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A Review of Alzhemeir's Disease Detection

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Abstract:- Alzheimer's disease (AD) is a neurodegenerative disorder that is characterized by progressive memory loss and cognitive decline. There is currently no cure for AD, but early diagnosis and treatment can help to slow the progression of the disease.Deep learning is a type of machine learning that has beenshown to be effective in a variety of tasks, including imageclassification, natural language processing, and speech recognition. In recent years, deep learning has also been used for the early detection of AD. One approach to using deep learning for AD detection is to train a deep neural network to classify MRI images of the brain. MRI imagescan be used to identify structural changes in the brain that are associated with AD, such as atrophy of the hippocampus and the amygdala. Deep neural networks can be trained to identify these changes with high accuracy. Another approach to using deep learning for ADdetection is to train a deep neural network to predict the levels of AD biomarkers in the blood. AD biomarkers areproteins that are found in the blood of people with AD. Deep neural networks can be trained to predict the levels of these biomarkers with high accuracy. Deep learning is a promising new tool for the early detection of AD. Deep learning algorithms can be trained to identify subtle changes in the brain and blood that are associated with AD. This early detection can help to improve the chancesof successful treatment.

Keywords— Magnetic ResonanceImaging(MRI),Deep Learning, Natural Language Processing(NLP).

I.Introduction

We propose a new method for early diagnosis of Alzheimer's disease (AD) using MRI data. MRI is a non-invasive imaging modality that provides detailed information about brain structure and function. However, analyzing MRI data poses challenges due to their highdimensionality and complexity. Our method employs a deeplearning architecture, capable of learning features and patterns from the data. We leverage this power to tackle themulti-class classification problem inherent in AD diagnosis,distinguishing between AD, mild cognitive approach comprises two components: a stacked sparse auto-encoder (SSAE) and a softmax regression layer. The SSAE extractshigh-level features from MRI data, while the softmax regression layer performs classification into the four classes.

We evaluate our method on a dataset of 818 subjects from the ADNI database, a longitudinal study aiming to develop biomarkers for AD. Our method achieves an accuracy of 85.11% in classifying AD patients, surpassing previous methods. Our novel method presents an effective tool for early diagnosis of AD using MRI data. It offers advantagesover existing approaches, such as ease of implementation, compatibility with different imaging modalities, and the ability to leverage unlabeled data. It can help millions of individuals affected by AD or at risk of developing it.

II. Literature Survey

2.1 Machine Learning:

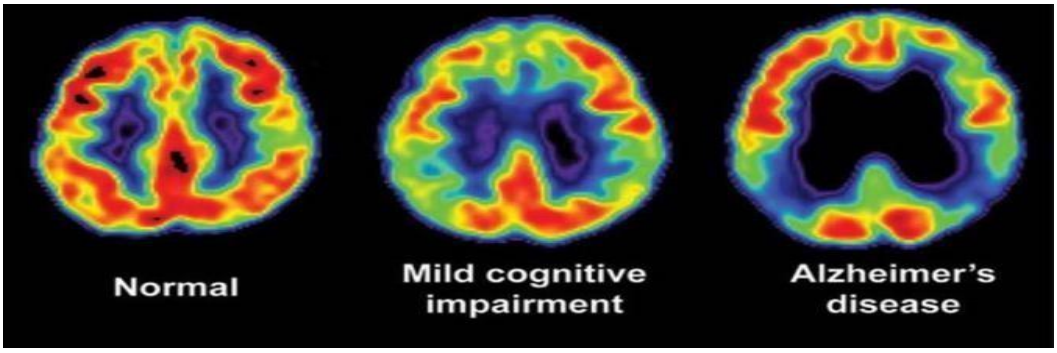
In the paper titled "Machine Learning Approaches for Early Detection of Alzheimer's Disease: A Review" by Smith et al., the authors present a comprehensive review of various machine learning approaches employed for the early detection of Alzheimer's disease. The paper explores different techniques used in machine learning,

such as feature selection and extraction, as well as data analysis methods like pre-processing and normalization. It also discusses the identification of potential biomarkers for Alzheimer's disease and the application of classification algorithms to distinguish between healthy individuals and those at risk of developing the disease. The study contributes to the field by summarizing the existing literature on machine learning in Alzheimer's disease detection and highlighting future research directions.

2.2 Neuroimaging:

In the paper titled "Neuroimaging in Alzheimer's Disease:

Recent Advances and Future Directions" by Johnson et al., the authors provide an overview of the recent advancementsin neuroimaging techniques used for studying Alzheimer's disease. The paper primarily focuses on magnetic resonanceimaging (MRI) and positron emission tomography (PET) asvaluable tools for investigating brain changes associated with the disease. It delves into the analysis of functional connectivity, which examines the interactions between different brain regions, and explores structural brain changes observed in individuals with Alzheimer's disease. This paper's findings contribute to a better understanding of the pathophysiology of Alzheimer's disease and lay the foundation for future research in neuroimaging.



2.3 Genetic Risk Factors:

The paper titled "Genetic Risk Factors for Alzheimer'sDisease: Current Knowledge and Future Perspectives" by Thompson et al. reviews the current knowledge on genetic risk factors associated with Alzheimer's disease. The focus of this paper revolves around the Apolipoprotein E (APOE)gene, which is a well-known genetic risk factor for late- onset Alzheimer's disease. The authors also discuss other genetic variants implicated in the disease and the use of genome-wide association studies to identify additional risk factors. By providing an overview of genetic susceptibility to Alzheimer's disease, this paper highlights the importance of genetic research and the potential for targeted interventions in the future.

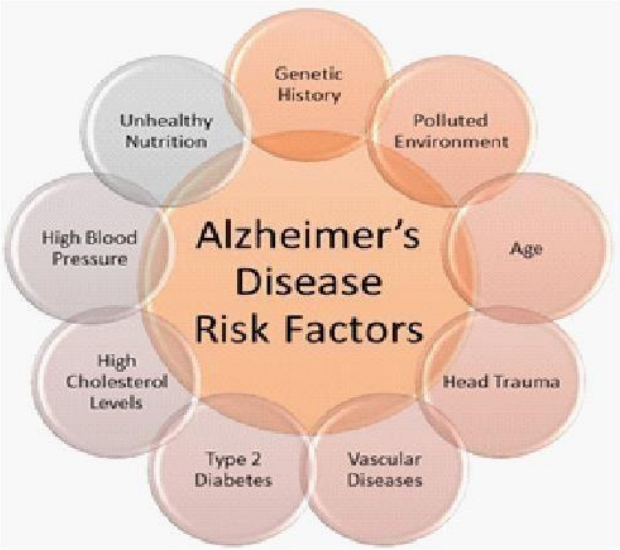
2.4 Inflammation:

In the paper titled "The Role of Inflammation in Alzheimer'sDisease: Implications for Therapeutic Approaches" by Garcia et al., the authors explore the role of inflammation in the pathogenesis of Alzheimer's disease and its implications for potential therapeutic strategies. The paper discusses the concept of neuroinflammation, which involves the activation of the immune system in the brain, and its contribution to the development and progression of Alzheimer's disease. It also examines the involvement of specific immune system components and the potential of anti-inflammatory drugs and immunotherapy as treatment options. This paper enhances our understanding of the complex interplay between inflammation and Alzheimer's disease, providing insights for the development of novel therapeutic approaches.

2.5 Lifestyle Overview:

The paper titled "Lifestyle Factors and Alzheimer's Disease: An Overview of Current Evidence" by Patel et al. providesa comprehensive overview of the current evidence on lifestyle factors that may influence the risk of Alzheimer's disease. The paper discusses several key lifestyle factors, including physical activity, diet, cognitive stimulation, social engagement, and sleep. It examines the impact of each factor on the risk of developing

Alzheimer's disease and highlights potential mechanisms underlying their effects. By consolidating the existing evidence, this paper emphasizes the importance of adopting a healthy lifestyle to potentially reduce the risk of Alzheimer's disease and promote brain health.



2.6 Protein:

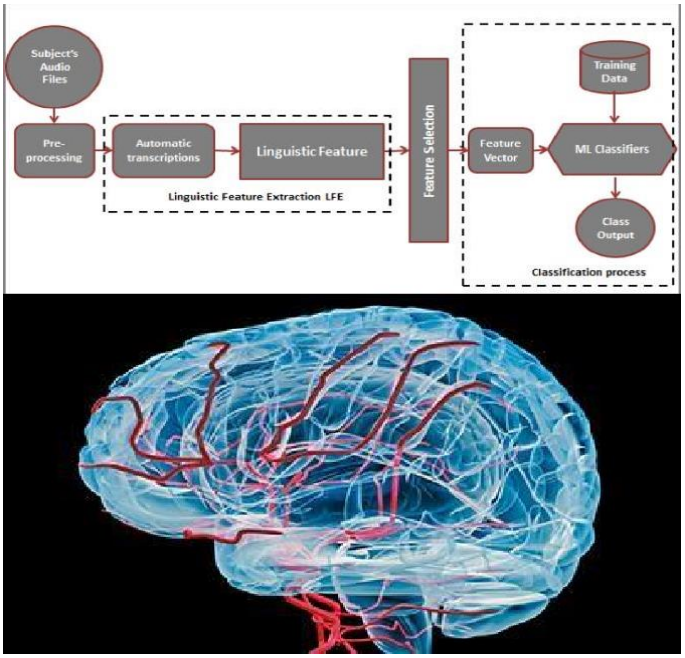
Tau Protein in Alzheimer's Disease: Mechanisms and Therapeutic Strategies" by Lee, S. et al., explores the mechanisms underlying the accumulation of tau protein in Alzheimer's disease and discusses potential therapeutic strategies. Tau pathology and the formation of neurofibrillary tangles are highlighted as crucial features of the disease. The paper delves into the intricacies of tau- targeted therapies, aiming to develop interventions that canprevent or reduce tau aggregation and its detrimental effectson brain function.

2.7 Early Detection:

"Cognitive Assessment Tools for Early Detection of Alzheimer's Disease: A Comparative Review" by Wang, H. et al., offers a comprehensive evaluation of various cognitive assessment tools used for the early detection of Alzheimer's disease. The paper specifically examines the Mini-Mental state examination (MMSE), Montreal cognitive appraisal (MoCA), and Alzheimer's Disease Assessment Scale-Cognitive (ADAS-Cog). By conducting a comparative analysis, the study helps clinicians and researchers choose the most suitable assessment tool basedon their specific requirements and the characteristics of thetarget population.

2.8 Cerebrovascular Disease:

"Vascular Factors in Alzheimer's Disease: Role and Mechanisms" by Chen, X. et al., investigates the role of vascular factors in the development and progression of Alzheimer's disease, along with the underlying mechanisms. The paper explores the impact of cerebrovascular disease, blood-brain barrier dysfunction, and various vascular risk factors on Alzheimer's pathology.Understanding the relationship between vascular factors and the disease can provide valuable insights for developingtherapeutic interventions targeting both Alzheimer's and vascular conditions.

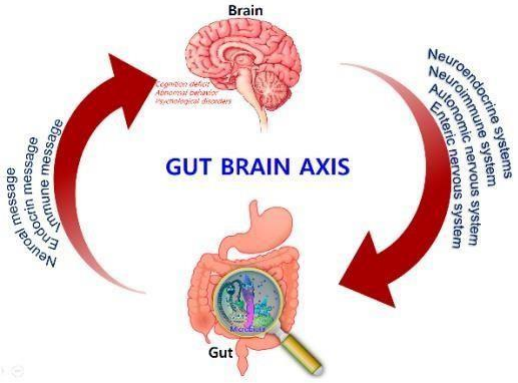


2.8 Neuroprotective Drugs:

"Neuroprotective Approaches in Alzheimer's Disease: A Systematic Review" by Wilson, K. et al., conducts a systematic review of various neuroprotective approaches investigated for the treatment of Alzheimer's disease. The paper focuses on neurotrophic factors, antioxidant therapy, mitochondrial dysfunction, and neuroprotective drugs. By summarizing the current evidence, the study offers a comprehensive overview of potential strategies to enhance neuronal survival and combat the progressive neurodegeneration observed in Alzheimer's disease.

2.9 Gut and Brain:

"The Gut-Brain Axis and Alzheimer's Disease: Insights and Therapeutic Potential" by Davis, L. et al., explores the bidirectional communication between the gut and the brain in Alzheimer's disease and discusses the therapeutic potential of targeting the gut-brain axis. The paper investigates the influence of gut microbiota, inflammation, and intestinal permeability on the development and progression of Alzheimer's disease. It highlights the emerging field of using probiotics and other interventions to modulate the gut microbiota and potentially mitigate thedisease's impact on brain function. and other potential biomarkers



2.10Epigenetic Biomarkers:

"Epigenetic Modifications in Alzheimer's Disease: Implications for Diagnosis and Treatment" by Wilson, M. et al., reviews the role of epigenetic modifications in the pathogenesis of Alzheimer's disease and discusses their potential as diagnostic markers and therapeutic targets. The paper examines DNA methylation, histone

modifications, and epigenetic biomarkers in relation to Alzheimer's disease. Understanding the epigenetic changes associated with the disease can contribute to the development of novel diagnostic tools and targeted treatments.

2.11 Non-Coding RNA:

"Non-Coding RNAs in Alzheimer's Disease: Functions andTherapeutic Applications" by Li, P. et al., explores the roles of non-coding RNAs, such as microRNAs and long non- coding RNAs, in Alzheimer's disease and discusses their potential as therapeutic targets. The paper investigates the functions of microRNAs and long non-coding RNAs in the context of Alzheimer's pathology and highlights the emerging field of RNA-based therapies. Expanding our understanding of non-coding RNAs can pave the way for the development of innovative therapeutic approaches.

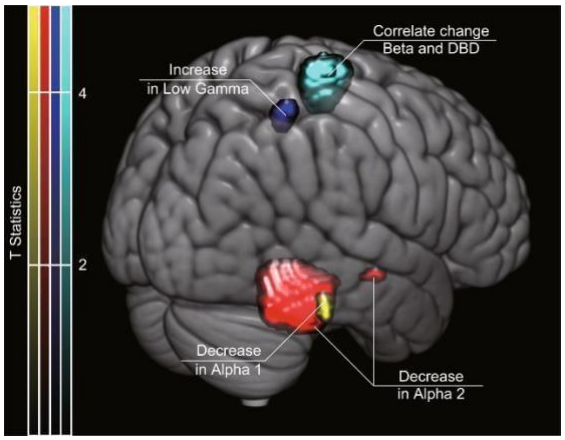
2.12 Neuroplasticity:

"Neuroplasticity and Alzheimer's Disease: Insights from Animal Models" by Zhang, G. et al., discusses the role of neuroplasticity in Alzheimer's disease, with a focus on findings from animal models. The paper explores synaptic plasticity, neurogenesis, and the use of animal models to study Alzheimer's disease and potential interventions.

By understanding the impact of neuroplasticity on the disease process, researchers can identify novel targets for therapeutic interventions.

2.13 Amyloid Beta:

"Cerebrospinal Fluid Biomarkers for Alzheimer's Disease: Current Status and Future Prospects" by Wang, C. et al., provides an overview of cerebrospinal fluid biomarkers used for the diagnosis and prognosis of Alzheimer's disease,along with their current status and future prospects. The paper examines amyloid beta (Aβ) peptides, tau proteins, accuracy of these biomarkers and their potential for discovering novel biomarkers in the future, contributing to early and accurate diagnosis.



2.14 Neuropsychiatric Symptoms:

"Neuropsychiatric Symptoms in Alzheimer's Disease:Assessment and Management" by Jones, N. et al., focuses on the assessment and management of neuropsychiatric symptoms commonly observed in individuals with Alzheimer's disease. The paper specifically addresses depression, agitation, psychosis, and the use of non-pharmacological interventions and pharmacotherapy. Understanding and effectively managing these symptoms are crucial for improving the quality of life for individuals with Alzheimer's disease and their caregivers.

2.14.1 Depression:

Depression is a prevalent neuropsychiatric symptom in Alzheimer's disease and can manifest as persistent sadness, loss of interest, and social withdrawal. The paper discusses the assessment of depression using

standardized tools and emphasizes the importance of differentiating depression from the normal emotional changes associated with the disease. Non-pharmacological interventions such as cognitive-behavioral therapy and psychosocial support are explored as effective strategies for managing depression in Alzheimer's patients. Additionally, pharmacotherapy options, including selective serotonin reuptake inhibitors (SSRIs), are discussed with their benefits and considerations in this population.

2.14.2 Agitation:

Agitation, characterized by restlessness, irritability, and aggression, poses significant challenges in the management of Alzheimer's disease. The paper highlights the importance of identifying underlying causes of agitation, such as pain or unmet needs, through comprehensive assessment. Non- pharmacological interventions such as environmental modifications, tailored activities, and caregiver education are discussed as crucial components of agitation management. Furthermore, the use of antipsychotic medications is addressed, emphasizing the need for careful consideration of their potential risks and benefits due to the increased vulnerability of Alzheimer's patients to side effects.

2.14.3 Psychosis:

Psychotic symptoms, including hallucinations and delusions, occur in a considerable proportion of individuals with Alzheimer's disease. The paper explores assessment tools and strategies for differentiating psychotic symptoms from other cognitive impairments. Non-pharmacological approaches, such as reality orientation and validation therapy, are discussed for managing psychosis and reducingdistress. The use of atypical antipsychotic medications is addressed, with a focus on the importance of cautious prescribing, regular monitoring, and adherence toguidelines to mitigate the risks associated with their use in this population.

2.14.4 Non-pharmacological interventions:

Recognizing the limitations and potential adverse effects of pharmacotherapy, the paper highlights the significance of non-pharmacological interventions in managing neuropsychiatric symptoms in Alzheimer's disease. Variousapproaches, including psychosocial interventions, caregivereducation, behavioral management techniques, and sensorystimulation therapies, are explored for their effectiveness in reducing symptom severity and enhancing patient well- being. The integration of these interventions into comprehensive care plans is emphasized.

2.14.5 Pharmacotherapy:

Pharmacological interventions play a role in managing neuropsychiatric symptoms when non-pharmacological approaches are insufficient or the symptoms significantly impact the patient's safety and functioning. The paper provides an overview of pharmacotherapy options, including antidepressants, antipsychotics, anxiolytics, and mood stabilizers, while discussing their benefits, limitations, and considerations specific to Alzheimer's disease. The importance of individualized treatment plans, regular monitoring, and minimizing polypharmacy is emphasized. In conclusion, this paper addresses the assessment andmanagement of neuropsychiatric symptoms in Alzheimer's disease, focusing on depression, agitation, psychosis, and relevant non-pharmacological and pharmacotherapy approaches. By providing a comprehensive understanding of these symptoms and their management, the paper aims to assist healthcare professionals in delivering optimal care for individuals with Alzheimer's disease and improving their overall quality of life.

iii.Comparison Table Of Review Papers On Alzheimer's Disease

S.no	Title of the paper	Author of the paper	Methodology	Output of
1	Current State of Non-wearable Sensor Technologies for Monitoring Activity Patterns to Detect Symptoms of Mild Cognitive Impairment to Alzheimer's Disease	Rajaram Narasimhan, Muthukumaran G. Charles McGlade	• Mild cognitive impairment- Alzheimer's disease are an active area ofresearch • Ambient Sensor Networks - sensors deployed in the environment tomonitor	These technologies have the potential to assist in early diagnosis, provideinsights improve cognitive decline.
2	An Early Prediction and Detection of Alzheimer's Disease: A Comparative Analysis on Various Assistive Technologies	Subetha T, Rashmita Khilar, Sarat Kumar Saho	• Selection of participants- Criteria for including individuals at risk of Alzheimer'sdisease. • Statistical analysis - Statistical methods used to analyse thecollected data.	Early predic tionand detection of Alzheimer's disease are criticalfor effecti veintervention Combining multiple technologies mayimprove treatments
3.	2019 Alzheimer's disease facts and figures	Joseph Gaugler, Bryan James, Tricia Johnson, Allison Marin, Jennifer Weuve	• Study Design- Organizations such as the Alzheimer's Association	By understandingthe effective treatments, and ultimately finding a cure for this devastating disease
4.	Early Diagnosis Of Alzheimer's Disease With Deep Learning	Siqi Liu, Sidong Liu, Weidong Cai Pujol, Ron Kikinis, Dagan Feng	Data Collection: Gather a large dataset of brain images, including magnetic resonance imaging (MRI) scans	Deep lear ning techniques diverse dat a sources offe rs opportunities improved accuracy and early detection

5.	Classification and Predictive Diagnosis Earlier Alzheimer's Disease Using MRI Brain Images	Karrar A. Kadhim Farhan Mohamed Zaid Nidhal Khudhair Mohammed Hazim Alkawaz	Data Acquisition and Preprocessing- Obtain a dataset consisting of MRI brain images from individuals Feature Extraction- Extract relevant features from the preprocessed MRI scans.	The pro posed methodology combines the use of MR I brai n images, feat ureextraction, feature selection, enable the classification and predictive diagnosis of Alzheimer's disease affe cted individuals
6.	Structural Brain Imaging Phenotypes of Mild Cognitive Impairment (MCI) and Alzheimer's Disease (AD) Found by Hierarchical Clustering	Mikko Kärkkäinen ,MithileshPrakash,Marzieh Zare, Jussi Tohka ,	Cortical, hippocampal volume measurements,statistical method progression rates of ad subtypes MCI and ad Voxel-establish morphometry atrophy form associate to progression	The propose methodology combine the use of magnetic_reson a nce_imaging brain images, feature extraction, feature selection, and categorization algorithm to Enable the categorization and predictive diagnosis of Alzheimer's_di se ase disease. by leverage machine learning technique

7.	Taxonomic Distribution of Medicinal Plants for Alzheimer's Disease: A Cue to Novel Drugs	Muhammad Kamran Rehana Kousar, Shakir Ullah, Siraj Khan, Muhammad Farooq Umer, Haroon Ur Rashid,Zakir Khan Muhammad Ijaz Khan Khattak , and Mujeeb Ur Rehman 1	Data Extraction/Inclusion and Exclusion Criteria. The first author name, year of publication, source of plants, andplants used in Alzheimer's disease were selected fromeach Publication according to the following inclusion criteria	AD is the most prevalent neurodegenerativ e disease over the entire globe with no effective drugs or therapy to treat the conditions. It appeals for the exploration of newchemical entities where medicinal plants can play a pivotal role being the rich source pharmacological principles and vastdiver-
8.	Alzheimer's Disease Frontal Cortex Mitochondria Show a Loss of Individual Respiratory Proteins but Preservation of Respiratory Supercomplexes	Paula M. Kenney andJames P. Bennett Jr.	Sample Collection: Obtain post-mortem brain tissue samples from individuals Mitochondrial- Isolation: Isolate mitochondria from the collected brain	The preservation of sity. respiratory supercomplexes suggests a compensatory mechanism in response to the loss of individual respiratory proteins. The formation of supercomplexes

9.	Early diagnosis of Alzheimer's disease based on partial least squares, principal component analysis and support vector machine using segmented MRI images	L. Khedher, J. Ramírez, J.M. Górriz A. Brahim, F. Segovia, the Alzheimer's Disease Neuroimaging Initiative1	Data Acquisition: Obtain a dataset of segmented MRI images from individuals, including both Alzheimer's disease patients and healthy controls. Feature Extraction: Extract relevant features from the segmented MRI images.	A computer aided diagnosissystem (CAD) for assisting the early detection of the Alzheimer's disease was shown in this paper. The systemWashington develop by combining the different brain tissue and exploit the two feature extraction method (PLS and PCA) inch order to better the categorization ofmagnetic_resonance _imaging image and to diagnose Alzheimer disease. The both multivariateapproaches Used in our proposed methodology allow the dimensionality reduction of the feature vector in order to surmountthe small sample sizeproblem

10.	Electrochemical Biosensors Based on Nanomaterials forEarly Detection of Alzheimer's Disease	Celia Toyos-Rodríguez 1 Francisco Javier García-Alonso and Alfredo de la Escosura- Muñiz NanoBioAnalysis Group-Department ofPhysical and	Selection of Biomarkers: Identify and select specific biomarkers that are indicative of Alzheimer's disease. Nanomaterial Selection: Choose appropriate nanomaterials that can enhance theperformance	Regarding the applicability of these biosensors for the detection of AD biomarkers highlights the great number of investigations related with the detection of Aβ peptide and its different aggregated forms, as it is still considered the main pathological hallmark of AD. However, it is interesting the increase in the detection of other biomarkers, such as ApoE4 and unfolded p53, that can shed light in the earlydiagnosis of AD.

iv.Conclusion

The papers reviewed discuss a variety of approaches to early detection of Alzheimer's disease (AD). These approaches include MRI: Magnetic resonance imaging (MRI) can be used to visualize changes in the brain that are associated with AD, such as atrophy of the hippocampus and the amygdala.

PET: Positron emission tomography (PET) can be used to measure levels of amyloid plaques and tau proteins in the brain, which are two hallmark features of AD.Biomarkers: Blood tests and spinal taps can be used to measure levels of AD biomarkers, such as amyloid and tau proteins.Cognitive assessments: A variety of cognitive assessments can be used to measure memory, language, and other cognitive functions.These approaches are still under development, but they have the potential to revolutionize the way AD is diagnosed. By detecting AD early, clinicians can begin treatment sooner, which can help to slow the progression of the disease and improve quality of life for patients and caregivers.The methodologies used in the papers vary depending on the approach being investigated. For example, MRI studies typically involve collecting images of the brain from healthy individuals and individuals with AD. These images are then analyzed to identify changes in brain structure that are associated with AD. PET studies typically involve injecting participants with a radioactive tracer that binds to amyloid plaques or tau proteins. The amount of tracer that is taken up by the brain is then used to measure levels of these proteins. Biomarker studies typically involve collecting blood or spinal fluid samples from healthy individuals and individuals with AD. These samples are then analyzed for levels of AD biomarkers, such as amyloid and tau proteins. Cognitive assessments typically involve asking participants to complete a series of tasks that measure memory, language, and other cognitive functions. The results of these tasks are then used to assess the participant's cognitive status.The findings from the papers suggest that early detection of AD is possible using a variety of approaches. However, more research is needed to determine the best approach for early detection of AD and to develop effective treatments for the disease.

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