

Diagnostic Value Of Deep Learning-based Hippocampal Subfield Segmentation For Early Alzheimer's Disease: A Systematic Review

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Although deep learning models show high performance on datasets and external validations, real-world clinical utility still requires broader multicentric prospective testing across diverse cohorts.

INTRODUCTION	METHODS	RESULTS	CONCLUSIONS	REFERENCES
Alzheimer's disease (AD) is a progressive neurodegenerative disorder marked by cognitive decline and brain atrophy, particularly in the hippocampus and cortical regions. Structural MRI features, especially hippocampal atrophy, have been analyzed using deep learning models including 3D CNNs, ResNet, Inception-based architectures, U-Net variants, and hybrid segmentation-classification frameworks.	This review adhered to the PRISMA guidelines. A comprehensive literature search was conducted on PubMed, Scopus, Embase, and IEEE Xplore for publications ranging from January 1, 2020, to December 31, 2025. The review assessed studies evaluating deep learning architectures, specifically 3D CNNs, ResNet, Inception-based models, and U-Net variants, applied to T1-weighted MRI data for the detection of Alzheimer's disease and prediction of MCI-to-AD progression. Data extraction focused on hippocampal atrophy analysis, validation across public datasets (ADNI, BioFINDER-1, OASIS), and the integration of attention mechanisms, self-supervised learning, and explainable AI (XAI). Key performance metrics, including diagnostic accuracy, area under the curve (AUC), and Dice similarity scores, were extracted and analyzed to determine clinical utility.	Ten studies published between 2020 and 2025 were included, with sample sizes ranging from 135 to 4,314. All studies assessed hippocampal and cortical atrophy. Models explicitly used hippocampal atrophy to detect AD and classify disease stages, as well as to predict MCI-to-AD progression. Tasks included segmentation, subtype identification, and longitudinal analysis. Accuracy ranged from 81.9% to 98.77% (AUC 0.850-0.905), with Dice scores up to 92.84%. Four AD subtypes were identified. Hippocampal-volume-based models showed superior generalizability. Attention mechanisms, self-supervised learning, and explainable AI improved performance and interpretability.	Deep learning models effectively leveraged hippocampal atrophy to detect and classify AD, predict cognitive decline, and track progression. Incorporating attention and explainable AI improved reliability and understanding, with external validation confirming robustness and clinical relevance.	Abbasian P, Hammond TA. A Comprehensive Analysis of Early Alzheimer Disease Detection from 3D sMRI Images Using Deep Learning Frameworks. Information. 2024 Nov 22;15(12):746. CONTACT ammadabid@kemu.edu.pk  ALZHEIMER'S ASSOCIATION  AAIC>26