Detection of Early-Stage Alzheimer's Disease via Hierarchical Classification of Proteomic and Clinical Profiles

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Alzheimer’s disease (AD) is a neurodegenerative, fatal brain disease characterized by impairments in memory, language, reasoning, and cognition. Identifying AD in its earliest stages of Mild Cognitive Impairment (MCI) allows patients access to the best possible treatments, and time to make crucial caregiving and financial decisions. Currently, no accurate diagnostic tests exist for early-stage AD; internationally just one in four patients are diagnosed. In this study, the development of a machine learning tool to accurately diagnose AD and identify high-risk MCI patients is proposed, using neuropsychological and blood proteomic profiles. A novel two-layer hierarchical framework was designed: The first layer diagnoses patients as healthy, MCI, or AD, and the second layer analyzes healthy/MCI patient profiles to predict future AD onset. The online Alzheimer’s Neuroimaging Initiative database of 560 patients was used to build the first model. A subset of 368 patients was used for the second model, using multiple observations per patient across a 12-month time-span. For each classification layer, a multi-pronged approach was developed to extract the most relevant biomarker data from patient profiles, integrating univariate and multivariate methods. Upon evaluation, the first model diagnosed patients with a 91% accuracy, based on linear components extracted from proteomic profiles. The second model predicted future AD onset for current MCI patients with a 92% ROC accuracy within a 6-48-month timeframe, using biomarkers selected from both proteomic and neuropsychological profiles. These results far outperform prior research and indicate that this tool will provide a low-cost, minimally invasive method of detecting early-onset AD.

Awards Won:
Third Award of $1,000
King Abdulaziz &amp
his Companions Foundation for Giftedness and Creativity: Award of $1000 for research in Medicine