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Lightweight Texture-Based Classification of Huffaz Status from Structural MRI Using GLCCorrelation and Brodmann-Area VOIs

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Abstract

Previous neuroimaging studies suggest that intensive Quran memorization may be associated with structural brain differences, but simple and interpretable MRI-based biomarkers remain limited. This study investigated whether a single interpretable radiomics feature, gray-level co-occurrence matrix (GLCM) Correlation, extracted from predefined Brodmann Area (BA) volumes of interest (VOIs), is associated with Huffaz status. A cross-sectional case-control design was used involving 47 participants (23 Huffaz, 24 non-Huffaz). Structural MRI scans were pre-processed using a standard SPM pipeline to generate modulated, warped, and smoothed tissue-class images (smwc*.nii). Inferential analyses were restricted to five literature-driven candidate regions (BA22, BA24, BA32, BA40, and BA46) to reduce multiplicity. Best-subset logistic regression was performed with sex forced into all models and Bayesian Information Criterion (BIC) used for model selection. Bootstrap resampling was applied to assess feature-selection stability. BA46 GLCM Correlation emerged as the lowest-BIC predictor set. Bootstrap resampling showed higher selection stability for BA46 (approximately 0.68 selection frequency) than for the other candidate regions (approximately 0.13–0.15), supporting a reproducible single-region signal within the tested set. These findings suggest that BA46 texture organization, as captured by GLCM Correlation, may differentiate Huffaz from non-Huffaz after adjustment for sex. The modest sample size and lack of external validation limit generalizability. Nevertheless, the findings support the potential of an interpretable single-feature radiomics biomarker and motivate further validation in larger independent cohorts, as well as robustness analyses across preprocessing and discretization settings. © 2026, VFAST Publisher. All rights reserved.

Author keywords

Brodmann Area 46; Gray-Level Co-Occurance Matrix (GLCM) Correlation; Huffa(Quran Memorization); Structural MRI Radiomics; Texture Analysis

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