

Quantification of upper limb impairment in the activities of the daily living in people with Multiple Sclerosis

Marco Pisa, MD¹, Jennifer Ruiz, PT, DPT^{2,3,4}, Gabriele C. DeLuca, MD., D.Phil., FRCPATH¹,
Marta de Andres Crespo, MScI⁵, Heather M. DelMastro, MS^{2,3}, Kayla M. Olson, MA, DPT,
Elizabeth W. Triche, PhD⁷, Albert C. Lo, MD., PhD²

¹ Nuffield Department of Clinical Neurosciences, University of Oxford, Oxford, UK OX3 9DU

² Joyce D. and Andrew J. Mandell Center for Comprehensive Multiple Sclerosis Care and Neuroscience Research, Mount Sinai Rehabilitation Hospital, Trinity Health Of New England, Hartford, CT, USA

³ Department of Rehabilitation Medicine, Frank H. Netter MD School of Medicine at Quinnipiac University, North Haven, CT, USA

⁴ Department of Medical Sciences, Frank H. Netter MD School of Medicine at Quinnipiac University, North Haven, CT, USA

⁵ Dept of Clinical Neurosciences, John Radcliffe Hospital, Oxford, United Kingdom

⁶ Yale-New Haven Hospital, Center for Outcomes Research & Evaluation (CORE), New Haven, CT, USA

Background: Impairment in upper limb (UL) function has been reported as an important indicator for disease progression in people with MS (PwMS), thus a relevant outcome in clinical trials. However, standard assessment of UL function is limited to Nine-Hole Peg Test (NHPT) which assesses fine dexterity. We aimed at deeply endophenotyping UL involvement in PwMS, and at identifying the most accurate set of measures needed to capture the complexity of UL impairment in the activities of daily living (ADL).

Methods: 257 PwMS underwent an extensive UL assessment using standardized measures of grip strength and endurance, coordination, sensation, dexterity, capacity and functionality. Limitation in ADL was defined from a clinician's perspective using a timed test (Test d'Evaluation de la performance des Membres Supérieurs des Personnes Âgées: TEMPA) and from patient's perspective using a questionnaire (Disabilities of the Arm, Shoulder and Hand: DASH).

Results: Upper limb impairment was highly prevalent in all the modalities tested, even in participants with no/mild disability. Box and Block Test (BBT), finger-nose test (FNT), and NHPT were independently selected at ROC analyses as the most accurate measures in detecting abnormalities in TEMPA and DASH. In multivariate regression models, BBT and FNT, and NHPT all contributed to predicting TEMPA (adj. R^2 0.795, $P < 0.001$), while only BBT and FNT predicted DASH.

Conclusions: UL impairment is highly prevalent in PwMS, even when global disability is mild. BBT and FNT are time-efficient and cost-effective measures that could complement the NHPT for more precise monitoring of PwMS at all disease stages.