scenario, understanding the role of Artificial Intelligence in the diagnosis and treatment of Alzheimer's Disease is essential to improve care strategies for the elderly. The application of these technologies can be guaranteed to reduce the social and economic burden of the disease, by enabling earlier diagnoses and more targeted therapies. In addition, technological innovations bring new possibilities for the continuous monitoring of patients, optimizing symptom management and ensuring a better quality of life (Medeiros *et al.,* 2022).

This integrative review seeks to analyze the contributions of Artificial Intelligence in the diagnosis and treatment of Alzheimer's Disease, considering the technological advances and challenges that still exist. The guiding question of this study was: "What is

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the importance of Technology using Artificial Intelligence for Alzheimer's patients?". From this investigation, it is expected to identify the main AI tools used in diagnosis, innovative therapeutic approaches, and the ethical and practical implications of these technologies in the care of patients with neurodegenerative diseases.

Through the analysis of recent studies, it is intended to highlight the potential of Artificial Intelligence to transform clinical practice in the field of neurology, with emphasis on neurodegenerative disorders. Thus, this work aims to contribute to the advancement of scientific knowledge and to the development of strategies that improve the care of patients with Alzheimer's, promoting earlier diagnoses, more effective treatments, and a higher quality of life.

DEVELOPMENT

POPULATION AGING

Population aging is a global reality that presents important challenges for health systems. According to the World Health Organization (WHO), the proportion of older people in the world's population is increasing rapidly, with a particular proportion that this group will account for 22% of the global population by 2050. In Brazil, it is estimated that, by 2025, the country will be the sixth in the world in number of elderly people, reflecting a trend of accelerated aging (WHO 2024).

Increasing evolution can be seen as an achievement of humanity, providing people with the opportunity to plan for the future differently than previous generations. However, this increase in life expectancy brings with it the need for a central element: health. Maintaining health and quality of life in old age is essential for additional years to be lived with well-being and autonomy (WHO 2024).

ALZHEIMER

Degenerative Alzheimer's disease (AD) is the most frequent neurodegenerative pathology associated with age, whose cognitive and neuropsychiatric manifestations result in progressive disability and eventual disability. In general, the first clinical aspect is the impairment of recent memory, while remote memories are preserved until a certain stage of the disease. In addition to difficulties in attention and verbal fluency, other cognitive functions deteriorate as the pathology evolves, including the ability to perform calculations,

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visuospatial skills, and the ability to use common objects and tools (Machado; Oak; Nephew, 2020).

The patient's degree of wakefulness and lucidity are not affected until the disease is very advanced. Motor weakness is also not observed, although muscle contractures are an almost universal feature in the advanced stages of the pathology (Brazil 2024). Impairment of memory, abstract thinking and judgment, accompanied by personality changes are striking symptoms. AD is an irreversible brain disease, which slowly destroys memory and the ability to ration until it limits the ability to perform everyday tasks (WHO 2005).

ARTIFICIAL INTELLIGENCE (AI)

In the context of the current global technological revolution, Artificial Intelligence emerges as a field of computer science dedicated to the study and development of machines and programs capable of imitating human behavior in decision-making and execution of tasks, ranging from the simplest to the most complex, the application of AI in the field of health is promising, enabling more accurate and efficient diagnoses (Sichman 2021; Ludermirv 2021).

The integration of AI in the healthcare field has been gaining strength due to its ability to process large volumes of data, identify hidden patterns, and offer innovative solutions to clinical problems, technologies such as machine learning, artificial neural networks, and natural language processing are applied in several areas, such as radiology, oncology, neurology, and mental health, allowing a significant advance in diagnostic accuracy and the choice of appropriate treatments. For example, AI-based algorithms are capable of analyzing medical images with high accuracy, identifying lesions, tumors, and cellular changes that often go unnoticed by traditional analysis methods (Neto *et al.,* 2020).

The future prospects for AI in healthcare are promising and indicate a trend of continued expansion. Emerging technologies, such as explainable AI (XAI), seek to provide greater transparency in the decision-making processes of algorithms, allowing doctors and patients to understand the recommendations provided by intelligent systems. In addition, the development of more robust predictive models can transform reactive medicine into predictive medicine, where diseases are detected and treated before they manifest themselves (Bruno; Pear tree; Faltay 2023).

However, the adoption of Artificial Intelligence in healthcare also presents ethical and practical challenges that need to be considered. Issues related to data privacy,

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algorithmic bias, and the accountability for automated decisions raise important debates about the governance of these technologies. Ensuring transparency, safety, and equity in AI systems is essential for their application in the field of health to be ethical and to benefit society as a whole (Da Silva; Passion; Rodrigues).

In addition, the advancement of AI in healthcare requires a reconfiguration of the role of healthcare professionals, who start to act as mediators between technology and the patient. This requires the continuous training of these professionals so that they can correctly interpret the results provided by the algorithms and apply these insights effectively in clinical practice. The proper use of AI does not aim to replace human action, but rather to enhance the capabilities of health professionals, promoting a more assertive and patient-centered medicine (Da Silva; Passion; Rodrigues).

METHODOLOGY

It is an integrative literature review, a method that allows the synthesis of existing knowledge on a given topic and the identification of gaps and trends in the field of research. Integrative review is widely used in academic and scientific research because it involves a critical and systematic analysis of previously published works, enabling the construction of new knowledge based on the articulation of the reviewed studies.

The data search was carried out within the virtual environment in the following databases: *National Library of Medicine* (PubMed/MEDLINE), *Scientific Electronic Library Online* (SciELO), Google Scholar, Virtual Health Library (VHL), *Cochrane Database of Systematic Reviews* (CDSR), Google Scholar, *Web of Science* and EBSCO *Information Services.* The selection of databases considered their relevance in the field of health sciences and the availability of scientific articles related to the topic under study.

Descriptors indexed in the Health Sciences Descriptors (DeCS) database and their counterparts in English and Portuguese were used. The search terms included: *"Alzheimer's Disease", "Artificial Intelligence in Health", "Quality of Life in the Elderly", "Dementia" and "Population Aging",* as well as their Portuguese versions: "Alzheimer's Disease", "Artificial Intelligence in Health", "Quality of Life in the Elderly", "Dementia" and "Population Aging". The search strategy included the use of Boolean operators to ensure greater coverage in the results obtained.

The inclusion criteria adopted were: original articles, with full text available, that addressed the application of Artificial Intelligence in the context of health, specifically in the

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diagnosis and treatment of Alzheimer's Disease. Publications made between the years 2015 and 2024, in Portuguese and English, were considered. On the other hand, doctoral theses, master's dissertations, monographs, technical reports, and studies that did not have a direct relationship with the use of Artificial Intelligence in health were excluded.

The process of selecting the articles followed well-defined stages: initially, the titles and abstracts were read for a preliminary screening. Then, the selected articles underwent a critical and detailed reading to assess their relevance and adequacy to the proposed theme. After this analysis, four scientific articles that met the established criteria were included in the study.

The guiding question that guided this integrative review was: "What is the importance of technology using Artificial Intelligence for people with Alzheimer's Disease?". This question guided the search and analysis of the data, allowing the construction of a solid base of scientific evidence on the subject in question.

RESULTS AND DISCUSSION

During the selection of the included articles, previously established criteria were considered to ensure the relevance and quality of the scientific evidence analyzed. The selection was carried out in stages, involving the search in the databases, the reading of the titles, the screening of the abstracts and, subsequently, the critical and detailed reading of the full articles. After this process, 07 (seven) articles that met the established inclusion criteria were included (Chart 1).

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Table 1: Studies included in the study

AUTHOR/ YEAR	TITLE	MAIN RESULTS
Brito *et al.*, 2023	Use of artificial intelligence in magnetic resonance imaging for the diagnosis of Alzheimer's disease: a review article	With artificial intelligence, neurodegenerative disorders can be investigated at a deeper level, providing a comprehensive view of the disease and paving the way for the application of precision medicine.
Silva *et al.*, 2021	Artificial Intelligence in the diagnosis of neurodegenerative diseases: a review Systematic Literature	The use of Artificial Intelligence in Alzheimer's Disease is promising and should be implemented in the health diagnostic routine, in order to ensure an early diagnosis of patients and adequate multidisciplinary follow-up
Souza *et al.*, 2023	Innovative Approaches in the Treatment of Alzheimer's Disease	All in all, the innovative approaches reviewed in this article represent a promising step towards the most effective and personalized treatment of Alzheimer's disease. While challenges persist, continued progress in this field offers renewed hope for patients, families, and health care workers involved in the care of these vulnerable individuals.
Vashistha *et al.*, 2019	Artificial Intelligence Integration for Neurodegenerative Diseases	The study found that unconventional AI algorithms have the potential to diagnose emergencies Acute complex neurodegenerative disorders within an optimized period.
Fonseca Junior *et al.*, 2024	Sleep disorders in Alzheimer's disease: a comprehensive review of the literature	It describes the evolution of knowledge about the potentially bidirectional relationships between AD and sleep disorders, as well as studies of the possible mechanisms of the association between sleep and neurodegenerative diseases.
Xu; Zhang 2019	Use of Magnetic Resonance Imaging and Artificial Intelligence in Parkinson's Disease Diagnostic Studies	present an overview of recently existing research that used ML/AI statistical methods to perform quantitative analysis of MR imaging data for the study of PD diagnosis. First, we reviewed recent research in three subareas: diagnosis, differential diagnosis, and PD subtypification.
Reis; Brands; Brands 2022	Diagnosis and treatment of Alzheimer's disease	Alzheimer's disease (AD) is a pathology that, today, represents the most common form of dementia in the elderly. AD is apparently underdiagnosed in the Brazilian territory, requiring better investigation and evaluation of cases from primary care to specialized services.

SOURCE: Authors, 2025.

During the reading, the importance of using artificial intelligence in neurovegetative disorders with a focus on Alzheimer's Disease was observed, both in early diagnosis, as

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well as in more effective and personalized treatment. Thus, it was noted that neurodegenerative disorders comprise a group of neurological conditions characterized by a progressive loss or dysfunction of neurons in specific areas of the brain and/or spinal cord. The clinical manifestation of these conditions can vary, including cognitive decline, speech difficulties, and motor deficits. Among neurodegenerative disorders, dementias are the most prevalent, affecting about 7 million people in Europe, and are expected to double by 2040 (Fonseca Junior *et al.,* 2024).

In addition, there is currently a wide range of computational technologies and tools available that can facilitate large-scale analysis in scientific research. This enables a deeper investigation of neurodegenerative disorders, offering a more comprehensive understanding of the disease. The creation of collaborative networks that encompass medical centers, research institutes, and highly qualified specialists can play a crucial role in improving the treatment process of these conditions (Fonseca Junior *et al.,* 2024).

On the other hand, degenerative Alzheimer's disease (AD) is characterized by the presence of amyloid deposits in the brain and neurofibrillary tangles, often resulting in the loss of neurons and deficiencies in neurotransmission systems, in this sense, Xu and Zhang (2019), point out in their study that the use of computer-aided diagnosis (CAD) has aroused interest in the computer vision research community. Several efforts have been made to adapt pattern recognition methods to the analysis of neuroimaging data, such as structural magnetic resonance imaging (sMRI), in order to diagnose AD in early stages.

However, Silva *et al* (2021) emphasize that studies show that an early diagnosis can significantly improve the prognosis. This is because it makes it possible to implement treatments and interventions that aim to slow the progression of the disease before advanced Alzheimer's symptoms appear, resulting in a superior quality of life for patients.

It is also important to note that individuals diagnosed with Alzheimer's usually have diffuse atrophy in essential regions of the brain, such as the temporal, frontal, and parietal lobes, in addition to evidence of neuronal loss, cortical synaptic degeneration, presence of senile plaques, and neurofibrillary tangles. Despite these changes, many patients do not manifest the typical clinical symptoms of the disease, which makes the diagnosis more challenging for neurologists. The application of Structural and Functional Magnetic Resonance Imaging at rest makes it possible to identify these lesions, offering the chance of a diagnosis in early stages (Silva *et al.,* 2021).

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In this sense, Souza *et al.* (2023) discusses innovative therapeutic approaches for AD, highlighting monoclonal antibody (mAbs)-based therapies as a promising strategy. These therapies aim to target specific proteins associated with neurodegeneration, such as beta-amyloid, which is one of the main pathological markers of AD. Research carried out by the Butantan Institute (Brazil, 2023) corroborates this perspective, indicating that the use of mAbs can significantly reduce beta-amyloid deposits, slowing the progression of the disease.

Kings; Marques; Marques (2022) point out that, from a pathological point of view, AD is characterized by the presence of beta-amyloid plaques and neurofibrillary tangles, which result in the loss of neurons and dysfunction of neurotransmission systems. The use of AI to map these changes in the early stages of the disease is essential for the personalization of therapeutic strategies, allowing for more targeted and effective interventions.

Another relevant aspect pointed out by Vashistha *et al.* (2019) is the use of AI algorithms in the analysis of electroencephalography (EEG) data for the diagnosis of neurodegenerative emergencies. These algorithms apply statistical analysis techniques to identify abnormalities in brain electrical signals, providing valuable information for the early diagnosis of complex conditions. This approach allows healthcare providers to identify neurological deficits before clinical symptoms become evident.

CONCLUSION

This study aimed to analyze the contributions of Artificial Intelligence (AI) in the diagnosis and treatment of Alzheimer's Disease, considering the technological advances and the challenges that still exist. The results found highlight the potential of AI to improve clinical practice, enabling earlier diagnoses, personalized treatments, and greater efficiency in the management of patients with neurodegenerative diseases.

The studies analyzed point out that the application of intelligent algorithms in the interpretation of neuroimages and in the analysis of clinical data allows the identification of patterns that often go unnoticed by traditional methods. This ability to detect changes in early stages of the disease is essential for the implementation of therapeutic interventions that slow the progression of Alzheimer's disease, improving the quality of life of patients and reducing the social and economic impacts associated with the condition.

Innovative therapeutic approaches, such as the use of monoclonal antibodies, stand out as a promise in the treatment of AD. Recent research indicates that these therapies

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have the potential to reduce deposits of beta-amyloid, one of the main pathological markers of the disease, opening up new perspectives for more effective and personalized treatments. However, it is observed that the adoption of AI in healthcare still presents ethical and practical challenges, such as issues related to data privacy, algorithmic bias, and the responsibility for automated decisions. Such aspects must be considered to ensure that the implementation of these technologies is ethical and benefits society as a whole.

This study was limited by the analysis of a restricted number of articles published between 2015 and 2024, which may limit the scope of the data. It is suggested that future research include a broader period and different databases, as well as explore the impact of AI at different stages of the disease and in diverse clinical settings.

It is concluded that Artificial Intelligence represents a promising tool in the diagnosis and treatment of Alzheimer's Disease, with the potential to transform medical practice and promote significant advances in neurology. The continuity of research in this field is essential for the development of even more effective and accessible technologies, contributing to more accurate diagnoses, personalized treatments, and a better quality of life for patients.

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