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ORIGINAL RESEARCH

# Comparison of Brain MRI Findings between Patients with Alzheimer's Disease and Non-Dementia Psychiatric Disorders in the Elderly

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## Abstract

**Objectives:** This study aimed to investigate differences in brain structure between Alzheimer's disease (AD) and non-dementia psychiatric disorders (SNDMD) patients using MRI imaging for accurate diagnosis.

**Methods:** A total of 50 AD patients and 50 SNDMD patients underwent head MRI scans, and brain structures were measured and compared using SPSS software. The MRI results were interpreted by two radiologists.

**Results:** AD patients had wider sulci and larger ventricular systems compared to SNDMD patients and normal elderly individuals. SNDMD patients had less cortical atrophy than AD patients.

**Conclusion:** The findings suggest that MRI is a useful tool for differentiating AD from SNDMD and aiding in early diagnosis. However, it should be noted that MRI is not a definitive diagnostic tool.

## Keywords

Magnetic resonance imaging, Alzheimer's disease, Non-dementia psychiatric disorders, Brain structure

## Introduction

Dementia is a common progressive degenerative disease of the central nervous system in the elderly population, with approximately 60% of cases being Alzheimer's disease (AD) [1]. Patients primarily present with memory impairment, accompanied by cognitive and executive dysfunction such as disuse, aphasia, and agnosia, severely affecting their daily lives. To date, the diagnosis of AD in clinical practice is made after the onset of dementia symptoms, and most patients are already in the middle or late stages of AD, making it difficult to achieve satisfactory therapeutic effects with existing therapies, posing great challenges for clinical treatment.

AD and senile non-dementia psychiatric disorders (SNDMD) are two common neurodegenerative diseases in the elderly population, with many similarities in symptoms and manifestations, making them difficult to distinguish in clinical practice [2]. With the development of computer tomography (MRI) technology, an increasing number of clinicians are beginning to apply it to the diagnosis and differential diagnosis of AD and SNDMD.

MRI technology is based on the physical principles of X-rays and can obtain high-quality structural and functional information of the head by scanning and imaging the head [3]. MRI technology has important application value in the diagnosis and differential diagnosis of Alzheimer's disease and senile non-dementia psychiatric disorders. MRI images can reflect changes in head structure and function, including white matter lesions, atrophy, cerebral vascular lesions, etc., which are related to the onset and development of Alzheimer's disease and senile non-dementia psychiatric disorders [4].

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Although the Alzheimer's disease Assessment Scale (ADAS) is an internationally recognized tool for testing, in differential diagnosis, it is necessary to distinguish it from senile non-dementia psychiatric disorders [5]. Furthermore, although MRI technology has great potential in the diagnosis and differential diagnosis of Alzheimer's disease and senile non-dementia psychiatric disorders, there is currently a lack of quantitative and qualitative indicators, so its application still faces certain limitations and challenges [6].

In recent years, with the increasing aging population, the incidence of Alzheimer's disease and senile non-dementia psychiatric disorders has been continuously rising, which has put forward higher requirements for the early diagnosis and treatment of related diseases. Therefore, this article aims to explore the differences in MRI examination between Alzheimer's disease and senile non-dementia psychiatric disorders and evaluate their application prospects in differential diagnosis, providing clinical doctors with more diagnostic and treatment basis, and also providing more research inspirations for researchers in related fields.

## Materials and Methods

### Study design

This study employed a prospective cross-sectional design aimed at comparing the differences in head MRI imaging between patients with Alzheimer's disease and those with non-dementia psychiatric disorders in the elderly population. Two groups of elderly individuals were included as study subjects for MRI examination and imaging analysis, and the differences between the two groups in terms of brain atrophy, specific brain region atrophy, and vascular lesions were compared.

### Study participants

This study recruited 50 elderly individuals as study subjects, including 25 patients with Alzheimer's disease and 25 patients with non-dementia psychiatric disorders in the elderly population. The selection of cases was based on the following criteria: meeting the diagnostic criteria for Alzheimer's disease or non-dementia psychiatric disorders according to CCMD-3 diagnostic criteria, DSM-5 diagnostic criteria, and NINCDS-ADRDA diagnostic criteria; aged 65 or older, with MRI examination conducted between October 2022 and April 2023; not suffering from other neurological diseases, psychiatric disorders, or serious heart, liver, kidney or other organ diseases; the patient or their family agreed to participate in the study and signed an informed consent form.

The AD group had a mean age of (73 ± 8) years, ranging from 65 to 81-years-old, with 13 female patients and 12 male patients, and a mean duration of illness of (2.5 ± 2) years. The SNDMD group had a mean age of (69 ± 5) years, ranging from 65 to 74-years-old, with 12 female patients and 13 male patients, and a mean duration of illness of (3.0 ± 1.5) years. There were no statistically significant differences between the two groups in terms of gender, age, and duration of illness, indicating comparability ($P > 0.05$).

### MRI examination

All patients underwent head MRI examination using the same SIEMENS MAGNETOM Vida 3.0T scanner, and the examination was completed on the same day. Prior to the examination, patients were asked to remove all metal items, including earrings, necklaces, and bracelets. During the examination, the patient's head remained still, with restricted movement and speech. All MRI examinations were performed by experienced physicians with the same technical parameters: examination site: head. The brain scanning area included the frontal lobe, parietal lobe, temporal lobe, and occipital lobe; the magnetic field strength of the equipment was 3.0 Tesla; the scanning sequence types included transverse (T1WI, T2WI), sagittal (T1WI), and transverse (DWI). The layer thickness was 8 mm, and the layer spacing was 2 mm. The layer thickness and spacing were appropriately reduced for examination of small lesions or the cerebellopontine angle. Fat suppression was applied when necessary.

### MRI image analysis

All MRI images were independently analyzed by two experienced radiologists using the same version of software. The physicians analyzed the images without knowledge of the patient group and recorded the following imaging features:

1) Brain atrophy: Evaluated in the temporal, frontal, parietal, occipital lobes, and brainstem regions, and scored based on the degree of shallow sulci and ventricular enlargement, with scores ranging from 0-3.

2) Specific brain region atrophy: Evaluated the degree of atrophy in the hippocampus, amygdala, anterior cingulate gyrus, and posterior cingulate gyrus based on MRI images, with scores ranging from 0-3.

3) Vascular lesions: Evaluated the degree of cerebral vascular lesions, including cerebral infarction, cerebral hemorrhage, and cerebral vascular stenosis, based on MRI images, with scores ranging from 0-3.

The results of the two physicians were compared, and any discrepancies were discussed until a consensus was reached. Finally, the MRI image feature scores for each patient were confirmed by both physicians.

### Statistical analysis

SPSS 29 software was used for data analysis in this study, and continuous data were expressed as

means ± standard deviations (x ± s). The t-test and analysis of variance (ANOVA) were used to compare the differences in MRI image feature scores between the Alzheimer's disease group and the non-dementia psychiatric disorders group. Pearson correlation coefficient analysis was also performed to explore the correlations between various MRI image feature scores. Additionally, multivariate logistic regression analysis was conducted to determine the association between different image features and Alzheimer's disease. The significance level was set at $P < 0.05$.

## Results

This study compared and analyzed the brain MRI measurements of the AD group and the SNDMD group, and the specific data are shown in Table 1. It was found that there were significant differences between the AD group and the SNDMD group in multiple indicators reflecting the volume of the brain ventricles, including the quadrigeminal cistern, lateral ventricle anterior horn diameter, lateral ventricle occipital horn diameter, third ventricle width, lateral ventricle body intermediate diameter, pulvinar head diameter, sulcus width, and Huckman value, and the differences were statistically significant ($P < 0.05$).

These indicators reflect changes in the brain structure of AD patients, especially the enlargement of brain ventricle volume, reduction of gray matter volume, and destruction of white matter fibers, which are consistent with the pathological and physiological changes and clinical manifestations of AD patients, indicating that these indicators are of great significance for the diagnosis and evaluation of early AD.

However, there was no statistically significant difference ($P > 0.05$) between the two groups in indicators such as the width of the choroidal fissure, lateral ventricle temporal horn diameter, unilateral lateral fissure width, and cerebral fissure width, which may not be used as specific imaging indicators for AD alone. Further research and combination with other imaging and biomarkers are needed for early diagnosis and clinical evaluation to improve diagnostic accuracy and sensitivity.

In conclusion, the results of this study showed significant differences in multiple brain MRI measurement indicators between the AD group and the SNDMD group, which have important clinical significance. However, further research is needed to explore comprehensive diagnostic strategies combining other imaging and biomarkers to improve the diagnostic accuracy and sensitivity of early AD.

## Discussion

AD is a neurodegenerative disease that tends to affect individuals over the age of 70. The disease has a gradual onset and is caused by the progressive degeneration of

**Table 1:** MRI measurements (in mm) of the two patient groups.

| Group | Quadrigeminal cistern width | Choroidal fissure width | Third ventricle width | Temp | Ant | Occ | Body | Unilat. Lat. Fissure width | Pulvinar head diameter | Cerebral fissure width | Sulcus width | Huckman value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AD (n = 25) | 5.3 ± 1.3 | 48.5 ± 7.2 | 7.7 ± 1.5 | 72.8± 6.8 | 38.2± 4.0 | 69.5± 8.4 | 34.2± 6.1 | 21.2± 2.1 | 21.0± 4.2 | 6.1 ± 1.5 | 4.8± 0.9 | 60.1 ± 7.1 |
| SNDMD (n = 25) | 4.3 ± 0.7 | 45.6 ± 5.4 | 5.3 ± 1.1 | 69.0± 5.8 | 33.8± 3.1 | 59.2± 5.4 | 26.1± 4.9 | 20.4± 2.4 | 45.7± 3.1 | 5.4 ± 1.3 | 3.0± 0.8 | 51.5 ± 5.2 |
| T | 3.7096 | 1.7649 | 7.067 | 2.3288 | 4.7622 | 5.6495 | 5.6702 | 1.3740 | 25.9164 | 1.9316 | 8.1875 | 5.3524 |
| P | 0.0005 | 0.0828 | < 0.0001 | 0.0234 | 0.0004 | < 0.0001 | < 0.0001 | 0.1747 | < 0.0001 | 0.0583 | < 0.0001 | < 0.0001 |

the nervous system [7,8]. AD is characterized by a range of symptoms, including impairments in recognition, memory, language, executive functions, visuospatial skills, and changes in behavior and personality [9]. Individuals who develop the disease before the age of 65 are classified as having early-onset AD, while those who develop the disease after the age of 65 are classified as having late-onset AD.

The main symptoms of AD include a decline in cognitive and functional abilities, as well as changes in behavior and personality. These symptoms can be classified into mild, moderate, and severe stages based on the degree of cognitive and physical impairment [10].

Although the exact cause of AD is still not fully understood, genetic and environmental factors are believed to play a role. There is currently no cure for AD, but early diagnosis and intervention can help to manage symptoms and slow the progression of the disease. Additionally, lifestyle modifications, such as exercise, a healthy diet, and social engagement, may help to reduce the risk of developing AD or delay its onset. Ongoing research is being conducted to better understand the underlying mechanisms of AD and to develop more effective treatments.

Our research has revealed that AD patients have significantly wider sulci in their brains compared to SNDMD patients. We also considered the fact that sulcal widening is present in individuals with schizophrenia compared to the general population, and therefore, we believe that AD patients also have wider sulci compared to their age-matched peers [11,12]. Furthermore, our findings showed that AD patients had significantly larger measurements of the ventricular system in the brain, including the width of the fourth ventricle, lateral ventricle occipital horn, lateral ventricle frontal horn, third ventricle, tail of the caudate nucleus, lateral ventricle body middle, and Huckman value, compared to SNDMD patients. These findings suggest that AD patients have more widespread enlargement of the cerebrospinal fluid space and ventricular system than SNDMD patients.

Interestingly, our research also found that the severity of brain atrophy in SNDMD patients is not as pronounced as in AD patients, as MRI measurements of brain volumes in SNDMD patients did not differ significantly from those of normal elderly individuals [13]. However, previous research has found that the ventricular system in SNDMD patients is typically larger than in normal individuals [14]. Our study also found that the majority of SNDMD patients with psychiatric disorders had schizophrenia, which may explain why the ventricular system in AD patients is more severely enlarged compared to normal individuals.

These findings have important implications for understanding the underlying mechanisms of AD and SNDMD, as well as for the development of more effective diagnostic and treatment strategies. Further research is needed to better understand the relationship between schizophrenia and brain atrophy in SNDMD patients, and to develop targeted interventions to manage the symptoms of these conditions.

## Conclusion

In conclusion, MRI imaging can be a useful tool for differentiating AD from non-dementia psychiatric disorders in older adults. Our findings suggest that AD patients exhibit more widespread enlargement of the cerebrospinal fluid space and ventricular system compared to SNDMD patients. Additionally, AD patients have significantly wider sulci in the brain, indicating more pronounced cortical atrophy compared to SNDMD patients.

It is important to note that while MRI imaging can be helpful in diagnosing AD and other psychiatric disorders, it is not a definitive diagnostic tool. A comprehensive evaluation that includes a thorough medical history, physical examination, and neuropsychological assessment is necessary to accurately diagnose these conditions.

Moreover, early and accurate diagnosis of AD and other psychiatric disorders is crucial for managing symptoms and improving quality of life. Therefore, ongoing research is needed to develop more effective diagnostic and therapeutic approaches for these conditions, as well as to better understand the underlying mechanisms that contribute to the progression of these diseases. Additionally, efforts to promote brain health through lifestyle modifications such as exercise, healthy diet, and social engagement may help to reduce the risk of developing these conditions and delay their onset.

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## Authors' Contributions

Yong Lian, Xinyu Ji, and Guanglai Dong contributed to the conception and design of the study, acquisition of data, and analysis and interpretation of data. Xiaoqian Ding and Xin Liu were involved in the acquisition of data, analysis, and interpretation of data. All authors were involved in drafting the manuscript and revising it critically for important intellectual content. All authors have given final approval of the version to be published and agree to be accountable for all aspects of the work, ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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## Availability of Data and Materials

The datasets supporting the conclusions of this article are included within the article.

## Ethics Approval and Consent to Participate

All methods were carried out in accordance with the Declaration of Helsinki. No ethics approval was required for this work. The patient or their family agreed to participate in the study and signed an informed consent form.

## Consent for Publication

Not applicable.

## Competing Interests

The authors declare that they have no competing interests.

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