

AI analysis of blood tests and MRI scans reveal two distinct types of multiple sclerosis

1 January 2026

Artificial intelligence (AI), using a simple blood test combined with standard brain images (MRI) has, for the first time, been able to identify two biologically distinct types of multiple sclerosis (MS), in research led by UCL and Queen Square Analytics, a UCL spin out company.

For the study, published in the journal *Brain*, researchers looked at blood levels of a special protein called serum neurofilament light chain (sNfL), which indicates the level of nerve cell damage and acts as useful measure about how active the disease is.

These sNfL levels were combined with brain MRIs, that showed the level of disease spread, and interpreted by a UCL developed machine-learning model, called SuStaln (Subtype and Stage Inference). Data from 634 participants across two clinical trials groups revealed two distinct types of MS.

Early-sNfL: These patients had high levels of sNfL early on in the disease, along with visible damage in a part of the brain called the corpus callosum. They also developed brain lesions (damaged areas) quickly. This type appears to be more aggressive and active.

Late-sNfL: These patients showed brain shrinkage in areas like the limbic cortex and deep grey matter before sNfL levels went up (so the disease had progressed far more before sNfL levels rose. This type seems to be slower, with overt damage happening later.

Researchers say by using this approach, it will enable doctors to much more precisely predict which patients are at higher risk of developing new brain lesions, paving the way for more personalised care.

Senior author of the study, Dr Arman Eshaghi (UCL Queen Square Institute of Neurology and UCL Hawkes Institute at Department of Computer Science) said: “MS is not one disease and current subtypes fail to describe the underlying tissue changes, which we need to know to treat it. The study was led jointly by Charles Wilard and Lemuel Puglisi from Queen Square Analytics.

“By using an AI model combined with a highly available blood marker with MRI, we have been able to show two clear biological patterns of MS for the first time. This will help clinicians understand where a person sits on the disease pathway and who may need closer monitoring or earlier, targeted treatment.”

Queen Square Analytics (QSA) is a spinout business from UCL which offers contract research services for neurological clinical trials, with a focus on multiple sclerosis. QSA was founded in 2020 by Dr Arman Eshaghi, Prof Frederik Barkhof, Prof Geoff Parker and

Prof Daniel Alexander supported by UCL Business, the commercialisation company for UCL.

With the availability of large data sets and AI, QSA is able to recognise patterns related to disease subtypes that were once impossible to detect. Data-driven subtypes can then be matched with treatments that target the identified biological changes, ultimately enabling the selection of effective therapies. Because changes in brain images and blood biomarkers appear before signs of clinical deterioration, these data-driven subtypes can now effectively enable clinicians to predict worsening disability.

More than 2.8 million people worldwide and 2.5 million in the world live with multiple sclerosis (MS). MS affects young adults, causing significant disability early in life. Clinicians define MS categories based on the clinical course. However, the clinical course does not relate to underlying causes, creating a mismatch between the diagnosed categories and the disease mechanisms. As a consequence of this mismatch, treatments, which are selected based on symptoms and disease course, may not be effective because they do not target underlying mechanisms. Measurable disease markers, such as those extracted from brain images or blood, reflect the underpinning disease biology.

Research paper: *Combined magnetic resonance imaging and serum analysis reveals distinct multiple sclerosis types* — Willard C., Puglisi L., Ravi D., Dmitrieva M., Mattiesing R, Barkhof F., Alexander D.C., Harlow D.E., Piani-Meier D., Eshaghi A, will be published in the journal *Brain* on date / tbc.

Key results include identification of early- and late-sNfL types, stronger correlations of data-derived stage with EDSS than MRI-only models, and higher lesion risk in the early-sNfL group. Figures and tables referenced: Figure 2 (subtype event ordering), Figure 3 (time-to-new-lesion curves), Table 5 (hazard ratios).

Cohorts: Model trained on a phase 2 MS trial dataset (n = 189) and externally tested on an interferon beta-1a trial dataset (n = 445).

Funding: Research funded by **Merck KGaA, Darmstadt, Germany**; and **National Institute for Health and Social Care Research (NIHR) Advanced Fellowship (NIHR302495)**.