The article by Behler et al. (2022) focuses on the different parameters' relationship with each other in patients with amyotrophic lateral sclerosis (ALS) using an AI-based approach. The parameters are cerebro-microstructural, oculomotor. The study aims to categorize ALS disease's different stages and understand the association between different parameters using unsupervised learning methods.

The authors use unsupervised learning techniques which are hierarchical clustering and k-means clustering. Using them, they partition patients into clusters based on similarities in their multidimensional data. First, hierarchical clustering is used to create a hierarchical structure of cluster arrangements, giving data about the relationships between clusters. Then, k-means clustering is used for partition refinement to get a final set of distinct clusters. Finally, principal component analysis (PCA) is used to reduce the dimensionality of the data before clustering, improving the analysis of complex datasets and also helps to understand the data much better.

The clustering results are visualized using dendrograms using hierarchical clustering, showing the hierarchical organization of clusters derived from the data. Each cluster is made of its mean values of the parameters under consideration. This helps in providing insight into the distinct profiles of patients within each cluster. Statistical analysis, like the correlation analysis and group comparisons using Mann–Whitney U tests, are done to validate the clustering results and assess the significance of differences between clusters and healthy controls.

The study shows strong associations between cognitive parameters and microstructural measurements in ALS-associated tract systems, supporting the validity of the chosen parameter set for cognitive staging in ALS. Then, the performance of patients in executive oculomotor tasks correlates strongly with cognitive test scores, this shows the frontal involvement in both domains. However, the inclusion of additional cognitive domains in the clustering analysis did not improve the results.

It does look like the unsupervised learning methods in the paper are applied correctly, with proper explanation of the chosen algorithms. However, I think that the clustering can be little misleading due to limitations such as the lack of postmortem examination confirmation. Finally, the study highlights the potential of AI-based approaches in ALS research for patient grouping and individualized care.